

## Chapter 12

### Planetary Climates: Terraforming in Science Fiction

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Terraforming narratives are based on a recognition that control of a planet's climate is fundamental to its successful colonisation and habitation. Dealing with planetary scale modifications to environments, such stories have encouraged scientific speculation about climate processes on other planets within our solar system, spurring thought about how the development of these extra-terrestrial systems provide models that help us to understand Earth's. Terraforming refers to planetary adaptation to enable their habitation by Earthbound life. In its guise as geoengineering, or terraforming on Earth, this speculation extends to environmental issues related to our home planet. Indeed, the IPCC's 2014 report describes geoengineering as a possible emergency solution to catastrophic climate change, particularly with regard to carbon management, carbon sequestration and solar radiation management.<sup>1</sup> This chapter examines the evolution of terraforming in science fiction (sf) through three important contributions to the tradition: Arthur C. Clarke's *The Sands of Mars* (1951), Frank Herbert's *Dune* (1965) and Kim Stanley Robinson's 'Mars' trilogy, comprising *Red Mars* (1992), *Green Mars* (1993) and *Blue Mars* (1996).<sup>2</sup>

Fundamental to terraforming narratives is a totalising perspective informed by climate science, ideas of weather control and sf speculation about scientific and technological mastery over nature. The representation of advanced technology creates narrative possibilities

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<sup>1</sup> IPCC, *Mitigation of Climate Change: Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. Ottomar Edenhofer, Ramón Pichs-Madruga, Youba Sokona, et al. (Cambridge University Press, 2014).

<sup>2</sup> Arthur C. Clarke, *The Sands of Mars* (London: Sidgwick and Jackson, 1976), Frank Herbert, *Dune* (Sevenoaks, Kent: New English Library, 1965), Kim Stanley Robinson, *Red Mars* (London: Voyager, 1996), Robinson, *Green Mars* (London: Voyager, 1996), Robinson, *Blue Mars* (London: Voyager, 1996). All hereafter cited parenthetically in the text.

for controlling an entire planet's environmental parameters and invites a particular fantasy of systematic environmental control that draws from sf's relationship with ideas of space as a new field for expansion, conquest and settlement. Paul N. Edwards argues that the history of climate science and modelling is based on a scientific project involving the construction of a global infrastructure of data capture enabling multiple parameters of Earth's environment to be monitored (such as the atmosphere's chemical composition, temperature and circulation). This data is analysed and used to build simulations of the Earth, which in turn allow a greater degree of control over an imagined Earth: 'If you can simulate the climate, you can do experiments. God-like, you can move the continents, make the sun flare up or dim, add or subtract greenhouse gases, or fill the stratosphere with dust. You can cook the Earth, or freeze it, and nobody will even complain. Then you can watch and see what happens'.<sup>3</sup> Enhanced knowledge of Earth's processes implies that these processes can be manipulated and controlled. Exemplifying the prevalence of support for weather control during the Cold War, Edwards cites von Neumann's assertion that 'There is little doubt [that] one could intervene on any desired scale, and ultimately achieve rather fantastic effects'.<sup>4</sup> Terraforming narratives extend ideas of weather and climate control to dramatise this enhanced ability to manipulate nature in accordance with human desire.

Themes of control connect terraforming to colonial American frontier narratives, which have shaped sf's texture and its critical engagement with climate change. The two themes are related: the colonisation and terraforming of other planets strongly recalls pastoral myths of America as both a wilderness to be tamed and a landscape offering an unparalleled abundance to those determined to cultivate it. The fulcrum for control of nature in terraforming narratives, however, is mastery over the climate. Transplanted to space, such

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<sup>3</sup> Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010), p. 140.

<sup>4</sup> Edwards, *Vast Machine*, p. 190.

narratives scrutinise the technological mastery of the climate and its concordance with American pioneer narratives. Terraforming narratives represent an escalation of the imperialist colonial imagination to climatic scales, thus connecting the colonial myth not just to the ecological aspects of expansion and habitation, but also to their underlying climatological dimensions.

