

## RESEARCH ARTICLE

# Can technology save the environment? Lessons from Iain M. Banks' *Culture* series

Simon Nicholson

A common theme in speculative fiction concerns technological overreach. All manner of scenarios have been developed by science fiction authors and filmmakers, warning of the potential for subjugation, obliteration, or alienation as technologies grow in power and scale. Yet within environmental circles, even though the dangers inherent in technological development are well appreciated, environmental challenges are coming to be defined more and more as technical matters to be resolved via technological means. This article explores some of the meaning and limits of this contemporary environmental techno-optimism, through engagement with the "Culture" novels of Iain M. Banks. The Culture novels chronicle a space-faring, post-scarcity civilization, and stand as a kind of best-case extension, in environmental terms, of humanity's present technological trajectory. The article wrestles with the potential for great benefit but also extraordinary risk that comes with treading down Banks' path and outlines the kinds of questions that must be asked and answered in an increasingly technology-saturated world. The article distills lessons from comparing Banks' novels to the "Biosphere 2" experiment. It also explores a few of the ways in which speculative fiction might be deployed in the classroom to better equip students and citizens to wrestle with existing and emerging technologies and their implications.

**Keywords:** Speculative fiction; Science fiction; Sustainability; Technology; Pedagogy

Jase felt pleasure at the girl's words (if not the snort), but at the same time detected in them a tinge of that mixture of contempt and patronizing smugness the Culture found it so difficult not to exhibit when surveying the mistakes of less advanced societies, even though the source civilizations of its own mongrel past had been no less fallible. Still, the underlying point held; experience as well as common sense indicated that the most reliable method of avoiding self-extinction was not to equip oneself with the means to accomplish it in the first place.

Iain M. Banks, *Consider Phlebas*

## Introduction

One oft-explored theme in speculative or science fiction concerns the dangers inherent in technological overreach. Some works that develop this theme imagine the suppression or enslavement of the human species at the hands (or other appendages) of self-aware machines, as in the *Terminator* or *Matrix* franchises. Others, such as the Terry Gilliam film *Twelve Monkeys* (1995) or post-apocalyptic visions contained in works like Cormac McCarthy's *The Road* (2006), are concerned with the virtual annihilation

of the human species through the willful or accidental unleashing of, say, nuclear weapons or manufactured microbial agents. And there are numerous works that explore technology-induced alienation—not in a "turning people into aliens" sense, but in the sense of technology's power to induce a rupture or discordance between individuals and their society (see Weldes, 2003), or between people and other sources of meaning. Examples include portrayals of desperate lives amid urban decay captured in movies such as *Blade Runner* (1982) or in the cyber-punk novels of William Gibson and Neal Stephenson.

These different warnings about technology run amok—warnings that might variously be called *subjugation*, *obliteration*, and *estrangement* of humanity as a consequence of technological advance—are also themes that can be found in environmental writings.

*Subjugation*, for instance, is an analytic trope for the environmentalists described by Jennifer Clapp and Peter Dauvergne (2011) as "social greens." For this community, the roots of the contemporary environmental situation lie in patterns of exploitation—that is, in subjugation of the poor and vulnerable at the hands of the powerful, or subjugation of groups of people via the systems, including of industrial capitalism and its technologies, that the powerful have created. *Obliteration* narratives are rife, from the generalist doomsaying of so-called "neo-Malthusians" like Paul and Anne Ehrlich, authors of a string of articles and popular books including *The Population Bomb* (1968)

and *One with Nineveh* (2004), to myriad forecasts of rapid climate change-induced cataclysm (e.g. Kolbert 2015; Wallace-Wells 2019), to scenarios that posit the gradual running down of the planet's capacity to support life. Common across "obliteration" narratives is the idea that humankind is currently suffering or set to suffer mightily as a consequence of human-induced environmental change. *Estrangement* can be found in the "End of Nature" motifs of writers like Bill McKibben (1989), with the idea that modern industrial life and its technological trappings have cut humanity off from nature and have torn us all from some more natural condition of deep intra-human and inter-species community.

The categories of subjugation, obliteration, and estrangement, when applied to the environmental conversation, are loose and overlapping. What connects them is a broad critique of industrialism. The notion that industrialism is a root driver of environmental harm has traditionally been a starting point for much environmental thinking, often accompanied by a deep skepticism about technological "fixes" for complex environmental challenges.

Yet the critique of industrialism that has long animated environmental thought has been receding. Even as techno-skepticism is still pervasive in some environmental circles, environmental challenges are coming, in general discourse and in policy conversations to be defined increasingly in technical terms, as problems to be resolved by the application of technological responses. Such an orientation is especially clear, for instance, in the calls of would-be geoengineers to work towards large-scale technological responses to climate change—think iron filings deposited into the Earth's oceans to promote great carbon-inhaling blooms of phytoplankton, or sulfur dioxide piped into the stratosphere to cool the planet by reflecting some amount of incoming solar radiation (Nicholson, 2010, 2013). It is also evident, though more subtly, in the efforts of more mainstream variants of environmentalism to grapple with the demands of producing more sustainable societal forms. In recent years the centrist strands of the environmental movement in the global North (that is, the wealthy, developed countries of the world) have come to organize themselves increasingly around calls for alternative, non-fossil fuel based energy technologies like solar, wind, and geothermal, and around a variety of so-called clean technologies—electric cars, next generation batteries, and the like—along with industrial processes that reduce the near-term ecological impacts of consumption and production. This is a very different sensibility from that contained in earlier, long-standing Northern environmentalist calls for conservation and preservation of species and places, or for de-industrializing or downsizing to keep human activities within ecological limits (see Wapner 2013).

The orientation of Northern environmentalism has, in other words, been shifting. An "ecological modernization" understanding has taken hold and gained ascendancy (see, for instance, Mol 2000; Schlosberg and Rinfret 2008). Rather than environmentalism serving now as a hard-hitting critique of industrial life, faith increasingly rests on the technological products of industrialism to save the day. As such, the dominant vision in the search for a sustainable

world has become, according to commentators such as philosopher of technology Aidan Davison (2001), a sort of global biospheric management. As Davison details, the newly dominant environmental vision is one in which the unintended environmental consequences of technology-driven actions are met with ever more sophisticated technological solutions, and, ultimately, in which the whole of nature, and significant aspects of human society and social goal-setting, are to be brought under a technocratic yoke.

