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The Anthropocene Divide

Obscuring Understanding of Social-Environmental Change

by Andrew M. Bauer and Erle C. Ellis

Much scientific debate has focused on the timing and stratigraphic signatures for the Anthropocene. Here we review the Anthropocene in its original usage and as it has been imported by anthropology in light of evidence for long-term human-environment relationships. Strident debate about the Anthropocene's chronological boundaries arises because its periodization forces an arbitrary break in what is a long-enduring process of human alterations of environments. More importantly, we argue that dividing geologic time based on a "step change" in the global significance of social-environmental processes contravenes the socially differentiated and diachronous character of human-environment relations. The consequences of human actions are not the coordinated synchronous product of a global humanity but rather result from heterogeneous activities rooted in situated sociopolitical contexts that are entangled with environmental transformations at multiple scales. Thus, the Anthropocene periodization, what we term the "Anthropocene divide," obscures rather than clarifies understandings of human-environmental relationships.

Since the Anthropocene's formulation by atmospheric chemist Paul Crutzen and ecologist Eugene Stoermer (2000) to recognize a new period of geologic time marking human transformations of Earth's environmental systems, the designation has been taken up vociferously across the academy. From Earth scientists to literary critics, scholars now debate the usefulness of distinguishing an Anthropocene from the Holocene, the currently recognized geological epoch spanning the past 11,600 years since Earth's last glaciation (e.g., Autin and Holbrook 2012; Braje 2016; Finney and Edwards 2016; Lewis and Maslin 2015; Waters et al. 2016a; Zalasiewicz et al. 2015). The implications of this designation have also been discussed as a framing concept for environmental governance (e.g., Biermann et al. 2016; Moore 2016; Purdy 2015; Ribot 2014) and as a way of disrupting the long-held distinction between natural history and human history (cf. Chakrabarty 2009; Malm and Hornborg 2014; Mikhail 2016). The Anthropocene is thus a potentially revolutionary concept—not just because it has become synonymous with the

unprecedented global environmental impacts of humans but also because it implies an end to basic frameworks of science, society, and scholarship that have long guided Western intellectual thought (e.g., Latour 2004). As the philosopher of science Bruno Latour (2014) has noted, it subverts traditional conceptions of an external objective world devoid of humans, given that human "action is visible everywhere—in the construction of knowledge *as well as* in the production of the phenomena . . . sciences are called to register" (6, italics in the original). Such statements underscore the need to evaluate how we understand human social action in the context of an Earth transformed by humans, especially in relation to anthropological concerns for historical relationships among humans, other organisms, and the material processes and associated discourses that give shape to environments.

While the Anthropocene has rightly called attention to a suite of grave global environmental consequences related to human activities, the various emphases among scholars now using the designation have also reoriented the concept in multiple directions, many of which work at cross-purposes from each other. For instance, while some argue that the concept dissolves the great binary between society and nature—"the end of the division between people and nature" in the words of environmental historian Jedediah Purdy (2015:3; see also McKibben 1989)—others emphasize its binary foundations, stressing, for example, that humans are now "overwhelming the great forces

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of nature" (e.g., Steffen, Crutzen, and McNeill 2007). The Anthropocene has become a differential lens through which disciplines across the academy are reviewing, debating, and reinventing their conceptions of humanity and nature.

Below we address the Anthropocene concept from a perspective more directly related to its original framing—asking foremost how the concept and geological time period might both constrain and enable scholarly understandings of human-environment relationships. To do so, we review the term's broader usage in light of archaeological and ecological evidence on long-term relationships among humans and the environments they both inhabit and produce.

Strident debate about where to place the Anthropocene's chronological boundaries arises—with the mid-twentieth or late eighteenth century being the most commonly advocated among others (cf. Crutzen 2002; Lewis and Maslin 2015; Ruddiman 2013; Smith and Zeder 2013; Waters et al. 2016a; Zalasiewicz et al. 2015)—because the Anthropocene's periodization forces scholars to apply an arbitrary break in what is a lengthy process of human modifications to both local and planetary environmental conditions. There should be no doubt that the magnitude of human influence on Earth's environmental systems has intensified alarmingly since the Industrial Revolution and particularly since the 1950s (e.g., Steffen, Crutzen, and McNeill 2007; Waters et al. 2016a). Nevertheless, an Anthropocene periodization that begins at these points fundamentally obfuscates qualitative similarities and historical linkages with the dynamics of human-environmental relationships in previous periods (e.g., Boivin et al. 2016; Braje 2015; Braje and Erlandson 2013; Erlandson and Braje 2013; Kirch 2005; Moore 2015; Ruddiman et al. 2015; Smith and Zeder 2013). To understand the role of human activities in transforming Earth, it is essential that these not be conceived as a binary distinction—before versus after—but rather as a continuously changing process, which necessarily calls attention to a variety of differentiated actors and historical, cultural, political, and ecological contexts. The challenge of the Anthropocene proposal is not simply its formal division of geologic time but also the need to call attention to the entanglements through which social relationships, inequalities, and environmental histories are continually unfolding and producing novel Earth trajectories.