Jack Williamson coined terraforming in his short story 'Collision Orbit'.<sup>5</sup> The term shaped a tradition of scientific speculation and research into the colonisation and adaption of other planets. Against the background of contemporary climate change on Earth, renewed interest in space colonisation has led to public-private partnerships and corporations investing in infrastructures for the capitalist development of the solar system.<sup>6</sup> Terraforming represents an instance of the feedback between sf, science, politics and economics and is thus a necessary literature of the Anthropocene. By examining how the terraforming tradition engages with themes of systematic environmental control and the persistence of the American colonial frontier narrative, this chapter highlights important critiques of power and mastery that are relevant to contemporary debates over the climate, particularly climate change and its mitigation.

### **Arthur C. Clarke's *The Sands of Mars***

*The Sands of Mars* is structured as a utopian tour of a burgeoning Martian colony as seen from the perspective of the sf writer Martin Gibson. Visiting Mars as a journalist to document his experience of the colony for an audience on Earth, Gibson participates in the Martian community's lifestyles and inspects the scientific and technical institutions terraforming the planet. Gibson must negotiate Earth's widespread scepticism of the project

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<sup>5</sup> Jack Williamson, 'Collision Orbit', in Stephen Haffner and Richard A. Hauptmann (eds.), *Seventy-Five: The Diamond Anniversary of a Science Fiction Pioneer* (Royal Oak, MI: Haffner Press, 2004), pp. 216-77.

<sup>6</sup> Deep Space Industries, Space-X and Virgin Galactic are examples.

and the interests of Martian officials desirous of favourable reports that might help secure public support and continued funding for the project. Many on Earth see colonisation as a financial sinkhole, thus exacerbating tensions between the two planets. This scepticism is partly responsible for driving the forms of systematic climatic control on Mars, most notably the oxygenation of Mars' atmosphere, a form of climatic manipulation that is predicated on the ability to harness nature for human ends. Terraforming seductively promises the godlike power to reshape matter to provide ideal foundations for a new society.

American colonial narratives are an enduring structuring device that connects the colonising project to the colonists' relationship with the Martian landscape. The colony's Chief Executive regards Mars as an enemy to be fought, thus revisiting a long tradition whereby the American landscape was alternately portrayed as a land of ease and plenty or as a wasteland, an enemy to be resisted and subdued. These narratives, particularly those emphasising hardship and calling for strenuous work to meet the demands of habitation in new lands, are transplanted to the colonisation of Mars which, as an exceedingly hostile landscape, complements the emphasis placed on the brutality of living on another planet. Frontier narratives suggest appropriate orientations to Mars and imply a series of suitable actions and behaviours based on the model of those stories. Such myths offer a framework for translating novel experience into familiar terms and affords the colonists a sense of control over their lives.

Yi-Fu Tuan argues that the hardships nature presents encourages a desire to escape from that nature, instilling a Promethean fear that incentivises technological development, urbanism and the formation of institutions that attempt to exert control over those forces.<sup>7</sup> Why embark on an interplanetary colonising process if the relative dangers far exceed those on Earth? The desire to surpass human limits by controlling and shaping nature can be seen

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<sup>7</sup> Yi-Fu Tuan, *Escapism* (Baltimore: Johns Hopkins University Press, 1998), p. 10.

as an expression of the desire to escape from the vicissitudes of nature and from the limits it imposes on humankind. This desire is emergent from the same impulses that drove the colonisation of America: a desire for self-determination was linked to an impulse to escape from the social control and infrastructures of the Old World to return to a simpler past where, it was imagined, people could shape their own lives. These impulses inform the desire to establish colonies on Mars. A pastoral desire for a return to a simpler time where fulfilment could be attained drives the frontier myth.

While *The Sands of Mars* revisits these frameworks, Clarke is aware of the tendency to relate frontier narratives to sf and has his narrator remark on the dangers of structuring the experience of Mars accordingly. Gibson learns that while these narratives have some explanatory potential, ‘the analogy cannot be pressed too far’ (90). Narratives of Mars colonisation represent an escalation of historical expansionist tendencies and construct Mars as more hostile and thus a prominent target for climatic control. The irony with which these patterns are treated in *The Sands of Mars* establish a critical distance while the points of correspondence between the two models of experience draw them closer together. The differences, however, call upon the colonists to apply sophisticated technology and a plan for systematised control to meet the demands of habitation.

