



MYTHOLOGIES OF OUTER SPACE

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ISBN 978-1-77385-588-2

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August

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terraforming &

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chris pak

“a kind of continuous conceptual drunkenness”?¹

analogy in science fiction

Terraforming stories can be thought of as creative experiments in imagining how we might make the future. What makes these stories distinctive are the possibilities they afford for thinking through concrete and abstract world-making endeavours across a range of dimensions. These stories are about world making insofar as they address themes related to creation and transformation. To examine and contend with the unknowns attendant on the crafting and habitation of new worlds, such stories often employ analogies to various ends, not only to familiarize that unknown but also to approach new modes of being and thought demanded by the experience of radically novel and estranging environments. These unknowns concern not only the physical aspects of adapting and living in inhospitable environments but also new possibilities for social, political, and economic arrangements that might be suited better to coping with the radically new.

Terraforming can be defined simply as the transformation of planets and other cosmic bodies to enable life that evolved on Earth to inhabit them. Geoengineering is simply terraforming on Earth. That word “simply” and the terms “terraforming” and “geoengineering” belie their ability to point to different technologies, to different ways of organ-

izing life and matter, and to diverse relationships to space and to one another, whether that other is human or otherwise.

We might conceive of the history of terraforming in science fiction (sf) as split into five periods, though it is important to acknowledge that these periods often overlap and the boundaries between them are ill-defined, and that any story that makes use of terraforming establishes a potential trajectory that may be developed by other writers widely separated in time and context. The story of terraforming that I present here is necessarily partial: prior to the post-World War II period, for example, a diverse number of terraforming works set on Earth and beyond were published. During this first period, which for convenience I label “scientific romances and interwar sf before the 1940s,” terraforming and geoengineering appear in such stories as H. G. Wells’s *The War of the Worlds* ([1898] 2005), in which invading Martians terraform, or more appropriately areform, the Earth so that it resembles conditions on Mars, and Han Ryner’s “A Biography of Victor Venturon” ([1909] 2011), first published in French. Ryner’s short story tells of a scientist’s attempt to move the Earth closer to the Sun. Because of space constraints, I will not be discussing works from this first period. The other four periods, which form the subtitles to the sections below, include “Pulp and Postwar SF of the 1930s–1950s,” “Cold War and Countercultural SF of the 1960s–1970s,” “The Reflective Period of the 1980s and 1990s,” and “The Expansion: Twenty-First-Century SF.” Terraforming stories are highly responsive to the contemporary contexts in which they are published. Such stories are just as much about the *now* as they are about the *to be*: ostensibly about the future, sf is actually about the future in the making.

pulp and postwar sf of the 1930s–1950s

Writing as Will Stewart, Jack Williamson coined the term “terraforming” in his 1942 short story “Collision Orbit.” This story imagines civilization’s expansion throughout the solar system, which is ostensibly united by a High Space Mandate, but which is really controlled by Interplanet Corp. This organization controls atomic power and thus wields political power throughout the solar system. “Collision Orbit” firmly associates terraforming with the twinned levers of energy and politics and turns on the search for new forms of energy that would shift this balance of power. This story asserts that science cannot be separated from society and politics: the practice of science—the attempt by the story’s protagonist, himself a scientist, to develop a new energy source that would shift this balance of power—is essentially a political project that seeks to reshape the interplanetary society.

“Collision Orbit” imagines political and social relationships in terms of the colonization of the American frontier. Our protagonist reflects on how the High Space Mandate “ended the world—the frontier world that he and his kind had wrested from the cold eternal night” (Williamson 1942, 81). Against this impersonal bureaucracy is poised the “rugged little democracy” on “this far frontier against the stars” (82). Notable here is that the spatial analogy of the colonization of the American West is synonymous with a scientifically oriented mode of habitation and governance. Terraforming is not just about the material aspects of planetary modification but is also implicated in the creation and preservation of a specific social order. The scientific outpost as frontier settlement does more than structure how we think about outer space and space colonization: it also structures how we value science and engineering. When set against the “eternal night” of deep space, the scientific frontier outpost valorizes scientific knowledge and its use both for controlling matter and for transforming the interplanetary society. The frontier analogy in sf combines science, society, and the control of the physical world: this frontier is as much about using scientific and technical knowledge as it is about social relations and adaptation to new modes of being.

