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New Empiricisms in the Anthropocene: Thinking With Speculative Fiction About Science and Social Inquiry

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Elizabeth de Freitas¹  and Sarah E. Truman²

Abstract

Interest in new empiricisms and transdisciplinary methods has led many social inquirers to engage with 20th-century post-classical physical science. Many of these projects have focused on alternative matter–mind mixtures and in/organic variation, concerned that past theories of sociality have dismissed the vibrancy and animacy of the nonhuman material world. This paper explores the power of speculative fiction to help us rethink empiricism in posthuman ecologies of the Anthropocene, in the midst of post-truth conditions and growing science denialism. We foreground speculative fiction as a way to open up scientific imaginaries, rethinking the relationship between nature, technics, and human “sense” making. We show how such texts offer alternative images of research methods for studying pluralist ecologies and new forms of worldly belonging.

Keywords

science studies, Anthropocene, animacy, speculative, methodology

Introduction

Much has recently been written about the need to rethink the nature and purpose of social inquiry (Clough, 2009; Maclure, 2013; Ruppert et al., 2013). We hear calls for new empiricisms and demands for speculative and transdisciplinary methods that might break up rigid and ossified research practices in the social sciences (St. Pierre, 2016). Many of these calls share a concern that past theories of sociality have dismissed the vibrancy and animacy of the nonhuman material world. To that end, new materialist thinkers such as Diana Coole and Samantha Frost (2010) argue that cultural theory must *renew* its commitment to materiality through engagements with 20th-century post-classical physical science. Associated attempts to remix the physical and social sciences, in the work of scholars like Manuel Delanda (2015) and John Protevi (2013), have turned to contemporary chemistry and biology, inspired in part by the Deleuze-Guattarian philosophical practice of engaging directly with scientific knowledge. Others have pursued a rapprochement between quantum and social science, showing how quantum theory can be used to make sense of human behavior (Barad, 2007; Wendt, 2015). Feminist theorists like Elizabeth Wilson (2015) suggest that sociologists would benefit from thinking with new insights from physiological and pharmacological empirical science, while Elizabeth Povinelli (2018) pursues new mixtures of geological and Indigenous knowledges, as a way of reckoning with the pressing problematic of nonlife (or geo), in

confronting the “end-times” of a particular biosphere. In related efforts, Bruno Latour (2017) and Isabelle Stengers (2018) seek new nonreductive forms of science adequate to the emergent complex naturecultures of Anthropocene¹ life.

Haunting these efforts is the fact that science often acts as handmaiden to industry and colonial acquisition. The old “white geologies” and biologies encode within them an extractive and enslaving logic, mobilized against racialized people and nonhuman animals (Yusoff, 2019). Concepts like the Capitalocene (Moore, 2016) and Plantationocene (Tsing, 2017) remind us that the Anthropocene has been manufactured by a portion of humanity invested in accelerated capitalist accumulation and white supremacy. Science has played a crucial role in shaping this “global” condition as a legacy of European imperialism. And yet it would be foolish to deny scientific knowledge as simply serving the white establishment, particularly today under neoliberal post-truth conditions. Science denialism is on the rise, allied with nationalist anti-establishment movements and libertarian free market interests (Drummond & Fischhoff, 2017).

¹Manchester Metropolitan University, UK

²The University of Melbourne, Victoria, Australia

Corresponding Author:

Elizabeth de Freitas, Manchester Metropolitan University, 53 Bonsall Street, Manchester, Greater Manchester M156GX, UK.

Email: l.de-freitas@mmu.ac.uk

Climate science in particular is contested by segments of the U.S. population as fabricated by scientists with a biased agenda (Lewandowsky et al., 2013). Sociologists and other scientists alike are warning that science is under attack by the Christian right (Alumkal, 2017). The Union of Concerned Scientists and various speakers at the March for Science have declared that President Trump is at war with science. Latour (2017) highlights how the language of “scientific consensus” is precisely what the climate-change deniers pounce on today, identifying themselves with the renegade science of Galileo and his fight against the theocratic establishment.

What new forms of empirical inquiry will emerge in these complex circumstances? As culture and media theorist Kara Keeling (2019) states in *Queer times, black futures*, “Working with and through scientific and technical knowledge in the service of humanistic inquiry is a challenge of world historical significance” (p. 195). Keeling turns to the power of speculative and poetic thought in her work, exploring how speculative thought operates in diverse contexts—in scientific laboratories, artistic studios, financial think tanks, and fiction workshops. In this article, we also turn to speculative thought, and like Keeling we turn to fiction as a way of imagining alternative forms of empirical inquiry. Speculative fiction (SF) often presents cosmic remixings of the socio-material sciences, thereby helping us to imagine a future empiricism for earthbound “terrans” who have forgotten that their planetary dwelling is also a living creature. We follow many others in Science Studies who have taken up SF to think through the many pasts, presents, and futures of science. Donna Haraway (2013), for instance, has played a pivotal role in exploring the role of speculative fabulation in scientific practice. And queer feminist science studies scholar Aimee Bahng (2017) has argued that the science fiction of Octavia Butler should itself be considered a kind of Science Studies, for how it mobilizes speculative thought to explore radical onto-epistemological modes of alien life, queer notions of reproduction, and decolonial kinship.

In this article, we explore the following questions:

1. Are there scientific imaginaries evoked in speculative fiction that might be helpful in rethinking the nature of empirical inquiry?
2. In what ways does speculative fiction present alternative research methods for studying pluralist post-human ecologies and new forms of worldly belonging?

We focus on the SF text *Annihilation* by Jeff VanderMeer (2014) precisely because it explores mutation, variation and destruction, and because the main character is a biologist whose scientific method undergoes transformation in an environmental disaster zone called Area X. We begin to

glimpse in Area X both an opportunity and a demand for empirical methods that remix the social and physical sciences to better suit Anthropocene naturecultures. Science in Area X becomes attuned to bio-technical exchange, chem-tactile forms of communication, and alt-forms of coupling, mutating, and learning. We analyze the novel throughout this paper, discussing the plot and character development, as a source for new images of empiricism and methodology. In particular, this SF novel attends to the post-truth un/reliability of empirical inquiry in a world where matter–mind mixtures and in/organic variation seem to undermine conventions of scientific observation, classification, and agency.