Every aspect of the colony, from its town planning, research and development and its social dimension is systematised according to scientific principles geared toward creating subjects suitably adapted for life on Mars. Although this top-down approach to systematised town planning provides a framework for order and control, Mars’ Warden notes how, unofficially, a different system for naming parts of the colony arises, based on cultural familiarity rather than scientific planning. These unofficial naming practises align the colony closely to examples of colonisation on Earth and draw the frontier narrative closer to

narratives of Mars colonisation. This form of systematisation does not rely on scientific planning but on a cultural mapping of one experience onto another.

The genetic modification of a native Martian airweed is essential to the terraforming project. The cultivation of this plant, which is expected to accelerate the oxygenation of the Martian atmosphere, involves an infrastructure of scientific research, experiments in adaptation and a systematised cataloguing of and expansion across Mars. Terraforming projects based on this ‘ecopoietic’ model resemble representations of the agricultural pastoral experience of American colonisation, but connect this theme directly to that of climatological mastery.<sup>8</sup> Especially troubling is the surprise discovery of native Martian fauna: an herbivorous and docile species that the colonists believe is following the airweed into decline. A curious young representative of this new species follows Gibson back to the colony, where it is discovered that it is amenable to training to facilitate the spread of the modified airweed across the Martian landscape.

These creatures exemplify how all aspects of nature are incorporated into the colonising process. The colonists see themselves as stewards who hold Mars in trust for the Martians while they restore the planet to a state suitable for the flourishing of native life-forms. However, the shadow of the frontier myth raises the spectre of slavery, where the ease of living in the new American continent sublimates the slave labour that makes such habitation possible. These scenes associate terraforming with ecological imperialism, itself a systematising project of control over nature that enables human habitation of new lands and the displacement of indigenous peoples, flora and fauna.<sup>9</sup> In *The Sands of Mars*, indigenous

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<sup>8</sup> Coined by the scientist Robert H. Haynes, ecopoiesis refers to ‘The creation of a self-sustaining ecosystem, or biosphere, on a lifeless planet ... a new word which means “the making of an abode for life”’; see Haynes, ‘How Might Mars Become a Home for Humans?’ (1993), *The Terraforming Information Pages* [users.globalnet.co.uk/~mfogg/haynes.htm](http://users.globalnet.co.uk/~mfogg/haynes.htm). Accessed 13 March 2018. The term combines eco, derived from the Greek oikos (οἶκος) for home, house, household, or family with the Greek poiesis (ποίησις) for fabrication, creation or production.

<sup>9</sup> Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe, 900–1900*, 2<sup>nd</sup> edn (Cambridge University Press, 2004).

life-forms are instrumentalised, modified and incorporated into the systematising project according to the administrator's plan.

Another component of the terraforming project extends the colonists' incorporation of nature to greater scales and emphasises how sophisticated technologies lead to enhanced powers of control over the climate. The clandestine Project Dawn involves the transformation of Phobos, one of Mars' moons, into a new sun. This intervention into cosmological nature provides a new source of energy that would increase Mars' energy budget and accelerate the expansion of the airweeds across Mars. Because a planet's climate is shaped by its position in relation to nearby stars, mastery over the creation of these fundamental sources of energy represents the ultimate form of climatic colonisation. Symbolically, the creation of a new sun is synonymous with the creation of new life and the birth of the colony. The ability to control matter at such scales positions humankind as new gods, a common theme for terraforming narratives, focussed as they are on the creation of new societies, new cultures, new life and new worlds. Terraforming is thus a colonial narrative of climatological control at ever-increasing scales.

Science and technology enable humankind to assume the mantle of gods by mastering the climate and systematically incorporating nature into its designs. Project Dawn helps the colony to achieve a level of self-sufficiency that allows the colonists to divest themselves of a reliance on Earth and enables them to thrive. It also helps to overturn Earth's scepticism toward the project since this demonstration of technological capability far exceeds that of Earth's scientists. Colonising Mars enables humankind to exceed its limits and escape from its reliance on nature, with all the unpredictability and vulnerability that entails. The godlike power of control is thus a retreat from the uncertainties of nature. While a fear of nature might lead us to infer that interplanetary colonisation would be avoided, the promise of becoming masters over the climate encourages the attempt to overcome nature and render it

manageable. Crucially, an anachronistic convergence of scientific planning, infrastructure management and an integrated workforce living according to principles of American pastoralism makes these transformations possible.