This use of the frontier analogy textures terraforming's representation throughout the twentieth and twenty-first centuries and forms the basis for one of the tradition's key themes. Robert Heinlein's 1950 novella *Farmer in the Sky* is perhaps the clearest example of how terraforming is imagined as homesteading, and he would revisit related pioneer themes in his 1966 novel *The Moon Is a Harsh Mistress*. Arthur C. Clarke's 1951 novel *The Sands of Mars* likewise uses the opposition between light and darkness, in this instance in relation to the creation of an artificial sun, to frame its portrayal of Mars colonization. Both stories, however, are aware of the limits of the frontier for defining the radically novel experience of space colonization. The Mars mayor in *The Sands of Mars*, for example, acknowledges the parallel between pioneer traditions and space colonization but cautions that “it can't be pressed too far. After all, men could breathe the air and find food to eat when they got to America!” (Clarke [1951] 1976, 90). The insufficiency of analogy is a key theme of terraforming stories and invites readers to adopt a critical stance when thinking about the unknown.

Judith Merrill's 1952 novella *Daughters of Earth* is a generational story that places women scientists centre stage. Each generation embarks on a colonizing endeavour that takes them farther from the solar system. Sf scholar Lisa Yaszek writes that “perhaps Merrill's most striking innovation, however, is to grant voice to those housewife heroines who stay planetbound while their daughters venture off to the stars” (Yaszek 2008, 38).

Daughters of Earth negotiates different analogies to consider how space colonization might look in context, rather than as it is portrayed from a colonizing centre. Analogy here is not about identifying similarity between two different contexts as much as creating those correspondences. Yet the narrative's progression subverts these analogies as new experiences highlight the otherness of habitation. The recourse to pioneer analogy is explained when the narrator speculates on "certain rhythms of human history which recur in (widening, perhaps enriched, but increasingly discernible) moderately predictable patterns of motion and emotion both" (Merril [1952] 1969, 102). Yaszek argues that *Daughters of Earth* insists that "subjective personal experiences, including commitments to other people and what Evelyn Fox Keller calls a 'feeling for the organism' under investigation, are key aspects of scientific labor" (Yaszek 2008, 38). The emphasis on emotion is crucial here as the story asserts that this dimension of human experience is as important a part of the project of science and the colonization of space as are invention and scientific rationalism.

The dramatization of the colonists' experiences on new planets is a way to imaginatively grapple with an unknown that is otherwise inaccessible. Even at this early stage of the terraforming narrative we see how science and engineering organize relationships to other planets. Terraforming here is developed out of grief: a dome collapse kills the inventor's husband, which drives her research into terraforming. Unlike the industrial processes Williamson and others imagine, Merrill's "TAP [the Thurman Atmosphere Process] is honest ecology. . . . An alien coming to Pluto would have a rough time finding out that the open-air cities are all artificial" (Merril [1952] 1969, 128). Earlier in the story it is remarked that terraforming on Mars results in colonists who "had grown up under primitive open-air frontier conditions," and later that they take this culture with them on their colonizing endeavours (118). Yet the narrator also notes that, "in spite of the growing emphasis on typically frontier-puritan monogamous family patterns, divorce was, of necessity, kept easy: simply a matter of mutual decision, and registration. For that matter, the morality in the early years was more that of the huddled commune than of the pioneer farmland" (146).

As Professor of Public Affairs Howard E. McCurdy writes, the frontier myth "is based upon a romanticized interpretation of history as far removed from reality as the Buffalo Bill Wild West Show was from the real events it sought to portray" (McCurdy 2011, 176). Space exploration is like homesteading the American West, but, as Merrill and other authors show, it is also radically unlike such pioneer traditions. The creative aspect of analogy works backwards to shape our conception of history as much as it works forward to shape our image of the future.

cold war & countercultural sf of the 1960s-1970s

During the third period of the terraforming story's development, sf that takes seriously the physical limits of space colonization begins to respond to developments in space science as well as to societal changes. We also see the emergence and consolidation of an ecological and environmental mode of terraforming already anticipated by stories such as Clarke's and Merril's. Rachel Carson's *Silent Spring* ([1962] 2002) drew international awareness to the problem of pesticide contamination, while Paul R. Ehrlich's *The Population Bomb* (1968) introduced fears of overpopulation to a wider popular consciousness. The 1969 Moon landing and the robotic exploration of the solar system, as well as the Mariner (1962-73) and Viking (1975-83) probes, revealed worlds that, were the vision of interplanetary colonization to persist, would require dramatically ambitious modes of terraforming.

