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Knowledge in the Age of Climate Change

By now, the facts and futures of human-induced climate change have been well rehearsed. Before the end of this century, global temperatures could approach 3 degrees Celsius warmer than average temperatures in the 1990s. Sea levels could rise up to a meter or more, threatening millions living in coastal areas. In these conditions diseases will likely spread more rapidly, food will become more and more scarce with anticipated population explosions, and droughts and storms will be increasingly severe. Mass-scale climate migrations will come to dominate our news cycles. And, of course, all of this will be felt most acutely in less developed countries. The implications of these projections produced by the Intergovernmental Panel on Climate Change (IPCC) nearly three decades ago were and continue to be all encompassing. They saturate the air we breathe, the water we drink, the food we eat, and the objects we use. They are, in short, deeply connected to what it means to be human on earth in the twenty-first century. Even if momentarily, it is not difficult to imagine the subtle ways we live and experience the material effects of climate change every day. Perhaps more difficult to conceive, though, are the ways climate change affects how we *think*

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and how we organize that thinking. How do these dire projections—their facticity, as Martin Heidegger would put it, but also simply our lived experience of what those projections portend—affect how we make meaning of ourselves and our world? What does it mean to generate knowledge in the age of climate change?

This issue is an attempt to map some of the epistemological shifts we have witnessed in these times of ubiquitous change. These essays begin to chart some of the ways in which climate change discourses have reshaped the contemporary architecture of knowledge itself, reconstituting intellectual disciplines and artistic practices, redrawing and dissolving boundaries, but also reframing how knowledge is represented and disseminated. The essays that follow roughly fall into three larger categories. The first focuses on the shape of global warming discourse as it has emerged *within* particular disciplines in recent years, such as history, journalism, anthropology, and the visual arts. How is climate change renovating these fields, perhaps necessitating a turn toward material science and experience? How, inversely, have particular disciplines influenced the language and discourse of climate change? The second category concerns what we're calling "interdisciplinarity 2.0." If in the 1980s and 1990s we witnessed a turn to interdisciplinarity among proximate disciplines in the humanities and social sciences—such as the convergence of political economy, literary studies, and sociology that we find in postcolonial studies, as well as gender and sexuality studies, for instance—then for the past decade or so we have witnessed a new kind of interdisciplinarity, in which the material sciences have had a pervasive influence on those already interdisciplinary human sciences. Scholars like Donna Haraway and Bruno Latour, of course, have been doing this kind of work for decades, but twenty-first-century developments in ecocriticism, object-oriented ontology, posthumanism, and the neurohumanities have brought an enduring materialism to the human sciences. Given this rebooted intellectual landscape, our interest lies in how climate change science and discourse have further dissolved the barriers between established fields of knowledge. Just as critical are the ways the human and social sciences are in turn reshaping the production of climate change knowledge. The third category emerges from these others, focusing on the forms of representation and dissemination in this new epistemological landscape. What formal strategies do music composers, novelists, and sculptors take up so that climate change might somehow be represented? How have emergent platforms and media—such as small-scale popular science journalism, open access publication, and online curation—engaged new audiences and disseminated climate-related work? The combination of these three categories is our way of taking the

temperature, as it were, of the contemporary order of knowledge and how that order has been deeply affected by the climatic shifts that we live and experience each day.



It should be clear, then, that the articles in this issue are part of a growing constellation of contemporary voices and texts. Of the many acknowledged and implied interlocutors in this collection, perhaps the most visible are the widely disseminated documents recently produced by world leaders. The agreement set at the twenty-first session of the Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change in Paris in December 2015 is of course the latest installment in a decades-long affair to reduce global carbon emissions and to provide assistance to those countries least prepared for a warmer world (United Nations 2015). The contributors to this collection provide a range of responses to COP21, principally critiques of its insufficiencies, its omissions, and its dissimulations. Given the continued prominence of religious faiths in our world, we cannot ignore the discursive force of religious leaders as they weigh in on the debate. Issued ahead of the Paris talks, Pope Francis's *Laudato Si'* (2015) and the "Islamic Declaration on Global Climate Change" (IICCS 2015) are ambitious statements made by the leaders of two of the world's most influential religions, both documents employing a combination of anticapitalism and religious naturalism in their call for an end to fossil fuel consumption altogether.