Theoretical Framework

We situate our project in the burgeoning theoretical space of *posthuman ecologies* where various scholars are rethinking the relationship between nature, technics, and human “sense” making (see Braidotti & Hlavajova, 2018). We use the term “ecology” precisely because it has become a paradigmatic concept in Western theorizing of life and society and much else, and because of the way it points to Indigenous and non-Western philosophies of matter–mind relationality and geontology (Povinelli, 2018; Todd, 2016). In addition, Hörl (2018) describes a “general ecology” that has become “denaturalized” in the Capitalocene, where plastics and digital e-waste are now ecological forces. Morton (2016) calls this “ecology without nature” while Parisi (2017) raises concerns that the new “ecological rationality” is conceived as fundamentally computational. Following these authors, we stretch this term ecology into new territory, attending to the metamorphic nature of matter and trans-species intimacies, while recognizing the nonrelational, the separating tendencies, and the “outside” of the ecological paradigm (Neyrat, 2017).²

This approach resonates with our previous work on worldly sensibility (de Freitas, 2018a), speculative thought and method (de Freitas, 2017b; Springgay & Truman, 2018; Truman, 2017), and our commitment to exploring posthuman ethnography (de Freitas, 2019a). It continues our work exploring links between qualitative research and new materialisms (de Freitas & Curinga, 2015; Snaza et al., 2016; Truman, 2019a) and probes the fissures between fact and fiction in the shaping of new empiricisms. We have collaboratively developed a method of working with SF texts, exploring the ways in which the storyworld opens up possibilities for new forms of social-material inquiry (de Freitas, 2017b; de Freitas & Truman, 2019; Truman, 2019b). This involves transdisciplinary “reading” practices, across theory and fiction, in search of alternative images of inquiry. Such work draws extensively from Science Studies, where the anthropological and sociological study of scientific practice has, for decades, shed light on the complexity of

empiricisms of all kinds (e.g., Fox-Keller, Haraway, Harding, Longino). Recent journal special issues make the case for an increased take-up of methods from Science Studies in efforts to rethink the intersections between materiality and sociality (de Freitas et al., 2017; de Freitas & Weaver, 2019).

In this paper, we analyze fiction as a mode of expression that offers insight into future and/or alternative worlds. Our reading of *Annihilation* and other SF texts is meant to offer poignant illustrations that complicate contemporary scientific inquiry and its influence on qualitative research in the Anthropocene. We first discuss SF craft practices, and their potential role in expanding our understanding of more-than-human relationality. We argue that SF can make visible the inorganic potentialities and inhuman forces by which a body becomes transindividual and learns to “branch out into territories beyond its own self-maintenance” (Colebrook, 2014, p. 138). It is precisely these kinds of sympathetic relationships that are pursued in particular SF literary texts (often during times of war), when new and different ways of mutating and propagating “offspring” are described, or when trans-species merge and play havoc with conventions of biology, geology, chemistry, genetics, and so on. SF narratives allow us to raise important questions in the “end-times” of the Anthropocene, about the future of the sciences and the possibility of generative and reparative sympathies. Our focus on sympathy in this paper—or what Haraway calls sympoiesis—is intended as a way of advocating for a form of inquiry into vast more-than-human meshworks, capable of “hosting” radical incommensurable differences (Chakrabarty, 2014).

Our focus is on how examples of SF pursue an ecological cosmic sympathy between human and nonhuman, and how close readings of these texts allow scholars to think creatively about new kinds of inquiry in the Anthropocene. Many SF texts utilize literary devices involving biochemical metamorphic transitions and altered forms of coupling and reproduction between humans and more-than-human entities (including aliens, bacteria, concepts). We realize that attention to trans-species transits and earthly belonging demands a careful consideration of how the whiteness and misogyny of the SF genre has been (and continues to be) contested through its very possibilities (Bahng, 2017). Thus, while exploring SF for past and possible futures of empirical inquiry, we emphasize the biological themes of reproduction and mutation in order to *interrogate the biopolitics of organic variation* (Subramaniam, 2014; Willey, 2016) and the *sentimental politics of benevolent sympathy* (Schuller, 2018). In other words, we aim to stay tuned to the complex political ramifications of empirical inquiry in Anthropocene naturecultures.

SF Craft

SF has been described as a “literature of cognitive estrangement” (Suvin, 1972, p. 372). This estrangement or defamiliarization occurs when the author builds an imaginative plot

that radically alters the “real world” empirical environment, or through language use that ruptures taken-for-granted knowledges. Defamiliarization is both a pedagogical tool and a literary device (Truman, 2017). Similarly, new materialist philosopher Rosi Braidotti (2013) uses the term *disidentification* to describe thinking processes that lead to the “. . . loss of familiar habits of thought and representation in order to pave the way for creative alternatives” (pp. 88–89). In an era of post-truth politics and growing anti-science movements, it might seem like folly to explore cognitive estrangement, defamiliarization, and disidentification with scientific consensus. On the other hand, probing the fissures between fact and fiction might be the very thing we need to do more carefully, under these complex onto-epistemological conditions.

SF stories often raise questions about mutation, metamorphosis, haptic encounters, alien genesis, coupling, reproduction, breeding, continuance, and belonging to worlds in various end-times. Consider, for instance, Afrofuturist Octavia Butler’s book *Lilith’s Brood* (2000) which introduces the Oankali, an alien species that rescues humans and brings them aboard their ship (which later is found to be a living thing with which one can bio-technically interact) after Earth is rendered uninhabitable by an unnamed war and climate disaster. The Oankali are a species of genetic engineers that evolve through genetic exchange, genetic mutation, and other-species intimacy. During the narrative, Lilith “mates” with an ooli—which is third gender of the Oankali and serves as a bridge between male and female Oankali and other species they encounter (in Lilith’s case, human). After mating with the ooli, Lilith assumes tactile capacities for interacting with the living ship. Lilith’s power grows through *sympathetic genetic exchange* with Oankali. She performs a kind of risky diplomacy across conventional divides, a diplomacy that ultimately betrays those conventions, seeking and forming new dependency relations (de Freitas, 2019b).

In African and American author Nnedi Okorafor’s (2015) *Binti*, the main character is an earth dweller Binti from the African Himba tribe. She has creative mathematical capacities and can meld with concepts and formalisms—Binti is a “master harmonizer” of mathematics, and can perform a kind of trance-like mathematical behavior which involves “treeing” and calling up currents and affects in the surrounding atmosphere. She is the first of her people to be accepted into university in another galaxy, but is forbidden to attend by her family. She sneaks away and heads to university across the galaxy on a living fish-like passenger ship. This book describes a world where technology and nature participate in a shared genesis. The ship sheds her skin after burning in atmosphere during re-entry to planets. Binti calls the third generation Fish-ship “the finest technology, finest *creature*” the earth has ever produced. This remixing of nature and technics changes the conditions of

life and death. In the third book of the trilogy *Binti: The Night Masquerade*, Binti is absorbed by New Fish (Third Fish's daughter) after being killed in the crossfire of a war. Binti's body is placed in the still growing New Fish, and the microbes that live in the breathing chamber mutate both New Fish and Binti's genes, repairing Binti and transforming New Fish into altered beings: part human, part microbe, part New Fish.

