



Against the Anthropocene

A Neo-Materialist Perspective

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HCM 3 (1): 1–28

URN:NBN:NL:UI:10-1-117064

Abstract

The dawning realization that the planet may have entered a new geological epoch called the Anthropocene could prove transformative. However, over the course of its brief history, the Anthropocene concept has often been framed in ways that reinforce, rather than challenge, the conventional modernist belief in a clear dividing line between human culture and a largely passive natural world, sharply limiting the concept's potential utility. Reflecting the overestimation of human agency and power inevitably implied by a term that is often popularly translated as the 'Age of Humans', some have already begun to argue that powerful humans can be trusted to create a so-called 'Good Anthropocene' through massive geo-engineering projects. No deeper re-examination of the human relationship to the planet is thus necessary or desired. By contrast, this article draws on emerging neo-materialist theory to suggest a radically different approach that emphasizes the ways in which humans and their cultures have been created by and with a powerful material environment. The technologies of the thermo-industrial revolution are framed not so much as evidence of human power, but as evidence that the material world has a much greater power to shape human minds, cultures, and technologies than has heretofore been recognized by most scholars. From a neo-materialist perspective, the new geological epoch might be better termed the Carbocene: an age of powerful carbon-based fuels that have helped to create ways of thinking and acting that humans now find exceedingly difficult to escape. Might a more humble and cautious view of a creative and potentially dangerous planet offer a more effective

means of spurring progress in combating global climate change than the misleading anthropocentrism inherent in a term like the Anthropocene?

Keywords: Anthropocene, neo-materialism, modernism, Carbocene, geology

Introduction

Essays that start off with a pop-culture reference do not often end well, but bear with me. Back in 1969, the American television series *Star Trek* aired an episode called ‘The Way to Eden’. A band of futuristic nature-loving hippies hijack the starship *Enterprise*, forcing Captain Kirk to take them to a planet they call ‘Eden’. When Kirk and his team follow the space hippies down to the planet, they discover it is covered with lush tropical plants and brightly colored flowers – seemingly a true Garden of Eden. But almost immediately one of the crewmembers burns his hand by touching a flower. All the beautiful plants, it turns out, secrete acid and bear poisonous fruits. Appearances notwithstanding, this Eden was hostile to human life. Aficionados of *Star Trek* apparently don’t think highly of this episode, and its rather heavy-handed and transparent critique of the era’s actual counter-culture is unfairly simplistic. However, for my purposes here the episode suggests an idea worth taking seriously: What if a seemingly beneficent and nurturing planet can easily become a death trap?

Read creatively, this might be one of the more interesting ideas we can extract from the recent efflorescence of work associated with a vein of post-humanist thinking referred to as ‘new materialism’ or ‘neo-materialism’. In recent years a wide variety of scholars have begun to fundamentally reassess materiality in ways that are turning the old postmodern social-constructivist theories and methods on their anthropocentric heads.¹ In their stead, neo-materialist theory proposes that humans and their cultures are best understood as the products of their material environment, not its masters. Even more fundamentally, neo-materialism challenges the still dominant modernist belief that human culture is distinctly separate from the material world, suggesting that matter not only helps to create human intelligence, creativity, and culture, but may often be best understood as *constituting* these things. At its heart, this emerging neo-materialist theory challenges the modernist

faith that the human intellect and culture have taken us out of nature, suggesting that humanists can build a powerful new methodological approach by adopting the contrary position: human culture must be understood and analyzed as a part and product of the material world, not its antithesis.

These neo-materialist ideas, however, do not play well with another set of new ideas swirling around the concept and neologism of the ‘Anthropocene’. Derived from the Greek roots *anthropo-*, for ‘human,’ and *-cene*, for ‘recent’ or ‘new’, this ‘Recent Human’ era is meant to suggest that anthropogenic changes to the planet have become so pronounced as to constitute a new geological epoch. Since first emerging in 2000, the Anthropocene has increasingly been embraced by both scholarly and popular audiences, offering a broad intellectual space in which to discuss the many physical, cultural, and social changes and challenges associated with global climate change, massive species extinction, and other contemporary environmental problems. Reflecting the growing acceptance of the term, in 2014 the Deutsches Museum in Munich, Germany, opened a major new exhibit titled ‘Welcome to the Anthropocene: The Earth in Our Hands’.² At least three scientific journals now use the word in their title, and the Amsterdam-based academic publisher Elsevier recently launched a new interdisciplinary humanistic journal called *Anthropocene*, dedicated to ‘addressing the nature, scale, and extent of the influence that people have on Earth’.³

Clearly, a sizeable and growing number of scientists, environmentalists, humanists, and others have found the Anthropocene name and concept to be useful. This is understandable, as the immense environmental, social, and political changes of the past and future caused by global climate change and other environmental shifts cry out for some sort of unifying term and concept. Nonetheless, I suspect that the ‘Anthropocene’ is a poor choice for that term, or worse, that the term has encouraged a way of analyzing the broader phenomenon that may be doing more harm than good. Indeed, there is some reason to fear that the Anthropocene concept may actually be hindering human progress in combating climate change and other global environmental threats. While perhaps not the intent of its creators and advocates, the term itself is unapologetically anthropocentric. Indeed, part of its appeal is that it forcefully counters the contemporary climate-change deniers who misleadingly argue that global warming – if it exists at all – is a

result not of human actions but rather of ‘natural’ processes. Yet in suggesting that humans were indeed powerful enough to cause such global ecological shifts, the Anthropocene concept also tends to encourage the hubristic modernist faith in the human ability to fix the resulting problems. Indeed, almost as soon as the term was coined, advocates of a so-called ‘Good Anthropocene’ began to emerge, suggesting that humans will be able to create painless technological fixes through massive geo-engineering projects.⁴

Alarmed by the breathtaking hubris inherent in such proposals, critics have countered that these optimistic plans to re-engineer the planet are a perverse misreading of the Anthropocene idea. While this is clearly true at some level, the eco-pragmatist arguments for a ‘Good Anthropocene’ can also be understood as a logical extension of the essential anthropocentrism of the concept itself. As soon as we begin talking about ‘man as a geological agent’ who is taking us into a new ‘age of humans’, we begin to overestimate human power and agency, tending towards a celebratory stance even when the intent is to be critical. Superman, one might observe, can use his super powers for good or evil, but he is still super either way. It is at this point where neo-materialist thinking sharply parts ways with the Anthropocene. Rather than emphasizing human power and accomplishments, a neo-materialist view suggests that we are neither particularly powerful nor especially intelligent and creative – at least not on our own. Instead, the theory argues that we humans derive much of what we like to think of as *our* power, intelligence, and creativity, from the material things around us. Indeed, in many ways these things should be understood as constituting who we are.