This article is a meditation on where a deep-seated, insufficiently skeptical faith in technological responses might lead, in environmental terms. The article looks at the technological paradox outlined above—the paradox that exists when the dangers that are inherent in technological development are well appreciated, even as technology is increasingly held out as the answer for humanity's and the planet's ecological ills.

The jumping off point for the article is the universe inhabited by the "Culture" in the grand science fiction novels of Iain M. Banks. Banks created a fictional universe in which global biospheric management (and, in fact, ecospheric management on a galactic scale) has been perfected. The chief intent in the following pages is to use Banks' rich galaxy-spanning scenarios to examine the human-determined technological and ecological trajectory and to consider, as a consequence, how to read technology at the dawn of the Anthropocene. In particular, the question here is, is the push toward the ever-greater deployment of technology in support of environmental protection a sensible one, and if so, can it avoid the trio of threats (subjugation, obliteration, and estrangement) set out above?

Ultimately, the article points to the attractions but potential limitations of a technology-focused orientation to environmental protection. The article explores whether there is, instead of putting all faith in technology, value to be found in leaving something beyond human control, not just as a buffer or a safety margin, but rather because something real and important is lost in a totally managed world. Environmentalism must continue, in the face of greater levels of technological sophistication, to wrestle with the meaning and worth of a self-willed "nature" outside direct human intervention, not just for nature's sake, but also because reducing "nature" to something that looks like an aesthetic gesture matters for how we understand ourselves and our relationship to the world around us. That is, there is a danger of estrangement that does not fade away in the face of technological advance, but rather grows more acute. Ecological collapse leading to human obliteration should not be our only concern. Close examination of the Culture novels suggests that there are other, more subtle potential tragedies that await the blind pursuit of unfettered technological advance.

The article also reflects, in a closing section, on the use of speculative fiction in the classroom, and on the important role that fictional accounts can play in stretching and honing the abilities of us all to imagine future social and technological conditions and the challenges and opportunities they will bring.

### The Culture and its ecological orientation

Iain M. Banks was a Scottish-born writer of fiction. His work, prior to his too-early death in 2013, ranged far and wide, in terms of both themes covered and situations conjured forth. He accomplished, in fact, something quite rare among writers of fiction, which was to maintain an almost even split between works of "traditional" literary fiction and works of the speculative variety. On the science fiction side, Banks' most notable and sure to be most enduring contribution was the Culture series. The Culture is a technologically advanced, space-faring civilization that first made an appearance in Banks' 1987 book *Consider Phlebas*, and ultimately appeared at the heart of eight further novels and a collection of short stories and essays.

In its sophistication and degree of artistic realization, the Culture represents a singular creative achievement. Furthermore, in common with all great science fiction authors, Banks accomplished more than a sketch of a possible future galactic condition. He was also able to shine a bright light on the Western political and social trajectory, along with its technological and cultural history and aspirations, in ways that have been illuminating for scholars of literary criticism (see, for instance, Vint 2007; Colebrook and Cox 2013), international relations and world affairs, (see, for instance, Jackson and Heilman, 2008), and others.

The Culture is a galaxy-spanning civilization with a complex history and citizenry. As international relations scholar Chris Brown (2001) has pointed out, the Culture rests on two main pillars. The first pillar is the Culture's having tapped into a seemingly unlimited energy source. With an end to energy scarcity comes, in the novels, an end to scarcities of all kinds. The Culture has mastered faster-than-light travel, the building from scratch of habitats that become homes to millions of people, and the capacity to meet all conceivable material needs and wants. The second pillar is the presence of extraordinary Artificial Intelligences (AIs). The AIs in the Culture series range from those controlling "knife missiles" and other autonomous weapons systems, to sentient humanoid-sized Drones, to other-worldly "Minds" that are housed within and maintain the operations of the giant ships and other habitats that the Culture's citizens call home.

The Minds, each capable of managing all of the intricate workings of entire planets with the deployment of just a portion of their mental/computational resources, are the administrators and caretakers of the human characters in this imagined universe, and the Minds also function in many of the novels as critical and sometimes chief protagonists. Under the Minds' careful gaze, the image is of a technologically advanced utopia that at once pairs liberal notions of individual freedom (for all sentient and autonomous beings, humanoid, drone, or Mind alike) with a social structure apparently devoid of political struggle. In this way, and in common with the *Star Trek* television series and films, a liberal utopia is made real (or, rather, made fiction), as material scarcity falls away and the political clashes that arise between individuals and groups disappear in favor of what Friedrich Engels termed the "administration of things" (see Draper 1970, 282).

Just as international relations scholars have been able to mine Banks' universe for insight (see Brown 2001; Jackson and Heilman 2008), so too the Culture novels should be of immense interest to scholars of environmental politics and environmental studies writ large. While there are few explicit environmental messages in the Culture series, it is clear that the vision is of a civilization released from the tethers of ecological limits, free to exploit energy and materials to the full extent of its technological capacities. This untethering has, in Banks' novels, facilitated the particular anarchic form that characterizes the Culture's social organization. It has also allowed the Culture to spread itself across the galaxy. The billions of individual "human"<sup>1</sup> citizens that make up the Culture are afforded lives of extraordinary material comfort, living for the most part as contented hedonists. Humans have the capacity to change sexes, to activate glands within their physical makeups to flood their systems with drugs of various kinds, and have been augmented to live, conceivably, forever (though most call it quits after 400 years or so). All of this technological and boundless biotechnological control allows the Culture's citizens to enjoy the passing time following an endless array of professional and personal pursuits. A central theme across the Culture series is that despite the individual anarchic behaviors that on occasion emerge once all material and most meaningful political constraints have been stripped away, still, a kind of ordered and structured society exists, built around loosely shared norms of right behavior.

So what, then, of the environment? Taken together, Banks' novels posit, in terms of environmental sensibility, an extrapolation from the techno-optimistic orientation that dominates our present Earth-bound human age. Banks' novels are suggestive of a future in which all human material and social needs are met and at the same time non-human life can flourish under human management.