Each of these novels raises different insights into species-centric images of life and survival, queering the white and heteronormative images of coupling, reproduction, and sexuality tacitly endorsed in our Western naturecultures. These texts help us interrogate our sense of belonging, and the potential of trans-individual sympathetic relationships with what Stacy Alaimo (2016) calls a "wider, more-than-human kin ship network" (p. 30). These texts also highlight new mixtures of technics and nature. Hayles (2012) uses the term "technogenesis" to support the notion that humans and technics have co-evolved together. Technics, in this account, can be anything from stone tools to modern computer processing, but points to an inherent technicity in any worlding process; such a technics is often indifferent to human endeavor. In other words, technics are diversely at work in more-than-human processes. This refusal to start with the assumption that technology is a tool or prosthetic serving human endeavor is essential as we take up the weird and wild worlds of SF science.

Moreover, this perspective helps us bracket the two capacities that are always posited as exceptionally human—technology and language. Simondon (2017) reminds us that technology is poorly understood in social theories that remain focused on the alienation of humans through automaticity, and fail to adequately place the human within a techno-ecology. All too often SF technology is nothing more than an exaggerated version of human thought and human technology, where faster computers and faster rockets advance the human world into a transhuman fantasy. SF narratives that embed technicity into the very fabric of life (alien or otherwise) allow us to think more broadly about ecology.

Annihilation by Jeff VanderMeer (2014) is another powerful example of such SF, as it offers readers a way of imagining *sympathetic* relations with the more-than-human, and shows how such sympathy must engage with affect, thought, and technics, while "holding onto" a nonrelational outside. In other words, *Annihilation* describes a sympathetic scientific inquiry that avoids the dangerous celebration of a bland connectivity across difference—it resists an empty endorsement of relationality (Colebrook, 2019a)—and instead pursues the complex frictions of violent naturecultures. We contend that the book's focus on 'weird' sympathetic relationality helps us explore the ways that inquiry must become 'situated' in radical new ways (the term "situated" doesn't quite capture the complexities of imbrication). As Deleuze suggests, sympathy is a bodily struggle that involves affect

and the power to be affected (Deleuze & Parnet, 2007, p. 53). This bodily struggle plays out in complex encounters in which various kinds of refusal are negotiated. Such a process involves a metamorphic "making with" that Haraway (2016) calls sympoiesis.

Sympathy: The limits of Scientific Classification

The word sympathy comes from ancient Greek (*sumpátheia*) and refers to the state of *feeling together*, derived from a composite of *fellow* and *feeling* (Schliesser, 2015; Spuybroek, 2016). Over the centuries, the notion of sympathy has been used to describe all sorts of activity—everything from contagious yawn catching to cosmological harmony to empathic and even telepathic association (de Freitas, 2018b). Today, in the midst of swarming affect and pan-human stupidity, we advocate for a sympathy that is not a 19th-century liberal humanist celebration of the malleability of the white subject (Barnes, 1997), but a more-than-human sympathy that respects and indeed relies upon radical difference and risky diplomacy.

Annihilation involves four female scientists (biologist, anthropologist, psychologist, surveyor) who enter the shimmering Area X to investigate strange mutations and life forms that break with all scientific knowledge. Their mission is to investigate a "localized environmental catastrophe stemming from experimental military research" (p. 94) which we eventually learn has nothing to do with military research. The scientists begin to rapidly *join* or merge with the environment, branching out into territories beyond their own self-maintenance. This eco-SF novel explores the myriad ways the earth is writing itself. The book is separated into five sections (Initiation, Integration, Immolation, Immersion, Dissolution), and is the first book in a trilogy.

The narrator of *Annihilation* is known only as "the biologist." We never learn the names of the other characters. They are simply described as "The anthropologist" or "The surveyor" or "The psychologist," emphasizing their professional identity and their purpose in the team. This nameless habit extends to the biologist's memories about "my husband" underscoring the gender politics of function and relationality. Even the site of the expedition "Area X" goes without name. And the training which the scientists receive, prior to entry, is also strangely lacking in the kind of detail that might be a mark of the real—they are told that there are four kinds of venomous snakes in Area X but possess no other facts about these. They are told that they are the 12th expedition into the region, and yet the accumulated information regarding the area, including the map, seems limited and superficial. There is a coastline, a lighthouse, various brooks and streams, and forests. They are told that it is a "transitional" ecology, and that strange new genetic

mutations are appearing, whereby species are adapting in unexpected and accelerated ways. It seems plausible that the old names are simply no longer viable in this transitional ecology.

The biologist joined the team because she was an expert in “transitional environments,” but her training with tidal pools and similar bridging ecologies, where cross-pollination and cross-transfers of other material occur, has not prepared her for the eerie and weird transitional species she finds in Area X, where walking for only six miles takes you through forest, swamp, jungle, marsh, beach, and so on. She is constantly taking samples from the strange organisms she encounters, extracting tissue to later examine the cellular activity under the microscope at base camp. She later finds brain cells in the walls of a ruined and inverted tower—remarkably human-like cells with nonhuman irregularities capable of flowering and spuming spores. Her first assumption is that her inhalation of such spores has contaminated the sample (rather than admit that the fruiting walls possess brain tissue). Other data indicate a strange hybrid biological process at work across the landscape, where lichen and moss rise up misshapen, forming inexact human limbs and heads and torsos, as though “the natural world around me had become a kind of camouflage” (p. 98) and that “Human lives had poured into this place over time, volunteered to become party to exile and worse” (p. 119). Importantly, the sympathetic transformation is not a one-way exchange, nor does it allow humans to survive in the ways they have always imagined.

Here sympathy refers to the kind of transindividual experience that allows one to be “moved” by the other, but also involves a learning process to actively move with the other. The biologist in Area X exhibits this kind of sympathy as a way of exploring the trans-intimacies that link “species” with/in environments, across previously established differences. Notably, her encounters within this unfamiliar ecology do not aim to cultivate a capacity for “familial feeling” applied further afield in the strangely alien Area X, for that would duplicate the oppression of state-sanctioned family relations onto a queer world (Barnes, 1997). Her capacity to queer and be queered is crucial in her burgeoning research practice in Area X, and ground in her past experiences. She recounts her previous interest in composting life forms, not as a cross-species exchange, companion, or otherwise, but as a kind of metamorphic agency without containment, as though her unsentimental disposition toward ecology was also what allowed her to join sympathetically with the alien environment of wildlife in Area X. When the mission in Area X is faltering, and some of the other team members are dead, she is still out seeking to learn with/about in ways that put her own organic life at risk.