### **Frank Herbert's *Dune***

*Dune* begins with the arrival of the ducal family Atreides to Arrakis, Duke Leto having accepted a contract for the management of spice production from the development corporation Combine Honnete Ober Advancer Mercantiles (CHOAM). Spice extends life, grants prescience and enables the Guild navigators to plot courses for spaceships travelling throughout the interplanetary empire. As such, spice holds the Galactic Empire together and is critical to its feudal power structures. Should spice production fail, the contract will be revoked and the Atreides will be barred from a seat on the CHOAM board of directors. The Atreides' mortal enemies, the House Harkonnen—with covert support from the Emperor—lead a surprise assault and kill Duke Leto, spurring an escape into the desert for Leto's concubine Jessica and his son Paul. Thus begins Paul's trial to marshal the native Fremen to oust the Harkonnen and assume control of the galactic empire.

Power is *Dune*'s central theme and is connected to the landscape, Arrakis' climate and ecology, and to the Fremen societies who have adapted to the planet. The planet's arid climate shapes the possibilities for social development and political self-determination throughout the novel. Herbert's inspiration for the Fremen comes in part from his early fascination with an idea of Native American cultures as representing ideal adaptations to their climates and as practising ecologically sound and low-impact lifestyles. Spice and water scarcity on the desert planet function as metaphors for oil or any number of scarce resources for which a struggle for control and management occurs.



Herbert's engagement with power and politics draws much from twentieth-century capitalist expansionism and the incorporation and control of natural resources. *Dune* references the systems of global exchange that supported American colonisation but overlays this with a contemporary critique of oil politics and American expansion in the Middle-East and Latin America, thus drawing parallels between the colonisation of America and economic colonisation in the twentieth century. CHOAM is modelled on OPEC and thus *Dune's* politics is rooted in an organisation that was constituted in response to Eisenhower's import quotas on oil in the 1960s and, ironically, organised in imitation of collective bargaining strategies between states in America.<sup>10</sup>

Control of spice is the ultimate aim of the economic and political infrastructures of *Dune*, and for Leto scientific planning is the key to achieving control. In one scene Leto and Paul witness a sandworm consuming a spice harvester. Without Leto's quick action in response to the failure of the precautionary measures designed to prevent the loss of life and property, the workforce would have died. Leto decries the lack of efficiency and the sloppiness of the operation and makes clear that his mission is to introduce a system of control that would replace the power derived through oppression, brutality and violence that the Harkonnen employed during their tenure as governors of the Arrakeen colony. Leto thus offers a vision of control over the planet based on industrial models for efficient resource extraction that is akin to the industrial terraforming models that Robinson would later critique in the *Mars* trilogy. The planet, however, resists Leto's attempts to impose a foreign order upon its landscapes and its inhabitants.

The other major organisations and Houses of the Empire rely on scientific planning as a means of control. The Bene Gesserit, an all-female society trained in the arts of psychological manipulation and body and mind control, have long been engaged in a

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<sup>10</sup> Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London: Verso, 2013), p. 167.

breeding program designed to produce an ideal male subject, the Kwisatz Haderach, an *übermensch* whose visions are untethered to space and time and who is thus able to see the past, future and, crucially, the present. This generations-long breeding program fails when Jessica rejects her selected partner in favour of Leto; her son, Paul, an unplanned factor in the Bene Gesserit scheme, is a living testament to the fantasy of the Bene Gesserit's overarching plans for control.

The myth of the Kwisatz Haderach dovetails with the Fremen myth of 'The Shortening of the Way', the compression of the Fremen terraforming project from generational to individual timescales. Pardot Kynes, the father of the incumbent Imperial Planetologist Liet-Kynes, initiates this long-term project and marshals the Fremen to transform Arrakis' climate into a verdant, water-rich system. The complementarity of the two myths is no accident, but a consequence of Bene Gesserit efforts to seed myths into colonial societies to enable future control and manipulation of the population—a scheme that Jessica capitalises from during her and Paul's flight into the desert. The Fremen terraforming project as seeded by Pardot Kynes is thus not only rooted in an enhanced form of colonial mastery, but is later appropriated by Paul to establish his own imperial authority.