This future visioning holds important messages for those struggling to make sense of the present ecological moment and humanity's trajectory. That is, there are implications and lines of inquiry in Banks' work that should be of interest to us all in the early-stage "Anthropocene." Since Nobel-prize winning chemist Paul Crutzen (2000) coined the term, talk of the Anthropocene, signaling the dawn of a human-dominated age or epoch, has exploded in environmental scholarship. Notably, in the wake of Crutzen's pronouncement, geologists have launched a process to determine whether the Anthropocene should be formally recognized as an interval of geological history. The work in these circles, as Jan Zalasiewicz, chair of the International Union of Geological Sciences' Anthropocene Working Group, has put it, is in determining and charting a human-induced "change in the Earth System" (Zalasiewicz 2014).

Whether or not geologists ultimately agree on a formal designation and set of markers for the Anthropocene, still the Anthropocene concept has proved useful for social scientists and scholars in the humanities. One strand of work deploying the concept has cast humanity in the role of a planet-molding force, shaping all aspects of the living and non-living planet by a combination of considered and accidental actions. Some, this is to say, treat the

Anthropocene notion as providing analytical purchase on the overwhelming or taming of natural systems by human-created technological and social systems. As Brad Allenby (2004) has put it, “[F]orget ‘natural history’—increasingly there is only human history. And that trend will only intensify: the evolution of information technology, economic structures and globalization, nanotechnology, and biotechnology will have far, far more to do with the structure of the future than any environmental policy we may think about.” At the same time, other interrogators of the Anthropocene suggest that even as humanity’s technological reach grows, so humanity still remains subject to the operations of complex natural systems and feedbacks. This strand of writing on the Anthropocene notion suggests that humanity’s interventions in planetary affairs have rendered the Earth *less* rather than *more* predictable and controllable (see, for instance, Hamilton 2017). The implication of this reading of the Anthropocene is that, although humanity has become a major geologic force, we humans are not all-powerful. The Anthropocene notion, then, can at once be suggestive of human dominance and also human boundedness.

Banks’ vision in the *Culture* novels is firmly on one side of that particular Anthropocene debate. The *Culture* novels do away with any notion of human boundedness, and instead portray a kind of universe-spanning Anthropocene. Moreover, the picture is of an Anthropocene that is protective and restorative—a “good” Anthropocene of the sort posited by the Breakthrough Institute and supporters in their “Ecomodernist Manifesto” (2015).<sup>2</sup> Ecologically speaking, the vision is of an entirely managed existence, in which every aspect of every artificial, constructed environment is directed toward the sustenance and pleasure of the sentient beings of the *Culture*. The environmental woes that torment humanity today melt away. Technological wonders will arise to repair any damage that humanity’s prior wielding of technology has wrought.

I described above, in the introduction, a contemporary environmentalism that has already fully embraced techno-optimism. That rendering is a bit simplistic, of course. As debates over the meaning and implications of the Anthropocene make clear, environmentalism has always been multi-stranded and diverse. For instance, in the history of environmental thought there has been push and pull when it comes to thinking about the role and impact of technology on environmental and social outcomes. Within environmental work, as in works of science fiction, technology has been characterized as savior as well as obliterator, equalizer as well as subjugator, and connector as well as alienator.<sup>3</sup> Moreover, even as a more technologically optimistic form of environmentalism is ascendant, many individuals and organizations within the broad environmental community continue to push for “degrowth” rather than endless technology-driven expansionism (Assadourian 2012), or argue that fossil fuels should be kept in the ground rather than pulled out of the Earth and set on fire (Princen et al. 2015).

Still, the general techno-optimism theme that I have been drawing out holds. The dominant strands within Northern environmentalism today look quite different

from those that held sway in the early history of the modern environmental movement (see, for a longer analysis of this shift, Nicholson 2016). Banks has crafted a future-vision in which this now-dominant strand of environmental thought is drawn out to a conclusion of ultimate human domination. In so doing he is building on ideas of biospheric control that themselves have a lineage in environmental scholarship. Tropes of the Earth as a garden to be managed and controlled by humans have long stood in contrast to celebrations of wilderness and wildness (Marris 2013) and prior mechanistic understandings of the planet abound. Consider an image of the Earth from space. For some, such an image is a reminder that the planet is fragile, solitary, and made up of a collection of connected parts and systems. For others, such an image suggests the notion popularized by Buckminster Fuller (1968) that the Earth is like a spaceship in need of an operating manual, a metaphor that opens the Earth to human management.

In and on the fictional worlds that Banks created, any number of non-sentient life-forms—various animals and plants—are living, it can be assumed, self-willed lives. These species are present, though, at the will and whim of the *Culture* (which means, ultimately, the will and whim of the Minds that structure and allow for the *Culture*’s existence). The material world is something to be shaped for human comfort, with some pockets of entirely self-willed life set aside for ... what? And where do humans ultimately fit in a universe that is managed in every conceivable way by far superior, almost all-powerful AIs? The result is an environmentalism (and even a society) that ultimately looks like an aesthetic gesture—a form of mercy, perhaps, from a civilization that can destroy planets and even solar systems without breaking a sweat.

### **Technosphere as Ecosphere: Remembering Biosphere 2**

So what is to be made of Bank’s vision? One way to read the *Culture* novels is as offering a thoroughly good deal for “nature,” and, in terms of survival and material comforts, for humanity. It certainly seems like a best-case extension of the current impulse toward generating technological responses to environmental ills. The vision suggests that the development of massive computational power could in time enable the comprehension and management of all of the Earth’s living systems, and in the more distant future, the potential for escaping Earth and moving on to and harnessing the resources and managing the destinies of other planets. Certain “natures” on Earth and other worlds would be preserved and might someday once again flourish via humanity’s machine-augmented and careful ministrations, and other natures would be constructed and managed, for human ends, no doubt, but in ways that allow for self-willed expression.

Turning away for a moment to reflect on the *Culture* novels, though, it does not take too much effort to imagine that roadblocks stand in the way of the achievement of the best-case scenario described above. Can more and more sophisticated science and technology offer technological

salvation? Or does that path lead to subjugation, obliteration, or estrangement? An additional question also presents itself: if the future presented by the *Culture* novels is possible, is it desirable? Is this a trajectory that those of us concerned with human and environmental futures should embrace?

### ***Obliteration, or, is the Culture possible?***

In unpacking the environmental meaning of Banks' work, the obliteration potential in an overly optimistic pursuit of technological salvation is a useful starting point. The first and obvious thing to say is that Banks' vision is a very long way off. At humanity's present level of civilizational and technological development, human beings remain quite patently unable to manage all aspects of Earth's functioning, let alone capable of undertaking the terraforming of new worlds. This has not, though, prevented attempts large and small at environmental control or a searching for the development of tools and methods that might one day make planetary control possible. The sometime futility of and folly demonstrated by efforts to take full control of environmental systems can be represented in many different ways. Here, let us focus on the oft-recounted story of Biosphere 2, one of the most famous attempts to reproduce on a small scale the workings of "Biosphere 1"—planet Earth.