Humans have obviously become quite powerful – powerful enough to populate nearly every habitable niche on the planet and alter its fundamental biogeochemical cycles. But rather than crediting humans alone, neo-materialism suggests that they accomplished these things only at the price of throwing their lot in with a lot of other things, like coal and oil, whose powers they only vaguely understood and certainly did not really control. Likewise, once the partnerships were made, these powerful things began to shape humans and their cultures in all sorts of unexpected ways, many of them not necessarily for the better. In sum, neo-materialist theory pushes us to consider how the planet has made humans rather than the other way around. The earth is not

in human hands, it suggests: humans are in the earth's hands. Nor are those hands necessarily very benevolent. To the contrary, it could be that some seemingly beneficent and nurturing planets – like those with easily accessible deposits of coal and oil, for example – might not really be all that hospitable to intelligent life. On such deceptively attractive planets, perhaps the most important lesson any big-brained creatures would need to learn is that partnering with coal and oil to increase their own power is the easy part. The hard part is to figure out how to keep these powerful partners from enslaving and destroying them.

A Good Anthropocene?

The term Anthropocene seems to have first been coined in the 1980s by the ecologist Eugene Stoermer, who apparently used it informally for many years. But the neologism only began to gain wide currency after the Nobel Prize-winning chemist and climate scientist Paul Crutzen adopted it in 2000.⁵ Tellingly, Crutzen himself admits that he gave no great thought to the name itself. During a scientific meeting in Mexico, he grew increasingly frustrated by his colleagues' use of the accepted geological term for the modern age – the Holocene, which began about 12,000 years ago – when discussing the anthropogenic changes to the planet's global cycles over the past few centuries. Trying to express how deeply humans were altering and damaging the planet, Crutzen seized on the term Anthropocene, perhaps unconsciously recalling Stoermer's earlier use of the word, or adding a 'po' to a similar neologism, the Anthrocene, previously suggested by the science writer Andrew Revkin.⁶ Regardless, while Crutzen's recognition of the planetary-scale changes he sought to give some label to was certainly well thought out in a scientific sense, it seems that his choice of a term for capturing this was more spontaneous than considered. He was simply trying to find an appropriate word to express the immense change in global biogeochemical cycles of the past 200 years. Precisely what neologism was used might well have seemed relatively trivial. What mattered was the pressing need to recognize that human activity was taking the planet out of the relatively stable climactic period of the Holocene and into a more volatile new geological epoch. Yet words and names do matter, of course, especially when they move beyond a small circle of early adopters. Crutzen's somewhat impulsive choice of the term Anthropocene may have been less than ideal.

While the informal use of the term has grown quickly in both scientific and humanistic circles, it has not been without its critics. If the starting point of the Anthropocene is identified as the advent of industrialization in Great Britain around 1800, as Crutzen and others suggest, some critics object that it is premature to designate a new geological epoch based on an event that by the geological scale of deep time happened mere nanoseconds ago. Likewise, while the cumulative atmospheric and oceanic effects of human activity are today readily evident, it can be difficult to find a marker in the physical geological record that is adequately fine-grained to identify a clear point of transition from the Holocene to an Anthropocene over such a brief period.⁷ Others argue that measurable anthropogenic effects on the planet began well before the industrial era, perhaps as early as the advent of agriculture in the Neolithic, the so-called ‘Early Anthropocene’ thesis. Yet these events roughly coincide with the start of the already accepted geological term for the modern age, the Holocene or ‘Entirely Recent’ epoch, which began about 12,000 years ago.⁸

Ultimately, it will fall to the International Commission on Stratigraphy (ICS) (a subcommittee of the International Union of Geological Sciences) to parse these technical debates. An ICS working group of international scholars is slated to decide in 2016 whether or not to recommend formal recognition of the Anthropocene as a new geological epoch. However, the final decision may well turn not just on whether the proposed Anthropocene meets the fairly straightforward scientific standards for designating a geological epoch, but also on whether formal recognition of the Anthropocene might provide a tool for more effectively grappling with the growing crisis of global climate change. By lending its considerable scientific authority to the idea, the ICS could provide a powerful message to the world that anthropogenic climate change has become so pronounced as to constitute a fundamental change in the great atmospheric, oceanic, and geological cycles of the planet. The official designation of a new geological epoch would suggest that humans have, through their technological activity and rapid growth in numbers, come to rival the effects of the great forces of nature that create and sustain the planet.⁹

From a historical and broadly humanistic perspective, the Anthropocene name and concept raise other concerns. As the Australian ethicist Clive Hamilton notes, ‘almost as soon as the idea of the Anthropocene took

hold, people began revising its meaning and distorting its implications'.¹⁰ Hamilton argues that the so-called 'ecopragmatists', such as Michael Shellenberger and Ted Nordhaus of the 'neogreen' Breakthrough Institute, have begun to argue that humans can engineer a 'Good Anthropocene'. Some advocates of this optimistic view – what Hamilton aptly calls the Promethean position – suggest that humans can manage the effects of global warming through immense and entirely unprecedented geo-engineering projects. For example, it might be feasible to spray huge volumes of sulphate aerosol particles into the upper atmosphere, thus reflecting more of the sun's heat back into space. Another plan suggests that humans could remove more carbon dioxide and other global warming gases from the atmosphere by fertilizing the world's oceans to encourage the growth of carbon-absorbing plants.¹¹ Buoyed by such technical promises, one advocate of the Promethean approach concludes, 'we must not see the Anthropocene as a crisis, but as the beginning of a new geological epoch ripe with human-directed opportunity'.¹²

Hamilton observes that the promise of such a 'Good Anthropocene' has broad appeal, as it 'absolves us all of the need to change our ways'. Yet he warns that by promising a painless technological fix, the ecopragmatist arguments may help to delay or derail more aggressive international actions to cut the production of global warming gases. Further, the longer the world delays, the more likely it will be that humans will have no choice but to engage in risky geo-engineering projects, with potentially disastrous results. 'We find ourselves in a situation where geoengineering is being proposed', Hamilton observes, 'because of our penchant for deceiving ourselves and inflating our virtues'.¹³

In all this, Hamilton's analysis seems apt. However, he is less convincing when he argues that the idea of the 'Good Anthropocene' and its related faith in geo-engineering are solely the products of a perversely mistaken reading of the original Anthropocene concept. To be sure, Crutzen and many other advocates of the concept clearly view the arrival of the Anthropocene as a dangerous existential threat to humans and the planet at large, not as an 'opportunity'. They hope that formal designation of the Anthropocene epoch, or even just the term's informal use, will encourage the world's nations to make serious reductions in carbon emissions – not put their hopes in risky geo-engineering projects. But at a deeper level, the rapid emergence of these optimistic scenarios was in many ways an entirely logical outgrowth of the Anthropocene

term and concept. At base, both optimistic and pessimistic views of the Anthropocene often share the conventional modernist belief that powerful humans and their cultures are distinct from the natural material world. Crutzen and others clearly wanted to adopt a term that would put the onus of responsibility on human beings, no doubt hoping to push back against the foolish climate change deniers, or those who admitted the reality of climate change but doubted that humans were the cause. This was an understandable goal. Yet in trying to ward off one threat, the advocates of the Anthropocene may have unintentionally given support to another and perhaps more insidious challenge. Indeed, as the overwhelming evidence of anthropogenic global climate change continues to accumulate, the unsubstantiated arguments made by the overt climate-change deniers may well fade into obscurity. Instead, the greater danger may increasingly come from the supposed eco-pragmatists who accept the reality of these global changes, but continue to embrace the modernist faith in a clear separation between human culture and nature. Indeed, arguments made by both the optimistic and pessimistic camps often depend on the idea that it is precisely this separation that gives humans their extraordinary power over the natural world. The two groups diverge only in the degree to which they believe humans can be trusted to use their power to effectively re-engineer the planet's climate.