Crucial, too, in the contemporary landscape of climate change knowledge are the nonfiction works written to be more accessible to the public but no less rigorous in their critical engagement. Particularly influential in recent years are Naomi Klein's *This Changes Everything* (2014) and Elizabeth Kolbert's *The Sixth Extinction* (2014), the former attending to the ways neoliberal capital simultaneously drives changing climates and prevents systematic action, and the latter situating our current climatic and ecological crises in a long history of mass extinctions on earth. These prize-winning works employ analogy, extended anecdote, and empirical evidence to galvanize a sense of shared urgency of our lived moment and anticipated futures. The concluding thoughts to Kolbert's book (2014: 38) demonstrate the strategies of the genre well: "By disrupting these systems—cutting down tropical rainforests, altering the composition of the atmosphere, acidifying oceans—we're putting our own survival in danger. Among the many lessons that emerge from the geologic record, perhaps the most sobering is that in life, as in mutual funds, past performance is no guarantee of future results. When a mass extinction occurs, it takes out the weak and also lays low the strong."

Indeed, this kind of straightforward and lucid prose style is part of what makes these works best sellers, no doubt reaching far wider audiences than most academic publications. Texts like these are pivotal to contemporary knowledge production, and these two in particular are not lost in this collection. In fact, tracing the varied uses of Klein's and Kolbert's books in this issue—especially in the contributions by Michael Segal, Noel Castree, Gary Tomlinson, and Claire Colebrook and Tom Cohen—affords a momentary taste of the decidedly heterogeneous nature of climate change discourse today.

Amid this density and diversity of climate discourse are also several recent influential texts in the humanities and social sciences. Unsurprisingly, the works that have gained the most traction among scholars and the broader public have been interdisciplinary patchworks, some combination of climate science, history, critical theory, aesthetic representation, and political activism. The focuses of these texts vary widely, from genealogical investigations, to studies of different scales of time, to close readings of geographically distinct crises. In *The Shock of the Anthropocene*, Christophe Bonneuil and Jean-Baptiste Fressoz (2016: xiii–xiv) take the genealogical approach, reading an array of thinkers, from Henri de Saint-Simon to Charles Fourier, Fernand Braudel to Bruno Latour, to construct a sprawling intellectual history intended to “help us change our world-views and inhabit the Anthropocene more lucidly, respectfully and equitably.” In contrast, *The Conflict Shoreline*, a collaboration between forensic architect Eyal Weizman and photographer Fazal Sheikh (2015), is a recent notable example of a more geographically specific text. Through a counterpoint of rigorous historical and political analysis and dozens of aerial photographs, satellite images, and maps, the book chronicles how climate change–induced desertification has exacerbated the Israeli state's decades-long expulsion of Bedouin indigenous to the Negev for the purpose of transforming the expanding desert into Jewish settlements, forests, and fields. Also focusing on populations most vulnerable to ecological crisis is Rob Nixon's American Book Award–winning *Slow Violence and the Environmentalism of the Poor*. Nixon (2013: 2) suggests that climate change, nuclear contamination, and other forms of environmental devastation enact a kind of “violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space.” The most impoverished of the “global South,” Nixon contends, are most threatened by what he calls “slow violence,” and the challenge lies in locating those memoirs, novels, films, and other media that can best make visible what so often remains invisible.

While many of these works mentioned to this point have some kind of presence in this issue, one essay stands out as the most widely engaged. That Dipesh Chakrabarty's "The Climate of History: Four Theses" is closely read by several contributors should come as no surprise, given the influence the article has had on a range of fields since its 2009 publication. In the essay Chakrabarty suggests that the crisis of climate change is larger in time and space than the crises of national belonging or global capital. The Anthropocene demands that we think in terms of a deeper history of life on earth (recorded as well as prerecorded geological histories) and that we move past our human exceptionalism to think of ourselves as one among innumerable interdependent species on earth, all threatened in some way in this newly named epoch. "Climate change," he says in the essay's conclusion, "poses for us a question of a human collectivity, an us, pointing to a figure of the universal that escapes our capacity to experience the world" (Chakrabarty 2009: 222). The contributors to this collection take up these questions of (in) experientiality, deep time, and species thinking in our moment of global warming, bringing them to bear on neuroscience, religious studies, food studies, and scientific modeling, among other diverse fields of knowledge.