Biosphere 2 was designed as a fully self-contained ecosystem. The structure was (and remains, at its new home in Arizona) broken into seven different biomes, from an area for intensive agricultural cultivation to a twenty-five feet deep "ocean" complete with coral reef. Part of Biosphere 2's early mission was to generate new tools and techniques for environmental management. There were also connections to the space program, based on the hope that the functioning of Biosphere 2 might provide the blueprint for a way to set up living quarters on other planets. As such, this extraordinary laboratory had to prove its ability to provide for all the needs of a human group for an extended period.

Four women and four men were sealed into Biosphere 2 in September 1991. Their assignment was a two-year test of the complex's ability to support human life. During this time the parameters of the experiment allowed contact with, but no assistance from, the outside world. Within a very short time, though, the strict no-assistance rule had to be compromised. First, a medical emergency forced the opening of the complex's shell. Then, there were problems with the operation of the living environment. Interactions between an over-rich soil and the plant species in the Biosphere caused a dangerous buildup of carbon dioxide. At the same time an unusually cloudy summer combined with the quick deaths of all useful pollinating insect species meant that the crew was forced to subsist on a drastically limited diet. Because of these food shortages, all of the program's participants lost large amounts of body weight and suffered a string of ailments (MacCallum, 2004).

The trials of the early inhabitants of Biosphere 2 stand as a forewarning for those who would imagine an environment entirely under human knowledge, management, and control. Ecosystems are complicated, with the potential

for human interventions to produce staggeringly negative unintended results. At the extreme, human meddling in pursuit of absolute control over the environmental condition could lead to the obliteration that is the subject of so many works of speculative fiction.

No such individual-level or planetary disaster, though, awaits the citizens of Iain Banks' *Culture*. The members of the *Culture* can live lives of free abandon, safe in the knowledge that no chance catastrophe need befall them, nor is there ever any danger of system-wide ecological collapse. To permit individual safety, every member of the *Culture* is in contact with the resident Mind through a device called a terminal, and the resident Mind has the power to rescue people, from even potentially catastrophic events, on a moment's notice. At the system level, the cognitive power of the Minds means that every conceivable problem or scenario can be anticipated and addressed through the application of vast computational processing power. In this the *Culture* is playing out a modernist fantasy: the urge to remove all that can do harm, the interposing of technology between human societies and the non-human world to eliminate chance, to manage risk, to overcome the threat of injury and death that always awaits mortal organisms interacting with their environment.

Patrick Jackson and James Heilman (2008) have examined this facet of the *Culture* in a piece titled "Outside Context Problems," in which they view it as a product of Enlightenment-age reason:

For *Culture* humans, it simply makes sense to live in such a way that they are more or less insulated from chance catastrophes, and in this way the *Culture*'s commitment to reason helps to reinforce its commitment to individual liberty by giving its citizens the maximum freedom to do whatever they please without having to worry about environmental restrictions.

The god-like Minds, then, limit the ability for harm to individuals. More than this, though, the Minds are able to act on a galactic level, to mitigate the ecological harms that come from human actions. In a post-scarcity world there is no environmental need for rationing or other forms of material sacrifice, no negative environmental consequences associated with particular developmental paths, and so forth. The message is that there are no inherent problems associated with technological development, since there is endless room for material expansion, and should a difficulty of any sort emerge, technology will always provide a solution.

Literary critics use a phrase borrowed from the ancient Greeks, *deus ex machina*, to refer to a plotline that introduces an improbable device to resolve an apparently irresolvable problem. In ancient Greek dramas, a particularly tangled plot element was sometimes resolved by divine intervention. The physical representation of a meddling God was introduced to the stage by a complicated piece of equipment—hence *deus ex machina*, literally "god from the machine." This is as apt a description of the Minds as we are likely to find.

The inhabitants of Biosphere 2, though, and indeed, the inhabitants of Biosphere 1—we mortal inhabitants of Earth—have no such *deus ex machina* waiting in the wings. Yet this has not stopped the emergence of a technophilic orientation, seemingly premised on the idea that new technologies (thanks to human ingenuity and the genius of the free-wheeling market) will always emerge to erase the problems caused by utilization of the present technological cache. The Culture novels draw a line into the future from this understanding of technological potential. The Biosphere 2 experiment, however, exposes the danger in such a conceit. The experiment was first and foremost about replication of the Earth-system. On that count Biosphere 2 must be considered a failure. The entire project gives lie to the idea that humanity knows enough about complex living systems, and their interplay with complex non-living systems, to authentically and realistically reproduce their workings.

Of course, the fact that humanity currently has nothing like the Culture's level of technological sophistication is not a reason in itself to shy away from planetary management. Perhaps in time technologies will be advanced and powerful enough that almost-absolute control of massively complex and coupled human-planetary systems is truly plausible. It would be foolhardy to avoid an obvious question, though: what if, in the pursuit of a level of technological sophistication that would enable humanity to fully manage the planet, we manage to destroy it? That is, is the pursuit of ever more complex technologies and ever more control over planetary functions a path to salvation or to obliteration?

It seems important to point out at this juncture that the Minds, while god-like in their capabilities, are hardly infallible. Minds lose their, well, minds in some of Banks' novels, becoming reclusive and occasionally dangerous, or at least unpredictable. Nor with all of their computational power are Minds able to foresee or account for every exigency. In the novel *Excession* (1998), for example, a collection of Minds faces a profoundly disturbing "out of universe" development that they, with all their power, were unable to predict. That is, even Minds make mistakes, or can be surprised. Even in Banks' projection of a future in which almost anything is possible, the modernist fantasy of zero risk and total control is unable to be fully realized.

In the absence of Minds, then, and perhaps even in their presence, the message from the epigraph that opened this paper certainly represents a viable vision of a "sustainable" engagement with technology: "[E]xperience as well as common sense indicated that the most reliable method of avoiding self-extinction was not to equip oneself with the means to accomplish it in the first place." This is a notion that applies as much to ecological annihilation via technological overreach as it does to annihilation by military means.