This may account for why terraforming stories set in the far future and beyond the solar system became increasingly popular from the 1960s. Frank Herbert's *Dune* (1965), which casts colonization as the technocratic exploitation of a planet's natural resources and of its people, was one of the most popular of these stories. Others, such as Ursula K. Le Guin's *The Word for World Is Forest* (1976), depart from the patterns of survivalism and the pioneer narrative but highlight how the terraforming tradition's focus on power, politics, and world creation makes it ideal for thinking through the dynamics of different historical periods. In *Dune* extractivism is the target of its economic and political inquiry, which it engages by collapsing Orientalized representations of the peoples of the Middle East and romanticized ideas of Indigenous peoples in North America. For Le Guin the political context is that of the Vietnam War. Both works draw on popular and scientific ideas about ecology to inform the presentation of what Patrick D. Murphy describes as "terragoguing," or the "adaptation of planetary environments 'to facilitate extraction of raw materials for Earthly consumption'" (quoted in Pak 2019, 286).

From the 1970s onward the scientist James Lovelock began promoting the Gaia hypothesis in a series of popular books beginning with *Gaia: A New Look at Life on Earth* ([1979] 1987). The Gaia hypothesis formalizes an sf conceit present in works since the 1920s: of planets as living organisms. The implications of the Gaia hypothesis for terraforming would be spelled out in Michael Allaby and James Lovelock's sf novel *The Greening of Mars* (1984), which presents an ecological model for terraforming that builds on the analogical reasoning afforded by the idea of Gaia. This period is a crucial one for the development of the terraforming narrative and for its potential to speak to the ecological and environmental concerns relevant to the contemporary climate change con-

text. Indeed, it is this focus on ecology and systems that makes the terraforming narrative a powerful resource for thinking through climate change. Adapting another planet or cosmic body so that its environment resembles that of Earth's is essentially an extravagant project in human-directed climate change. Sf, then, has long been committed to using the speculative propensity of the form to explore what it would mean to alter planetary environments in ways that would resonate with and sometimes inform twenty-first-century discourses of climate change.

the reflective period of the 1980s & 1990s

During the 1980s and '90s terraforming stories become increasingly conscious of the values that the tradition reinforces. They also continue to develop the connection to environmentalism and ecology that was forcefully established during the countercultural period. It is also the period during which sf reflects more consistently on the entrepreneurial colonization of space. The influence of systems thinking too, of which the Gaia hypothesis is a part, provides many of the analogies upon which the representation of terraforming is patterned. Works such as Orson Scott Card and Kathryn Kidd's *Lovelock* (1994), S. C. Sykes' *Red Genesis* (1991), and Brian Aldiss and Roger Penrose's *White Mars* (1999) use the utopian possibilities of the form to imagine societies that address Earth's failures. Yet it is Kim Stanley Robinson's work, in particular the *Mars* trilogy, comprising *Red Mars*, *Green Mars*, and *Blue Mars*, that stands as the pre-eminent engagement with terraforming during the 1990s. Indeed, Aldiss and Penrose's *White Mars* is in part a response to Robinson's vision.

The Mars trilogy can be read as a meditation on the terraforming tradition in sf, as well as a reflection on terraforming beyond sf: in popular and scientific discussion, in relation to environmentalism and climate change and to utopian politics and the politics of dissent. I'd like to draw attention to one example of how analogy is reflected upon in the second novel, *Green Mars*. This is from the scientist Sax Russell, who begins the trilogy as a caricature of the scientist figure in sf but who undergoes a sea change in this book (Robinson 1996b, 236):

Perhaps, he thought, they had gone polyploidal, not as individuals but culturally—an international array, arriving here and effectively quadrupling the meme strands, providing the adaptability to survive in this alien terrain despite all the stress-induced mutations. . . .

But no. That was analogy, rather than homology. What in the humanities they would call a heroic simile, if he understood the term, or a metaphor, or some other kind of literary analogy. And analogies were mostly meaningless—a matter of phenotype rather than genotype (to use another analogy). Most of poetry and literature, really all the humanities, not to mention the social sciences, were phenotypic as far as Sax could tell. They added up to a huge compendium of meaningless analogies, which did not help to explain things, but only distorted perception of them. A kind of continuous conceptual drunkenness, one might say. Sax himself much preferred exactitude and explanatory power, and why not? If it was 200 kelvin outside why not say so, rather than talk about witches' tits and the like, hauling the whole great baggage of the ignorant past along to obscure every encounter with sensory reality? It was absurd.

