

Engineering Planets, Engineering Ourselves: The Ethics of Terraforming and Areoforming in an Age of Climate Change

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Abstract

The concept of terraforming, the engineered transformation of alien planets into habitats suitable for human settlement, has taken on new meaning in science fiction and contemporary culture as climate change has indicated that human beings are currently transforming this planet but without a clear plan for sustaining inhabitability. Literary depictions by Kim Stanley Robinson of both climate change and terraforming raise ethical questions about the engineering of this and other planets, while the science fiction novels of Joan Slonczewski raise ethical questions about engineering human beings to adapt to alien environments. Together, they provide ways of thinking about the intertwined ethical questions of engineering the biosphere and engineering the species in the context of human and environmental sustainability. In particular, some works, such as the novels of Karen Traviss, raise the issue of how much the human species might have to engineer itself to pay the price of its unplanned engineering of planet Earth.

Nearly twenty years ago Bill McKibben claimed that "we are at the end of nature" (8). In support of this seemingly hyperbolic statement, he referred to a 1957 scientific paper which claimed that "Human beings are now carrying out a large scale geophysical experiment" (qtd. in McKibben 10), by pumping rapidly increasing amounts of carbon dioxide into the atmosphere.

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Many people, myself included, thought McKibben had gone over the top. A strong jeremiad, *The End of Nature* reflected hubris in imagining that human beings could be so powerful. So, some of us took him seriously without being convinced, others dismissed him, and most Americans ignored his evidence. One group of writers, though, had not only already taken the ideas McKibben espoused seriously, but had written about them before *The End of Nature* appeared.

Twelve years before readers were challenged by McKibben's prognostications, Arthur Herzog published his novel *Heat*, in which he depicted a runaway green house effect. He presumes that governments will have to engage in conscious climate engineering to counteract the dire effects of the unconsciously determined climate changes that post World War II industrialism has produced. Years in advance, Herzog posits that what McKibben recommends will prove necessary but insufficient. Backing off will not be enough. Rather, Herzog argues, to address global warming and the greenhouse effect, we will have to *terraform* planet Earth, but do so intelligently rather than blindly. As Kim Stanley Robinson remarks in a 2005 essay about his *Forty Signs, Fifty Degrees, and Sixty Days* global warming trilogy, the term "terraforming," coined in the 1930s as part of space exploration literature, had always meant engineered climate change on other planets in order to make them more like Earth, commonly called "Terra" in science fiction (SF). A common motif in SF, Arthur C. Clarke promoted it in his 1951 novel *The Sands of Mars* and the movie *Aliens* with Sigourney Weaver depicted one such effort with a character referring to the project as a "shake and bake colony." But Robinson comments that, in working on his 1990s novels about Mars, "it occurred to me that we were already terraforming Earth, in the here and now, but by accident, and in ignorance of how it worked or what might happen" (1).

In the *Mars Trilogy* Robinson addressed ethical questions surrounding the terraforming of another planet. Concomitantly he raised considerations about the idea of *areoforming* people to adapt to aspects of Mars that should not or could not be terraformed. These adaptations included spontaneous natural responses over time, such as reactions to the reduced gravity, as well as intentional responses through gene therapy. Although less common in SF than terraforming, evolutionary adaptation of the human species to alien environments has been treated in a variety of novels and occasionally with the intensity of the Mars trilogy, but generally not identified with any kind of label in the way that Robinson does. For example, beginning before the publication of Robinson's trilogy and continuing into the period after it, Joan Slonczewski also took up the issue of *areoforming*, or adapting people to the planets on which they settle, in a series of linked novels, although in a much more distant future and in other solar systems.

Continuing to work on the issue of terraforming after his trilogy, Robinson published *Antarctica*, a novel about industrial exploitation of that continent in the context of gradually intensifying climate change. But in his global warming trilogy, *Forty Signs of Rain* (2004), *Fifty Degrees Below* (2005), and *Sixty Days and Counting* (2007), Robinson addresses the possibility of *abrupt climate change*.

