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ELH, Volume 86, Number 2, Summer 2019, pp. 275-304 (Article)

Published by Johns Hopkins University Press *DOI: https://doi.org/10.1353/elh.2019.0015*



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SCIENCE FICTION AND THE TIME SCALES OF THE ANTHROPOCENE

BY URSULA K. HEISE

I. SCALE AND THE STUDY OF NARRATIVE

Questions of scale have been widely discussed in studies of literature in general and narrative in particular over the last two decades. These discussions have revolved around three complexes of issues: the broadening of canons, the use of digital tools, and the ability of existing narrative forms to engage with large scales of space and time.

The broadening of textual canons that literary scholars engage and its impact on critical methods and the understanding of literary forms has been debated at least since the 1980s. Comparatists addressed this question in Charles Bernheimer's 1993 ACLA Report on the State of the Discipline, *Comparative Literature in the Age of Multiculturalism*, an anthology of essays that explored how comparative literature might scale up to a genuinely global understanding of its subject matter. After the turn of the millennium, the paradigms of "world literature," proposed by Pascale Casanova and David Damrosch, and of distant reading, articulated by Franco Moretti, outlined approaches to the new global scope of literature: considerations of scale, in other words, had to do with the object of literary study.¹ More specialized fields such as the study of modernist literature have also seen extensive debates about the globalization of their canon and the questions of scale this expansion raises.²

In its original formulation in the essay "Conjectures on World Literature," Moretti's concept of distant reading referred to the study of global literature through the intermediary of expert scholarship rather than first-hand close reading as it has been practiced in the North American academy since the 1960s. But over the next decade, it became more closely associated with the use of digital quantitative methods in literary study that Moretti also came to pioneer, even as the task of reading an ever-growing world literary canon in a comparatist vein took on additional historical dimensions. Literature, especially texts produced before 1900, became increasingly available in electronic formats, and offered the possibility of researching archives with research questions in mind that had been previously unanswerable: questions, for example, about a corpus of thousands rather than just a few dozen Victorian novels. The numerical scaling-up of the canon at that moment came to include not only study objects but also methods, since a body of 4,000 or more novels cannot be researched only by means of close reading. New digital tools that were being developed to address this vastly expanded canon became themselves objects of heated debate between those such as Moretti and Matthew Jockers, who argued that they offered a different, if not necessarily better, perspective on literary history, and those who defended close reading as the unalienable foundation of humanistic study. Debates about scale, then, came to include questions of investigative methods and tools.

The third dimension of literary-critical debates about scale, to which this essay will seek to contribute, concerns the ways in which literary forms accommodate and sometimes generate ideas about space, time, and agency. Ever since investigations of the modernist legacy in literature and culture shifted in emphasis from postmodernism to globalization in the mid-1990s, the question of how literary forms might scale up from the individual, the family, or the nation to the world as a whole have informed numerous concepts and analyses: Moretti's concept of "modern epic"; Bruce Robbins's and Pheng Cheah's explorations of cosmopolitanism and literature; Gayatri Spivak's and Wai-Chee Dimock's investigations of "planetarity" (as distinguished from "globalization") and planetary literature; and the approaches to literature by David Palumbo-Liu, Nirvana Tanoukhi, and Robbins in the context of Immanuel Wallerstein's world-systems theory, to name just a few.3 Analyses more specifically focused on fiction have in addition proposed concepts such as the "encyclopedic novel," the "meganovel," the "systems novel," and the "maximalist novel" to describe the morphology of typically very long novels from the last fifty years that have aspired to capture the totality of the world.⁴

Most of these studies focus on ways in which literary forms—the novel above all—might be able to accommodate the spatial scale and cultural heterogeneity of an entire planet. The concept of the Anthropocene, which has taken on increasing cultural significance over the last fifteen years, adds the time dimension to this complex challenge. Coined by the ecologist Eugene Stoermer in the 1980s and formally proposed as a new geological term by Stoermer and the atmospheric chemist Paul Crutzen in 2000, the Anthropocene designates the most recent period of geological history as the Age of Man

because of humans' pervasive impacts on global ecosystems, which range from changes in land use, deforestation, and species extinction to climate change.

Considering these and many other major and still growing impacts of human activities on earth and atmosphere, and at all, including global, scales, it seems to us more than appropriate to emphasize the central role of mankind in geology and ecology by proposing to use the term "anthropocene" for the current geological epoch. The impacts of current human activities will continue over long periods.⁵

These impacts, Stoermer and Crutzen argue, signal an era different from the Holocene, the current designation of the last 12,000 years of earth's history.

Regardless of whether geologists will officially accept this term or not, it has become a popular shorthand over the last decade for global human ecological impacts, especially climate change (indeed, in quite a few contexts, the Anthropocene has become synonymous with climate change, even though it refers to a much broader set of processes in Stoermer and Crutzen's publications). As the historian Julia Adeney Thomas has highlighted, the Anthropocene challenges us to reconsider what "the human" means across scales that are not easily compatible with each other: "In considering the Anthropocene, all scales matter, but it is not clear that they all matter equally to our discipline [of history].... Paleobiology, microbiology and biochemistry... produce visions of 'the human' that are incommensurable with one another, as well as with the historian's usual conception of personhood and society."⁶ The clashing scales of geological time, of the microbes and bacteria that make up part of human bodies, and of the chemical flows of nutrients and toxins through organisms, Thomas argues, all lead to different reconceptualizations of human individuality and collectivity.

Large temporal scales, in particular, have come to the fore in discussions of the Anthropocene. In the perspective of many scholars, writers, and artists, the Anthropocene forces us to consider human society and the conditions that have enabled its survival in the past over long time spans, as well as to assess impacts that may last hundreds, thousands, or even tens of thousands of years into the future. Most prominently, the historian Dipesh Chakrabarty has argued that "The time of human history—the pace at which we tell stories of individuals and institutions—has now collided with the timescales of two other histories, both deep time, the time of evolution of life on the planet, and geological time. . . . [W]e have fallen into 'deep' history, into deep, geological

time."⁷ This collision entails that collective human temporality now has to be thought on at least three different scales: on the scale of a human history that has generated multiple inequalities between humans, on the scale of a humanity that has become an agent as a species, and on the scale of a geological power that transforms the planet's physical nature:

With this collapsing of multiple chronologies—of species history and geological times into our very own lifetimes, within living memory—the human condition has changed. This changed condition does not mean that the related but different stories of humans as a divided humanity, as a species, and as a geological agent have all fused into one big story, and a single story of the planet and of the history of life on it can now serve in the place of humanist history. As humans we have no way of experiencing—as distinct from cognitively knowing or deducing (from the effects of our human desires and actions)—these other modes of being that are also open to us today.⁸

What the Anthropocene requires, Chakrabarty argues, is to reimagine what humans are:

To call human beings geological agents is to scale up our imagination of the human. Humans are biological agents, both collectively and as individuals. They have always been so. . . . But we can become geological agents only historically and collectively, that is, when we have reached numbers and invented technologies that are on a scale large enough to have an impact on the planet itself.⁹

For both Thomas and Chakrabarty, then, the Anthropocene, by scaling up the human, undermines concepts of human individuality and sociality that have to date informed the way in which the stories of human pasts and futures are told. It challenges philosophers, historians, writers, and artists to design stories that accommodate human agency at the scale of the entire species, the entire planet, and geological epochs of time.