Terraforming in *Dune* is informed by Norbert Wiener's theorisation of cybernetics and its utility for understanding feedback mechanisms in climatological and ecological systems. Communication and control are central concepts for establishing these feedback systems and became popular ideas in ecological discourse in the 1960s. Cybernetics shares with sf an interest in technical speculation on closed systems. Wiener posits societies as elements within a system that is able to exert pressure to shift those systems from one state of equilibrium to another and to maintain them in the desired state.<sup>11</sup> In *Dune*, this understanding of systems becomes the lynchpin for controlling societies by transforming the

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<sup>11</sup> Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (New York: Da Capo, 1988).

climate. When the Harkonnen successfully oust the Atreides, they leave Liet to die of exposure in Arrakis' deep desert. Liet hallucinates his father's early lectures, which employ the discourse of cybernetics to understand how the Fremen might alter Arrakis' climate by functioning as 'an ecological and geological force of almost unlimited potential' (467).

Terraforming encompasses temporal and physical dimensions that play on compression and control, the failure of which illustrates the fragility of such plans when confronted with the unexpected and with competing interests. Paul's prescient visions function as a critique of control: his ability to see the past, future and the present as it unfolds is a metaphor for climatological modelling systems. Edwards recounts the history of climate modelling that emerged from research into weather prediction and weather control.<sup>12</sup> Ecological principles fundamental to climate modelling, such as sensitive dependence on initial conditions, feedback systems and cascading effects are omnipresent in *Dune*, while Paul's prescience is described as being subject to the same limiting factors as climatological models. Paul's ability to foresee the future implies a capacity to shape that future. However, his visions are not inevitable and are dependent on the actions of other entities, which may reveal new configurations of the future previously inaccessible to his foresight. The Bene Gesserit goal of creating the ultimate predictive modelling system—a human computer—would allow them to future-proof their society and to achieve an unheard of level of control. Paul's actual experience of prescience and his failure to foresee all facets of the future and, more troubling still, his inability to intervene to avoid the jihad that promises to sweep the Empire once he assumes authority at the narrative's end shows how power and its use must constantly negotiate limitations. Control over a planet and its population is at best fraught and at worst a fantasy.

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<sup>12</sup> Edwards, *Vast Machine*.

## Kim Stanley Robinson's Mars Trilogy

Robinson's groundbreaking Mars trilogy reflects on and connects different modes of terraforming to climate change and geoengineering on Earth. The trilogy juxtaposes two trajectories for the adaptation of a planet's climate: industrial models that focus on the extraction of key resources for consumption on Earth, and ecopoietic and 'eco-economic' models that take seriously the destructive potential of climatological mastery and which attempt to mitigate against climatological and ecological collapse. Like *Dune*, the Mars trilogy emphasises an unpredictability that deflates fantasies of total systematic control. It rejects top-down forms of authority in favour of a distributed power that Colin Milburn connects to the figure of nanotechnology but which, in line with terraforming themes, can be represented by the bacterium and ecopoiesis, itself a metonymy for ecological and social networks.<sup>13</sup> The trilogy documents the formation of a Martian society from a small research community of one hundred scientists, its expansion and revolution against Earth's metanationals, right through to the creation of an independent Martian government. Recalling *The Sands of Mars*, this transformation of political self-determination is compared to the colonisation of America. The dangers of using such analogies are raised even as capitalism and terraforming are aligned to the exploitation of peoples and their land. The interlacing of environmental ethics, the social and ecological impact of climate change and the relationship of science to society and politics are core themes of the trilogy's investment in terraforming.