And yet her training is what also makes her ill-prepared for “what appeared to be the uncanny” (p. 69). Her encounters with the alien environment fuel a persistent paranoia,

as she imagines herself watched and observed by the strange new wildlife:

At one point, [a pair of otters] glanced up and I had a strange sensation that they could see me watching them. It was a feeling I often had when out in the wilderness: that things were not quite what they seemed, and I had to fight against the sensation because it could overwhelm my scientific objectivity. (VanderMeer, 2014, p. 30)

We are reminded of the ground-breaking work of Science Studies scholar Evelyn Fox-Keller (1985), and her analysis of the paranoid disposition of certain scientists. Is the biologist encountering an alien existence, or are these animals merely the projections of human desire? Is the environment haunted by humans from previous expeditions? After an encounter with a beast who also seems in the midst of some inner human-like mental contortion, she says “For several hours, my thoughts turned inward toward explanations for what I had seen: parasites and other hitchhikers of a neurological nature. I was searching for entirely rational biological theories” (p. 17). Here we begin to suspect that past expeditions continue to live in the milieu in other organic forms, having broken out from beyond the sustenance of their own individual survival.

Naturing Nature: Metamorphosis

But to what extent does this work of fiction help us imagine a scientific empirical practice in “our” world? Latour (2005, 2017) demonstrates how science is a highly terrestrial human practice dedicated to encountering various agencies that proliferate and populate the world. In other words, science, at its best, is deeply committed to a mutational “metamorphic zone” and to increasing the number of alien and/or nonhuman voices that can speak, on their own behalf, as part of a growing political ecology. From this perspective, science opens up environments so that “we” can better sympathize across species and across materiality. For instance, science shows how human bodies are bacterial colonies, or that atoms are indeterminate coalitions of micro-particles, or that forests mobilize vast signaling networks. These are all examples of how science, at its best, proliferates nonhuman agencies and remixes the metamorphic zone of life. Notably, Latour’s image of science differs from many science denialists who critique science for not being absolute. In other words, denialists cannot trust 20th-century science because it is too fragile and tentative in its claims, always hedging, prevaricating, and affirming an onto-epistemology of indeterminacy, contingency, uncertainty, and dependency relations. While new materialisms celebrate these qualities of contemporary science, those who are distrustful often critique what they now see as a postmodern science that is too biased and relativistic! (Latour, 2018).

Latour argues that scientific practice actually expands a more inclusive *realism* through acknowledging (often making visible to humans) the myriad entangled agencies and more-than-human power networks that compose “metamorphic matter.” Latour presents a science that is meant to create opportunities for new forms of nonhuman sign-making, thereby multiplying political and material agencies across an ecology. This is an image of science that increases the ontological pluralism, expanding the alliances, and ultimately assembling another more-than-human political body—a science that populates the world with diverse nonhuman agencies (gluons, amoebas, gravitational waves, etc.), according to an immanent ontology *that is no less ‘realist’ for being thoroughly ‘situated’*. It may well be that the biologist’s methods of inquiry in *Annihilation* are not adequate to the new ecology she encounters, but the point of science is to pursue that encounter nonetheless, uncovering previously unknown agencies and composing a risky diplomacy (Latour, 2017).

Apparatus play a pivotal role in Latour’s approach to scientific method, and have been theorized in much qualitative research that draws on new materialisms. Notably, the team of female scientists in *Annihilation* brings no current technology, nothing digital or satellite-based, no video, or complex measuring instruments into their investigations of Area X. There is some sense that such technology might be too easily absorbed and appropriated by the unknown forces at work. Rather, they use old-school microscopes to examine samples. They are given paper notebooks and told they must document in detail all their observations and findings. Significantly, these field notes eventually figure very prominently in the narrative, when the biologist finally enters the Lighthouse to find a two-story heap of stacked notebooks from previous scientific missions. These accounts by previous scientists form a midden of written refuse, a testimony to past inquiry, abandoned and forgotten—indeed she finds more field notes than could have possibly been left by only 12 expeditions. She picks through the pile, reading here and there, and learning about the various teams who have come before.

What do these notebooks testify to? Have they increased our understanding of Area X? Are they accounts of a learning process or filled with a violent refusal to merge and engage in trans-intimacies? The midden of scientific notebooks underscores the limitations of observational science and conventional forms of documentation—a mulched sloppy pile of unreadability. If this pile is the accumulated knowledge of Area X, it seems to add up to a refuse heap. Or perhaps more accurately, it emphasizes how scientific observation, as a canonical empirical activity, may in fact be a very personalized accounting of oneself, a form of reflexive *composting*. The novel thus helps us imagine a new form of observation that might be theorized around this

insight—a form of observation that is essentially a generative process of *composting*. This moves us away from social constructivist readings of observation that undervalued the force of matter, to a theory of observation that reckons with co-relational and de/creative processes.

The Materiality of Language

Poststructuralist literary scholars have for decades discussed everything from the author-reader co-creation of meaning, to subject dissolution, to infinite deferral of meaning (e.g., Barthes, Foucault, Derrida); and more recently feminist new materialists have drawn attention to the flesh and materiality of text and how such narration might materially transform readers (Grosz, 2004; Kirby, 1997; Truman, 2016a, 2016b, 2019b). In a related fashion, *Annihilation* draws attention to the materiality of writing and textuality.

For instance, we learn that a linguist was trained for the expedition, but suddenly decided to drop out. Why her sudden departure? This is the first clue that the materiality of language plays a key role in this novel, and that the human science of linguistics is ill-prepared to reckon with what the team will find in Area X. Indeed, the novel contests our limited grasp of the technicity of language, overhauling the very notion of communication and signal; the novel complicates our investments in separating meaning from matter, and text from context.

The four scientists uncover an open hole and descend into what appears to be an inverted tower; here they encounter a living language while investigating this strange architectural “feature” of the otherwise “natural” environment, a remnant of a past “built environment.” The tower is a mixture of human invention (cement) and the carapaces of organic life (seashells), immediately signaling the fact that human technics are always already mobilizing (and being mobilized by) the agencies (and deaths) of nonhuman life. The tower, made of stone and coquina, is a key image for the story, an image that stands for the dark matter within (or beyond) the erect lighthouse beacon to which it is thematically and plot-linked. The biologist takes a huge interest in the inverted tower and is drawn below into its underground twisting path.

Once inside the tower, the scientists encounter what the biologist will name the *Crawler*. Notably, this is the first use of a proper name in the novel, in that she uses the term to name what seems to be a creature. As they descend the stairwell into the tower, they first spy, at about shoulder height, a glistening green vine clinging to the inner wall and heading downward into the spiral staircase. As the biologist examines it more carefully, the vines resolve into tiny words, a cursive lettering that rises off the wall. She is surprised to understand the words, and recognize them as

human words, filling her with an intertwined sense of elation and dread. In the vine, she reads, “Where lies the strangling fruit that came from the hand of the sinner I shall bring forth the seeds of the dead to share with the worms that . . . ” (p. 23). The anthropologist asks of the words, “what are they made of?” which draws our attention to their strange materiality while we simultaneously absorb the sound, syntax, and semantics of the ominous unfolding refrain. The written words “are made of” green fernlike moss or fungi or some other kind of eukaryotic organism, writhing with curling filaments: “A loamy smell came from the words along with an underlying hint of rotting honey” (p. 24). Here the earth seems to be writing itself.