Chakrabarty's insistence that this scaling-up calls for a new universalism and an epochal consciousness has been widely and controversially debated. Marxist and postcolonial theorists have argued that this species thinking erases the class differences that continue to structure who produces and who suffers from climate change. Geographers and philosophers have questioned how much agency humans really have, and how agency at the collective level goes along with powerlessness for the individual. In my own contribution to these debates,

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I have argued that environmentalism should claim cosmopolitanism as a conceptual and practical resource for the future: rather than a biological presupposition, experiencing ourselves as a species—just as, at another level, we experience ourselves as citizens of nations, abstract entities of a similar kind—is a utopian project that always has to involve a sense that the human/*homo sapiens* is an ongoing project of assembly that starts from conditions of inequality and questions of multispecies justice.¹⁰

The philosophical debates about deep time, species agency, and humans' collective force and impacts have unfolded for a decade now and have been covered in depth in humanities and social science scholarship. Rather than rehearsing them again here, I will focus on the question of storytelling in the Anthropocene. If the Anthropocene indeed calls for a scaling-up of the imagination, how might that imagination translate into narrative? What characters and plot architectures would it involve? What models do existing narrative forms offer for telling the story of our climate-changed presents and futures? I will focus here on the temporal scales that the Anthropocene challenges us to imagine, and the kinds of agency that propel narrative forward over the longue durée. While new forms of art and literature are no doubt called for to meet this challenge, I will argue, some of the narrative resources for addressing long time intervals actually lie in narrative forms that preceded the rise of the novel and have accompanied it throughout its history.

II. THE ANTHROPOCENE AND THE UNTELLABLE

Hundreds of nonfiction books, novels, short stories, documentaries, and feature films have engaged with climate change and other manifestations of the Anthropocene over the last three decades: the publication of the Australian novelist George Turner's *The Sea and Summer* in 1987 (retitled *The Drowning Towers* in its 1988 American edition), one of the earliest science fiction novels to engage with the "Greenhouse Culture" of the late twentieth century, and Bill McKibben's *The End of Nature* in 1989, one the first nonfiction books to ring the alarm regarding climate change, may serve as convenient markers for the beginnings of stories about anthropogenic global warming.¹¹ So many stories about climate change are being told that the term *cli-fi*—climate fiction—coined by the journalist and novelist Dan Bloom in 2007, is now often used to describe texts and films concerned with the issue. Not all of these works deal with climate change as we currently

understand it, and quite a few of them do not fall into the genre of science fiction, as the term cli-fi might suggest. But the popularity of the shorthand indicates increased attention to the question of how literature and film might be able to engage with climate change—to the point where some environmentalists wish for "the great climate change novel" that might exert the galvanizing influence on climate change activism that Rachel Carson's *Silent Spring*, a 1962 book of scientific nonfiction that ingeniously opened with a dystopian short story, had on the awareness of environmental toxins and on the rise of the North American environmental movement.¹²

The anxiety that existing narratives, especially in their fictional variants, might so far have fallen short of truly persuasive forms and strategies in their engagement with the magnitude of climate change (and also other dimensions of the Anthropocene such as biodiversity loss and population growth), has remained a recurring concern among literary and film critics. In *Anthropocene Fictions*, a meticulous survey of climate change novels in English, Adam Trexler argues that these narratives are limited by existing cultural story templates and calls for formal innovation beyond the parameters of conventional storytelling.¹³ Scale is particularly important in these experiments because

climate change introduces disproportionate scale effects, so miniscule choices such as car ownership, vacation destinations, choices between urban and suburban homes, and thermostat settings contribute to catastrophic effects.... Climate criticism must develop ways to describe this interpenetration between domestic and planetary scales.¹⁴

Timothy Clark similarly notes that such scale disparities demand new forms of representation for climate change.¹⁵ In considering the limits of current climate change art and literature, he wonders whether current conventions of representation can be reinvented, or whether "the Anthropocene form[s] a threshold at which art and literature touch limits to the human psyche and imagination themselves?"¹⁶ He locates these limits in what readers typically expect from storytelling:

[T]he psychology of narrative—of what makes for people a credible or compelling story is itself a problem for representations of the Anthropocene... In the literary representations of the Anthropocene the techniques available to engage a reader's immediate emotional interest emerge as most often at odds with the scale, complexity, and the multiple and nonhuman contexts involved.¹⁷

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More sweepingly, the Bengali novelist Amitav Ghosh argues in his book *The Great Derangement: Climate Change and the Unthinkable* that the mainstream novel, in the form that arose in Europe in the eighteenth century and has come to dominate the literary scene worldwide, is incapable of dealing with climate change. Unlike premodern epic, Ghosh argues, the modern novel is structured so as to separate human culture out from nonhuman processes and forms of agency, which are relegated to the natural sciences; it is concerned with everyday people and ordinary affairs, not improbable and extraordinary events; and it is keyed to the scale of the individual, the family, and the nation, not the globe. In combination, these dimensions disable the mainstream novel from engaging with the Anthropocene: "The *longue durée* is not the territory of the novel," Ghosh concludes.¹⁸

This argument accurately diagnoses why a certain kind of novel has found it difficult to scale up the imagination of the human. But it does not equally apply to all types of novels: none of the constraints Ghosh discusses apply to science fiction, for example. For at least one hundred and fifty years, science fiction has often featured nonhuman agents, from robots to aliens and artificial intelligences. It has routinely focused on extraordinary events such as the discovery of new planets, encounters with aliens, and revolutionary technological change. Neither is scale in and of itself a problem for a genre whose settings include entire planets, solar systems, and galaxies. Indeed, given these ingredients of the genre, one way of describing science fiction is as a continuation of the epic tradition in the age of the novel.¹⁹ And one might also respond to Clark's concern about readerly interest in nonhuman and large-scale narratives by noting that science fiction has had a large popular audience even though—and arguably because—it often (though not of course always) integrates such elements.

That certain kinds of novels perpetuate dimensions of epic is not a new argument. Against Mikhail Bakhtin's contention that the rise of the novel terminated epic storytelling, Moretti argues in *Modern Epic* that some literary works from the last two hundred years continue the traditional work of epic, namely, giving an account of the entire world as it is known to the community that produces it. From Johann Wolfgang von Goethe's unstageable *Faust 2* to Gabriel García Márquez's *Cien años de soledad*, Moretti traces attempts to capture the capitalist world system in its entirety. Unlike classical epic, he argues, modern epic builds the awareness that it cannot ultimately accomplish its aspiration of being a "world text" into its narrative structure, conscious as it is of the "discrepancy between the totalizing will of the epic and the

subdivided reality of the modern world."²⁰ Curiously, though, Moretti never mentions science fiction as the genre that most clearly attempts, and often falls short at, precisely this task. And yet, telling stories of entire species, on a planetary scale of space and on a geological scale of time, has been part of what has distinguished science fiction as a genre over the course of its history (which does not, of course, imply that every work in the genre individually takes on these scales).

For this reason, one would assume that science fiction, exempt from the constraints Ghosh discusses, would be in a privileged position to tell stories about climate change and the Anthropocene. Ghosh, in this vein, asks, "Is it the case that science fiction is better equipped to address the Anthropocene than mainstream literary fiction?"²¹ But in answering this question, he draws on the Canadian novelist Margaret Atwood's claim that "science fiction and speculative fiction . . . 'draw from . . . imagined other worlds located somewhere apart from our everyday one," to conclude that "the Anthropocene resists science fiction: it is precisely not an imagined 'other' world apart from ours; nor is it located in another 'time' or another 'dimension."22 This argument—that science fiction cannot engage with a pressing problem confronting contemporary society because its settings are not modeled on the world as it currently exists—is an oddly literalist misreading of the genre on both Atwood's and Ghosh's parts. One might argue, as Fredric Jameson famously did, that the basic strategy of science fiction is to present to us our own society as the past of a future yet to come. Or one can claim with the science fiction writer William Gibson that the future of earlier science fiction has arrived, but is just not evenly distributed yet, which invites readers to apprehend the present as a kind of future. But either way, science fiction is of course always about the here and now, through the detour of the imagination of the future.²³

The Americanist Mark McGurl has suggested a quite different perspective on narrative, genre, and the Anthropocene. In his essay "The Posthuman Comedy," he proposes that it is precisely genre fiction with its often symbolic or flat characters that might be best-suited to reflect how thinking in geological time intervals can make humans seem ephemeral and unimportant, even laughable. McGurl writes: "Not only does genre fiction seem to violate the law of writing what you know from personal experience; not only does it bear 'formulaic' flatness on its grubby sleeve, catering to tastes unformed by the university, but its darkly dorky aesthetic unseriousness is an affront to the humanities hell, an affront to humanity. Look at those characters, little more than the toys of allegory!"²⁴ Horror novels and science fiction tend to focus

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on humans' entanglements with natural and/or technological others, he argues, and in the process they often recur to character types and plot architectures that tend toward the comedic in that they question humans' exceptionality and autonomy.