#### ***Estrangement, or, is the Culture desirable?***

An additional lesson can be teased out by looking at Biosphere 2 alongside the Culture series. The entire Biosphere 2 experiment required, in Timothy Luke's (1997) words,

the construction of a "technosphere as ecosphere." This is to say that Biosphere 2 is essentially a gigantic machine. It cannot function but for the proper operation of an intricate collection of pumps, pipes, computers, transplanted flora and fauna, and sealed enclosures. The complex is a complete fabrication—even if working perfectly, Biosphere 2 is an echo of the Earth, in no meaningful way its equivalent. This is true not just in a technical sense, but in an aesthetic sense. Says Luke,

[In Biosphere 2] 'Nature' is not Nature, but rather something that has been digitally sampled, botanically colorized, zoologically compressed, and ecologically scanned into a biospheric simulation of itself that could not and would not exist without the engineering needed to stage this odd ecological experiment.

To live in an increasingly technology-saturated world is to interpose additional layers between the built and the non-human environments. When we consider that "Nature" has always been something against which and upon which we cast our identities, the erection of increasingly dense and elaborate layers of technology between the social and natural worlds means that the other-than-human is becoming increasingly more distant. For some, this is an immensely troubling proposition, an "estrangement" or alienation that is its own tragedy (McKibben, 1989; Fukuyama, 2002).

It is also a proposition that deserves some unpacking. Turning back to the Culture novels, the overriding impression is of a civilization that has moved beyond environmental concerns as we presently understand them. Yet still, even with the almost unfathomable levels of technological sophistication and the post-scarcity existence that the novels describe, there is an environmental sensibility. A civilization with the technological power of the Culture must be expected to have extraordinary impact on the "natures" (that is, the existing planetary ecologies) of the worlds with which they interact or inhabit. The impact of the Culture's orientation to the use of energy and matter on planetary environments and their indigenous "natures" is hinted at in the 1990 (reprinted 2008) book *Use of Weapons*, in which there is a short meditation on the Culture citizens' preferred habitats. It is made clear that the Culture avoids terra-forming<sup>4</sup> of existing planets as a general rule, preferring instead to leave planets functioning in their "natural" states. A small percentage of the Culture live on home worlds, many of which are said to have been terra-formed at previous points in the contributing civilization's history, before the Culture's environmental aesthetic—that is, leave nature be, save as an object of study (a favorite pastime of many of the Culture's citizens) and entertainment—became prevalent.

Now, it is worth pointing out that most members of the Culture live largely divorced from planetary environments, occupying instead gigantic spaceships known as General Systems Vehicles (GSVs), or inhabiting terra-formed asteroids that were previously devoid of life, or living on gigantic constructed "Orbitals"—artificial ring-shaped worlds placed

in orbit around suitable stars and overseen by a resident Mind. Every aspect, environmental and otherwise, of such habitats would be "artificial" and closely managed, though given the Culture's reach and power, this is a difference in scale of environmental intervention rather than kind.

Perhaps the technophilic vision of a heavily-managed, biospheric nature ruled by the dictates of technology is to be Earth's fate. It certainly seems a fair assessment of the present technological trajectory. Many have argued, however, that something would be indelibly cast aside in such a world. In Peter Huber's (1999) conservative environmental manifesto *Hard Green*, for instance, he compares the "Malthusian hell" forecast by those concerned with Earthly and natural limits with what he calls a "Faustian hell," by which he means a dark vision of what the world may look like if a future marked by total biospheric management is made real:

The new ecological hell now in sight is very different from the old. The Malthusian hell is as black as the waters before God's creation; the Faustian hell is merely beige, the color of man's concrete and computers. In the Malthusian hell, the ascent of man causes the collapse of everything else and that, in turn, destroys man, too. The whales and the ocean drown first, followed almost immediately by all the human occupants of the lifeboat. In the Faustian hell, the ascent of man causes the collapse of everything except man. Everything sinks but humanity.

Humanity could survive, and even, as with the Culture, thrive in and on such a world. Yet human life would need to find new sources for meaning, and color, and worth—the functions of identity-making that nature has always played. Here, then, we have a potent variant of the *estrangement* mentioned in the introduction.

What is to be made of this, though? Is estrangement from "nature" to be humanity's ultimate, everlasting fate? In Banks' hands, the Culture has managed to find its way to an environmental sensibility characterized by non-intervention in self-willed natural systems, even as the Culture's citizens have created and discovered myriad new sources of meaning. Perhaps, ultimately, that is what is demanded of us, especially given that in a world in which nature is already being destroyed and dismantled at alarming and accelerating rates, the search for alternative forms of meaning is already being thrust upon us.

It bears asking, ultimately, whether the vision of fully realized human control of the non-human world painted by Banks can really be called an "environmentalism". As noted in this article's introduction, environmentalism has traditionally been conceived as a critique of industrialism, as an identification and acceptance of ecological boundaries, and as a way to appreciate that humanity exists within rather than beyond nature. Banks offers something different and perhaps something new.<sup>5</sup> By erasing all sense of limits Banks extends an ecomodernist fantasy. Whether or not this fantasy is realizable, wrestling with the human capacity to shape the world is fundamentally what the

Anthropocene conversation is about. A close reading of Banks shows clearly that technology is at the heart of what it means to be human and that wrestling with technology is at the heart of the struggle to comprehend, define, and determine the Anthropocene's onset.

### Conclusion: Avoiding technological subjugation

The inhabitants of Biosphere 2 placed themselves entirely in the service of machines. Even the living systems that provided the conditions for human sustenance were entirely manufactured and designed. In a similar fashion, every aspect of human life in the Culture novels is ultimately at the whim of the Minds. Ralph Waldo Emerson, in the poem "Ode, *Inscribed to William H. Channing*," summarized the then-emergent technological condition thus: "Things are in the saddle, And ride mankind." How are we to use technology for human and environmental betterment without becoming entirely subject and subservient to our creations?

The kinds of questions posed in the sections above are of the thorny variety that students and scholars of environmental politics are forced now to reckon and wrestle with. For the last few years, early in each semester, I have set students in my global environmental politics courses at American University in Washington DC a "visioning" exercise. I split the class into groups and ask them to consider, what will Washington D.C. look like 200 years from now? I am actually asking each group to do two things. First, I ask them to imagine extrapolations of existing trends. I ask them to imagine, what will things look like if big, future-shaping trends like technological development and urbanization and climate change continue on their current course? And second, I ask my students to imagine Washington D.C. as they would like it to be. What *could* the city and the region look like? I ask, what kinds of utopia can you imagine humanity reaching toward?