Within the story world, the words themselves are *fruiting bodies* as well as *semantic-syntactic forms*. The writing on the wall is both *matter* and *meaning*, and the biologist feels the phrases infiltrating her mind in unexpected ways, “finding fertile ground” to grow and mutate. She leans in to get a closer look and accidentally inhales a tiny spray of golden spores that spews out from the vine. The scientists pursue the cursive curly filaments, quivering alive and foreboding. They find tiny “hand-shaped parasites” that live among the words, active creatures that sustain the words, while destroying them as well. The novel directs out attention to the *composting of words, as though they were both garbage and nourishment*.

My samples told a series of cryptic jokes with punch lines I didn’t understand. The cells of the biomass that made up the words on the wall had an unusual structure, but they still fell within an acceptable range. Or, those cells were doing a magnificent job of mimicking certain species of saprotrophic organisms. I made a mental note to take a sample of the wall from behind the words. I had no idea how deeply the filaments had taken root, or if there were nodes beneath and those filaments were only sentinels. The tissue sample from the hand-shaped creature resisted any interpretation, and that was strange but told me nothing. By which I mean I found no cells in the sample, just a solid amber surface with air bubbles in it. At the time, I interpreted this as a contaminated sample or evidence that this organism decomposed quickly. Another thought came to me too late to test: that, having absorbed the organism’s spores, I was causing a reaction in the sample. (p. 71)

The meaning and materiality of the words absorbed by the biologist begin to affect her both chemically and psychologically. Like the other SF stories mentioned earlier, the transaction is not one directional, and transgresses conventional borders between meaning and matter.

Unreliable Scientific Narrators

The literary device “unreliable narrator” is used effectively in this novel to keep readers suspicious about the veracity of

any given account. Authors use unreliable narrators to create stories that are radically open to unraveling, breaking up the sometimes oppressive controlling nature of story to contain events. The device goes some way to countering the kind of totalizing tendency in many current SF films where humanity and world are rescued (usually by a white man) for a proper humanity and “people yet to come” (Colebrook, 2019b). The unreliable narrator may be willful in their deceit or simply ignorant of the larger forces that are at work in the storyworld. Examples of unreliable narrators are everywhere in literature. Authors use cues to help readers know that the perspective is entirely situated and perhaps flawed. The biologist of *Annihilation* is an unreliable narrator, which keeps the reader wondering whether this is an accurate and true account of an actual expedition into a strange new ecology, or whether this is the dream or delusion of someone who is under hypnosis. This unreliability is a crucial element in our reading of the book, and pivotal for how it sets up new STEM imaginaries in post-truth conditions. In *Annihilation*, we are cued early on to the narrator’s limited understanding of the events she recounts. The first pages have us wondering if the entire account is a hypnotic simulation, entirely built up from the psychological concerns of the main character, undergoing an experiment of some kind, especially as the term “transference” is used to describe the entry into the Zone (p. 5).

The use of an unreliable *scientific* narrator is a significant device for problematizing the biological knowledge that our main character brings to the new alien ecology. “. . . all of this speculation is incomplete, inexact, inaccurate, useless . . . our instruments are useless, our methodology broken, our motivations selfish” (VanderMeer, 2014, pp. 192–193). The fact that the biologist is unreliable resonates with insights from Science Studies that emphasize the partial, situated, and contested nature of scientific knowledge (Subramaniam, 2014). These insights are not meant to undermine science, but point toward its complexity and ongoing evolution as a practice. As narrator, the biologist speaks in first person, delivered in an almost affectless neutral voice, posing as the detached objective scientist, a position that she cannot possibly maintain in this strange environment. The almost theatrical performance of scientific neutrality and rationality is under siege in the posthuman ecology, where new mixtures of mind and matter emerge. There are no isolated and transcendent points or positions of objective observation in Area X. Indeed, the biologist’s scientific methods are increasingly transindividual, as she merges with the environment. This kind of immersive transformation—the very opposite of classical objectivity—is precisely what is entailed in the kind of sympathetic relationality discussed above, in which a shared bodily struggle sustains an assembling of divergent agencies. We propose that her research methods become a kind

of posthuman ethnography as she explores this radical mutational ecology where ethno and eco mix.

We want to think further with unreliability and propose that unreliable first-person scientific narrative voice is crucial in helping the reader begin to imagine a different socio-material research practice. At the same time, we are fully conscious of how this unreliability is fuelling anti-science sentiment on the far-right. Rather than read her affectless tone as resistance to change, we defend her impersonal “naturalist” voice as indicator of her eager and diplomatic transpecies relationality. The biologist’s disposition is what allows her to engage with the posthuman ecology, rather than with some emotional and sentimental image of the holobiont (Schuller, 2018). It is this kind of engagement that puts both self and world at risk; scientific experiments with consequential meaning often involve this kind of indifference to survival, when the scientist is said to pursue truth without concern for their own safety, but with increased sensitivity to the agentic capacities of the non-human (Johnson, 2008). Although in some cases this is the heroic packaging of the (male, able, hetero, white) scientist, we believe in this case it is worth considering the risks involved in empirical research, as a form of truth-seeking under post-truth conditions. In *Annihilation*, for instance, the psychologist is an untrustworthy scientist, as she aims to manipulate the team through attempts at hypnosis, but the biologist is ultimately trustworthy, although unreliable. In this case, the biologist develops a resistance to the hypnotic refrains, precisely because her reckless empirical methods brought her into intimate contact with the spores of the Crawler. Attending to these complex tensions between being *trustworthy* but *unreliable* might help us grapple with science denialism and new empiricisms under post-truth conditions.

Kortekallio (2019) suggests that the biologist’s exposure to the Crawler’s infectious spore-words changes everything: she states “After this . . . I realize that everything surrounding me is undoubtedly and uncontrollably alive, and as a consequence lose the sense of being the center of my world” (p. 61). This de-centering of the human and their assumed control creates a feeling of “becoming instrument” that both the reader and the biologist experience, as they feel a resonance, impressibility, and the disturbing but also enhancing feeling of “being played” by both the unreliable narrator and the highly unpredictable environment (Kortekallio, 2019). Notably, this is not about identification and a process whereby the reader is “becoming” the first-person narrator—rather Kortekallio argues that we maintain an awareness of the fictional nature of the text while aligning with the first-person narration, much like other examples of posthuman

narration (Clarke, 2008). She equates this strategy with the feminist new materialist scholars’ notion of “thinking-with” (i.e., Haraway, 2008).

In becoming-instrument and thinking-with Area X, the reader begins to appreciate that the “viscosity” of the ecology is so totalizing that one cannot distance oneself from it. In other words, the reader tags along with the scientists who *undergo* inquiry, as much as they *perform* inquiry. This kind of ecological reading is not attunement, but more like being played (with all the betrayal that such a term implies) by the environment. Granted, there are multiple ways of attuning, and Kortekallio (2019) explains how “being played” also entails the anxiety of influence that might lead to defensiveness, and perhaps also to the fetishizing of familiar established forms of inquiry.