The ideological opposition between terraforming Mars and leaving it untouched is dramatically presented as an opposition between Sax Russell and Anne Clayborne. Clayborne attempts but fails to explode fantasies of control to reveal how politics and economics shape history. Metanationals begin transforming Mars into an annexe of Earth in *Red Mars*, seeing

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<sup>13</sup> Colin Milburn, 'Greener on the Other Side: Science Fiction and the Problem of Green Nanotechnology', *Configurations*, 20 (2012), 53-87.

it as a mine for supplying scarce resources that is overseen by their own security forces. These plans are incommensurate with those who left Earth to escape its bureaucratisation and its looming environmental and social crises. Loss of control is a prevalent theme that is exacerbated by the increasing complexity of the diversifying communities on Mars. John Boone laments the loss of control, explicitly challenging the scepticism that scientific planning is met: ‘societies without a plan, that was history so far’ (*Red Mars*, 336). Boone grasps for a plan that would give him a sense of control over unfolding events, treating with ambivalence the diversity of interests that lead to outcomes unaccounted for in his vision of a Martian society. The systematising project he envisions exemplifies the struggle to create a utopia on Mars, ‘a scientific system designed for Mars, designed to their specifications, fair and just and rational and all those good things’ (*Red Mars*, 335). The scientifically planned utopia confronts the realities of terraforming and settlement and becomes both a struggle and a compromise over ideal modes of existence.

Boone speculates on a scientific utopia based on rationalism and liberalism, attempting to work through a new approach to a problem undermined by the history of applied science. Arkady Bogdanov’s corrective—that scientists working to create a pocket utopia that excludes the wider population represents a failure of utopianism—is taken up by other members of the First Hundred scientists on Mars and later by the Martian underground, culminating in the formation of a Martian government based on a distributed political power. Russell, the core architect of the terraforming project, establishes several plans for planetary adaptation that exclude other voices from decisions over ideal approaches to transforming the land. He initiates schemes that contravene ethical and practical prohibitions on terraforming, such as the unauthorised seeding of modified lichens across the planet. Russell sees Mars as a lab, a testing ground for approaches to transforming Mars. This is more than an analogy, but a statement of the degree to which systematic climatological control undergirds the

terraforming project. If the planet is a lab, how far do the colonists' competing interventions into Mars' climate afford experimental controls? The illusion of control harks back to colonial narratives and Russell begins to reflect on the intersection between science, society and politics in *Green Mars* and *Blue Mars*. His change of outlook is tied to a new orientation to his ideological difference with Clayborne regarding terraforming, who resists the project as an imperial subjugation of nature to Earth's destructive consumption of matter.

Revolution is asymptomatic of the desire to cut ties with Earth and to free Mars' future from a systematising economic plan. Instead of overarching control, the colonists seek a distributed agency guided by agreement to principles set out in the Dorsa Brevia agreement of *Green Mars*. The terraforming plan is also subject to revision following expressions of alternative visions for Mars' future. Terraforming becomes a chance to remake history to avoid the mistakes of the past. Frontier narratives provide thematic and formal elements that inform representations of interplanetary colonisation but are also the subject of the trilogy's reflection on history. Terraforming is a form of systematic colonial mastery that ties climatological change to society and politics, with history as one dimension of the system that sits as a shadow to contemporary events. Climatological control, control of the future of the planet and political and social control converge at the end of *Green Mars* through a revolution that exemplifies the diffusion of power among the populace, leaving the First Hundred as powerless as anyone. Recalling the jihad of *Dune*, Toitovna acknowledges their lack of control and accepts that they 'could only ride the tiger' (*Green Mars*, 681).

There is a naivety and hubris involved in thinking that the new Martian society can be imposed from above, a view that resonates with the social control envisioned in *Dune*. The models that inform policy on Mars and which guide the scientific program are undermined throughout the trilogy, notably because the system's social and political levels cannot be modelled. Following Bogdanov, many colonists take control of their fate to break out of a

‘fantasy of the past’ (*Red Mars*, 410). Habitation provides a different perspective on appropriate relationships to the land. Underscoring the pervasiveness of Earth’s social systems in influencing the development of terraforming and colonisation, Bogdanov diagnoses the problem thus: ‘To be twenty-first century scientists on Mars, in fact, but at the same time living within nineteenth century social systems, based on seventeenth century ideologies’ (*Red Mars*, 113). The colonists’ early refusal to assess the systems within which they are embedded bespeaks their preference for a fantasy of control that dominates the colonising process as the systems Bogdanov speaks against are instantiated on Mars.