McGurl's analysis highlights that long time intervals in narrated time change which characters or agents can be expected to play a role in such stories: humans might be reduced to the status of flat or minor characters. But there is no reason that storytelling needs to be tied exclusively to well-rounded, individual human characters of the kind that the realist novel has popularized. Narrative theory since the structuralist days of Algirdas Julien Greimas has analyzed narrative agency in terms of "actants," which can be embodied in human characters.²⁵ But the two concepts do not correspond exactly, since an actant can be represented by more than one character (Rosencrantz and Guildenstern in William Shakespeare's Hamlet, who always appear together, are two characters but just one actant), by a divinity (Poseidon in Homer's *Odyssey* is himself an allegory for natural processes), or by an object (a fairy's magical wand). Bruno Latour borrowed the term from Greimas for Actor-Network Theory in the 1980s so as to highlight that the dynamic of social networks is not driven only by humans, but also by organisms, substances, and institutions to whom we do not usually grant agency. From this use in anthropology and sociology, the term migrated back into literary and cultural studies and into some of the new materialisms of the last twenty years as a way of understanding human agency in connection with nonhuman forms of agency. In this sense, somewhat different from the original structuralist version, the concept of the actant is a useful tool for thinking about how narratives that seek to tell the story of humans' long-term entanglements with the planet might connect the stories of individual humans with narrative arcs that involve cosmological, geological, and evolutionary processes.

III. TIME SCALE AND ANISOCHRONY IN SCIENCE FICTION

What strategies, then, have futuristic narratives developed to engage with long time spans, and how do they represent human and nonhuman forms of agency? To what extent do these narratives offer models for telling stories about the Anthropocene? From the perspective of narrative theory, the problem of deep-time storytelling is one of "anisochrony," as Gérard Genette called it in his classic *Narrative Discourse: An Essay in Method.*²⁶ By this he means the difference

between the duration of the narrated events and the duration of the narration itself. How long it takes a narrator to tell a particular story is of course impossible to determine with precision unless the narrative itself provides this information (many do not), and how long it takes a reader to work through a text also varies considerably (contrary to film, where the duration of the work corresponds exactly to the duration of its reception). Genette therefore focused on the relation between the time of events and the space of the printed text: whether a threehundred-page novel covers a day, a decade, or a century matters for its architecture, and so do its strategies for focusing on particular moments in what he calls "scenes," and summarizing or eliding other intervals of time (summaries or ellipses, in his terminology).²⁷ For narratives that engage with the Anthropocene, therefore, one of the major problems is the discrepancy between geological or evolutionary time spans to be narrated, on one hand, and the limited length of the average novel, on the other: a century in three hundred pages or less may be conceivable, but how does one fit 800,000 years into such a format (as H. G. Wells does in his-unusually short-novel The Time Machine), or two billion years (as Olaf Stapledon does in Last and *First Men*)? Science fiction has sometimes reduced this gap at least marginally through the popular format of the trilogy or even longer series of novels that deal with the same storyworld and plot. But even with such an expansion of the space of narration, the strategies that authors choose to solve the problem of anisochrony and to marshal the *longue durée* into a few hundred or at most a couple of thousand pages matter for the understanding of history and agency they outline. Most of the novels that I will survey in what follows were written well before the concept of the Anthropocene began to circulate, and most of them are not concerned with climate change thematically. Nevertheless, their methods of representing long time spans offer models for what strategies climate narratives in the contemporary could rely on-and to some extent already do.

1. Time Travel

Time travel immediately leaps to mind as a narrative device that science fiction typically uses in connecting presents to remote futures.²⁸ Time travel, in Genette's terminology, generates a temporal ellipsis, a time span that is omitted in the narrative. In science fiction, such ellipses are usually explicit and definite in the sense that they are clearly indicated in the text and that their duration is specified.²⁹ Yet time travel really is not a normal case of temporal ellipsis, because it takes

not just the reader but the narrative characters through time so as to witness the *longue durée*. In time travel plots temporal ellipsis is not just a leap that the narrator and readers perform, but one performed by the characters themselves, so that it migrates from the narrative discourse (the way in which the events are conveyed to the reader or viewer) to the story (the narrated events themselves).

In Wells's *Time Machine*, a prototypical time travel story, the protagonist uses a machine to propel himself further and further into the future. In the unfolding evolutionary plot he witnesses, social classes evolve (or devolve) into different biological species, and over the long term, the entire human species changes. On his last trip, the time traveler witnesses humanity devolved into crab-like creatures 800,000 years into the future. Similarly, in Sheri S. Tepper's longer and far more complex 1997 novel The Family Tree, scenes from the late twentieth century are juxtaposed with incidents and characters from another realm whose exact nature the reader cannot initially identify with precision. Only gradually does it emerge that the characters from this alternative sphere are actually beings who live 5,000 years in the future. When these future beings travel back to the twentieth century and encounter contemporary humans, it also turns out that they are themselves not humans at all, but the intelligent descendants of twentieth-century animals who were genetically manipulated in research labs. In both cases, time travel stages a juxtaposition between the present and the far future that offers a means of connecting individual human stories to large evolutionary time spans. And in both cases, the evolutionary narrative reverses humans' separation from the rest of the animal realm, although Wells and Tepper differ in casting this narrative as a story of decline or as a narrative with at least the possibility of utopia.

2. Time Leaps and Serial Protagonists

Unlike time travel, works of science fiction that deploy time leaps do away with the possibility of keeping focus on the same protagonists: in the more common version of temporal ellipsis, only the reader leaps through time, not the characters themselves. One of the longest and no doubt the most famous time leaps in science fiction occurs in Stanley Kubrick's 2001: A Space Odyssey, as the camera cuts from a bone, thrown into the air by a chimpanzee who has just used it as his first weapon, to a bone-shaped space ship travelling interstellar space. Leaping over four million years of evolution, this cut connects the first discovery of technology in the prehuman past to another technological discovery that is about to unfold in humans' immediate future.

In both cases, human evolution itself is pushed forward through the encounter with mysterious monoliths, artifacts from an alien civilization that propel humans into new evolutionary phases, leaving older evolutionary stages and characters behind. Neal Stephenson's 2015 novel Seveneves, less ambitiously but no less abruptly, leaps a few millennia into the future. The first approximately 550 pages of the novel portray the explosion of Earth's moon, which makes the planet uninhabitable and drives the scant remnants of humanity into outer space, where they can only survive a demographic reduction to seven female survivors by means of genetic engineering. The heading "5,000 years later" then introduces another three hundred pages that are situated five millennia after the explosion of Earth's moon. As humans return from space to Earth and encounter two communities that have survived and evolved against all odds in subterranean and submarine environments, conflicts ensue over the true meanings of humanness and sovereignty over the planet's territory. Even though they differ profoundly in their idiom and intent, Kubrick's film and Stephenson's novel nevertheless both point to recurring patterns in human evolution and the question of whether humans will ever be able—without alien intervention-to overcome tendencies of aggression, militarism, and self-destruction. It is these recurring patterns that compensate for the absence of continuous human character stories.