Resisting a Sentimental Relationality

As a rumination on forms of inquiry in environmental disaster zones, the novel *Annihilation* has direct relevance to our own climate crisis. The need to grapple with the reality of these “end times” has been taken up in the humanities and is directly linked to the future of science (Danowski & Viveiros de Castro, 2017). To that end, we see at least two kinds of end-times and annihilation in Area X. First, there is the annihilation that the psychologist, as team leader, is meant to offer the team if they need it—she uses the word *annihilation* as one of the key hypnotic words meant to induce immediate suicide when uttered. This is an all-too-human annihilation, a suicide that serves the controlling forces outside of Area X. There is a second kind of annihilation in the novel that involves a slow merging with the genetic tissue of other organisms, that is, the surrender to an environmental force within the relational milieu that is larger than the individual organism’s will to survive. This is a kind of metamorphosis and dissolution. This kind of annihilation transcends and destroys speciation. The biologist is herself undone by the transitional environment, but her annihilation is a slow dissolution, through contagion or infection, when the spores she inhales infiltrate the body, and transform her into a flame of new life.

Creative mimesis plays the ultimate de/creative role in Area X where annihilation is achieved through the *environmental technics of mimicry* and the proliferation and permutation of minute characteristics. The Crawler operates through a kind of mimicry using the biologist’s and others’ thoughts. This relentless assimilating mimicry is like a “thorn” in the side of the world, mutating at scales and speeds beyond human perception. The biologist muses,

It creates out of our ecosystem a new world, whose processes and aims are utterly alien—one that works through supreme

acts of mirroring, and by remaining hidden in so many other ways, all without surrendering the foundations of its *otherness* as it becomes what it encounters. (p. 191)

The book thus offers an image of nonnarcissistic mixtures of matter-meaning and posthuman “naturalist” forms of inquiry. The novel helps us imagine a world where sociality and materiality are de/creatively imbricated beyond human interest; the Crawler’s spore-script is not intended for future human expeditions—the words are not intended as messages to warn the incoming. This is not a sentimental connectivity in Area X. Communication is an environmental more-than-human activity, rather than a willed message from source to human receiver. The biologist must learn how to recognize the experimental indifference of the world, to human endeavor. In the biologist we glimpse the burgeoning of a posthuman science, invested in a new kind of impressibility, but still clinging to her conventional scientific training as she brings forth new methods of encountering an outside: “My sole gift or talent, I believe now, was that places could impress themselves upon me, and I could become a part of them with ease” (p. 110).

Importantly, the book resists a sentimentality about such radical relationality and impressibility. In her brilliant analysis of race, sex, and science in the 19th century, Kyla Schuller (2018) suggests that past investments in a sentimental biopower of “impressibility” have often been a means for separating the “sensitive” civilized white and heteronormative subject from the abject other. We are cautious and wary that emphasis on sympathy and affect and plasticity inherits “the political legacies of liberal humanism . . . [and may] unwittingly recapitulate the conceptual apparatus of the biopolitics of feeling” (Schuller, 2018, p. 11). For this reason, it is essential to recognize the “hierarchical intimacies” that structure the relational space of Anthropocene life, and to seek “a sympathetic coordination [that] is not a bland alignment between different agents, nor an identification amongst group members, nor the creation of a unified homogeneous assemblage, but is a coordinated assembling of heterogeneous agencies” (de Freitas, 2018b). Such rethinking of agency, and its correlate concept of causality, is no easy matter. Latour argues that conventional renderings of science rest on a faulty concept of causality, which ascribes all the agency to the cause and none to the effect.

Shedding our attachment to causes that literally control all the action would entail queering time as we know it. This demands a new kind of causality which tracks the reciprocal mutations of the metamorphic zone, linking animacies and agencies across times in new ways. (de Freitas, 2019b, p. 6)

Afterthoughts on the Future of Empiricism

The plot and poetics of SF novels like *Annihilation* immerse us as readers into worlds where more-than-human sympathy

and posthuman ecologies are *part* of the fabric of reality. Such SF literary realities invite us to imagine both scientific method and the annihilation of the socio-biological body. In search of new forms of Anthropocene inquiry, such narratives help us make sense of new corporeal metamorphosis and mind-body mixtures. These texts help researchers bracket the “anthropos” so as to understand the multiple ways in which diverse “peoples” inherit the climate crisis. We emphasize that our proposal does not defend the same old euro-centric sciences, nor does it necessarily imply human survival in the Anthropocene—again, we are not advocating for a sentimentalism or biopolitics of feeling that imprints whiteness or humanity onto everything that was once alien or other. Stories like *Annihilation* underscore both the plurality of earthly end-times as well as grand cosmic scales of destruction.

We close by asking: To what degree are these SF texts resonant with current concrete empirical practice? To that end, the historian of Science Myra Hird and critical geographer Kathryn Yusoff offer insight into the “emerging science of mineralogical evolution” in their study of the strange new naturecultures of a toxic superfund site where microbial alliances are formed with minerals, metals, and human health experts (Hird & Yusoff, 2019, p. 265). The Butte superfund site was an abandoned open pit copper mine, later flooded to “contain” the initial disaster, thereby forming a metal-laden lake. The lake attracted migrating birds and became a local compost site of mass death and bacterial innovation after flocks of Canadian Geese mistook the shiny surface for a pristine place to land. Hird and Yusoff describe the inhuman trajectories that animate the toxic metal lake, as well as the humans who come in search of new bacterial actants that might cure human cancer. We suggest here that Hird and Yusoff have created a *posthuman ethnography*, or a geostory, making visible to the reader the complex agentic and metamorphic socio-material zone of a posthuman ecology. This is not a work of science fiction, but the practices described therein share many qualities with those we have found in SF. The authors present an empirical inquiry that matches the Latourian description of science we cited earlier, where the drama unfolds through a set of frictional encounters, between human and nonhuman characters, a drama that is *ground in the relational performances of those characters*.

We believe this work on the emergent mineral-microbial alliances and “inhuman trajectories” (between life and non-life) at this ecological disaster site offers a glimpse into the future of Anthropocene inquiry. The example of Hird and Yusoff gestures toward a form of inquiry into naturecultures which are somewhat indifferent to the survival of the bounded human organism, and yet this is also a site where new sympathetic and symbiotic relationships flourish. Their ethnographic method tracks a more-than-human belonging and becoming that entails more than simply autopoietic

self-maintenance, differing from both conventional ethnography and the individualistic-organism image of ecology we've inherited from systems theory (Clarke, 2017).