In *Red Mars*, the colonists celebrate a milestone in the terraformation project: an ice comet is directed on a collision course to Mars, bringing with it water while raising the atmosphere’s temperature. Boone delivers a speech at a festival in which he offers a vision of syncretism that uses the figure of the splice to characterise the process of societal construction on Mars. Boone raises the analogy between Mars colonisation and the colonisation of North America even as he acknowledges the differences between the two, calling for ‘a new Martian way, a new Martian philosophy, economics, religion!’ (*Red Mars*, 410). This is not a call for systematic environmental control so much as a call for engagement, experimentation and invention. After the invention of a life-extending treatment on Mars, Frank Chalmers reflects on America and Russia’s attempt to withhold the treatment on Earth to mitigate the climate crisis through strict population controls. The colonists later learn that the life-extending treatment ‘was being used as an instrument of control back on Earth’ (*Green Mars*, 601). These responses to climate change function as an alibi for authoritarian control.

Boone reacts to the economic plan that is enacted on Mars when arguing with Phyllis Boyle about her brand of venture capitalism. She accepts as an article of faith the idea that ‘Everyone on Mars will profit from it, that’s [capitalism’s] nature’, to which Boone replies

that ‘the colonial era is over’ (*Red Mars*, 364). Ironically, when Russell takes Boyle on a tour of Mars’ landscape, he tries as Clayborne once tried with him to show her the Martian landscape from a different perspective, one not tied to the interests of the metanationals she represents. Boyle fails to recognise the beauty and wonder that Russell sees and asks who was responsible for designing the lichens they walk amongst. He replies, ‘Could be no one. Quite a few of the species out here weren’t designed’ (*Green Mars*, 235), and later reflects on the ecopoietic model of terraforming as ‘fundamentally intriguing. The birth of a world. Out of their control’ (*Blue Mars*, 450). Russell’s approach to terraforming from *Green Mars* onward eschews total control for a responsive engagement with nature, an outlook that would go on to shape the developing Martian community.

Nevertheless, as Michel Duval points out, this incessant search for answers can be seen as a desire to escape from fear by establishing a measure of control over nature through the accumulation of knowledge. Russell describes science as ‘a system for generating answers’ yet fails to explain the purpose for these answers (*Green Mars*, 502). Russell begins to reflect on the relationship between history and natural history, both of which resist experimentation: ‘Values drove history, which was whole, nonrepeatable, and contingent. It might be characterized as Lamarckian, or as a chaotic system, but even those were guesses, because what factors were they talking about, what aspects might be acquired by learning and passed on, or cycling in some nonrepetitive but patterned way?’ (*Green*, 280). By introducing human history to Mars, control of the land becomes a way to control the development of human communities within those environments. Russell recalls Chalmers’ claim that ‘colonialism had never died ... it just changed names and hired local cops. We’re all colonies of the transnats’ (*Green Mars*, 283). Industrial terraforming models of the type Boyle endorses thus reveal themselves to be an enhanced form of colonial mastery. The history of



capitalism explains their current status as subjects of corporate control—a control that extends its systematising and incorporating influence to Mars.

Arthur Randolph explains that the new communities arriving to Mars ‘had been trying specifically to get away from dominant powers—transnational, the West, America, capitalism—all the totalizing systems of power. A central system was just what they had gone to great lengths to get away from’ (*Green Mars*, 422). Nadia Cherneshevsky points out that ‘America also stands for the melting pot. The idea of the melting pot. It was the place where people could come from anywhere and be a part of it. Such was the theory. There are lessons there for us’ (*Green Mars*, 422). The myth of America is contradictory and combines residual associations that still have power and utility for thinking about the formation of new cultures. These reflections inform the Martians’ approach to building an independent government.

Randolph’s view of the tension between global and local interests emphasises a contradiction at the heart of Martian values: ‘We truly want some global control, and yet we want freedom for the tents as well’ (*Blue Mars*, 135). Despite the model of the Swiss canton Graubunden, ‘the truth was, they were in a new situation. There was no historical analogy that would be much help to them now’ (*Blue Mars*, 136). The complexly interpenetrated economies of Mars presents challenges that cannot be translated by models on Earth. When several members of the Martian government visit the budding colonies on Saturn in an attempt to build an interplanetary alliance, one Saturnian accuses the Martian delegation of hypocrisy and of attempting to exert control from above. Mars’ environmental policy attempts to maintain environmental equilibrium, but in doing so autonomy is threatened at the local level. Russell’s reflections on scientists and technicians as apolitical leads him to think of politics as a form of science. He concludes that the distributed power of a polyarchy would theoretically lead to ‘the greatest amount of individual freedom and collective good,