By proposing to name the planet's new geological epoch solely after humans, the advocates of the Anthropocene thus trap themselves in a dilemma. If humans are truly powerful enough to justify naming an entirely new geological period for them, then it is difficult to argue against the proposition that they might, at least in theory, be capable of using that same power to engineer a Good Anthropocene. Perhaps recognizing this contradiction, some advocates of the Anthropocene have tried to minimize the implicit hubris of the term. In a 2011 article, Paul Crutzen and his co-author, the environmental journalist Christian Schwägerl, freely embrace the idea that humans have become uniquely powerful, noting that they are 'taking control of Nature's realm, from climate to DNA'. But having implied that such human power justifies the term Anthropocene, they then insist that it should not be understood as supporting a Promethean view of the human species. 'Rather than representing yet another sign of human hubris', they argue that the Anthropocene 'would stress the enormity of humanity's responsibility as stewards of the Earth'. The term would 'highlight the immense

power of our intellect and our creativity, and the opportunities they offer for shaping the future'. The authors' desire to limit human self-aggrandizement seems sincere. Yet it is difficult to understand how highlighting 'the immense power' of the human intellect and creativity is likely to be taken as anything *but* 'another sign of human hubris'. Elsewhere in the article, Crutzen and Schwägerl even begin to sound rather like eco-pragmatists themselves. 'The awareness of living in the Age of Men', they argue, 'could inject some desperately needed eco-optimism into our societies'.¹⁴ Likewise, the authors give an odd twist to the modernist belief that humans have left the natural world, exhorting the reader to, 'Remember, in this new era, nature is us'.¹⁵ Humans, the authors seem to suggest, were unnatural in the past, or at most mere manipulators of their environments. Now, however, human technological abilities are so vast that they have *become* nature itself. Tellingly, the authors make no attempt to explain where these vast human powers came from in the first place.

A seemingly more radical solution to the dilemma of the Anthropocene is offered by Mike Ellis, a member of the ICS Working Group and the head of climate change studies at the British Geological Survey. Ellis insists that the case for the Anthropocene term is simple: the 'principal process of change on the planet is us, so the name of our epoch should reflect that'. But perhaps in part to counter the human power and hubris implied by this, Ellis goes a step further to insist that, whatever their power, humans remain entirely a product of nature. The Anthropocene, he argues, 'acknowledges that humans and the human process is as much a natural process as any other natural process that we are used to thinking about, such as volcanoes and earthquakes'. Even more radically, Ellis strikes at the heart of modernist thinking by insisting that human cultures too are natural: 'The things we do and the things we make; the rules and legislation we come up with to control the way we live, they are a natural process and it emerges out of this thing called the Earth'.¹⁶ As will become clear in the next section, this argument perhaps comes closest to that suggested by a neo-materialist analysis. However, absent a compelling explanation of exactly how the Earth plays a role in creating human cultures and power, Ellis's assertion seems to be a bit of whistling in the dark. Perhaps he recognizes that the Anthropocene runs the risk of exaggerating human power over nature, yet he is unsure how to fix the problem, other than by simply declaring everything humans

do to be natural. Further, if Ellis is indeed correct that the Earth helped to create human culture and power, then it begs the question of why the resulting geological epoch should be named for humans alone.

At their essence, these debates and contradictions reflect the faltering state of the modernist project, with its insistence that human power derives from their abstract intellectual and cultural abilities that have lifted them above the natural material world to the position of managing and controlling it. Whether they view this unique human position as predominantly destructive or constructive, most advocates of the Anthropocene accept it as true, while the few who question it lack the tools to do so effectively. This is not surprising. Particularly in the western-influenced civilizations whose technologies and practices have generated many of the global changes that the Anthropocene concept seeks to recognize, humans have long understood themselves as the divinely dominant species whose mission it was to subjugate and harness the Earth. As the historian of technology David Noble argues, the modern western drive to master the material world and create a New Eden is merely a secularized version of the earlier Christian belief that humans were destined to regain the God-like powers they lost when they were kicked out of the first.¹⁷ Perhaps this Anthropocene, this ‘New Human Age’, has not yet turned out quite so well as hoped. But for the transcendently inclined, this may be just a rough spot on the millenarian road to New Eden. Surely humans with their nearly miraculous intelligence will rise above it all to triumph in the end? As Stewart Brand, an unapologetic advocate of geoengineering, asserts, ‘We are as Gods and HAVE to get good at it’.¹⁸

Even Hamilton, who is otherwise a trustworthy guide to these complex matters, falters in the end. He notes the irony inherent in the naïve optimism of the eco-pragmatists, observing that they are in essence asking us to ‘redouble our belief in the perfectibility of humankind’ and to put even more faith in modernist rationalism and technological solutions. ‘Yet how can we think our way out of a problem’, Hamilton rightly asks, ‘when the problem is the way we think?’. But having correctly diagnosed the disease, Hamilton seems oddly unwilling to accept the logical cure: to abandon the modernist worldview altogether and embrace the possibility that all human power, culture, and technology are to a significant degree creations of the natural material world. This is surely in part because for many decades humanistic scholars emphasized

social-constructivist and other postmodern theories that minimized the importance of the material environment. This left humanists with no truly effective means of putting humans back into the material world while also providing a clear explanation for how they became so very different than all the other animals on the planet. By de-centering the human to instead emphasize the many ways in which the material world both creates and entraps them, the developing neo-materialist theory may offer a possible solution. Yet it is not one that offers much intellectual space for a term and a concept as unapologetically anthropocentric as the Anthropocene.

The Neo-Materialist Flip

The assertion that the material world, or nature as some prefer to call it, creates humans not just as biological creatures but also as cultural and social creatures might at first strike some as largely nonsensical. However, for many non-western peoples, and quite possibly for the vast majority of humans who lived before the modern era, the idea that a lively and dynamic natural world shapes humans in all their dimensions seems entirely self-evident.¹⁹ Imbued with their own religiously inspired belief that humans possessed a divinely created soul that was by definition distinct from the world of mere matter, the westerners who encountered such animistic peoples in past centuries typically dismissed them as superstitious savages.²⁰ Yet today, as a growing body of scientific and humanistic insights suggest the increasingly profound connections between humans and their material environment, it looks as if the animists got it more or less right: humans and their cultures have been, and always will be, products of their material world.