These two authors, Robinson and Slonczewski, provide readers with literary examples for analyses of several interrelated issues. One would be the expected question of whether or not terraforming is ethical. But that question raises two other ones: which human interventions in the ecology of Earth's biosphere are ethical? Which interventions represent environmental

injustice? That question in turn allows for a rethinking of the meaning of the word *terraforming* itself. Does it mean making other planets more like Earth; or, does it mean making over any planet into some imaginary human home, such that Earth itself is undergoing a largely unplanned global engineering project that ought to be labeled *terraforming* with all of the ethical questions that surround planetary interventions?

Finally, consideration of these questions allows a dialogical ethical argument for thinking through an appropriate relationship between terraforming and areoforming dependent on consideration of humanity's right to life as distinct from its right to expansion. What if declining to engineer humanity's way out of self destruction is not an option? What if for *Homo sapiens* as a species to survive, and countless other plant and animal species along with us, we must actually intensify our engineering of this planet's ecology? And, if we decide to go that route, should we be working on engineering the rest of nature, including the entire atmosphere, or should we be engineering humans, other animals, and plants to be capable of adapting to a drastically altered global environment from the one we now know? Certainly, the engineering of plants to survive desertification, altered climate zones, and changes in rainfall patterns is already under way. The cloning of animals to date would appear to provide the basis for a similar project of adaptation engineering.

Robinson's *Mars Trilogy* projects a future history of human colonization and transformation of Mars, including extensive scientific attention to re-engineering the planet's atmosphere. Simultaneously humans are becoming Martians as a result of inhabiting that planet through multiple generations, undergoing a variety of physical mutations and cultural adaptations. On Mars, transformation goes forward extremely rapidly, and after awhile no one wants to return the ecology to its pre-contact condition. At the same time, events on Mars have little impact on life on an ecologically devastated Earth, because too few people can migrate to impact our planet's problems. Thus, Mars can only be viewed from afar as an experiment from which some technologies, systems of organization, and methods of eco-engineering can be learned and applied. Today on Earth the question arises of whether or not it is possible to mitigate the effects of anthropogenic greenhouse buildup and global warming in any reasonable amount of time that will not either result in large scale human die off or require major habitat re-engineering, such as rebuilding and reconfiguring tundra regions where the permafrost has melted. But Robinson raises the question of whether or not it might be less risky to try and re-engineer ourselves rather than our environments; or, perhaps we ought to consider working on ecological destruction mitigation and human adaptation simultaneously.

In his new global warming trilogy, directly focusing on abrupt climate change, Robinson presents a more immediate approach to environmental issues. The first volume basically introduces the characters and demonstrates the ways in which the impacts of global warming are accelerating with Washington, DC, flooded due to a convergence of weather patterns. The second volume tackles the rapid arrival of expected impacts of global warming: significant intensification of weather extremes and the stalling of the North Atlantic current. But also, the novel ends with the breakup of the Ross Ice Shelf and the specter of a significant and sudden rise of sea levels as Antarctic glaciers speed up their calving into the ocean. Although carbon sequestration and other carbon draw downs are being implemented, their immediate impact appears likely to be negligible in halting significant population devastation and long term climate changes.

In *Sixty Days and Counting*, Robinson continues the romance and mystery plots that affect individual characters while they work through the American National Science Foundation and the newly elected President's administration to combat the most immediate effects of global warming, undertake the retooling of the American energy and transportation infrastructures, and expand international cooperation (some of Robinson's proposals for the future in this novel are already becoming part of contemporary reality as President-elect Obama incorporated the energy grid transformation in his proposed economic recovery plan). Intensive technological and scientific action restarts the North Atlantic current, and the international community initiates huge pumping projects to address sea level rise without totally flooding coastal populations. Various mechanisms for carbon draw downs and sequestration, mostly based on existing technologies, are also implemented, with Robinson likely basing these mitigations on Pacala and Socolow's "stabilization wedges" discussed in *Science* in 2004 (see Pacala and Socolow; Broecker and Kunzig, Chapters 13 and 14). But, this extensive terraforming of the earth is recognized as having many unintended consequences, such as the creation of inland saltwater lakes that will produce local environmental havoc and a necessarily inconclusive degree of success because the stabilization and then reduction of atmospheric carbon dioxide levels is a multi-century project. Through the blog entries of the President and a likely intensive extinction event in China, Robinson suggests that all of the dominant forms of economic organization and political manipulation of economies will have to be replaced with some version of eco-economics if human beings are likely to survive their current terraforming practices. Current global economic policies and structures, whether transnational corporate control of coal mining or government road building, promoting new housing construction through financing or exporting fast food and car cultures, all depend on growth models that emphasize a short term maximization of profits without long term conservation of resources or local environments and accounting practices that do not incorporate the costs of pollution or the loss of species.