A different strategy of bringing individuals' stories together with long arcs of time combines time leaps with serial protagonists, when a work of science fiction tells stories of a leading or at least exemplary individual at a particular moment in humans' future history and then time-leaps to the next decisive period and individual. Isaac Asimov's series of novels from the 1950s—Foundation, Foundation and Empire, and Second Foundation—to which Asimov added two sequels thirty years later, exemplifies this strategy.³⁰ The core trilogy propels readers into a future 20,000 years onward from the moment when humans began to travel in space and settle on other planets. At that moment, the known galaxy is structured as an empire administered from the city planet Trantor and includes thousands of planets and hundreds of billions of humans. The plot revolves around an academic discipline called psychohistory, founded by the scholar Hari Seldon as a combination of history and statistics. This combination allows Seldon to predict the long-term future, including the impending collapse of the Empire and an era of anarchy and violence that will last 30,000 years. He also forecasts that creating a repository of human knowledge and skill far from the political center, the Foundation, to curate a Galactic

Encyclopedia for future generations, will shorten this interregnum to 1,000 years. But since psychohistory can predict the behavior of large populations, not of individuals, this plan can only succeed if the majority of the human population is unaware of the plan.

The narrative problem that this plot poses quite explicitly is how one might tell an essentially statistical story about the behavior of large populations in which individuals are assigned a marginal role from the start. In shifting narrative agency from individuals to statistical categories, Asimov deploys temporal ellipses and serial protagonists. The trilogy moves from the moment just prior to the collapse of the Empire to half a millennium later by means of short time leaps that take the reader from one turning point in the history of the Foundation to the next, each about a century apart. These turning points—shifts in the economic, political, and military relations of the Foundation with its planetary neighbors and increasingly with the remnants of the fallen Empire-are every time propelled by individuals who recognize that what previous leaders believed to be Hari Seldon's plan needs to be fundamentally readjusted. This makes for quite compelling narrative vignettes, but of course contradicts the Seldon principle that the novel cycle is based on: even as the broad history of the galaxy proceeds as Seldon had predicted on the basis of statistical forecasts, the history of the Foundation itself seems to depend on the actions of individuals.

Seems to—but the plot complicates ideas of individual agency. It turns out that even the leaders who change the Foundation's nature and path forward are often only partially aware of all the realities that surround them, misinterpret them, or are deliberately misled by the agents of a second Foundation created by Seldon. More mysterious in its location and mission, this second institution understands its charge to be the psychological manipulation of the first Foundation leaders so as to keep the Seldon plan on track. Who really is in charge (even of their own minds), who manipulates history, and what the Seldon plan consists of becomes increasingly complicated over the course of the trilogy. Nevertheless, the Seldon plan remains the narrative masterplot within the novels until the sequels that Asimov added in the 1980s. In these sequels, the Seldon plan with its future vision of another Empire is replaced by a completely different vision of a future galaxy-wide union of humans with their natural environments that goes by the name of Gaia, no doubt under the influence of James Lovelock and the rise of the environmental movement in the 1960s and 1970s.

A similar combination of time leaps and serial protagonists structures the narrative architecture of David Mitchell's 2004 *Cloud Atlas* and Michael Cunningham's 2005 Specimen Days, novels which leap forward in time from one character to another in different time periods from the nineteenth century to the present and to moments in the future. Both Mitchell and Cunningham, though, subtly suggest that the successive protagonists might be reincarnations of each other, as if to undercut the disconnection between different historical moments that is created through the narrative ellipses. In the future-oriented thrust of Asimov's *Foundation* cycle, humans' terrestrial past has fallen prey to collective amnesia, to the point where even the idea of an originary planet is considered a mere myth by most citizens of the future, and an ancient robot on the moon turns out to be the sole curator of the human past on a now radioactive Earth. Mitchell's and Cunningham's novels, by contrast, suggest cyclical returns through their narrative structure, reinforced in the case of *Cloud Atlas* through the novel's return from its futuristic scenes back to the earliest moments of the narrative. The more recent authors, therefore, use temporal ellipses for a very different portrayal of long arcs of human and ecological history than Asimov does. And yet, in all three cases, the reader is invited to a certain skepticism regarding humans' agency when it is considered against such long temporal horizons. The long-term patterns, whether explicitly forecast in the novel or implicit in the juxtaposition of scenes, raise the question to what extent the individual characters truly make decisions of their own or are subject to a pattern that they may not be aware of. From a metafictional perspective, this is of course also a question about the nature of narrative and the extent to which human-like actants are able to shape their own futures or are always determined by the narrative architecture of which they form part.

3. Species Narrative

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Other works of science fiction have gone even further in abandoning individual humans as narrative actants, replacing them instead with entire species. The British novelist Olaf Stapledon's work has in this context attracted renewed critical attention because of its experiments with species narrative and deep time, especially in *Last and First Men* (1930) and *Starmaker* (1937).³¹ *Last and First Men* offers an evolutionary narrative whose outline of the history of humankind over two billion years and eighteen successive human species remains startling in its temporal reach almost a century after its publication.³² From attempts to establish a cosmopolitan world government that starts in the "age of Einstein," the story follows the first five human species as Earth is repeatedly overrun by Martian invaders.³³ Then

changes in the moon's orbit force humankind to migrate to Venus, where further species of humans evolve and disappear. Millions of years later, a cosmic event that heats up the sun and makes the inner planets of the solar system uninhabitable forces humans to relocate to Neptune, which becomes the home of the last ten human species. Another cosmic, supernova-like event that is predicted to occur a few thousand years into the narrator's future will render the entire solar system as well as neighboring systems unfit for human habitation, and thereby seals humankind's upcoming extinction at the end of the novel: humans decide no longer to procreate, ending the "great living epic," as Stapledon calls it (205).

To illustrate the length of time it covers, the novel is punctuated by four time scales that represent, by means of the same line, an ever-expanding past and future time horizon, from two thousand years in the past and future to 200,000 years, 20 million years, and 2 billion years, as if to illustrate visually the novel's engagement with anisochrony—covering ever longer spans of time with similar lengths of narration: "As the horizon expands to cover new swathes of the future, the significant details from the previous timeline disappear from view as they compress into the 'Today' of the next timeline," Charles Tung has pointed out.³⁴ A fifth time scale reaches beyond the novel's narrated time back to the formation of the sun 10 trillion years ago (see Figure 1).

Stapledon attributes this deep-time narrative to an unnamed member of the last species of humans on Neptune, where "a million million citizens . . . live in perfect accord" (228) in a society that prizes philosophy and art as well as science and history. Living in socio-erotic groups of 96 and connected with each other by telepathy, like the fifth species of humans millions of years earlier, they have extended this capacity to minds of the past and thereby acquired the ability to relive past events through the eyes of individual sentient beings. For this reason, the narrator has access to the entire span of human history even though record-keeping has lapsed many times as humankind has descended into various types of primitive or even animal-like existence. The story that the narrator channels through the mind of a human in Stapledon's time is one of long cycles of rise and decline, achievement of almost utopian civilizations that are then brought down by disease, disaster, or internal contradictions, only to rise again, slowly, in a millenarian pursuit of the perfect balance between animality and spirituality, individualism and collectivism, causality and contingency, knowledge of the past and planning for the future. Several of the





human species that succeed each other are genetically engineered for particular traits and environments; others evolve from them by the normal processes of genetic change and natural selection.