The western path back to an idea that many may have considered obvious for millennia – albeit in a somewhat different form – has been long and somewhat torturous. Since at least the second half of the nineteenth century, historians and many other so-called humanists tended to view the socio-cultural and the material spheres as clearly distinct and often opposing explanatory factors. Cultural explanations might encompass everything from ideas about anarchism to the influence of Lao Tzu's *Tao Te Ching*; the material, everything from steam engines to the tuberculosis bacillus. The degree to which each pole has

prevailed has waxed and waned ever since. Hegel's *Geist*-haunted cultural idealism soldiered on towards an 'end of history' it never quite reached, Beard and Veblen basked for a time in the sunny shadow of their materialist technological determinism, and Marx and Engel's dialectical materialism offered an ill-fated promise to synthesize them all.

In more recent years, the socio-cultural pole has been disproportionately dominant. Ever since the now nearly three-decades old 'cultural turn', social constructivism and other so-called postmodern theories have occupied the center of the academic solar system, largely banishing its materialist counter-weight to the more distant outer orbits. But probably no one expected that it would remain there forever, and it hasn't. The rumblings of a materialist revival have been growing steadily louder over the past decade. It was a sign of the times when the well-known postcolonialist Dipesh Chakrabarty surprised many with his 2009 manifesto, 'The Climate of History', where he dared to suggest that the once-dominant postmodern approaches to analyzing the past are inadequate given the challenges of the present. Historians, he argued, must now learn to 'look on human history as part of the history of life ... on this planet'.²¹ Other scholars have begun to organize under the broad banner of what they identify as a 'new materialism', an approach which they argue is better informed by contemporary realities like global climate change, revolutionary developments in epigenetic theory, and new scientific insights into the plasticity of minds and brains, to mention only a few.

Matter is back, and it's back in a big way – perhaps even as big as the cultural turn it in some ways seeks to replace. And yet: Is this anything more than just another fashionable swing of that eternally oscillating academic pendulum? Having grown weary of analyzing discourse, are we now instead to spend our days talking of ships and shoes and sealing wax? After the profession has spent the better part of 30 years mostly giving a cold shoulder to materiality, I'm tempted to say that a little equal time for cabbages, kings, and other things might not be an entirely bad idea. Yet, my sense is that most neo-materialists are up to something more than just trying to stick a thumb on their side of the culture-matter scale of balance. Indeed, the really intriguing promise of neo-materialism lies with its potential to finally move us beyond the still entrenched modernist assumption that human culture is largely or

entirely distinct from matter: or that we humans make matter, but it does not make us.

At least in most western-influenced societies, the dichotomous view runs deep. Shocked by the insanities of environmental and biological determinism that culminated in World War II, the anthropologist Claude Lévi-Strauss and others erected a clear line between culture and matter. Culture, they argued, was entirely an abstract invention of human minds, influenced by but ontologically distinct from their material environment and bodies. Technology, language, art, and all the many aspects of symbolic thought – these were manifestations of culture, and solely the tools through which humans understood and manipulated matter. Certainly they were not products *of* that matter.²² Other humanists soon lent a hand in creating and policing this defensive boundary, and their united labours largely succeeded. By 1959 the American anthropologist Leslie White likely felt it was verging on the self-evident to observe that, ‘Between Man and nature hung the veil of culture, and he could see nothing save through this medium’.²³ In the 1980s, the theoretical basis of the divide shifted, yet it only deepened as postmodern cultural methods gained in dominance. While all but the most extreme of constructivists acknowledged that the material environment played at least some role in shaping human history,²⁴ most were still chiefly interested in exploring the opposite phenomenon: the diverse ways in which humans understood and shaped the material world to their own culturally determined ends.

But as Chakrabarty suggested, the academic climate is indeed changing. In another sign of the times, the French anthropologist Philippe Descola – a protégé of Lévi-Strauss who holds the chair his mentor once occupied – is now trying to reunite culture with matter, while of course still consigning genetic and environmental determinisms to their well-deserved dustbins. In his recent career-defining *magnum opus*, Descola exhorts scholars to move ‘beyond nature and culture’, in many ways abandoning the divide his mentor had helped to create.²⁵ While typically preferring the term ‘matter’ to the hopelessly fraught western concept of ‘nature’, much of the recent rise in new materialist²⁶ thinking has also, if often only implicitly, challenged the divide. To be clear, none of these theories seek to breathe new life into the moribund corpus of crude determinist theories of the past, and none seek to argue that a material world of ‘real’ things drives the mere epiphenomena of culture.²⁷ Rather, they suggest that matter is no more solid or real than

culture, but also that culture is no more powerful than matter, simply because the two are, at least in many instances, one and the same thing.

The case for moving beyond the matter-culture dichotomy can't easily be explained in the course of a brief essay. But let me try to at least sketch some of the broad outlines of the argument. One of the striking things about neo-materialist ideas thus far is that they have emerged in so many different disciplines. In part, this stems from a widespread dissatisfaction with the long dominance of social-constructivist methods rooted in semiotic theory in which all meaning, and perhaps even reality itself, emerges from the internal relationship between abstract words and concepts. As the urban historian Chris Otter suggests in his recent critique of one influential theory – the social construction of technology, or SCOT – to view society as shaping technology ‘is to operate at a level of abstraction that obscures as much as it reveals’ and which ‘introduces analytic partitions into a world typified by circulation and metabolism’.²⁸ Likewise, in his aptly titled 2010 book, *In Defense of Things*, the Norwegian archaeological theorist Bjørnar Olsen warns that his discipline’s long infatuation with a relational or semiotic theory of matter has badly underestimated the power of things to create or constitute human culture. ‘The univocal stressing of the relational’, Olsen argues, has ‘caused us to lose sight of the individual qualities of things, their intrinsic power’.²⁹