Another pervasive question that animates this collection, one crucial to the broader climate change intellectual landscape, concerns aesthetic representation. As recently as 2005, Bill McKibben famously asked, "Where are the books? The poems? The plays?," noting what he observed as a dearth of climate change-engaged art. "Art," he continues, "is one of the ways we digest what is happening to us, make the sense out of it that proceeds to action" (McKibben 2005). His call, it turned out, was timely. A global creative "digestion" was indeed coming into its own. "Moving images and sounds and words," McKibben (2009) wrote four years later, revisiting the subject, "have been flooding out into the world." And this aquatic metaphor, it appears, was also prescient of much of the creative work to come. Water—its devastating excess, but also its haunting absence—has become central to climate change aesthetics globally since the turn of the century. Take, for instance, Vincent Huang's interactive installation in the Tuvalu Pavilion at the 2015 Venice Biennale. Visitors walked through the pavilion on wooden platforms floating on a shallow pool of water. As more weight bore down, water subtly seeped onto the platforms, soaking the bottoms of visitors' shoes—an allegorical experience for the ecological impact of humans on the vanishing Pacific island nation of Tuvalu. In another form, we find a kind of literary analogue to this interactive experience in Amitav Ghosh's 2004 novel *The Hungry Tide* (2004: 37), in the narrator's description of the precarious position of an island

in the Sundarbans region of Bangladesh: “At low tide, when the embankment, or *bādh*, was riding high on the water, Lusibari looked like some gigantic earthen ark, floating serenely above its surroundings. Only at high tide was it evident that the interior of the island lay below the level of the water. At such times the unsinkable ship of a few hours before took on the appearance of a flimsy saucer that could tip over at any moment and go circling down into the depths.”

The simultaneous aesthetic beauty and imminent devastation of these images is a hallmark of some of the best climate change–inflected aesthetics to date. If Huang achieves this dialectic through installation, and Ghosh through narrative, composer John Luther Adams does it through sound in his Pulitzer Prize–winning symphony *Become Ocean*. “Life on this earth first emerged from the sea,” he writes in the album’s liner notes. “Today, as the polar ice melts and sea level rises, we humans face the prospect that we may once again, quite literally, become ocean” (Adams 2014). Adams transposes this sense of “becoming” into a minimalist ebb and flow of sound that washes over the listener, a series of gradual swellings and releases built through brass, woodwinds, piano, and strings. At its quietest, the symphony is whimsical and utterly sublime; at its peaks, the work is soaring, massive, and heaving. Rounding out this snippet view of climate-aquatic aesthetics is yet another vector in Nnedi Okorafor’s speculative fiction. To read her 2015 cyberpunk novel *The Book of Phoenix* is to enter a dystopian world in which global warming has advanced far into the IPCC’s projected future. New York City has become tropical: mango trees and palm trees line the streets, a new strand of malaria plagues the city, and “the poor and illegal” inhabit the now partially submerged skyscrapers of Lower Manhattan, “commut[ing] to the city using boat services provided by New York’s government” (Okorafor 2015: 57). The shock of such a transfigured familiar landscape evokes an uneasy melding of horror, wonder, and curiosity, very much in line with the aquatic forms of Adams, Ghosh, and Huang.

This growth of engagement with climate change that we find in contemporary artistic practice, and certainly in the earlier mentioned best sellers, declarations, and critical investigations, is of course not without precedent. We may have witnessed an explosion of participation in climate discourses in the past two decades, but those discourses indeed have a long and variegated history. Briefly, we want to sketch a version of that history, providing a few of what we’re calling “threshold texts” that chart a certain historical movement of climate change thought and expression. We prefer this term because our aim is not to be comprehensive or to make grand claims about foundational texts or ideas but instead to chronicle a series of

paradigm shifts in the architecture of knowledge that is particular to the disciplinary constellation in this issue. Each of the following texts marks in some way a kind of “threshold moment” in the evolution of climate change knowledge as it manifests in the articles in this collection and the contemporary epistemological landscape presented here.



As all the essays in this collection are in some way concerned with a certain “cultural processing” of anthropogenic climate change, we might begin this sketch by turning to a few relatively early texts to participate in that processing. The first we have in mind is, and is not, about climate change. It is a summary of arguments published in London’s *Star* newspaper in 1799 of the trial of *Hornblower v. Boulton and Watt*. Watt, unsurprisingly, refers to James Watt, inventor of the Watt steam engine patented in 1784, a machine considered pivotal to the expansion of the Industrial Revolution. In the article’s recounting of the case, we find that Watt has taken Jonathan Hornblower to court for violating his patent, the latter claiming that the patent applied only to an abstract idea, not to an actual machine: “He [Watt’s attorney] contended that this invention of Mr. Watt was the greatest practical advance ever made in the arts, and was universally admired through every part of Europe. By it a single bushel of coals would raise one foot high thirty millions of pounds weight. It possessed a force more than double the power of gunpowder. Could this operation be performed by a mere abstract idea—by a thing not tangible?” (*Star* 1799).