In order to tell its story of two billion years of evolution, the novel forgoes individual human characters almost entirely. The narrator might be a posthuman individual, but the reader is given so little information about him or her that this voice does not crystallize into a full character. A few individual humans appear in the first four chapters, which deal with conflict and cosmopolitanism on Earth, but they remain truly minor characters. Afterwards, the actants become the successive species, and in some sections the different civilizations and cultures that vie with each other in a particular epoch. They include, for example, the Sixth Men, engineered for life on Venus; the Flying Men, part of the ninth human species who have glider wings and like to spend most of their time in the air; and the pygmies and giants who inhabit Neptune in the last stages of humankind. The individuals in some of these species have a life span of 50 years, in others 50,000 years, and the last humans can attain 250,000 years, so that even if the narrative did focus on a single individual, it would encompass what must appear as geological time spans to a twentieth- or twenty-first-century reader. Instead, the narrative foregrounds the mentalities and histories of human species that persist over tens of thousands and in some cases millions of years. The models for this narrative strategy are Darwin's evolutionary theory, on one hand, as the narrator spells out changes in the different species' physiologies and adaptations to their vastly different environments, and comparative cultural history as it was practiced in the early twentieth century, on the other hand. Sweeping comparisons of different nations and civilizations such as Oswald Spengler's 1918/1922 Der Untergang des Abendlandes (published in English as The Decline of the West) or Salvador de Madariaga's 1929 Ingleses, franceses, españoles: Ensayo de psicología comparada (published in English as Englishmen, Frenchmen, Spaniards: An Essay in Comparative Psychology) broadly model the kind of idiom that Stapledon uses in his large-scale characterizations of the eighteen human species and the various subspecies and numerous successive civilizations they give rise to over two billion years.

Such an ecological and cultural history of the future might make for a rather abstract and tedious narrative, and certainly does take *Last and First Men* far afield from the usual territory of the novel. But in fact, the least engrossing parts of the book are the early chapters that do feature at least some individual characters.³⁵ Later, it

is the breathtaking temporal sweep of the narrative and the sheer inventiveness of Stapledon's profiles of future species that keep the reader turning the pages. But it is also the narrator's attitude: he or she describes all the successive species, whether they are admirable, despicable, or just banal, with affectionate attention to detail, outlining profiles of how the different species and civilizations developed their particular characteristics with an eye to geology and ecology, genetics and culture, without ever becoming deterministic about any one dimension. The Fifth Men, for example, whom the narrator characterizes as "the first to attain true human proportion of body and mind" (169), stand out by their interest in the past:

With meticulous love they would figure out the life stories of extinct types, such as the brontosaurus, the hippopotamus, the chimpanzee, the Englishman, the American, as also of the still extant amoeba.... The reconstruction of the past, not merely as abstract history but with the intimacy of the novel, thus became one of the main preoccupations of the Fifth Men. Many devoted themselves to this work, each individual specializing very minutely in some particular episode of human or animal history, and transmitting his work into the culture of the race. Thus increasingly, the individual felt himself to be a single flicker between the teeming gulf of the never-more and the boundless void of the not-yet. (177–78)

The Fifth Men's interest in extinct human as well as nonhuman organisms vividly illustrates the flattening of ontological distinctions between humans and other species in the long-term perspective. But the Fifth Men's engagement with the past recuperates the "intimacy of the novel" that Stapledon's narrator eschews in his or her own immersion in deep time. Indeed, it is the Fifth Men who first develop the ability to access the past directly through the mind of a human or higher mammal that was alive at the time, a historical knowledge that ends up causing them immense distress because of the magnitude of past suffering, as well as enormous pleasure. But this description of the Fifth Men's experience of the past also highlights the delicate balance Stapledon's narrator seeks to strike, between enough detail to make each stage of human development compelling, and enough abstraction that the long arcs of the species narrative remain visible and allow emotional distance and relativity of moral judgment.

Striking this balance does not mean that the narrator dedicates equal attention to each of the successive species. Proportionally, ever less narration is devoted to the more remotely futuristic reincarnations of

humankind than to the ones more proximate to the twentieth century and the first few human species. The narrator him- or herself comments explicitly on this temporal telescoping about four-fifths of the way into the novel, when it becomes clear that only half of humans' history has been told and the rest, all of which will take place on the planet Neptune, will be summarized much more quickly:

> I have told man's story up to a point about half-way from his origin to his annihilation. Behind lies the vast span which includes the whole Terrestrial and Venerian ages, with all their slow fluctuations of darkness and enlightenment. Ahead lies the Neptunian age, equally long, equally tragic perhaps, but more diverse, and in its last phase incomparably more brilliant. It would not be profitable to recount the history of man on Neptune on the scale of the preceding chronicle. Very much of it would be incomprehensible to terrestrials.... To appreciate fully the range and subtlety of the great living epic, we ought, no doubt, to dwell on its every movement with the same faithful care. But that is impossible to any human mind. . . . Before continuing our long flight let us look around us. Hitherto we have passed over time's fields at a fairly low altitude, making many detailed observations. Now we shall travel at a greater height and with speed of a new order. We must therefore orientate ourselves within the wider horizon that opens around us; we must consider things from the astronomical rather than the human point of view. (205-6)

Flight, a recurring obsession for various human species and cultures in the narrator's account, here becomes a metaphor for the act of narration itself. Specifically, flight metaphorizes the mode of "summary" theorized by Genette, the speeding-up of narrative discourse in relation to narrated time.³⁶

That this acceleration takes place in the time periods most remote from the reader highlights a structural paradox that also emerges in other deep-time accounts of the future: even as the narration is cast as the typical anterior future, the retrospection from a moment in the future that is characteristic of science fiction, the time structure of the narrative is projective. Rather than providing the greatest detail about the moment of narration that one would assume the *narrator* is most intimately familiar with, this moment remains more general and abstract than the times closest to the *reader's* present, which one would assume to be haziest in a far-future society's memory.³⁷ Stapledon's Neptunian far-future narrator justifies this inversion by reasoning that "for the readers of this book, who are themselves tremors in the opening bar of the music, it is best that I should dwell chiefly on things near to them" (205).³⁸ This justification, elegant and glib at the same time, points to one of the structural challenges in deeptime narrative: moments remote from the present—whether past or future—are more difficult to account for in as much detail as moments close to it, and even if a writer were able to imagine such details, it is unclear how intelligible or relevant they would be to the reader. In this particular sense, Stapledon's narrative architecture remains tied to the twentieth century.

4. Time Collages

Doris Lessing's Canopus in Argos series of five novels, published in the late 1970s and early 1980s—Re: Colonised Planet 5, Shikasta; The Marriages of Zones Three, Four, and Five; The Sirian Experiments; The Making of the Representative for Planet 8: and Documents Relating to the Sentimental Agents in the Volyen Empire—was inspired by Last and First Men, which Lessing read with fascination during her childhood in what was then Rhodesia.³⁹ Canopus in Argos unfolds deep-time history as an ongoing struggle between three galactic forces, Canopus, Sirius, and Shammat. Shikasta and The Sirian Experiments retell Earth's history from the Canopean and Sirian viewpoints, respectively; some parts of this history reach deep into the geological past, whereas others deal with the history of the twentieth century and the near future. In The Sirian Experiments, this history is delivered as a first-person narrative by Ambien II, one of the ruling group of Sirians, whereas in Shikasta it is pieced together as a modernist collage of alien agents' accounts, humans' journals, and narratives by many other hands that together deliver a dismal picture of the human species. Many of the vignettes of individual lives that make up Shikasta feature compelling micro-narratives, but humans in both volumes remain firmly under the colonizing rule of Canopeans and Sirians and the intermittent sway of Shammat, an evil force whose nature is never defined clearly. It is the Canopean agents' reports in *Shikasta* as well as Ambien II's sweeping summaries of Earth's past in *The Sirian Experiments* that interestingly defamiliarize history at the human scale. Both alien species think in far vaster temporal horizons than humans and consider planet Earth unusually tumultuous, both ecologically and socially. Individual humans have little or no agency in this scenario, as Ursula K. Le Guin noted in her review of Shikasta.⁴⁰ In Lessing's long-term scenario, humans' fate is entirely dominated by processes of imperialism, colonialism, and oppression that have shaped their evolution from primordial times.