But it would be a mistake to think of this rising neo-materialist tide as primarily reactionary, and nor is it necessarily antithetical to constructivist theories. Rather, once scholars began to permit their gaze to wander from a narrow focus on an isolated human culture, they began to realize that non-human organisms and things were much more than just empty carriers of human symbolic meaning. In their 2010 collection of essays, the political scientists Diana Coole and Samantha Frost defined new materialist theory as an approach that sees matter as ‘active, self-creative, productive, unpredictable’, a matter that ‘becomes’ rather than simply ‘is’. Humans, they argue, are not so much the manipulators of a distinctly separate material world, but rather the products of that material world.³⁰ In another oft cited new materialist work, the 2009 book *Vibrant Matter*, the Johns Hopkins political ecologist Jane Bennett takes a similar stance in her argument for what she terms a ‘vital materialism’. Scholars, Bennett argues, should ‘readjust the status of human actants: not by denying humanity’s awesome, awful powers,

but by presenting these powers as evidence of our own constitutions as vital materiality'. In perhaps one of the most succinct statements of the potential significance of new materialist ideas to date, Bennett asserts that, 'human power itself is a kind of thing-power'.³¹ The Stanford archaeologist Ian Hodder offers a related argument in his 2013 book, *Entangled*. 'Entanglement', Hodder writes, 'is a mix of humans and things, culture and matter, society and technology'.³² In one of many original insights, Hodder suggests that the human relationship with even inanimate things can best be understood as a form of domestication, as things like 'clay, metal, oil, nuclear particles, water, and so on' become dependent on humans for their care and maintenance, much like domesticated cattle or silkworms.³³

By this point, many will have likely spotted the telltale fingerprints of Bruno Latour and Actor Network Theory (ANT), which has indeed escaped its balkanization in Science and Technology Studies to influence a much wider scholarly audience. By incorporating non-human organisms and things into the complex network from which human societies emerge, Latour and other actor network theorists opened the door to recognizing that human power and agency emerged from their interactions with the material world. Despite the extraordinarily broad influence of ANT, however, Latour himself admits that scholars have yet to develop an adequately robust understanding of materiality. In a 2005 article he noted that most social sciences have continued to marginalize material things, consigning them to 'a position that is so ridiculously useless that ... it will make absolutely impossible any serious consideration of objectivity – I mean of "thinginess"'.³⁴ The goal of a truly *material* materialism must be to recognize the difference between our ideas and representations of the parts of an object, while still realizing that 'the parts themselves go their own ways and follow, so to speak, their own directions'. Any adequate materialism must thus recognize the creativity and generativity of real matter, a dynamic materialism that 'accounts for the surprise and opacity that are so typical of techniques-as-things'.³⁵

One means of moving beyond a strictly relational understanding of the non-human is to consider other things in terms of their ecological interactions, relationships that constitute a type of network in their own right. To do so, however, it is essential to escape the tendency common to both scientists and humanists of seeing the ecological sphere as

distinct from the human sphere, aside perhaps from some clearly defined pathways of influence between them. Instead, neo-materialist scholars must develop methods that understand and analyze human culture as fundamentally an ecological phenomenon, and ecological phenomena as inextricable parts of human culture. To that end, new materialists have much they can learn from the work of environmental historians, a field that surprisingly few new materialists have incorporated into their theories and methods. As one of the founders of the discipline, Donald Worster, was already insisting in 2003, the ‘unexamined cultural determinism which underlies mainstream historiography is just as problematic’ as any form of environmental or materialist determinism.³⁶ Joined by some intrepid historians of technology, environmental historians have been mounting indirect attacks on the conventional boundaries between culture and matter through highly empirical historical studies that undermine some closely related dichotomies: technology and nature, city and country, and human and animal.³⁷ Of these, let me mention a few of the most important for supporting my argument against the Anthropocene.

Drawing on the new field of animal history, some scholars have challenged the assumption that what we call a ‘technology’ must be an unnatural machine or process. If a cow or horse deliberately bred by humans to serve a specific instrumental purpose is best understood as a technology, the line between the technological and the natural blurs.³⁸ But this is not just a semantic sleight of hand. Rather, as the historian Edmund Russell notes in his call for an ‘evolutionary history’, the genetic structures of organisms like dogs, cattle, and cotton have coevolved with human sociocultural phenomena. In this co-evolution, human cultural practices – say, a preference for meaty but docile animals – became embedded in the appearance, behaviors, and genetic code of the cattle.³⁹ The cultural was thus utterly indistinguishable from the natural. Even more importantly, these new types of cattle then affected human biology and culture, as for example by facilitating the spread of a genetic mutation enabling adults to digest milk.⁴⁰ Russell’s ‘evolutionary history’ approach deals an even more powerful blow to anthropocentrism by arguing that a mere plant – a specific strain of long-fibered cotton that had co-evolved with several native peoples of the Americas – was at least as important to the rise of the British

industrial revolution as were new technologies or social relations, a point I will return to shortly.⁴¹

Another example of the potential utility of neo-materialism deals with the materiality of power. In contrast with Foucault's concept of power as primarily a matter of knowledge production and the bounding of acceptable thought, a growing number of scholars have begun to argue that all social power is really a form of energetic or material power. As Hodder puts it, 'Power is the differential flow of matter, energy and information through entanglements'.⁴² Nor are these energetic and other material means of manufacturing consent merely empty carriers whose material properties are irrelevant to the content. Rather, when humans use things like coal or oil to generate social power, these things demand that humans conform to their material needs, thus shaping the way power is created and exercised. In his much-admired revisionist take on the American Ludlow Massacre of 1914, *Killing for Coal*, the historian Thomas Andrews makes a good case that the material nature of coal – the demands it exacted and the possibilities it created among the miners who worked in and with it – played a central role in fostering solidarity and power among coal workers.⁴³ Pursuing a related vein, Timothy Mitchell's provocative 2011 book, *Carbon Democracy*, insists that the material nature of coal not only helped create modern democracy, but in an even deeper sense *constituted* that democracy.⁴⁴ Democratic thought and practice are not primarily products of the spread of an abstract idea, he argues, but are rather in and of themselves material phenomena. To transform coal into useful and profitable commodities involved 'establishing connections and building alliances', Mitchell writes, 'connections and alliances that do not respect any divide between material and ideal' or even between the 'human and nonhuman'.⁴⁵

Finally, some of these concepts are supported by – and are probably in part a result of – a growing body of scientific work that suggests even our much-vaunted human intelligence and creativity must also be understood as partly material phenomena. By this is meant not the largely undisputed point that all human cognition is a result of biochemical processes. Rather, some cognitive scientists and philosophers now argue that the human mind – not the brain, mind you – is not confined to our skulls, or even our bodies, but is rather *extensive* with its surrounding environment.⁴⁶ Andy Clark, the most prominent advocate of this 'extended mind' thesis, argues that human cognitive abilities can be

distributed in a network of external props and aids like files, texts, and maps, aspects of our material surroundings without which some fundamental part of what we consider to be our intelligence would vanish.⁴⁷ Obviously, many might object that these external material things are merely tools or scaffolding for an internal mind still safely ensconced in its bony skull.⁴⁸ Yet Clark insists there are good reasons to embrace the idea that the mind is literally extensive with material things, as ‘it drives home the degree to which environmental engineering is also self-engineering’. In changing our material physical environment, Clark suggests, we also reconfigure ‘our minds and our capacities of thought and reason’.⁴⁹ Rather than pursuing the idea that the mind is extensive with the material environment, Harvard historian Daniel Smail and other advocates of neurohistory focus more on the biological brain itself. Yet their concept of the brain is similarly linked to the external environment. Drawing on recent insights from neuroscience, they point out that the physical brain is highly plastic and amenable to constant rewiring. As humans use their intelligence and culture to change their material surroundings, Smail argues that new patterns of behaviour ‘generate new neural configurations or alter brain-body states’.⁵⁰

In sum, it seems evident that the intellectual ground is shifting beneath our feet. What is striking is that so many scholars coming from so many different fields and angles of attack seem to be pointing to basically the same conclusion: the long-established belief that culture is an abstract and solely human-generated phenomenon entirely distinct from the material world is, at least in some important cases, simply wrong. Humans and their cultures don’t *construct* a separate material world in their own image – they are rather the inextricable results of a constant process of growth and co-evolution *within* that material world. To paraphrase the Sunday comics character Pogo: ‘We have met the material and it is us’.