Here's the surprising thing: almost invariably (with the odd notable exceptions), in the responses I hear back, Washington D.C. ends up looking, in 200 years, pretty much as it does now. Even after having read and discussed, by that stage in the semester, a number of accounts detailing environmental challenges, including writings that outline the possibility of social disruption and dislocation driven by ecological collapse, few of my students seem to be able to imagine, or at least to express, a world in dramatically worse shape than the world of today. Nor can they imagine a city and a world that has been remade around humanity's harmonization with natural systems, or radical technological advance such that Earth systems are entirely, 200 years from now, under some kind of beneficent human control.

These exercises and others have taught me that my students can imagine, in quite abstract ways, sea-level rise and species extinction and a more volatile climate system, but have trouble expressing what this will mean for the lives of human individuals to come, let alone future human societies and future collections of non-human species. When I ask them to explore positive potentials, they can imagine new technologies that better clean wastewater

and protect the region's watersheds. I hear about cars that run on hydrogen or modestly revamped public transportation systems. I don't hear much, though, about discontinuities—about dramatic technological, environmental, or social changes that will completely alter the present condition, for good or ill.

This is one critically important place where works of speculative fiction can help. Rich literary worlds like those inhabited by the Culture offer a place to examine what Warren Belasco (2006) has described, in another context, as “wild cards, surprise turns, near misses, lucky breaks, unexpected decisions, and even chaos” via engagement with rich and vibrant future-oriented scenarios and worlds. The Culture novels are not about the Earth. They say nothing about the current or future conditions of Washington, DC, or any other Earth-bound habitation. The novels do, though, force one to think carefully about the sorts of future visions that individuals and groups of people carry around and that shape present-day environmental policies and other interventions. Speculative fiction can help people probe big, rich, essential questions that can otherwise pass unexamined: What kind(s) of future are worth striving for? What kind(s) of future can be imagined as extrapolations from the current situation of the world? How much control do any of us really have over the world to come, in the sense that any of us might well ask, where might any current individual or group efforts make most difference?

In my environmental politics course, the week following the “what will Washington D.C. look like” exercise involves groups of students reading, considering, and then presenting one of a range of alternative visions of humanity's future. Some students read excerpts from *Use of Weapons*, (Banks 2008) one of the Culture novels. Others read excerpts from social dystopias, or a piece that vividly describes human life 10,000 years hence in a series of hyper-technological densely urban centers surrounded by self-willed wilderness (Nash 2015). The discussions that then emerge as the class reconsiders the future of Washington, DC in the wake of engagement with speculative fiction are invariably livelier and wider ranging.

Reading works by Banks and other writers of speculative fiction appears, at least with my students, to do two things. First, it provides them with license to free their imaginations. They are reminded that radical change, far from being abnormal, is actually the general way of things. They are able to craft visions of a future Washington DC surrounded by gigantic walls to hold back encroaching seas or of a city abandoned as waters rise. Washington DC is imagined as an eco-utopia with thriving small-scale agriculture and industry, or as a techno-utopia managed by AIs. Any of these visions is more plausible than the idea that the Washington DC of 200 years from now will look much as it does today. Second, reading speculative fiction forces students to confront the subjugation, obliteration, and alienation potentials in technological life. In my own classes I introduce these themes to students during our conversations following their reading, rather than in advance, as a way to orient them to the roles that technology might play in their future-visioning. I can just as easily

imagine that these categories or others like them might prove useful in organizing reading lists for class discussion, with students invited to select readings and draw out instances of technology run amok. This is all to say that one important thing such an exercise does is open the eyes of students to the different functions that technology plays in creating the social world. Works of speculative fiction can help, that is, to awaken people from the “technological somnambulism” of which Langdon Winner (1986) wrote—the tendency people have to sleepwalk through technological decision-making, blissfully ignoring the central role technology plays in shaping social existence.

Technology will be at the heart of the sustainable world of the future, if humanity is indeed to create such a world. Coming to terms with technology, and, particularly, its governance is one of the most crucial challenges that humanity faces. A key thing to realize is that there are very many different kinds of possible technological future. The Culture-style future of massively intricate and all-powerful machines is but one. Another possibility is that decisions are taken and institutions built that put brakes or limits on certain technological pathways, leading humanity to a different set of relationships with technology and thereby with ecology.

Take the notion of solar radiation management or solar geoengineering, for instance. Solar radiation management (SRM) has been posited as a response to climate change. Operational SRM systems would increase planetary albedo as a way to reflect a small amount of sunlight back into space in order to avoid some amount of planetary warming. Leading proposals include the deposition of reflective particles in the upper atmosphere or the artificial brightening of marine clouds. These are proposals that fit squarely within a Banksian view of the future. They would represent new, elaborate efforts at human management of basic planetary features. But to describe SRM as Banksian makes it sound like humanity has a range of binary choices. The technological world is not so easy to navigate. This is not a Banksian vs. some other version of the future choice set. This is because the vision of the Culture novels is an endpoint, whereas every contemporary human engagement with technology should treat technology as a *means*. There may well be forms of SRM that increase human connection with the non-human world, that accrue the bulk of any benefit to the most vulnerable humans and ecosystems, and that allow for community-scale rather than globe-spanning systems of control (see, for instance, Olson 2012; Nicholson 2013). The ends to which technologies are directed should be of utmost interest and concern to all who are interrogating the nature of the Anthropocene.

At the present moment, technological development and deployment tend to proceed along what looks, at least at first glance, like a single path, a path that happens to fit neatly with the high-consumption of late-capitalism, and by pitching the environmental dilemma as a set of discrete problems with technical solutions, the social and political dimensions of the environmental crisis are veiled, along with the sacrifices that technological change calls for. The broad beliefs that underpin this way



of thinking—that technology is generally a positive force, and that technological development can be trusted to continue, apolitically and autonomously, along a generally good “progressive” path—have become pervasive articles of faith. This faith, in turn, has had a powerful impact on the nature of environmental thought and action. From this perspective, things are basically on the right track. All that is allowed is tinkering at the edges, trusting that the basic system is sound.

Perhaps this is the right path. The universe of the Culture offers the hope that the human and the non-human worlds may both end up in a much better state if ways to more completely separate them are developed. However, there are dangers ahead. Subjugation, obliteration, and alienation are never far away when powerful technologies are wielded by a fallible species. Says Michael Zimmerman (1994).