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The modernist fragmentation of text and multiplication of perspectives that Lessing uses in Shikasta is deployed to quite different effect in later science fiction texts. David Brin's 1990 Earth tells a story that is set in 2038 and stretches only over a few years. But its multiple characters, quotations from online chat forums (before they existed in the real world), fictional books, and news shows seek to give a sense of the heterogeneity of the planet, even as an epic thread that features indigenous deities and myths conveys a sense of its unity. In addition, italicized passages at the beginning of sections in *Earth* recount the geological history of the planet as a kind of bildungsroman, a deeptime framework for the novel's short-term plot. Brin borrowed this narrative architecture from John Brunner's 1968 science fiction novel Stand on Zanzibar, which in turn took its cue from the modernist works of John Dos Passos. This fragmented structure developed in the high-modernist novels of Dos Passos as well as James Joyce, Virginia Woolf, André Breton, Alfred Döblin, and others as a strategy for capturing the diversity as well as the unity of the modern metropolis and the nation-state. In Brunner's and Brin's hands, it becomes a way of narrating individual human lives along with the history of the human species and, in Brin's case, the geological history of planet Earth.

Set in the early 24th century, Kim Stanley Robinson's 2012 novel 2312 similarly builds on Dos Passos's and Brunner's legacy. 2312 portrays humankind as having built settlements on several planets, moons, and asteroids across the solar system. Humans have terraformed formerly uninhabitable places and in the process have transformed their own bodies: there are very small and very large individuals, many people with computers built into their brains, and some with animal genes. Almost everyone can choose and transform their own gender and sexuality several times as they move through life, being father or husband at one point and mother or wife at another, and many have both male and female genitals. The natural and built environments and the social orders they have created are similarly varied, if not always as easily changeable. To capture this diversity, Robinson focalizes the narrative through half a dozen different characters, and he intersperses the narrative chapters with excerpts from fictional books and how-to manuals, lists of activities and commodities, and detailed descriptions of outer-space habitats that amount to a kind of futuristic nature writing. Passages from history books and lists of inventions, in particular, help to supply the deep-time perspective that bridges the gap between the reader's twenty-first century and the 24th-century setting.⁴¹ The overall sense that the novel conveys is not of a single human future

but of multiple futures that are different ecologically, biologically, genetically, socially, economically, and politically. This technique drives home an arc of deep time that does not cast human history as singular or as separated from natural history, but as an unfolding of multiple ecocultural futures, some of which just might be utopian.

5. Time Palimpsests

The structural challenges I have mentioned—negotiating narrative detail with long arcs of plot, and the detail of contemporaneity with the indeterminacy or unintelligibility of far futures—also emerges in a recent experiment with deep-time storytelling in the medium of the graphic novel, Richard McGuire's *Here*.⁴² This novel reaches 3.5 billion years into the past—about the time when organic life first emerged on the planet—and approximately 22,000 years into the future. McGuire accomplishes this feat by focusing on one very particular place, a corner of a living room of a house somewhere in the Northeast of the United States. The house was built in 1907, and is inhabited by successive families until the entire area is flooded sometime early in the twenty-second century.

McGuire's narrative technique has been discussed in detail in previous analyses.⁴³ Each two-page spread of the novel shows a very small-scale space, the "here" of the title, in a particular year that is indicated in a box in the upper left-hand corner. But other, smaller panels, sometimes just one, sometimes several, sometimes a whole cluster, are embedded into the main panel on each page, functioning as windows onto other times. Each of the smaller panels also comes with its own year indicator. Sometimes a mini-narrative unfolds over the embedded panels on several successive pages; at other times readers have to piece together such mini-narratives from panels that appear dozens of pages apart. Sometimes the relationship between the different panels on one page is clear—for example, a page that shows people dancing in the room at different moments in time-while at other times the connection remains elusive. Temporal continuities, echoes, and clashes emerge over the pages of this graphic novel and invite the reader to detect similarities and contrasts over the decades, centuries, and millennia in a layered palimpsest of time.

As Mahlu Mertens and Stef Craps have highlighted, the novel's architecture in a sense imitates that of an "archaeological site" and directly "evokes the Anthropocene: the panel organization creates the illusion of the book as a pile of stratigraphic layers."⁴⁴ The protagonist of this novel is not a human-like character, but the place itself, the

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Figure 2. A vision of the past 80 million years ago in McGuire's Here ©.

here that undergoes myriad changes over time, some natural and some humanmade. From the undifferentiated oceanic mass that existed about three billion years ago, a continent and a landscape emerge, and at one point a dinosaur is seen fleeing from the viewer (see Figure 2).

Native Americans are shown inhabiting the forest in this place from the 1400s to the 1600s, in later periods along with European colonialists. The house itself is built across the street from other colonialstyle houses in 1907, and a flood inundates it in 2111, presumably as a consequence of climate change and rising sea levels. In 2213, a tour guide leads a group on a virtual visit to the house, which has materially disappeared: the guide displays the house and some of the objects that were used in it by projecting images from a fan-shaped electronic device on a boardwalk over a lake or ocean front—obviously constructed after the twenty-second-century flood. The guide herself is virtual, as we find out when one of the visitors comments on how lifelike she appears (see Figure 3).

Even further into the future, this part dystopian, part high-tech landscape itself has given way to a lush, almost tropical natural landscape with huge flowers, hummingbirds, and other creatures that



Figure 3. The futuristic guide's fan device is a metaphor for McGuire's own temporal juxtapositions in $Here \ O$.

resemble dinosaurs (see Figure 4). In these images 22,000 years into the future, *Here* returns to the prehuman landscape of 65 million years ago, before a meteorite wiped out eighty percent of the planet's species and provided mammals with the evolutionary advantage that gave rise to humans in the first place. Even though people are a dominant presence in the images of this graphic novel, they remain minor, unnamed characters against this vast temporal background of geological and ecological change. And one panel opens up an even longer temporal future that includes the passing of life and perhaps planet Earth itself. It shows a family watching a scientific program on TV that describes the sun's projected transformation into a supernova eight million years into the future. So even the lush ecosystem of 22,000 years hence will only be a temporary stage in the long-term evolution of the planet.

But summarizing the plot of *Here* in this way undermines, in a sense, what makes the book compelling as a narrative: its radically nonlinear structure. The reader is forced to piece together this big picture gradually from scattered images, and picking up on the bits of smaller-scale connected narratives or resonances between different moments makes for its suspense. The projective fan that the futuristic



Figure 4. A vision of the future in 22,000 years in Richard McGuire's Here ©.

guide holds up to display objects that were found on the site of the former house becomes the central symbol of this technique, as one small point in space functions as a fulcrum for all moments in time, attracting various points from the prehuman past and posthuman future, as well as moments from successive generations of humans. McGuire's meditation on humans' impermanence over long time intervals echoes themes in many other works of science fiction that I have discussed here, but translates them into a palimpsestic narrative architecture that is innovative by the standards of the graphic novel, linking human to more-than-human histories of geology and evolution.