The lawyer’s language, of course, is hyperbolic, but for his argument to be taken seriously (which it was) that hyperbole had to have been grounded in some common understanding of the invention’s significance. The historicist language is striking: “the greatest practical advance ever made in the arts.” The machine, the logic goes, will bring progress, making culture and society more perfect as time moves on. The optimism, the celebration of power, and certainly the reference to the “single bushel of coals” is almost haunting from our twenty-first-century vantage point. It is a telling, albeit small, window into the ideology of a particular moment in Britain’s history, a moment that in retrospect we have come to see as the first great historical acceleration of the burning of fossil fuels. If this document tells us anything, it’s that the earliest days of human-caused climate change were (at least in part) days of elation, confidence, and hope for the future.

Watt’s engine gestures to one principal method of placing carbon dioxide (CO₂) into the atmosphere, and a half century later we find another in the work of George Perkins Marsh. Prior to the publication of his celebrated *Man*

and *Nature* in 1864, Marsh delivered a now well-known speech in 1847 to the Agricultural Society of Rutland, Vermont, in which he claimed that “climate itself has in many instances been gradually changed and ameliorated or deteriorated by human action”: “The draining of swamps and the clearing of forests perceptibly effect the evaporation from the earth, and of course the mean quantity of moisture suspended in the air. The same causes modify the electrical condition of the atmosphere and the power of the surface to reflect, absorb and radiate the rays of the sun, and consequently influence the distribution of light and heat, and the force and direction of the winds” (Marsh 1847).

This claim of the effects of “human action” on the climate very much resembles our contemporary Anthropocene discourse, that humans have become a geological force in their capacity to alter the earth’s surface, atmosphere, and life-forms. And without naming it as such, Marsh early on managed to identify the role of deforestation in changing climates. Deforestation was crucial to his understanding of warming temperatures produced by the interrelation of the sun, the atmosphere, and the earth’s surface, effectively prefiguring what would be more empirically substantiated in the final years of the nineteenth century by Swedish chemist Svante Arrhenius, who all but coined the term *greenhouse effect*.

Moving into the twentieth century, the next critical threshold of climate change knowledge centers on CO₂. The transfer of CO₂ from inside the earth into the atmosphere, of course, had been well under way by the end of the nineteenth century, as the Watt trial summary demonstrates, but the idea that CO₂ had somehow accelerated the change of climates was not yet common knowledge (Fleming 1998: 107). Appropriately enough, a British steam engineer was one of the first to be taken seriously about the effects of CO₂. In his essay, “The Composition of the Atmosphere through the Ages,” Guy Callendar (1939: 38) estimates that “some 9,000 tons of carbon dioxide [are transferred] into the air each minute”:

This great stream of gas results from the combustion of fossil carbon (coal, oil, peat, etc.). . . . As man is now changing the composition of the atmosphere at a rate which must be very exceptional on the geological time scale, it is natural to seek for the probable effects of such a change. From the best laboratory observations it appears that the principal result of increasing atmospheric carbon dioxide . . . would be a gradual increase in the mean temperature of the colder regions of the earth.

Callendar is certainly getting closer to the heart of the matter, but he never actually suggests that these atmospheric and climatic changes may be det-

rimental. In fact, Callendar, as well as Arrhenius, speculated that global warming might even benefit certain societies, providing more land for cultivation, among other potential advantages (Fleming 1998: 115). Telling, too, is Callendar's emphasis on the "colder regions of the earth," and the apparent elision of those that were likely already quite warm in 1939, regions that would presumably *not* benefit from increased temperatures.

The same year Callendar published his essay, *Time* magazine published an article on what must have been bizarre news of a "warming world," giving us an early window into how climate change knowledge initially reached the general public. The four-paragraph article cites figures provided by a few noted meteorologists and gives a sweeping tour of thumbnail anecdotes about the "retreating" ice sheets of Greenland and the warming Arctic Sea. Despite its claim of a warming world, however, the article remains uncertain: "The reason for such climate changes is obscure. . . . Meteorologists do not know whether the present warm trend is likely to last 20 years or 20,000 years" (*Time* 1939: 27). The article, we should note, remains neutral on change, reading it as neither beneficial nor harmful. Indeed, the article almost seems symptomatic of some kind of fracture in the climate change discourse of the time, either among climatologists themselves about the reasons for change or in the communication channels between scientists and journalists. What is clear, though, is that journalists were some of the earliest mediators between climate change scientists and the general public, distilling knowledge to make it palatable and understandable to a lay audience. Interestingly, the uncertainty we find in this *Time* article is still not entirely straightened out a decade later in the *Saturday Evening Post*, at the time a weekly cultural magazine. The 1950 *Post* article is several times longer than the *Time* article, but its discursive strategy is similar: it surveys evidence of hotter temperatures from Boston to Greenland to Kenya, comparing this with anecdotal evidence of cold climes in the decades and centuries prior, and short quotations from a geographer at the University of Stockholm are used to authorize the evidence. In contrast to the 1939 *Time* article, however, the *Post* article seems a bit more sure of its knowledge: it suggests that "this is more than a brief, superficial change" and, intriguingly, that the "most reasonable conclusion is that the earth is emerging from the last lingering chill of one of a succession of little ice ages." And in contrast to the 1939 piece, the latter does begin to read the changes negatively, as one of its image captions demonstrates: "The choking dust storms of America's Midwest, the 'freak' New England hurricane of 1938, the fact that Utah's Great Salt Lake is rapidly drying up—all these point toward a definite climatic upheaval"