The Power of Things

While this brief overview of the neo-materialist flip is necessarily somewhat superficial, it should be adequate to make clear that the concept of the Anthropocene suffers from a serious flaw: its fundamentally anthropocentric framing of the biogeochemical phenomena it proposes

to label. This is most obvious, of course, in the proposed term itself. Since the vast majority will lack enough knowledge of Greek and geological nomenclature to realize that the term literally means the ‘Recent Human’ epoch, many will simply translate it as the ‘Human Age’ or the ‘Age of Humans’. In a 2011 *National Geographic* article, the journalist Elizabeth Kolbert (or perhaps the magazine’s editors) went even further, with an article titled, ‘Enter the Anthropocene – Age of Man’.⁵¹

Consider that none of the other officially recognized geological periods are named for a specific class or order of creatures, much less one species. So what could justify doing so now based on changes that have occurred over the past 200 years, mere seconds in the vast ages of the Earth gone by? The answer, at least in part, is that the term Anthropocene is not intended to be merely descriptive but to also be explanatory. Certainly this is why it is of so much interest outside of the geological community. The Anthropocene is the ‘Age of Humans’, at least in the popular imagination, because humans have created it. Precisely what verb is used varies – created, influenced, caused, and others all pop up – and their meanings are inevitably rather slippery. However, it seems fairly obvious that for most people, the term suggests that humans and humans alone brought the era named for them into existence. Further, some will also quite reasonably conclude that humans did so with at least a measure of foresight and intent. Surely ‘Man’ must have to some degree set out to create the ‘Age of Man’?

It is with these broader meanings of the term that a neo-materialist approach takes issue. The idea of human intent is easily enough dispatched. At least until very recently, it seemed uncontroversial to state that humans in no way planned, chose, or intended to bring about any fundamental changes in the planet’s biogeochemical cycles, aside perhaps from a broad belief that it was their destiny to master the Earth. To the contrary, humans clearly had no idea what they were getting into when they first began to domesticate plants and animals or burn coal and other hydrocarbons, and nor did they necessarily choose to pursue these entanglements with material things in any conscious sense. Numerous scholars have suggested that the initial domestication of key plants and animals like wheat and dogs was probably largely unintentional, the result of a mutually beneficial co-evolution between two organisms.⁵² As Edmund Russell notes in regards to the supposed human ‘domestication’ of dogs from wolves, one might just as easily argue that wolves

domesticated the humans who proved oddly willing to share their food with them in exchange for some assistance in warning that enemies or predators were approaching.⁵³ There are, of course, many examples where humans deliberately and consciously made significant changes in the planet, particularly in more recent years. Efforts to drive certain animals or other organisms into extinction, such as wolves or the polio virus, have sometimes succeeded or come close to it. Likewise, humans have deliberately cut down vast forests or reengineered desert or semi-desert areas through massive rerouting and storage of water. However, for the most part these more consciously planned and executed human activities are not the core focus of the Anthropocene concept. Rather, reflecting the close ties between global climate change and the Anthropocene, the term is often used as a convenient means of referring to global changes in atmospheric and oceanic chemistry. In this regard, however, it is evident that humans did not set out to cause such global geochemical changes. Instead, they were largely the unanticipated and unintended consequences of the large-scale use of hydrocarbons, fertilizers, and other modern technologies. Even the vast majority of recent extinctions were not intended, but rather were a secondary consequence of human destruction of critical habitats.

More importantly, this lack of human intent or conscious choice points to a deeper neo-materialist critique of the Anthropocene: that humans by and large did not create these global changes on their own. Rather, many were a result of the partnerships humans formed with powerful material things whose potentialities often pushed them in directions they neither envisioned nor intended. Here the archaeological theorist Ian Hodder's concept of an entangling process of material domestication is very useful. Humans like to believe that they choose to use essentially passive raw materials like coal or wheat for their own purposes, and in a sense this is true. Obviously coal deposits did not force humans to extract and burn them any more than wild wheat plants forced humans to select those with the biggest grain heads and carry them back to their settlements. But to therefore conclude that humans alone were responsible for the course of events that resulted from burning coal and domesticating wheat is equally nonsensical, and can only be sustained by placing humans and their cultures firmly outside of the material realm. As Hodder suggests, humans initially 'domesticated' material things like coal to meet very limited and immediate needs.

Yet once they began to recognize the tremendous ability coal had to increase their own power, they became increasingly entangled in sustaining and maintaining the resulting relationship. Indeed, as Timothy Mitchell and others suggest, the material nature of coal even helped to create phenomena like democratic states that humans subsequently insisted were solely the product of an abstract and immaterial culture. Coal shaped the humans who used it far more than humans shaped coal.

As discussed earlier, the exact starting point of the Anthropocene is a matter of some debate. Yet Crutzen and many others propose the year 1800 when the British Industrial Revolution began to gain steam. However, this Industrial Revolution was far from being solely a human creation. As already mentioned, Edmund Russell points out that a critical component in this first industrial ‘take off’ was the recent British access to the long-staple cotton from a plant that had co-evolved with the native peoples of the New World for many centuries. This unusually long-fibered cotton was better able to stand up to the rough treatment meted out by the new mechanical spinning and weaving machines, which of course would increasingly be powered by coal-fired steam engines. That the critical role cotton played in all this has been largely ignored by generations of earlier historians offers a telling example of the discipline’s tendency to marginalize the material in favor of celebrating – or bemoaning, depending on the author’s proclivities – a largely abstract understanding of human creativity and initiative.⁵⁴

In sum, a neo-materialist perspective asks us to recognize that critical historical events like the British Industrial Revolution were the product not only of humans and an immaterial culture or intellect, but also of the material things they partnered with, like coal and cotton. Yet if other non-human material things played such an important role in creating an era of deep changes to our global environment, why would we wish to name the resulting epoch solely after ourselves? The answer, as already suggested, is that the concept of the Anthropocene reflects rather than challenges the conventional modernist view that humans and their cultures are entirely distinct from the material world: shaping and perhaps being shaped by it, but not fundamentally a part of it. In other words, that humans and their cultures are fundamentally unnatural. This is a very problematic idea, as it tends to badly

exaggerate human social, cultural, and technological ability to engineer the material environment. Further, by overestimating the role of humans in creating global problems, the concept of the Anthropocene also encourages us to overestimate the human power to fix them, as can be seen with the advocates of the ‘Good Anthropocene’. Indeed, as Timothy Mitchell and others have shown, the artificial division of human culture from the material world often served to justify elite domination. Claiming that the material environment and the technology used to manipulate it were entirely distinct from the sociocultural realm of politics, technocrats in particular argued that they should be free from any democratic oversight or control.⁵⁵ But if Andy Clark and others are correct that these changes in the environment also constituted changes in our very nature as humans, no conveniently painless ‘technological fix’ is likely to succeed. Instead, we may have to undergo a very difficult process of disentangling ourselves from some very powerful material things that have increasingly come to dictate our collective fate.