In this article, we have used literary speculative fiction (SF) as a way of exploring scientific imaginaries in the Anthropocene, and hope to have demonstrated how SF may be helpful to researchers who are seeking ways to complicate empirical method and methodology. SF depictions of new empiricism can spur us on to act with more-than-human sympathy in posthuman ecologies that demand a pluralist and plastic sense of worldly belonging. Books like *Annihilation* offer a glimpse into other-worldly earthly terrains, much like the ecologies in which we actually find ourselves today. We hope to have shown how the novel's plot, imagery, and character development help us explore questions about the future of posthuman empiricism, in a world where new matter–mind mixtures and in/organic variation proliferate.

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ORCID iD

Elizabeth de Freitas  <https://orcid.org/0000-0003-0795-8804>

Notes

1. The Anthropocene can be described as the epoch in chronological time when human impact on earth has reached a geologic scale—and the implications of this on the future of life on earth.
2. Even as we write this, the term “ecology” has become almost emptied out in its over-application (Neyrat, 2017). Latour (2017, 2018) notes that ecology has in fact failed us in fundamental ways, as a field dedicated to more-than-human relationality. And yet, at this point, it still indexes a set of powerful ideas (Hörl, 2018).

References

- Alaimo, S. (2016). *Exposed: Environmental politics and pleasures in posthuman times*. University of Minnesota Press.
- Alumkal, A. (2017). *Paranoid science: The Christian right's war on reality*. New York University Press.
- Bahng, A. (2017). Plasmoidal improprieties: Octavia E. Butler, Slime molds, and imagining a Femi-Queer commons. In C. Cipolla, K. Gupta, D. A. Rubin, & A. Willey (Eds.), *Queer feminist science studies* (pp. 310–326). University of Washington Press.
- Barad, K. (2007). *Meeting the universe half way: Quantum physics and the entanglement of matter and meaning*. Duke University Press.
- Barnes, E. (1997). *States of sympathy: Seduction and democracy in the American novel*. Columbia University Press.
- Braidotti, R. (2013). *The posthuman*. Polity Press.
- Braidotti, R., & Hlavajova, M. (2018). *Posthuman glossary*. Bloomsbury Press.
- Butler, O. (2000). *Lilith's Brood*. Grand Central Publishing.
- Chakrabarty, D. (2014). Climate and capitalism: On conjoined histories. *Critical Inquiry*, 42, 1–23.
- Clarke, B. (2008). *Posthuman metamorphosis: Narrative and systems*. Fordham University Press.
- Clarke, B. (2017). Planetary immunity: Biopolitics, Gaia theory, the holobiont, and the systems counterculture. In E. Hörl (Ed.), *General ecology: The new ecological paradigm* (pp. 193–216). Bloomsbury.
- Clough, P. T. (2009). The new empiricism: Affect and sociological method. *European Journal of Social Theory*, 12, 43–61.
- Colebrook, C. (2014). *Death of the posthuman: Essays on extinction, vol. 1*. Open Humanities Press.
- Colebrook, C. (2019a). A CUT IN RELATIONALITY: Art at the end of the world. *Angelaki: Journal of the Theoretical Humanities*, 24(3), 175–195.
- Colebrook, C. (2019b). *Unthinkable extinction: Cinematic time and the panorama of history*. <https://alienocene.files.wordpress.com/2019/06/cc-unth-ext.pdf>
- Coole, D., & Frost, S. (2010). *New materialisms: Ontology, agency and politics*. Duke University Press.
- Danowski, D., & Viveiros de Castro, E. (2017). *The ends of the world* (R. Nunes, Trans.). Polity Press.
- de Freitas, E. (2017a). Karen Barad's quantum ontology and posthuman ethics: Rethinking the concept of relationality. *Qualitative Inquiry*, 23(9), 741–748.
- de Freitas, E. (2017b). Non-human findings from the laboratory of speculative sociology. *Minnesota Review*, 88, 116–126.
- de Freitas, E. (2018a). The biosocial subject: Sensor technology and worldly sensibility. *Discourse: Studies in the Cultural Politics of Education*, 39(2), 292–308.
- de Freitas, E. (2018b). Love of learning: Amorous and fatal. In S. Bignalle & R. Braidotti (Eds.), *Posthuman ecologies: Complexity and process after Deleuze*. (pp. 87–104). Rowman & Littlefield.
- de Freitas, E. (2019a, April). *Posthuman ecologies: The future of ethnographic environ/mentality* [Paper presentation]. Panel Focused on Futures of Ethnography. Annual Meeting of the American Education Research Association, Toronto, Canada.
- de Freitas, E. (2019b). Science studies and the metamorphic multiple earth: Bruno Latour's risky diplomacy. *Cultural Studies ↔ Critical Methodologies*, 20, 203–212.
- de Freitas, E., & Curinga, M. X. (2015). New materialist approaches to the study of language and identity: Assembling the posthuman subject. *Curriculum Inquiry*, 45, 249–265.
- de Freitas, E., Lupinacci, J., & Pais, A. (Eds.). (2017). Science and technology studies x educational studies: Critical and creative perspectives on the future of STEM education. *Educational*