(Abarbanel and McClusky 1950: 23). We have finally encountered a cultural response that more closely resembles our discourse of crisis in the twenty-first century. But the article is still silent on carbon, insisting on foregrounding a kind of “natural process” argument over an anthropogenic one.

A few decades further into the century, art and literature begin to make up for this midcentury silence on human action. One unequivocal threshold artwork is Robert Smithson’s 1970 earthwork *Spiral Jetty*. Sitting in the pink-hued waters of Utah’s Great Salt Lake, the sculpture jets out from the shore in a 1,500-foot-long, 15-foot-wide coil. Made of basalt rock, mud, and salt crystal from the immediate area, the earthwork remains nearly fifty years later, having become a kind of allegory for the human’s geological impact in our Anthropocenic moment. The work was also built to register climate fluctuations, surfacing in the water when the lake is in drought and sitting just below the water’s surface when the rains from the nearby mountains run in. Published just one year after Smithson built *Spiral Jetty*, Ursula Le Guin’s sci-fi novel *The Lathe of Heaven* is another pivotal early climate change aesthetic piece. A futuristic work set in 2002 in Oregon, the novel takes a far less subtle approach:

Rain was an old Portland tradition, but the warmth—70° F. on the second of March—was modern, a result of air pollution. Urban and industrial effluvia had not been controlled soon enough to reverse the cumulative trends already at work in the mid-Twentieth Century; it would take centuries for the CO₂ to clear out of the air, if it ever did. New York was going to be one of the larger casualties of the Greenhouse Effect, as the polar ice kept melting and the sea kept rising. (Le Guin 1971: 31)

Removed from narrative context, of course, this climate description feels didactic, even belabored, rehearsing a story very much familiar to us today. But what reads as normal now was likely a jarring, alienating reading experience in 1971, a shock to the system that we perhaps have become increasingly immune to today. With the publication of Le Guin’s novel, CO₂ now inches closer to widespread acceptance among most media, elected officials, and the public as the primary climate change causing greenhouse gas. Her novel brings us to the edge of our contemporary era of global warming discourse.

That contemporary discursive era begins in earnest in the late 1980s. A brief 1988 *New York Times* report documents a landmark event signaling this new era of protocols, policy, and crisis management. The event was the testimony of National Aeronautics and Space Administration (NASA) clima-

tologist James Hansen before the US Senate Energy and Natural Resources Committee. He announced to receptive lawmakers and the global media that NASA was “99 percent certain” that climate change was real and imminent (Shabecoff 1988). The article reads much like something written today: it goes back to basics to explain the greenhouse effect; it cites mathematical models and experts; it discusses melting polar ice sheets *and* rising sea levels; it identifies CO₂ as the biggest atmospheric pollutant, the result of burning fossil fuels and destroying forests. Hansen’s testimony finally put climate change on the agenda of policy makers and elected officials. The media had latched on and the public started to take the issue seriously (Besel 2013: 138). That same year, the United Nations formed the IPCC, which published its first assessment report in 1990, highlighting the scientific, technical, and socioeconomic urgencies of global warming. The era of warning and crisis was indeed well under way.

At this point in the history of climate change knowledge, the field opens and crowds. We could highlight any number of texts and voices from the 1990s to the present, but perhaps the next signal discursive event belongs to Paul Crutzen and Eugene Stoermer. In an issue of the newsletter of the International Geosphere-Biosphere Program released in 2000, the two atmospheric chemists test a new term. In the brief two-page essay, the authors list some of the ways mankind has become a “geological force”: fossil fuels that took millions of years to form are rapidly depleting; species have become extinct; and much of the ozone layer has been destroyed. They write, “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 the use of the term ‘anthropocene’ for the current geological epoch” (Crutzen and Stoermer 2000: 17).