IV. SCIENCE FICTION AND ANTHROPOCENE EPIC

As this survey of narrative strategies shows, science fiction has developed a variety of techniques over the last century for addressing the anisochrony that deep-time narrative entails. Regardless of how one assesses the aesthetic or political achievement of the narrative experiments that I have discussed here, they prove Clark's and Ghosh's anxieties over the adaptability of the novel to the Anthropocene to be unfounded. The sheer number of texts and films that have recently

engaged with deep time, with the Anthropocene, or specifically with climate change shows that the *longue durée* does not stymie the narrative imagination.

But it is true that at least some of the fictions I have analyzed here take the form of the realist novel to its limits—and in this respect, Clark's and Ghosh's arguments may be partially right. Wells's Time Machine, Brin's Earth, Mitchell's Cloud Atlas, and Robinson's 2312 are all still recognizable as novels because they centrally feature conventional individual characters (even though Brin's and Robinson's texts also include other types of actants). They narrate the stories of these characters at the individual timescale even as they frame them by deep-time plots. As Benford remarks in his introduction to the 1999 British edition of Last and First Men, Stapledon's work does not include many of the everyday affairs and activities readers usually expect from the novel. He therefore concludes that Last and First Men is "not a novel, perhaps, but surely science fiction." 45 One may disagree with this diagnosis, but it is true that Stapledon's novel, Lessing's Shikasta, and McGuire's Here diverge more fundamentally from the conventions of the realist novel in that they shift agency away from individual characters to other actants, turning human and human-like individuals into minor characters, and move the central plot to a time scale that spans millions or even billions of years. But the tradition of the novel has always included experimental texts, and Moretti's concept of modern epic sought precisely to highlight texts that deviate from the canonical realist novel and take up elements of epic storytelling so as to capture, in his reading, the modern capitalist world in its entirety. As I suggested earlier, science fiction forms part of this modern epic impulse, but the texts I have discussed here reach far into cosmological futures to tell their stories, and in many cases beyond planet Earth.

To call them modern epics is not to understate the magnitude of their differences with older kinds of epic: most of them do not invoke a transcendental order to legitimize their moral ideas, and typically they do without extraordinary human protagonists. But considering these works in the tradition of epic and in the context of other novelistic experiments with epic elements foregrounds the way in which they take up premodern forms of narrative: cosmologies, myths, origin stories, and narratives about the emergence and eventual disappearance of species, places, or civilizations. Since telling such stories has always formed part of the repertoire of science fiction, it is not surprising that such fiction has now emerged as one of the major genres for narratives

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about the Anthropocene. Indeed, the themes, tropes, and strategies of science fiction have increasingly migrated into mainstream fiction and into environmental nonfiction in recent years, and in a certain sense, the Anthropocene idea itself relies on a science fiction conceit by inviting us to look at our present through the eyes of a future geologist studying the Earth's strata millions of years hence. This anterior future, now standard in narratives about the future of the planet, has always been the purview of science fiction as a genre.⁴⁶

The physicist Geoffrey West, in his magisterial book on scale in biological organisms and certain social systems, reports with amusement that he was asked by the film crew tasked with remaking the Japanese science fiction film *Godzilla* whether a creature like that, one hundred meters or three hundred feet tall (150 feet taller even than its Japanese precursor in the 1950s) could exist. No, he answered, impossible—it would collapse under its own weight.⁴⁷ Scaling up, in biological organisms as in works of the imagination, requires changes in structure. Scaling up our imagination of the human, as Chakrabarty challenges us to do, similarly requires different architectures of narrative.

Novels will no doubt continue to be written. But they may increasingly adopt some of the epic themes and strategies that I have highlighted here: stories of large-scale change and forces influenced by and yet not controlled by humans, stories about the emergence and demise of communities that relate in different ways to the planet's changing ecology. The larger-than-life hero or single protagonist may decrease in importance, since epic-style narratives over the last century have tended to shift the major narrative actants from individual human characters to collective and sometimes nonhuman actors. Individual humans as minor characters will no doubt continue to abound-but they may end up being just that, minor characters. These changes in structure imply that the new forms of epic will require different readerly work and generate different readerly pleasures than realist and modernist novels. But not wholly unprecedented ones: part of scaling up the imagination in narrative means rediscovering how we scaled it down during the rise of the novel in the first place.

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NOTES

¹ "World literature" occurs throughout Pascale Casanova, *La republique mondiale des lettres* (Paris: Seuil, 1999); and David Damrosch, *What Is World Literature*? (Princeton: Princeton Univ. Press, 2003). See Franco Moretti, "Conjectures on World Literature," *New Left Review* 1 (2000): 56–58.

² See Jahan Ramazani, A Transnational Poetics (Chicago: Univ. of Chicago Press, 2009); Susan Stanford Friedman, *Planetary Modernisms: Provocations on Modernity Across Time* (New York: Columbia Univ. Press, 2015); and "Scale and Form; or, What Was Global Modernism?", ed. Thomas S. Davis, *Modernism/modernity Print Plus* (2 January 2018), https://modernismmodernity.org/forums/scale-and-form.

³ Moretti, Modern Epic: The World-System from Goethe to García Márquez, trans. Quintin Hoare (London: Verso, 1996); Gayatri Chakravorty Spivak, Death of a Discipline (New York: Columbia Univ. Press, 2003): 71–102; Wai Chee Dimock, "Introduction: Planet as Duration and Extension," in Through Other Continents: American Literature across Deep Time (Princeton: Princeton Univ. Press, 2008), 1–6. See Cosmopolitics: Thinking and Feeling Beyond the Nation, ed. Pheng Cheah and Bruce Robbins (Minneapolis: Univ. of Minnesota Press), 1998; and Immanuel Wallerstein and the Problem of the World: System, Scale, Culture, ed. David Palumbo-Liu, Nirvana Tanoukhi, and Bruce Robbins (Durham: Duke Univ. Press, 2011). See also Christian Moraru, "World,' Globe,' 'Planet': Comparative Literature, Planetary Studies, and Cultural Debt after the Global Turn," Futures of Comparative Literature: ACLA Report on the State of the Discipline, ed. Ursula K. Heise (London: Routledge, 2017), 124–33.

⁴Edward Mendelson, "Encyclopedic Narrative: From Dante to Pynchon," *Modern Language Notes* 91.6 (1976): 1267; and "Gravity's Encyclopedia," *Mindful Pleasures: Essays on Thomas Pynchon*, ed. George Levine and David Leverenz (Boston: Little, Brown, 1976), 161–95; Frederick R. Karl, "American Fictions: The Mega-Novel," *Conjunctions* 7 (1985): 248–60; Tom LeClair, *In the Loop: Don DeLillo and the Systems Novel* (Champaign-Urbana: Univ. of Illinois University Press, 1988); Stefan Ercolino, *The Maximalist Novel: From Thomas Pynchon*'s Gravity's Rainbow to Roberto Bolaño's 2666 (London: Bloomsbury, 2014).

 $^5\,\mathrm{Paul}$ J. Crutzen and Eugene F. Stoermer, "The 'Anthropocene," Global Change Newsletter 41 (2000): 17.

⁶Julia Adeney Thomas, "History and Biology in the Anthropocene: Problems of Scale, Problems of Value," *American Historical Review* 119.5 (2014): 1589.

⁷ Dipesh Chakrabarty, "The Human Condition in the Anthropocene," Lectures, Yale University, New Haven, 18 and 19 February 2015, https://tannerlectures.utah.edu/Chakrabarty%20manuscript.pdf, 179, 181.

⁸Chakrabarty, "The Human Condition," 180.

⁹Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35.2 (2009): 206–7.