While Robinson has focused his SF on the near future, with the global warming trilogy set just a few years out, Slonczewski is a biology professor and SF author who works with a longer time line to envision ways in which people can and should genetically adapt or be bio-engineered in relation to the planets they seek to inhabit; at the same time she also proposes organic, rather than mechanical, models of bio-engineering for ongoing terraforming that work at building symbiotic relationships with existing plants and animals on a planet rather than replacing them with more human friendly variants. In other words, for Slonczewski, human survival and adaptation continue the dialogical interaction that characterizes inhabitation of this planet, but they do so in far more self-conscious and ecologically aware forms than is typically the case for her readers, who might favor organic gardening, for instance, but give no thought to the importation of exotic species or don't consider the ways that voluminous ingestion of synthetic chemicals have chromosomal impacts on their offspring. Her heroes accept the need and the ethical responsibility to translate and re-transcribe themselves as much as, and at times as an alternative to, terraforming a planet or re-transcribing a species. I can only mention her key novels here: *A Door into Ocean*, *Daughter of Elysium*, *The Children Star*, and *Brain Plague*. Although not near future SF, since they are placed in other solar systems at an indefinite point in the future, they do raise the flip side of biosphere management and engineering, which is species bioengineering, both for our own survival and the survival of other species and even planetary biospheres.

Perhaps the most radical terraformist SF author today is Karen Traviss, whose six-volume Wess'har Wars series puts forward a terraforming based on an extreme version of restoration biology driven by dehomocentric, heterospecies egalitarianism. That is to say, all sentient

species have equal rights to life with humanoid species having no special privileges. She combines vegan practices with population control and reduction, and sets up a showdown between humans on an earth at the end of the 24th century utterly wracked and devastated by anthropogenic ecological imbalance and a technologically advanced alien species committed to ecological restoration that benefits all sentient beings. Those nation states that accept the inevitability of harsh and extensive mitigation, including population reduction fare better than those who do not. The situation on Earth that Traviss presents at the end of *Judge* fleshes out the kind of world only briefly described by Ursula K. Le Guin's Terran ambassador near the end of her SF classic, *The Dispossessed*. In both novels, Earth is a world so racked by human despoliation that only extreme regimentation holds hope for the survival of the human species and any partial restoration of the biodiversity that is rapidly disappearing today. Although action packed, Traviss's six novels also contain extensive environmental ethical debates often times highly reminiscent of Val Plumwood's work, especially in *Environmental Culture*, where Plumwood has a chapter titled "Towards a Dialogical Interspecies Ethics."

In his "Imagining" essay, Robinson claims that "depending on how we react to it, the possibility of abrupt climate change could be a *good thing*" (17). Why? Not so much because it would force quantum leaps, literally, in long-range projective bio-engineering, but because it would require an accelerated contingency evolution of human society, which would have no teleological predictability. There is no use pretending that we haven't been altering the world over millennia. At the same time, we also have to stop pretending that such alterations have no consequences, that their pace makes no difference, and that they can and should only go one way: We change the world, but most people don't imagine that it is also changing us as a species. Yet, if indeed blind terraforming is producing an ecological crisis that threatens human survival and the survival of countless other species, and nontransformation is neither a realistic option or an adequately timely one, then perhaps we need to start paying more attention to writers and scientists who are exploring the possibilities at the extreme ranges of ethics, science, and social behavior so that we can make informed decisions about future forms of terraforming and more serious efforts at human areoforming of ourselves and our societies in the face of the changes past practice has wrought. Whether these are cautionary tales based on hyperbolic extrapolation or prophecies of a future rapidly being defined by today's minuscule responses to scientific consensus, these SF works offer readers provocative scenarios for considering humanity's role and responsibilities in the world.

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