This announcement would go on to spark a contentious still-unfolding debate among scholars about the Anthropocene’s timeline. In the essay, though, they provisionally date it to the late eighteenth century, “when data retrieved from glacial ice cores show the beginning of a growth in the atmospheric concentrations of several ‘greenhouse gases’” (17). Incidentally, this beginning also corresponds, they say, with the 1784 invention of Watt’s steam engine.

This epochal naming of course did not suddenly change the material conditions of everyday life. What it changed, or has sought to change, is our cosmology, the way we conceive of ourselves as being-in-the-world. That new cosmology has a dually expanding temporality: it retroactively recodes

humanity's role on earth since the eighteenth century and demands that we assume our place in the sediments of geological deep history, but it is also generative and outward-oriented, naming an epoch so that we might someday become more conscious of ourselves and our world and maybe even *do* something about it. What the Anthropocene names is a new order of time consciousness. And what this issue proposes is that this new structure of consciousness has saturated and will continue to saturate the knowledge we produce in the twenty-first century, that this new mode of living and thinking in the world is, perhaps, inescapable. All the essays in this collection are of this new cosmology of the Anthropocene, each digging into its own (inter)disciplinary tool kit to carve out its own space in that cosmology. Each of these essays is, therefore, in some direct or indirect way an inheritor of the genealogy of climate change knowledge. They participate in the contemporary epistemological order, but they have in them traces of how humans for centuries have come to know their warming world.



Embedment, niche construction, ocean deserts, keeling curves, radiative forcing, ecoacoustics, fitness landscapes, orbital wobbles, particles per million, Anthropocene epigenetics, deep history, species, geological force, zoocentric, tipping points, feedforward and feedback loops—if Raymond Williams were writing *Keywords* today, these would be among the new and interruptive terms constituting the lexicon of critical knowledge in an age of climate change. They, of course, would not be the only terms. In Williams's (2015) own formulation they would number as a handful of the concepts and figures coconstituting an “emerging” constellation of thought, alongside a set of other still “dominant” and lingeringly “residual” epistemological frameworks organizing the landscape of contemporary critical consideration.

But is that actually the case? Certainly, it is true that this brief list represents only a very partial sample of a much larger and constantly expanding catalog of the new keywords of the Anthropocene. But is it the case that the epistemological and ontological dispensation they coarticulate remains amenable to Williams's account of the constant, essentially timeless interplay of the dominant, the residual, and the emergent? This time around, is “emergence” different? Does the knowledge world of the Anthropocene (and the posthumanist materialism it is rapidly articulating) coexist with prior critical dispensations (including the older humanist materialism Williams is often held to represent), modifying and altering those previous modes of thought, perhaps marking their transition from a once dominant to a now

truly residual status, but nevertheless existing alongside them, inviting us to continue to draw something from these other, long-established forms of thought? Or is the epoch of the Anthropocene a true paradigm-shifting moment? As an epoch of thought, is it as radical in its break from the past as the geological leap from the Holocene?

And if so, how so?

In one or another form, that question runs throughout this collection of essays, not only as a challenge to fashion new forms of thought adequate to the moment but as a question of what to do with our prior modes of thinking, of what to preserve, or abandon, from the projects of critical knowledge before the moment (or, more precisely, before the moment of *awareness*) of climate change.

By one way of answer we turn to one of these new keywords: *feedback* (and, as Tomlinson's essay reminds us, we must also attend to its paired word *feedforward*). Whatever else it is, the epoch of the Anthropocene is an epoch of feedback loops: intensified, expanded, cascading. The fundamental story is familiar. The release of CO₂ into the atmosphere enters into a feedback loop with the planet's carbon cycle and the wobbles in the earth's multimillennial calendar of orbits around the sun, intensifying the effects of radiative forcing, warming the planet, and accelerating glacial and arctic melt, sea-level rise, desertification, coral degradation, and species loss, which in turn threaten global food chains, coastal communities around the planet, transcontinental water supplies, and countless else. As human actions become ever more forceful, the feedback loops of anthropogenic climate change threaten the future of human actors. But as demonstrated by this collection of essays, and the broader discourse of which it is a part, *feedback* denotes more than this. It denotes more than tragic irony. It denotes, potentially, a catastrophic flight beyond irony or any other human capacity to find any adequate rhetorical mode of representing "our" relationship to history: as, at the height of "our" planetary agency, "we" vanish as actors altogether—"we" annul "ourselves." This is the point Tomlinson makes in his analysis of the fundamental change in the nature of "niche construction" that has been wrought in the epoch of the Anthropocene. As he powerfully argues, human life has long been wrapped in a network of environmental feedback loops. We have evolved by adapting to environments that have evolved by adapting to human actions. In that way, we have constantly expanded the human niche, to the point of making that niche coterminous with the globe. What is different, now, is that a set of forces (he includes "astronomical dynamics, tectonic shifts, volcanism, [and] climate cycles") that have had a structuring