Conclusion

At least some of the advocates of the Anthropocene clearly hope that the term and the concept will be useful in educating the public and inspiring more support for action on critical issues like global climate change. I do not doubt the sincerity of their efforts nor the urgency of achieving their goal. However, it seems fair to ask whether the Anthropocene is really an effective means of achieving these ends. For all the reasons suggested here, I suspect it is not. Indeed, by aiding the arguments for geo-engineering a ‘Good Anthropocene’, the term may even be counterproductive. The concept does have the good effect of drawing our attention to the scale and rapidity of recent global changes. However, intentionally or not, it also tends to reinforce the very same set of modernist ideas that caused many of these problems in the first place: that humans and their cultures are distinct from their material environment; that material things are essentially passive ‘natural resources’ that humans bend, with more or less success, to their own will; and that humans largely chart their own course through history, unmoored from the ‘natural’ material world that encompasses everything but themselves.

A neo-materialist perspective suggests a markedly different and perhaps more useful concept: that humans and their cultures are best understood not as the creators of their destiny and environment, but as products of a material world that is constantly creating and recreating them. In this light, we make a profound conceptual error in suggesting and imagining that we alone have created a new geological epoch, when humans and their cultures have for hundreds of thousands of years been shaped by the Earth and its material powers. Indeed, if this age has anything of value to teach us, it may well be that humans are not in control, that we do not create our world in any conscious sense but are swept along by powerful material things that we only partly comprehend. Our increasingly frenzied attempts to develop technological fixes to problems we failed to anticipate and even yet do not fully understand, suggests that the modern technological world is making humans weaker rather than stronger, vulnerable rather than resilient. Humans may appear to be the dominant species of the moment, yet it is because the planet itself has helped to make us so. We are as much creatures of coal and cotton as we are of any transcendent intellect or spirit.

It is difficult to imagine an equally evocative alternative to the term Anthropocene that would be adequate to convey these complex ideas, though I can easily think of some that would at least avoid a dangerous anthropocentrism. The Carbocene, for example, would have the benefit of recognizing the powerful co-starring role played by coal and hydrocarbons like oil and gas in creating our current era. If we use the Greek rather than the Latin word for carbon, it provides the evocative though perhaps overly obscure Anthrakacene. Or perhaps the Thanatocene, a name that would simply describe the mass extinctions that future geologists, should there be any, will easily be able to identify in the stratigraphic record. Tellingly, while the oft-used phrase ‘Welcome to the Anthropocene’ might come off as ironically benevolent, would anyone think to bid welcome to less comfortable names like the Thantocene or the Carbocene?

Yet whatever the term used, neo-materialist theory can point us towards embracing a more modest understanding of the human place on the planet. Indeed, humans might do well to consider returning to a far more ancient understanding of the material environment, one in which the planet is recognized as being both powerful and dangerous, perhaps at times even hostile to human wellbeing and intentions. Contrary to our naïve and often religiously rooted beliefs, the Earth may now be in

the process of revealing itself to be deeply inhospitable to intelligent hominid life. Somewhat like a real-life version of Star Trek's fictional planet 'Eden', the Earth might best be thought of as a very dangerous place, a seemingly benevolent world that actually exudes a sort of material acid that is harmful to any big-brained creatures foolish enough to touch it. Perhaps our planet is filled with deadly things that a species with a modest allotment of intelligence and an opposable thumb can all too easily use to destroy itself. Rather than believing that humans are a threat to the Earth, what manner of ethics and behaviours might emerge from realizing that the Earth may well be a threat to us?

Welcome to the Thantocene.

Notes

- 1 While they do not all explicitly embrace the new materialism name, some key works include: Diana Coole and Samantha Frost, *The New Materialisms: Ontology, Agency and Politics* (Durham, 2010); Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, 2010); Philippe Descola, *Beyond Nature and Culture*, transl. Janet Lloyd (Chicago, 2013); and Ian Hodder, *Entangled: An Archaeology of the Relationships between Humans and Things* (New York, 2012). I have also further developed some of these ideas in: Timothy J. LeCain, 'An Impure Nature: Memory, Geese, and Neo-Materialism at America's Biggest Toxic Superfund Site', *Global Environment* 11 (2013) 16–41, and Timothy J. LeCain, 'Copper and Longhorns: Material and Human Power in Montana's Smelter Smoke War, 1860–1910', in John McNeill and George Vrtis (eds), *North American Mining and the Environment* (Berkeley, forthcoming).
- 2 Deutsches Museum website, <http://www.deutsches-museum.de/en/exhibitions/special-exhibitions/2014/anthropocene/>, accessed 3 May 2014.
- 3 Ian Sample, 'Anthropocene: is this the new epoch of humans?' *The Guardian*, 16 October 2014; Elsevier website, <http://www.journals.elsevier.com/anthropocene/>, accessed 3 May 2014.
- 4 Hamilton, *Earth Masters: The Dawn of the Age of Climate Engineering* (New Haven, 2013).
- 5 Will Steffen, Jacques Grinevald, Paul Crutzen, and John McNeil, 'The Anthropocene: conceptual and historical perspectives', *Philosophical Transactions of the Royal Society* 369 (2011) 843.