The Anthropocene(s)

To contribute usefully to the Anthropocene conversation, it is critical to differentiate what the designation has come to mean among the various academic fields that have taken it up. The Anthropocene's multiple referents (e.g., as marker of anthropogenic stratigraphic materials, as period in which Earth's climatic and environmental workings have been shaped by humans, as the end of the division between society and nature) have allowed it to be adopted with a variety of different emphases among scholars of the natural sciences, humanities, and social sciences. Ironically, many of these framings work at cross-purposes from one another, a point we stress in arguing

that the Anthropocene divide obscures understandings of the long-term dynamics of human-environment relationships.

For many scholars of the humanities and social sciences, the Anthropocene stands in for a dark period of human-environment relationships associated with modernity and the outgrowth of the Eurocentric belief in the divide between nature and humanity that now "catastrophically affects the destinies of all—plant, animal, and human—through global warming and mass extinctions" (Carrithers, Bracken, and Emery 2011:663). Environmental historian Ian Miller (2013), for example, has specifically argued that the Anthropocene be considered coeval with the development of "ecological modernity." Yet, by highlighting humans' current roles in shaping planetary conditions, the Anthropocene has largely come to signify a period in which this great divide is now obsolete. In environmental imaginaries and historiographies, it is a period that is "after nature" (Purdy 2015:3). Thus, for many anthropologists it represents the dissolution of the long-standing modernist binary that has structured understandings of human social life in distinction from a separate natural world. The Anthropocene has also engaged anthropologists in critically evaluating how the natural sciences represent humans as a single entity—that is, the species (cf. Bauer and Bhan 2016; Carrithers, Bracken, and Emery 2011; Gibson and Venkateswar 2015). The emphasis on the human species as a "geophysical force" has allowed some scholars to raise foundational epistemological and ontological questions about the nature of history, historical subjects, and the world humans inhabit. For instance, by signaling a period of human-caused global environmental change, the Anthropocene has spurred a philosophical recognition of phenomena and objects (e.g., climate) that are beyond, or at least challenge, human perception and experience (e.g., Morton 2013). In this way, the Anthropocene has disrupted historiography in this new period and how the ontological relationships between subjects and objects, the constitution of social actors, and the mediation of perception and historical imagination are theorized (cf. Chakrabarty 2009; Latour 2014; Mikhail 2016; Morton 2013; see Bauer and Bhan 2018).

Among the natural sciences, the Anthropocene has come to more strictly reference a period during which humans now dominate the "great forces of nature" (Steffen, Crutzen, and McNeill 2007) or rather, as the environmental scientists William Ruddiman and colleagues (2015) have characterized it, when humans have "replaced nature as the dominant environmental force on Earth." Earth system science (ESS) views Earth as a system of interacting "spheres"—the atmosphere, lithosphere, hydrosphere, and biosphere—and uses Earth system models to describe the long-term dynamics of Earth's interacting physical, chemical, and biological processes (Schellnhuber 1999; Steffen, Crutzen, and McNeill 2007). By connecting human history with ESS, this work helped build a foundation for assessing the most critical scientific claim of the Anthropocene narrative: that human activities have substantially changed the functioning of the Earth system. While evidence of human alteration of local environments has long been widespread, the claim that humans are altering the functioning of Earth as a

whole has now been confirmed by a wide array of observations, perhaps most prominently by long-term trends in atmospheric carbon dioxide and their coupling with human combustion of fossil fuels and other alterations of the global “biogeochemical” cycling of carbon that are causing global changes in climate. These global changes are now potentially forcing the Earth system to undergo an irreversible step change or regime shift (tipping point) from a Holocene-like climate state to an Anthropocene climate state (Steffen, Crutzen, and McNeill 2007; Steffen et al. 2016; Waters et al. 2016a).