by maximising the amount of control that an individual had over his or her life'. In *Green Mars*, Russell attempts to explain to Clayborne his goals for the terraforming project: 'It's hard to express. Something like a net gain in information. A net gain in order' (*Green Mars*, 186). This is a functional description of life itself for Russell, an anti-entropic increase in complexity, rather than a form of systematic, totalising control. These two visions of order come into conflict as control inhibits Russell's quest for a net gain in complexity.

Vlad Taneev and Marina Tokareva argue that 'Economics serves to justify the current power structure' (*Red Mars*, 352) and that the arbitrariness of the assigned values to specific resources elides the realities of humankind's exploitation of the planetary environment and its inhabitants. They propose an economic system that attempts to address the totalising incorporation of nature by entailing a return to the land. The *Mars* trilogy argues that humankind must embrace their powers for control in the service of nature and human communities. Remarking on the power that nanotechnology promises for the construction of a space elevator that would connect Earth and Mars, Boone links humankind's technological capacity to issues of claim-making, ownership, sovereignty and conflict: 'People squabbling like those old gods on Olympus, because nowadays we're just as powerful as they were'—or more, chimes Nadia (*Red Mars*, p. 381). Technology provides an unmediated power which gives an illusion of systematic control. This power invites political and economic disputes that challenge how that power is wielded. Eco-economics emerges as an alternative distinctive for its determination of value based on ecological principles and not capital. Eco-economics is enshrined in the Dorsa Brevia agreement alongside a principle that situates Mars as a model for further expansion into space: 'What we do here will set precedents for further human habitation of the solar system, and will suggest models for the human relationship to Earth's environment as well' (*Green Mars*, 489). This article highlights a cusp beyond which multiple histories might develop along two broad lines: greater or less

totalising control through the reshaping of the climate to satisfy human desire. These choices are encapsulated in the opposition between industrial and ecopoietic models that respectively position humankind as masters of or participants in shaping the climate.

Terraforming has become an increasingly important subgenre of sf in relation to climate and climate change, having developed into a mode of literature that critically engages with the fantasies of control that advanced technology seems to offer for mastering nature. Terraforming invites speculation regarding the nature of power and control over space and time, particularly with regard to the climate. They highlight the pitfalls attendant on the recycling of historical orientations toward nature and society, primarily in its engagement with colonisation, empire and economic expansion. By mapping how the past reasserts itself in new forms, they draw attention to the persistence of cultural memory and to the difficulties of adapting to new contexts. Such works also seek to preserve the utopian potential embedded in these sequences of interaction and mythmaking. *The Sands of Mars* and the *Mars* trilogy point to the utopian potential offered by the idea of terraforming and inhabiting other worlds—of building new societies that might escape the mistakes of the past. By the time Robinson's *Mars* trilogy was published, utopia and the patterning of frontier narratives on sf literature was recognised as far more problematic than in Clarke's context, yet both writers were concerned with identifying and stripping away the fantasies that accompany ideas of systematic control over nature and the habitation of new lands as recapitulating American colonial frontier narratives. Herbert's *Dune*, by contrast, attempted to deflate myths of power and control and was critical in reshaping notions of the sf hero as a flawed character unable to escape the implications of such mythmaking.

These narratives trace a movement in sf that is both iterative and reflective.

Terraforming narratives build models, not only for thinking about the future, but for thinking

about the impact of the past and present on the trajectory of that future. They enact a practice of speculation, critical thinking and testing with regard to the key themes of systematic climate control, community and the modes appropriate to engagement with non-human nature. These models are not primarily intended to shape specific practices (although specific examples of sf make the attempt) but rather construct imaginative landscapes where the influence of history on society can be posited, critiqued and debated. As Robinson's *Mars* trilogy exemplifies, sf engages with other works in the tradition as well as with developments in the sciences and humanities to revise the assumptions of earlier narratives while offering new ways of conceptualising social, political and economic relationships that might offer productive approaches to understanding and inhabiting a world subject to climate change.