- 6 Steffen et al., 'The Anthropocene', 843.
- 7 Jan Zalasiewicz, Mark Williams et al., 'Are we now living in the Anthropocene?', *GSA Today* 18 (2008) 5.
- 8 The 'Early Anthropocene' thesis is most closely associated with the work of the University of Virginia paleoclimatologist William Ruddiman. See: William F. Ruddiman, 'The Anthropogenic Greenhouse Era Began Thousands of Years Ago', *Climatic Change* 61 (2003) 261–292.
- 9 Steffen et al., 'The Anthropocene', 843.
- 10 Clive Hamilton, 'The New Environmentalism Will Lead Us to Disaster,' *Scientific American*, online, 19 June 2014, permanent address: <http://www.scientificamerican.com/article/the-new-environmentalism-will-lead-us-to-disaster/>.
- 11 Hamilton, *Earthmasters*, 57–71, 25–35.
- 12 Quoted in Hamilton, *Earthmasters*, 203. The original is Erle Ellis, 'The planet of no return', *Breakthrough Journal* 2 (Fall 2011) 39–44.
- 13 Hamilton, *Earthmasters*, 182.
- 14 Paul J. Crutzen and Christian Schwägerl, 'Toward a New Global Ethos', *Environment* 360, 24 January 2011, http://e360.yale.edu/feature/living_in_the_anthropocene_toward_a_new_global_ethos_/2363.
- 15 Crutzen and Schwägerl, 'Toward a New Global Ethos'.
- 16 Quoted in Sample, 'Anthropocene'.
- 17 David Noble, *The Religion of Technology: The Divinity of Man and the Spirit of Invention* (New York, 1999).
- 18 Steward Brand, *Earth Discipline: Why Dense Cities, Nuclear Power, Transgenic Crops, Restored Wildlands, and Geoengineering Are Necessary* (New York, 2010), quote on 1.
- 19 The French anthropologist Philippe Descola develops this point at length in Philippe Descola, *Beyond Nature and Culture*, trans. Janet Lloyd (Chicago, 2013). The original French edition is, *Par-delà nature et culture* (Paris, 2005).
- 20 Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca, NY, 1990).
- 21 Dipesh Chakrabarty, 'The Climate of History: Four Theses', *Critical Inquiry* 35 (2009) 197–222, quote on 198.
- 22 Philippe Descola, *The Ecology of Others*, trans. Genevieve Godbout and Benjamin P. Liley (Chicago, 2013) 35.
- 23 Leslie White, 'Man, Culture, and Human Beings', *The Michigan Alumnus Quarterly Review* 46 (5 December 1959) 1–7, quote on 2.

- 24 Julia Adeney Thomas makes the important observation that humanists inspired by linguistic or semiotic theory were more likely to embrace the idea that social constructs were entirely self-referential human creations unencumbered by material reality. See: Julia Adeney Thomas, 'Comment: Not Yet Far Enough', *The American Historical Review* 117 (2012) 797, note 5.
- 25 Descola, *Beyond Nature and Culture*.
- 26 I use the terms neo-materialism and new materialism somewhat interchangeably, though my preference is for the former, and I will here associate the latter more with the particular set of concepts most closely associated with political ecology, literary studies, ethics, and other less historically oriented disciplines.
- 27 Latour makes this point: Bruno Latour, 'Can We Get Our Materialism Back, Please?', *Isis* 98 (2007) 140–41.
- 28 Chris Otter, 'Locating matter: the place of materiality in urban history,' in: Tony Bennett and Patrick Joyce (eds), *Material Powers: Cultural Studies, History and the Material Turn* (New York, 2010) 54.
- 29 Bjørnar Olsen, *In Defense of Things: Archaeology and the Ontology of Objects* (London, 2013) 156. Otter makes a similar point: Otter, 'Locating matter', 45–46. See also: Michael Shanks, 'Symmetrical Archaeology', *World Archaeology* 39 (2007) 589–96.
- 30 Coole and Frost, *The New Materialisms*, 9.
- 31 Bennett, *Vibrant Matter*, 10.
- 32 Hodder, *Entangled*, 208.
- 33 *Ibid.*, 86.
- 34 Bruno Latour, 'Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern,' *Critical Inquiry* 30 (2004) 237.
- 35 Latour, 'Can We Get Our Materialism Back, Please?', 140–41.
- 36 Quoted in Richard C. Foltz, 'Does Nature Have Historical Agency? World History, Environmental History, and How Historians Can Help to Save the Planet', *The History Teacher* 37 (2003) 9–28.
- 37 The links between environmental history and history of technology are recognized in the development of a hybrid subfield called 'envirotech'. A sophisticated envirotech method is developed in the introduction to Sara B. Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône* (Cambridge, Mass., 2011). See also: Martin Reuss and Stephen H. Cutcliffe (eds), *The Illusory Boundary: Environment and Technology in History* (Charlottesville, 2010), and Dolly Jorgenson, Finn Arne Jorgenson,

- and Sara Prichard, *New Natures: Joining Environmental History with Science and Technology Studies* (Pittsburgh, 2013).
- 38 Philip Scranton and Susan R. Schrepfer (eds), *Industrializing Organisms: Introducing Evolutionary History* (New York, 2004).
- 39 For a discussion of how properties of plants pulled humans into certain relations, see: D. Q. Fuller, 'Contrasting patterns in crop domestication and domestication rates: Recent archaeobotanical insights from the Old World', *Annals of Botany* 100 (2007) 903–24; and M. A. Zeder, 'Central questions in the domestication of plants and animals', *Evolutionary Anthropology* 15 (2006) 139.
- 40 A good summary is Andrew Curry, 'The milk revolution', *Scientific American* 500 (1 August 2013) 20–22.
- 41 Edmund Russell, *Evolutionary history : uniting history and biology to understand life on Earth* (Cambridge, 2011).
- 42 Hodder, *Entangled*, 214. A somewhat similar argument is made in: Edmund Russell, James Allison, Thomas Finger, John K. Brown, Brian Balogh, and W. Bernard Carlson, 'The Nature of Power: Synthesizing the History of Technology and Environmental History', *Technology & Culture* 52 (2011) 246–259.
- 43 Thomas G. Andrews, *Killing for Coal: America's Deadliest Labor War* (Cambridge, Mass., 2008).
- 44 Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London, 2011).
- 45 Mitchell, *Carbon Democracy*, 7.
- 46 The seminal article is Andy Clark and David J. Chalmers, 'The Extended Mind', *Analysis* 58 (1998) 7–19.
- 47 Andy Clark, 'Where Brain, Body and World Collide', in: L. Malafouris, C. Knappett (eds), *Material Agency* (New York 2008) 15. See also: Andy Clark, *Being There: Putting Brain, Body, and World Together Again* (Cambridge, Mass.: MIT Press, 1997); Andy Clark, *Natural-born Cyborgs: Minds, Technologies, and the Nature of Human Intelligence* (Oxford, 2003); Andy Clark, *Supersizing the Mind: Embodiment, Action, and Cognitive Extension* (Oxford, 2008).
- 48 Clark, *Supersizing the Mind*, 76.
- 49 *Ibid.*, xxviii.
- 50 Daniel Lord Smail, *On Deep History and the Brain* (Berkeley, 2007) 155.
- 51 Elizabeth Kolbert, 'Enter the Anthropocene – Age of Man', *National Geographic* (March 2011) 60–85.

- 52 A good summary is Zeder, 'Central questions in the domestication of plants and animals', 139.
- 53 Russell, *Evolutionary History*, 54–70.
- 54 Ibid.
- 55 Many have made this point, but few more effectively than Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley, 2002).

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