In these frameworks the Anthropocene is seen to demarcate a shift from humans as merely agents of local ecological changes to agents of geophysical history that are capable of affecting all planetary life by modifying the Earth system (cf. Chakrabarty 2009; Hamilton 2015; Morton 2013:7; Steffen, Crutzen, and McNeill 2007). Unsurprisingly, the Earth systems scholarship from which the term largely emanates has also focused on the Anthropocene’s utility in confirming humans’ planetary impacts within the stratigraphic systematics of the Geologic Time Scale maintained by the International Commission on Stratigraphy—that is, how humans’ global physical environmental impacts produce an unambiguous and permanent signature in Earth’s lithological and sedimentary records (e.g., Steffen et al. 2016; Vince 2011; Waters et al. 2016a; Zalasiewicz et al. 2015). On these lines, scientific debate focuses on where to place the Anthropocene’s stratigraphic boundary, or “golden spike.” The mid-twentieth or late eighteenth centuries are the most commonly advocated among a slew of other suggestions, including the “Orbis spike” of 1610, the mid-Holocene rise of agricultural land clearing, using the term to apply to the entirety of the Holocene, and even the megafaunal extinctions of the late Pleistocene (e.g., Braje and Erlandson 2013; Crutzen 2002; Erlandson and Braje 2013; Hamilton 2015; Lewis and Maslin 2015; Smith and Zeder 2013; Waters et al. 2016a; Zalasiewicz et al. 2015).

It is important to stress that proposals for formalizing the Anthropocene as a new epoch are based on three different forms of evidence that are not all applicable to the analytical framing of the Anthropocene by humanities and social science scholars noted above. Formal geological time periods are delimited through the identification of Global Boundary Stratotype Sections and Points (GSSPs or “golden spikes”) or the identification of Global Standard Stratigraphic Ages (GSSAs; Zalasiewicz et al. 2015). While both GSSPs and GSSAs are commonly used to mark geologic time transitions, GSSPs require the identification of a physical marker in a specific stratigraphic sequence of rocks, sediments, ice, or other layered materials, while GSSAs are simply chronologic times selected to mark significant changes in the Earth system. For example, Zalasiewicz et al. (2015) proposed to use radionuclide deposits from atomic bomb testing as a potential Anthropocene GSSP and recommended the precise timing of the first atomic bomb test be used as an Anthropocene GSSA. ESS presents a third form of evidence by identifying major shifts in Earth system functioning as an Anthropocene state transition (Steffen et al. 2016). While the first two approaches (GSSP and GSSA) are concerned with identi-

fying anthropogenic strata or significant historical events, the last is concerned with environmental processes.

It should already be clear that these different designations should not be conflated. While a stratigraphic designation (GSSP) might serve as a practical reference for geological systematics to order sediments, the other (ESS) is a reference to the historical behavior of the relationships among Earth’s various interacting “spheres”—the atmosphere, lithosphere, hydrosphere, and biosphere—that have been similarly categorized for heuristic and analytical purposes. In that sense, only this last mode of designation is primarily concerned with understanding long-term relationships among human inhabitants and the workings of the Earth system. It is also the only Anthropocene designation that speaks directly to the concerns of humanities and social science scholars for the period’s dissolution of natural history and human history or for assessing the species as a “geophysical actor.” Indeed, ESS is foundationally concerned with how human activities both are embedded within and help to constitute the Earth system (e.g., Schellnhuber 1999). By way of contrast, stratigraphers concerned with GSSP designations might usefully categorize a new geological period by the presence of plastics and Styrofoam in sediments, just as an archaeologist of South India might identify the Iron Age by the presence of Black and Red Ware ceramics (e.g., Thapar 1957); yet neither stratigraphic designation necessarily implies an ontological shift in human-environment relationships. Moreover, the GSSP need for stratigraphic identifiers to mark globally synchronous Earth changes, rather than diachronous changes that typify historically specific environmental changes, prohibits the application of GSSPs to characterize more gradual and accumulative human alterations across Earth’s surface (Edgeworth et al. 2015; Ruddiman et al. 2015; Turner et al. 1990).