impact on the viability and ordering of life but which we have not previously had the capacity to effect (“feedforward” elements) have now been drawn inside a massively expanded human “niche” and, thus, drawn into the cycle of *feedback* loops. As that occurs, as the full boundary between what is and is not within our feedback loops collapses, so too does the isolable “difference” of the human. We no longer have the capacity to stand in an ironic, tragic, or melancholic reflection on what “we” have wrought. Because “we” have vanished—into “zoe.”

Or that is the implication: one which Tomlinson (and multiple other contributors) acknowledges, even while seeking some way of visualizing, or mobilizing, or, in Catherine Malabou’s terms, producing “a kind of mental phenomenon” of this experience of becoming-force, being-zoe, living-as-planet-makers in order to act on it.

On this point—on what is apprehensible as a desire, or a will, or an urge toward a perspective on the Anthropocene that is somehow both within it and at some (perhaps purely imaginative) remove from it—the question of what to do with our other knowledge, our other epistemologies, returns to view. As it becomes dominant, what space does the knowledge-world of the Anthropocene have for other knowledge forms? Not just residual forms. Not only prior forms. But forms yet to be imagined, forms yet to emerge. Or is even asking that question the symptom of an illusion we can no longer afford? Is knowledge in the age of climate change a total and unitary field?

On those questions the notions of “feedback” and “feedforward” take on a second significance, one of deep importance to the contemporary organization of knowledge. As we gestured to earlier, James Chandler (2009) has observed that the nature of “interdisciplinary” knowledge (particularly in the humanities) has been in the midst of a major transformation in recent years. Key to that change, he has suggested, is a gradual outward expansion of conversations among the disciplines, as exchanges among relatively proximate fields (philosophy, psychology, and linguistics, to take one influential trio) have extended to conversations among the more distant disciplines: literature, geology, and evolutionary biology, to take examples from this collection. This is the transformation we earlier had in mind in referring to our moment as the moment of “interdisciplinarity 2.0.” What we now want to ask concerns the nature of the feedback loops not just among “single” disciplines but among the broadly defined and long-standing container categories of the human, social, and natural sciences (what Castree calls the “three cultures”) during this epoch of critical time. Tomlinson’s account of “niche construction” is again helpful here, particularly if we begin with the fields of

knowledge generally grouped under the human or humanistic sciences. From that perspective, Chandler's discussion of the transformation in the humanities can be seen as a process of gradually expanding niche construction by the humanities disciplines, as they enter into a set of ever-wider feedback loops not only with the relatively proximate interpretive social sciences but with quantitative disciplines and the sciences of living systems. At that point of the human sciences' massively expanded niche, what, though, happens to interdiscursive, transdisciplinary feedback loops? Do they persist, such that each field (literature, religion, evolutionary biology, philosophy, geology, music, ecology, etc.) continues to modify and coevolve the others even as each field is itself modifying and coevolving? Or is this a moment for *all* the sciences (even as we underline the question for the human sciences), one that is structurally analogous to the moment of the "human" as *it* is caught up in the intensifying loops of anthropogenic climate change? Have we, in a word, reached a tipping point in these exchanges after which the human sciences, like the human, vanish—to be replaced, suddenly but definitively, by the zoe-sciences? Is that the moment we are in?

Perhaps, and as the essays collected here variously stress, wrestling with that question is one of the primary challenges of grappling with the problem of knowledge in the time of climate change. As is another. If we *have* crossed that event horizon—that tipping point in which climate change has radically altered not only the planet, and life on it, but the order of knowledge itself—have we also finally come to the end of feedforward loops? Or is it possible to imagine a reinvention of feedforward possibilities, a reimagination and a new fabrication of some point of feedforward vitality from the conjoined perspectives of the human, social, and natural sciences? Can we fashion a perspective on the Anthropocene that is somehow both within it and at some (seeming) critical distance from it, a perspective through which we *can* "mobilize" our knowledge of having come to this point in the history of knowledge and, so, also mobilize the form that knowledge and the imagination can now take for the future of the planet?