I am both fascinated and appalled by the technological marvels invented by a dangerous and witty ape who speaks. ... So long as technological innovation is driven by a revulsion against corporeality and mortality, and by a craving to make the clever ape's ego into an immortal god, those innovations will contain an unintegrated dark side that will threaten to undermine every achievement, including efforts by the prosthetic god to flee from a planet poisoned by man's rage against mortality.

Ultimately, visioning the future is a fraught enterprise. Speculative fiction is at its best when it opens a window not just onto possible futures, but onto *contemporary* life. It helps identify some of the drivers— particular scientific, social, and political forces—shaping the present human and ecological trajectories. At the same time, speculative fiction works, in turn, to mold and define those very forces.

One current powerful dream, seldom stated directly but written in the notion that economic growth can be endless even as we live in a world with ecological limits, is that the future of our species lies in the stars and comes with an abandonment of the Earth. Once the planet is used up salvation will come, or future humans will find a way beyond it. Perhaps the implication to draw from this is that we must strive to perfect our management of the Earth so that we might one day manage the galaxy. So, by this view, humanity's proper goal, made imperative by the deteriorating state of the planet, should be ever more far-reaching intervention in natural processes—Earth-wide biospheric management, as a natural extension of the singularly-drawn present path. But if there are no Minds, no *deus ex machina*, waiting in the wings, what then? How might this change the relationship between humankind and machine?

In an age of accelerating environmental pressures, questions about the direction of human social and technological development can hardly be elided or ignored. Nor are technologies and complex technological systems simply going to melt away. To avoid Winner's “technological somnambulism” we must all strive for rich and

deep understandings of where past and present decisions might lead. Stumbling forward with blind, unfettered faith in the market, or just-over-the-horizon technologies, or the promises of political demagogues, is hardly the stuff that will guide the transition to forms of human life that are compatible with long-term ecological realities.

With any tool or technological system, any technology employed by fallible humans in search of individual or common good, there is always potential for disaster. Present humans have no Minds to curtail and save humanity from its worst impulses, and as Banks' novels make clear, even in the presence of Minds, bad things can happen. Until such time as humanity gives over all meaningful decisions to AIs, and perhaps even past that point, speculative fiction will continue to play the role that stories have always played in shaping human behavior and choice. Just as the *Odyssey*, which predated written word, provided a guide by which to make good choices and as caution against humanity's hubris, so too will speculative fiction continue this tradition for humanity's technological future. In this vein, the Culture series stands as a particularly artful means to shed light on humanity's present and future condition.

#### Data Accessibility Statement

No new data was produced in the preparation of this article.

#### Notes

- <sup>1</sup> Banks uses the term “human” in many of the Culture novels to describe the dozen or so species from different planets that have come together to form the organic component of the Culture. It is made clear, though, in a story in the collection *The State of the Art* (2004) that our particular species, *homo sapiens*, is not a part of the mix, though across Banks' novels the Culture exists contemporaneously with our present human civilization.
- <sup>2</sup> The “Ecomodernist Manifesto” was published in 2015 by a group of 18 prominent authors. The document urges pursuit of a “good Anthropocene,” to be achieved by using existing and emerging technologies to achieve “decoupling [of] human development from environmental impacts”. See Asafu-Adjaye et al. 2015.
- <sup>3</sup> My thanks to DG Webster for this insight.
- <sup>4</sup> I.e. large-scale planetary engineering, including weather, topographical, and ecological manipulation, to render a place suitable for human habitation.
- <sup>5</sup> Thanks to Simon Dalby for this point.

#### Acknowledgements

The author would like to thank DG Webster, Alastair Iles, and Kate O'Neill for their editorial guidance, and Anne Kapuscinski and two reviewers for instructive feedback on an earlier version.

#### Competing interests

The author has no competing interests to declare.