- Studies: A Journal of the American Educational Studies Association*, 53(6), 551–559.
- de Freitas, E., & Truman, S. (2019, June). *Science dis/trust in the end-times: Bruno Latour and the three-body problem* [Paper presentation]. *The Association for Philosophy and Literature Annual Conference*, Klagenfurt, Austria.
- de Freitas, E., & Weaver, J. (2019). Rethinking social inquiry in the wake of science studies: Transdisciplinary pursuits in times of climate change, information flows, and fading democracies. *Cultural Studies ↔ Critical Methodologies*, 20, 195–202.
- Delanda, M. (2015). *Philosophical chemistry*. Bloomsbury Academic.
- Deleuze, G., & Parnet, C. (2007). *Dialogues II: Revised edition*. Columbia University Press.
- Drummond, C., & Fischhoff, B. (2017). Individuals with greater science literacy and education have more polarized beliefs on controversial science topics. *Proceedings of the National Academy of Sciences*, 114(36), 9587–9592. <https://doi.org/10.1073/pnas.1704882114>
- Fox-Keller, E. (1985). *Reflections on gender and science*. Yale University Press.
- Grosz, E. (2004). *Nick of time*. Duke University Press.
- Haraway, D. (2008). Companion species, mis-recognition, and queer worlding. In N. Giffney & M. J. Hird (Eds.), *Queering the non/human* (pp. xxiii–xxvi). Ashgate.
- Haraway, D. (2013). SF: Science fiction, speculative fabulation, string figures, so far. *Ada: A Journal of Gender, New Media, & Technology* (3). <https://doi.org/10.7264/N3KH0K81>
- Haraway, D. (2016). *Staying with the trouble: Making kin in the Chthulucene*. Duke University Press.
- Hayles, K. (2012). *How we think: Digital media and contemporary technogenesis*. The University of Chicago Press.
- Hird, M., & Yusoff, K. (2019). Lines of shite: Microbial-mineral chatter in the anthropocene. In R. Braidotti & S. Bignalle (Eds.), *Posthuman ecologies: Complexity and process after Deleuze* (pp. 265–282). Rowman & Littlefield.
- Hörl, E. (Ed.). (2018). *General ecology: The new ecological paradigm*. Bloomsbury.
- Johnson, G. (2008). *The 10 most beautiful experiments*. Alfred A. Knopf.
- Keeling, K. (2019). *Queer times, black futures*. New York University Press.
- Kortekallio, K. (2019). Becoming-instrument: Thinking with Jeff VanderMeer's Annihilation and Timothy Morton's Hyperobjects. In S. Karkulehto, A. Koistinen, & E. Varis (Eds.), *Reconfiguring human, nonhuman and posthuman in literature and culture* (pp. 57–75). Routledge.
- Latour, B. (2017). *Facing Gaia: Eight lectures on the new climatic regime*. Polity Press.
- Latour, B. (2018). *Down to earth: Politics in the new climatic regime*. Polity Press.
- Lewandowsky, S., Gignac, G. E., & Oberauer, K., (2013). The Role of Conspiracist Ideation and Worldviews in Predicting Rejection of Science. *PLoS ONE*, 8 (10), e75637.
- MacLure, M. (2013). Researching without representation? Language and materiality in post- qualitative methodology. *International Journal of Qualitative Studies in Education*, 26(6), 658–667.
- Massumi, B. (2014). *The power at the end of the economy*. Duke University Press.
- Moore, J. W. (2016). *Anthropocene or capitalocene? Nature, history, and the crisis of capitalism*. Kairos Books.
- Morton, T. (2016). *Dark ecology: For a logic of future coexistence*. Columbia University Press.
- Neyrat, F. (2017). Elements for an ecology of separation: Beyond ecological constructivism. In E. Hörl (Ed.), *General ecology: The new ecological paradigm* (pp. 193–216). Bloomsbury.
- Okorafor, N. (2015). *Binti*. Tor.
- Parisi, L. (2017). Computational logic and ecological rationality. In E. Hörl (Ed.), *General ecology: The new ecological paradigm* (pp. 75–100). Bloomsbury.
- Povinelli, E. A. (2018). Mother earth: Public sphere, biosphere, colonial sphere. *Eflux*. <https://www.e-flux.com/journal/92/204673/mother-earth-public-sphere-biosphere-colonial-sphere/>
- Protevi, J. (2013). *Life, war, earth: Deleuze and the sciences*. University of Minnesota Press.
- Ruppert, E., Law, J., & Savage, M. (2013). Reassembling social science methods: The challenge of digital devices. *Theory, Culture, & Society*, 30(4), 22–46.
- St. Pierre, E. A. (2016). The Empirical and the New Empiricisms. *Cultural Studies ↔ Critical Methodologies*, 16(2), 111–124. <https://doi.org/10.1177/1532708616636147>
- Schliesser, E. (Ed.). (2015). *On sympathy*. Oxford University Press.
- Schuller, K. (2018). *The biopolitics of feeling: Race, sex and science in the 19th century*. Duke University Press.
- Simondon, G. (2017). *On the mode of existence of technical objects* (C. Malaspina & J. Rogove, Trans.). Univocal.
- Snaza, N., Sonu, D., Truman, S. E., & Zaliwska, Z. (2016). Introduction: Re-attuning to the materiality of education. In N. Snaza, D. Sonu, S. E. Truman, & Z. Zaliwska (Eds.), *Pedagogical matters: New materialisms and curriculum studies* (pp. xv–xxix). Peter Lang.
- Springgay, S., & Truman, S. E. (2018). On the need for methods beyond proceduralism: Speculative middles, (in)tensions, and response-ability in research. *Qualitative Inquiry*, 24(3), 203–214.
- Spuybroek, L. (2016). *The sympathy of things: Ruskin and the ecology of design, 2nd edition*. Bloomsbury Academic Press.
- Stengers, I. (2018). *Another science is possible*. Trans. Stephen Muecke. Polity Press.
- Subramaniam, B. (2014). *Ghost stories for Darwin: The science of variation and the politics of diversity*. University of Illinois Press.
- Suvin, D. (1972). On the poetics of the science fiction genre. *College English*, 34(3), 372–382.
- Todd, Z. (2016). An Indigenous feminist's take on the ontological turn: "Ontology" is just another word for colonialism. *Journal of Historical Sociology*, 29(1), 4–22.
- Truman, S. E. (2016a). Becoming more than it never (actually) was: Expressive writing as research-creation. *Journal of Curriculum and Pedagogy*, 13(2), 136–143.

- Truman, S. E. (2016b). Intratextual entanglements: Emergent pedagogies and the productive potential of texts. In N. Snaza, D. Sonu, S. E. Truman, & Z. Zaliwska (Eds.), *Pedagogical matters: New materialisms and curriculum studies* (pp. 91–108). Peter Lang.
- Truman, S. E. (2017). *Speculative methodologies & emergent literacies: Walking & writing as research-creation* [Unpublished doctoral dissertation]. University of Toronto.
- Truman, S. E. (2019a). Feminist new materialisms. In P. Atkinson, S. Delamont, A. Cernat, J. W. Sakshaug, & R. A. Williams (Eds.), *SAGE research methods foundations*. <https://doi.org/10.4135/9781526421036808740>
- Truman, S. E. (2019b). SF! Haraway's situated feminisms and speculative fabulations in English class. *Studies in Philosophy and Education*, 38, 31–42. <https://doi.org/10.1007/s11217-018-9632-5>
- Tsing, A. (2017). *The mushroom at the end of the world: On the possibility of life in capitalist ruins*. Princeton University Press.
- VanderMeer, J. (2014). *Annihilation*. Farrar, Straus and Giroux.
- Wendt, A. (2015). *Quantum mind and social science: Unifying physical and social ontology*. Cambridge University Press.
- Wiley, A. (2016). *Undoing monogamy: The politics of science and the possibilities of biology*. Duke University Press.
- Wilson, E. (2015). *Gut feminism*. Duke University.
- Yusoff, K. (2019). *A billion black anthropocenes or none*. University of Minnesota Press.

Author Biographies

Elizabeth de Freitas is a professor at Manchester Metropolitan University. Her research focuses on philosophical investigations of mathematics, science and technology, pursuing the implications and applications of this work in the social sciences. She has published five books and over 50 articles. Her recent work explores speculative mathematics and digital life.

Sarah E. Truman is a postdoctoral research fellow at University of Melbourne. Her current research focuses on how literary studies, speculative fiction, and STS imaginaries are enacted in the secondary English curriculum. She co-directs *WalkingLab* (www.walkinglab.org) and her personal website is www.sarahetruuman.com.