¹⁰ For the details of my argument, see Heise, *Imagining Extinction: The Cultural Meanings of Endangered Species* (Chicago: Univ. of Chicago Press, 2016), 220–26.

¹¹ George Turner, *The Sea and Summer* (London: Orion, 1987), 4, 8, 15, 18, 107, 113, 361.

¹² Mahlu Mertens and Stef Craps, "Contemporary Fictions vs. the Challenge of Imagining the Timescale of Climate Change," *Studies in the Novel* 50.1 (2018): 151.

¹³ See Adam Trexler, *Anthropocene Fictions: The Novel in a Time of Climate Change* (Charlottesville: Univ. of Virginia Press, 2015): locations 507, 505, and 303, Kindle.

¹⁴ Trexler, location 546, Kindle. Misspelling of "miniscule" belongs to Trexler.

¹⁵ See Timothy Clark, *Ecocriticism on the Edge: The Anthropocene as a Threshold Concept* (London: Bloomsbury, 2015), 80.

16 Clark, 176.

¹⁷ Clark, 178, 181.

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¹⁸ Amitav Ghosh, *The Great Derangement: Climate Change and the Unthinkable* (Chicago: Univ. of Chicago Press, 2016), 59.

¹⁹ See Heise, Imagining Extinction, 215.

²⁰ Moretti, Modern Epic, 2, 5.

²¹ Ghosh, 72.

²² Margaret Atwood, In Other Worlds: SF and the Human Imagination (New York: Nan A. Talese, 2011), 8, in Ghosh, 72–73.

²³ See Fredric Jameson, Archaeologies of the Future: The Desire Called Utopia and Other Science Fictions (London: Verso, 2015), 288; and Pagan Kennedy, "William Gibson's Future Is Now," New York Times (13 January 2012), http://www.nytimes. com/2012/01/15/books/review/distrust-that-particular-flavor-by-william-gibson-bookreview.html?pagewanted=all. For a more detailed discussion of Jameson's and Gibson's approaches to science fiction, see Heise, *Imagining Extinction*, 218–20; for a more in-depth review of Ghosh, see Heise, "Climate Stories: A Review of Amitav Ghosh's *The Great Derangement*," boundary 2 (19 February 2018), https://www.boundary2.org/2018/02/ ursula-k-heise-climate-stories-review-of-amitav-ghoshs-the-great-derangement/.

²⁴ Mark McGurl, "The Posthuman Comedy," Critical Inquiry 38.3 (2012): 550.

²⁵ Algirdas Julien Greimas, *Structural Semantics: An Attempt at a Method*, trans. Daniele McDowell, Ronald Schleifer, and Alan Velie (Lincoln: Univ. of Nebraska Press, 1983), 197–221; "Actants, Actors, and Figures," *On Meaning: Selected Writings in Semiotic Theory*, trans. Paul J. Perron and Frank H. Collins (Minneapolis: Univ. of Minnesota Press, 1987), 106–120.

²⁶ Gérard Genette, Narrative Discourse: An Essay in Method, trans. Jane E. Lewin (Ithaca: Cornell Univ. Press, 1980), 86–95.

²⁷ See Genette, 109–112 for an explanation of scenes; for summaries, see 95–99, and for ellipses, 106–9. On narrative, he writes: "[T]he isochrony of a narrative may also be defined . . . not relatively, by comparing its duration to that of the story it tells, but in a way that is more or less absolute and autonomous, as *steadiness in speed*. By 'speed' we mean the relationship between a temporal dimension and a spatial dimension (so many meters per second, so many seconds per meter): the speed of a narrative will be defined by the relationship between a duration (that of the story, measured in seconds, minutes, hours, days, months, and years) and a length (that of the text, measured in lines and in pages). The isochronous narrative, our hypothetical reference zero, would thus be here a narrative with unchanging speed, without accelerations or slowdowns, where the relationship duration-of-story/length-of-narrative would remain always steady" (Genette, 87–88).

²⁸ For a perceptive analysis of fictional time travel in connection with developments in philosophy and the sciences, see David Wittenberg, *Time Travel: The Popular Philosophy of Narrative* (New York: Fordham Univ. Press, 2012).

²⁹ See Genette, 106–9.

³⁰ See Isaac Asimov, *Foundation* (Garden City: Doubleday, 1951); *Foundation and Empire* (Garden City: Doubleday, 1952); and *Second Foundation* (New York: Gnome Press, 1953).

³¹ For an excellent interpretation of *Starmaker* and its relevance to Anthropocene discussions, see Timothy Wientzen, "Not a Globe but a Planet: Modernism and the Epoch of Modernity," *Modernism/modernity Print Plus* (2 January 2018), https://modernismmodernity.org/forums/posts/not-globe-planet.

³² For an insightful interpretation of *Last and First Men* in the context of a "second modernism" that highlights long time spans rather than the individual moments of

everyday time with which first modernism is associated, see Charles M. Tung, "Baddest Modernism: The Scales and Lines of Inhuman Time," *Modernism/modernity* 23.3 (2016): 518–22, 525, 533–34.

 33 Olaf Stapledon, Last and First Men (Mineola: Dover, 2008), 13. Hereafter cited parenthetically by page number.

34 Tung, 529.

³⁵ In his preface to a 1999 edition of the novel, the science fiction writer Gregory Benford suggested that readers simply skip the first four chapters ("Foreword," in *Last and First Men* [London: Gollancz, 2009]: vii).

³⁶ Genette, 95–99.

³⁷ Mertens and Craps point to a similar inversion and the narrative implausibility it entails in Dale Pendell's 2010 *The Great Bay: Chronicles of the Collapse*, whose narrator is situated 16,000 years into the future (see Mertens and Craps, 143–44).

³⁸ For a more detailed exploration of how Stapledon constructs a future history, see John Huntington, "Olaf Stapledon and the Novel about the Future," *Contemporary Literature* 22.3 (1981): 349–65; and "Remembrance of Things to Come: Narrative Technique in *Last and First Men*," *Science-Fiction Studies* 9.3 (1982): 257–64.

³⁹ Doris Lessing, *Re: Colonised Planet 5, Shikasta* (London: Cape, 1979); *The Marriages of Zones Three, Four, and Five* (London: Cape, 1980); *The Sirian Experiments* (London: Cape, 1980); *The Making of the Representative for Planet 8* (London: Cape, 1982); and *Documents Relating to the Sentimental Agents in the Volyen Empire* (London: Cape, 1983).

⁴⁰ See Ursula Le Guin, "Doris Lessing's First Sci-Fi Book Reads Like a Debut Novel," *The New Republic* (13 October 1979), https://newrepublic.com/article/115631/ doris-lessing-shikasta-reviewed-ursula-le-guin.

⁴¹ For a detailed analysis of 2312 and its relationship to the modernist novel, see Heise, "Terraforming for Urbanists," *Novel: A Forum on Fiction* 49.1 (2016): 10–25.

⁴² See Richard McGuire, *Here* (New York: Pantheon, 2014).

⁴³ See Lee Konstantinou, "A Theory of *Here*," *The Account: A Journal of Poetry, Prose, and Thought* (2015), https://theaccountmagazine.com/article/a-theory-of-here; and Mertens and Craps, 138–42.

⁴⁴ Mertens and Craps, 140.

⁴⁵ Benford, v.

⁴⁶ Gerry Canavan first articulated the idea of the Anthropocene's future geologist as a science fiction motif. For a more detailed discussion of the Anthropocene as a science fiction idea, see Heise, *Imagining Extinction*, 215–20.

⁴⁷ See Geoffrey West, *Scale: The Universal Laws of Life, Growth, and Death in Organisms, Cities, and Companies* (New York: Penguin, 2017), 36.

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