There is one last piece to this shifting epistemological architecture with which we want to conclude, one that nearly every essay in this collection addresses, however implicitly. It is one thing to *know* the kind of world climate change promises, but it is quite another to *feel* that promise, to viscerally experience it, to inhabit it psychologically. Slavoj Žižek (2010: 328) frames this paradox as a chasm "between knowledge and belief": "We *know*

the (ecological) catastrophe is possible, probable even, yet we do not *believe* it will really happen.” It is the difference between awareness (of facticity), on the one hand, and the *absorption* of that awareness, on the other, where that absorption manifests as a lived, felt, affective response. For Chakrabarty (2009: 221), this gap comes from our incapacity to “experience ourselves as a geological agent”: the ungraspability of the modes of deep time and species thinking that this newfound “agency” demands. Our experience, the reasoning goes, refuses phenomenalization. We have arrived at an impasse of non-feeling and nonreflexivity, rendering us “structurally alien” to “our own apocalypse,” as Malabou incisively puts it in this issue.

But despite this apparent foreclosure of affect, the question of feeling persists throughout this collection. What animates many of these essays are the ways in which climate change discourse has not simply reshaped the order of knowledge, but how it has done so in the service of this elusive figure of “feeling.” The presumption being that “believing” or “feeling” is a necessary precursor to mass mobilization, to bringing on the radical shifts in habit, lifestyle, and worldview that could potentially limit the effects of climate change. Many of these articles reveal a certain desire to narrow this seemingly unthinkable gap between knowing and feeling or, at least, to begin to work through what makes it unthinkable. Malabou, for one, through her neurohistorical optic, makes an appeal for what she calls “new addictions,” mental structures different from the ones that brought about this crisis in the first place. Willis Jenkins’s proposal for alternative social practices of eating—new modes of commensality with landscapes and nonhumans—also seems in search of experience and feeling. And there is a related sense in Matthew Burtner’s suggestion that ecoacoustic music might potentially allow us to “feel place” differently, where “songs of loss” would enable us to experience changing landscapes in novel ways. Yet another strand comes from the cluster of essays in this collection concerned with how best to represent and communicate the science of climate change to the public and to scholars in the human and social sciences. For several contributors, medium is pivotal to narrowing that gap: for Segal, it is long-form science-driven narrative; for David Buckland, Olivia Gray, and Lucy Wood of Cape Farewell, it’s aesthetic experience; for Tomlinson, it’s modeling and visualization. Finally, moving through all these considerations is how these essays rhetorically and formally *perform* this desire to make us feel, how they enact in language and form this attempt to convince us, as readers, to believe. Here Burtner’s field journal excerpts stand out, as does Bently Spang’s evocative personal account of textures, colors, places, and histories. Notable, too, are the invigorating

formal experimentations in Cohen and Colebrook's essay. As they use the figure of the vortex to theorize a notion of the "critical" as a kind of infinitely valent politics in the time of climate change, Colebrook and Cohen enact that vortex in form and language, their prose gradually accelerating and surging toward a culmination of ecstatic Benjaminian wreckage, leaving the reader reeling, and, indeed, feeling. In all manner of ways, the essays here call on us to push against the numbness that is said to define us as a geological force, insisting that our experience can and must be phenomenalized, that we must search for the hidden movements and mutations that our being-in-this-warming-world comprises.

Like this quest for feeling and belief, this collection can only be a gesture toward the continually receding horizon of our changing world. The essays that follow represent an initial foray into the nexus of knowledge and climate change, just as the keywords, genealogies, and intellectual landscapes outlined here are the initial strokes in a vastly larger and evolving picture. However, these essays do, we think, point toward the coming expansiveness of knowledge production. The exigency of our melting, rising, and vanishing world will only continue to seep into intellectual and artistic disciplines, to deepen the interconnections among the human, social, and natural sciences, to create new vocabularies and languages, to instigate new modes of representation and dissemination. We will also likely witness a recoding in hindsight of past knowledges, those that came before the awareness of climate change, pulling them into the fray of the interdisciplinary feedbacks that will continue to define future knowledge production. Ever-expanding fields of knowledge, coevolving, overlapping, merging, and switching courses, feeding back and forth and back and forth. In this epoch when the human is everything and nothing, unique and precariously ordinary, we might wait and see if knowledge becomes a singular system in perpetual expansion, with infinite epistemological monads shooting from one disparate node to another within a larger constellation we might call, for now at least, the zoe-sciences and geoethics of the earth.

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