Analogical reasoning based on a series of biological concepts mapped onto culture leads Sax to reject the very methods employed to reach his conclusion. Later we see Sax modify his position, but the fundamental point about the dangers of analogy is retained. Sax's struggle here concerns a disconnect between an embodied sensory reality that is actively perceived by individuals and groups in context and the conceptualization and communication of this reality in language. It is through metaphor (or simile, "or some other kind of literary analogy" [236]) that these perceptions become concepts that can be communicated. The danger here is that conceptions of history and culture (including science) inherited through language and social convention can work to elide the conception of the radically novel as distinctive. Our ways of talking about, in this instance, the development of a specifically Martian culture as analogous to the development of a single polyploid organism (that is, having more than two sets of chromosomes, unlike mammals, which have two sets of chromosomes and are thus diploid) obscures the diversity of the interactions and contestations between individuals and groups that show that Martian culture is a continuously developing and contested identity.

What's critical here is a sensitivity to how analogy can be used to explain different dimensions of the colonizing project and to interrogate what it means to be human and to be part of a society. We might here think about the common analogy used to justify space exploration: that humans have always been explorers, and that space exploration is simply an extension of our originary diaspora from Africa in our evolutionary past. As Andrew Kennedy (2016, 224) points out,

Such expansion [out of Africa] was done in a complicated way with groups overlapping, traversing the ground at an average rate of around 1 km a year, hardly an explosive rate of exploration by humans who are claimed to have a genetic disposition to move at whatever cost. Space exploration is not analogous in any way to this expansion.

What this analogy elides, as Merrill points out, is that there are always those who stay behind: humans have also been homemakers and dwellers.

the expansion: twenty-first-century sf

In the twenty-first century terraforming and geoengineering are becoming increasingly familiar terms beyond sf communities and specialist scientists and have become a source for excavating new ideas about climate change, science, and society. Terraforming stories continue to explore the dissonances between the rhetoric and imagination of interplanetary colonization and its currently unknowable experience. Robinson has continued to extend his interrogation of the values attached to terraforming and to further enmesh the motif with contemporary climate change discourse, most notably with his 2015 novel *Aurora*, which presents a counter-narrative of failed terraforming, and the 2020 novel *The Ministry for the Future*, which includes meditations on geo-engineering. In response to this latter novel, Robinson was invited to speak at COP26, the 2021 edition of the United Nations Climate Change Conference, about climate change futures. As public-private partnerships and private space exploration become more visible in popular culture we also see stories developing the focus on the corporate extension into space already addressed by works such as Frederik Pohl and C. M. Kornbluth's *The Space Merchants* (1952). These include Ian McDonald's *Luna* sequence, comprising *Luna: New Moon* (2015), *Luna: Wolf Moon* (2017), and *Luna: Moon Rising* (2019), and Jane Killick's *In the Shadow of Deimos* (2021), a novel based on the popular board game Terraforming Mars.

I'd like to end with one fascinating alternate history, Mary Robinette Kowal's *Lady Astronaut* trilogy (2019–20), which posits a runaway climate change scenario caused by a meteorite strike on the East Coast of the United States in 1952. This trilogy's premise enables it to develop a complex analogy for our contemporary climate-wracked context and considers how the colonization of the Moon (and in the background Mars) might look were the Mercury 13 a necessary part of the space program. The Mercury 13 were

a group of thirteen women pilots who, during the 1960s, demonstrated that they were able to pass the same tests used to select men for training as astronauts, though this program was controversially cancelled. McCurdy writes that Geraldyn Cobb, the first pilot to pass the tests, remarked during a meeting at Congress that “there were women on the *Mayflower* and on the first wagon trains west, working alongside men to forge new trails to new vistas. We ask [for] that opportunity in the pioneering of space” (quoted in McCurdy 2011, 298). Analogy is thus a powerful device for re-framing conceptions of human identity to provoke a reorientation of perspective. What the examples considered throughout this essay show is that terraforming stories contend with analogy to connect the centrifugal pull of images of space as a frontier to a centripetal examination of values on Earth. The outcome of this dynamic is to invite a critical stance toward the project of space colonization as well as to the implications of terraforming for thinking through our historical relationship to Earth, not only to widen but also to reinvent our conception of what it means to be human.

notes

1. Robinson 1996b, 236.

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