## References

- Allenby, B.** 2004. Engineering the Earth. In Olson, R and Rejeski, D (eds.), *Environmentalism and the Technologies of Tomorrow: Shaping the Next Industrial Revolution*. Washington, DC: Island Press.
- Asafu-Adjaye, J, Blomqvist, L, Brand, S, Brook, B, Defries, R, Ellis, E, Foreman, C, Keith, D, Lewis, M, Lynas, M, Nordhaus, T, Pielke, R, Jr., Pritzker, R, Roy, J, Sagoff, M, Shellenberger, M, Stone, R and Teague, P.** 2015. An Ecomodernist Manifesto. <http://www.ecomodernism.org/>.
- Assadourian, E.** 2012. The Path to Degrowth in Overdeveloped Countries. In Worldwatch Institute (ed.), *State of the World 2012: Moving Toward Sustainable Prosperity*. Washington, DC: Worldwatch Institute. DOI: [https://doi.org/10.5822/978-1-61091-045-3\\_2](https://doi.org/10.5822/978-1-61091-045-3_2)
- Banks, IM.** 1987. *Consider Phlebas*. New York: Orbit.
- Banks, IM.** 1998. *Excession*. New York: Spectra.
- Banks, IM.** 2004. *The State of the Art*. San Francisco: Night Shade Books.
- Banks, IM.** 2008. *Use of Weapons*. New York: Orbit.
- Belasco, W.** 2006. *Meals to Come: A History of the Future of Food*. Berkeley, CA: University of California Press.
- Brown, C.** 2001. 'Special Circumstances': Intervention by Liberal Utopia. *Millennium: Journal of International Studies* **30**(3): 625–33. DOI: <https://doi.org/10.1177/03058298010300031601>
- Clapp, J and Dauvergne, P.** 2011. *Paths to a Green World: The Political Economy of the Global Environment*. (2<sup>nd</sup> ed.) Cambridge, MA: MIT Press.
- Colebrook, M and Cox, K.** (eds.). 2013. *The Transgressive Iain Banks: Essays on a Writer Beyond Borders*. Jefferson, North Carolina: McFarland & Company.
- Crutzen, PJ and Stoermer, EF.** 2000. The Anthropocene. *Global Change Newsletter* **41**: 17–18.
- Davison, A.** 2001. *Technology and the Contested Meanings of Sustainability*. Albany, NY: State University of New York Press.
- Draper, H.** 1970. The Death of the State in Marx and Engels. *The Socialist Register* **7**: 281–307.
- Ehrlich, P and Ehrlich, A.** 1968. *The Population Bomb*. New York: Ballantine Books.
- Ehrlich, P and Ehrlich, A.** 2004. *One With Nineveh: Politics, Consumption, and the Human Future*. Washington, DC: Island Press.
- Fukuyama, F.** 2002. *Our Posthuman Future: Consequences of the Biotechnology Revolution*. New York: Picador.
- Fuller, B.** 1968. *Operating Manual for Spaceship Earth*. Carbondale: Southern Illinois University Press.
- Gilliam, T.** (dir.). 1995. *Twelve Monkeys*. Universal Pictures. Film.
- Hamilton, C.** 2017. *Defiant Earth: The Fate of Humans in the Anthropocene*. Cambridge, UK: Polity Press.
- Huber, P.** 1999. *Hard Green: Saving the Environment from the Environmentalists: A Conservative Manifesto*. New York: Basic Books.
- Jackson, PT and Heilman, J.** 2008. Outside Context Problems: Liberalism and the Other in the Work of Iain M. Banks. In Hassler, DM and Wilcox, C (eds.), *New Boundaries in Political Science Fiction*. Columbia, SC: University of South Carolina Press.
- Kolbert, E.** 2015. *Field Notes from a Catastrophe: Man, Nature, and Climate Change*. New York: Bloomsbury.
- Luke, TW.** 1997. *Ecocritique: Contesting the Politics of Nature, Economy, and Culture*. Minneapolis: University of Minnesota Press.
- MacCallum, T, Poynter, J and Bearden, D.** 2004. Lessons Learned From Biosphere 2: When Viewed as a Ground Simulation/Analog for Long Duration Human Space Exploration and Settlement. *SAE Technical Paper: No. 2004-01-2473*. DOI: <https://doi.org/10.4271/2004-01-2473>
- Marris, E.** 2013. *Rambunctious Garden: Saving Nature in a Post-Wild World*. London: Bloomsbury Press.
- McCarthy, C.** 2006. *The Road*. New York: Alfred A Knopf.
- McKibben, B.** 1989. *The End of Nature*. New York: Random House.
- Mol, A.** 2000. The Environmental Movement in an Era of Ecological Modernisation. *Geoforum* **31**(1): 45–56. DOI: [https://doi.org/10.1016/S0016-7185\(99\)00043-3](https://doi.org/10.1016/S0016-7185(99)00043-3)
- Nash, R.** 2015. Island Civilization: 1,000 Years Into the Future. In Nicholson, S and Wapner, P (eds.), *Global Environmental Politics: From Person to Planet*. New York: Routledge.
- Nicholson, S.** 2010. Intelligent Design?: Unpacking Geoengineering's Hidden Sacrifices. In Maniates, M and Meyer, JM (eds.), *The Environmental Politics of Sacrifice*. Cambridge, MA: MIT Press.
- Nicholson, S.** 2013. The Promises and Perils of Geoengineering. In Worldwatch Institute (ed.), *State of the World 2013: Is Sustainability Still Possible?* Washington, DC: Island Press. DOI: [https://doi.org/10.5822/978-1-61091-458-1\\_29](https://doi.org/10.5822/978-1-61091-458-1_29)
- Nicholson, S.** 2016. The Birth of Free-Market Environmentalism. *The Journal of Interdisciplinary History* **XLVI**(3): 421–433. DOI: [https://doi.org/10.1162/JINH\\_a\\_00870](https://doi.org/10.1162/JINH_a_00870)
- Olson, R.** 2012. Soft Geoengineering: A Gentler Approach to Addressing Climate Change. *Environment* **54**(12): 29–39. DOI: <https://doi.org/10.1080/00139157.2012.711672>
- Princen, T, Manno, J and Martin, P.** (eds.). 2015. *Ending the Fossil Fuel Era*. Cambridge, MA: MIT Press. DOI: <https://doi.org/10.7551/mitpress/9780262028806.001.0001>
- Schlosberg, D and Rinfret, S.** 2008. Ecological Modernisation, American Style. *Environmental Politics*, **17**(2): 254–275. DOI: <https://doi.org/10.1080/09644010801936206>
- Scott, R.** (dir.). 1982. *Blade Runner*. Ladd Company. Film.
- Vint, S.** 2007. *Bodies of Tomorrow: Technology, Subjectivity, Science Fiction*. Toronto: University of Toronto Press. DOI: <https://doi.org/10.3138/9781442684072>
- Wallace-Wells, D.** 2019. *The Uninhabitable Earth: Life After Warming*. New York: Tim Duggan Books.
- Wapner, P.** 2013. *Living Through the End of Nature: The Future of American Environmentalism*. Cambridge, MA: MIT Press.
- Weldes, J.** 2003. *To Seek Out New Worlds: Exploring Links Between Science Fiction and World Politics*.

- New York: Palgrave MacMillan. DOI: <https://doi.org/10.1057/9781403982087>
- Winner, L.** 1986. *The Whale and the Reactor: A Search for Limits in an Age of High Technology*. Chicago: University of Chicago Press.
- Zalasiewicz, J.** 2014. "Response to Adrian J. Ivakhiv's 'Against the Anthropocene' Blog Post,". *Immanence* 7.
- Zimmerman, ME.** 1994. *Contesting Earth's Future: Radical Ecology and Postmodernity*. Berkeley, CA: University of California Press.

**How to cite this article:** Nicholson, S. 2019. Can technology save the environment? Lessons from Iain M. Banks' *Culture* series. *Elem Sci Anth*, 7: 40. DOI: <https://doi.org/10.1525/elementa.378>

**Domain Editor-in-Chief:** Anne R. Kapuscinski, University of California, Santa Cruz, US

**Associate Editor:** Kim A. Locke, Geographical Sciences, University of Maryland, US

**Guest Editor:** D. G. Webster, Environmental Studies, Dartmouth College, US

**Knowledge Domain:** Sustainability Transitions

**Part of an *Elementa* Special Feature:** Envisioning sustainable transitions: Insights and challenges from science fiction

**Submitted:** 02 August 2016   **Accepted:** 28 September 2019   **Published:** 14 October 2019

**Copyright:** © 2019 The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC-BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. See <http://creativecommons.org/licenses/by/4.0/>.



*Elem Sci Anth* is a peer-reviewed open access journal published by University of California Press.

OPEN ACCESS 