Periodization criteria for Anthropocene formalization in the Geologic Time Scale are thus clearly problematic for understanding long-term human environment relationships. Yet, it is worth stressing that the most literal translation of its etymology in scientific nomenclature references the “recent age” (*cene*) of “humans” (*anthropos*). Indeed, the Anthropocene concept appears first and foremost as a temporal designation—a period during which scholars recognize humans’ emergence as a “great force of nature,” the end of the division between society and nature, or the global presence of stratigraphic material evidence produced by the *anthropos*. Considering that the Anthropocene is at root a chronological designation about human activities and their relationships to the global environment, one might expect that anthropology would have had input into its formulation.

An Archaeology of the Anthropocene

It is remarkable that the scholarly discipline most focused on long-term changes in human-environmental relationships has been one of the most peripheral to discussions on the Anthropocene. As archaeologist Keith Kintigh and colleagues (2014) have recently noted, archaeology has hardly contributed to the formulation of the Anthropocene concept. Many of the early

canonical pieces that defined the Anthropocene cite little or no archaeology (e.g., Crutzen 2002; Crutzen and Stoermer 2000). Indeed, its principal advocates over the last 15 years were largely natural scientists who stressed humans' unique species-level effects on the Earth system over the last few centuries, largely dismissing the archaeological record of prehistoric periods as insignificant. While some of these foundational papers included historical scholarship in support of their claims of the uniqueness of environmental systems following the Industrial Revolution, they did not substantially rely on archaeological evidence. In fact, the pioneering work of Ruddiman and colleagues is the exception that seemingly proves the rule in this characterization: Ruddiman (2003) seriously considered the archaeological record to argue that prehistoric human agricultural activities greatly affected the climatic history of Earth by at least the middle Holocene but was generally dismissed early on by some of the more strident advocates of the Anthropocene (e.g., Ruddiman 2007; Ruddiman et al. 2016; Steffen, Crutzen, and McNeill 2007). This is not to suggest that early proponents of the Anthropocene did not have some general understanding of an archaeological record for long-term environmental change; clearly they did (e.g., Steffen, Crutzen, and McNeill 2007). However, the Anthropocene's emphasis on humanity's large-scale planetary effects allowed many scholars to easily overlook the archaeological and ecological evidence for pervasive long-term, human-related environmental changes that were tied to specific places or regions. As more recent scholarship on the Anthropocene has begun to incorporate regional archaeological records for human-related environmental histories, proponents of the Anthropocene have been forced to confront the difficulties of clearly demarcating it temporally (cf. Boivin et al. 2016; Braje and Erlandson 2013; Butzer 2015; Crumley et al. 2015; Edgeworth et al. 2015; Erlandson and Braje 2013; Rosen et al. 2015; Ruddiman et al. 2015). Indeed, the archaeologist Karl Butzer (2015) has suggested that the Anthropocene should be considered an "evolving paradigm." Yet an emphasis on global-scale changes has continued to allow many scholars to explicitly argue that anthropologists, archaeologists, paleoecologists, and others building on place-based and regional environmental evidence have little to contribute to Anthropocene scholarship (e.g., Hamilton 2015). This position is untenable.

If the Anthropocene is an "evolving paradigm," it is because its formulation depends on several underlying ontological challenges that require an anthropological and ecological intervention. To begin with, much of the Anthropocene literature reproduces the very dichotomy of nature and society that many scholars suggest it dissolves, separating one recent period during which the two realms could be usefully held apart from another more recent period in which they cannot. Such scholarship inherently perpetuates the natural-cultural distinction and also ignores historical and cultural diversity of human-environment conceptualizations; if, for instance, the Anthropocene represents a period in which people no longer acknowledge a clear divide between nature and society, as some

argue, then many people were living in it well before Western scientists designated the period (e.g., Bradley 2000; Escobar 1999; see Bauer and Bhan 2018 for discussion). Moreover, in singling out the agency of humans as a "geophysical force," the Anthropocene narrative also "silences" (sensu Trouillot 1995) a wide variety of social distinctions and landscape histories that are critical to contemporary understandings and experiences of socio-environmental conditions. In attributing climate change to humanity as an homogenous actor or species, it obscures underlying social differences and "asymmetries related to both the production and experience of environmental circumstances" and associated vulnerabilities (Bauer and Bhan 2016:66; Malm and Hornborg 2014; Ribot 2014; Sayre 2012). This is the case even as the most common proposals for marking the Anthropocene highlight decidedly Eurocentric drivers of Earth and human history, such as the invention of the steam engine (see discussion in Crossland 2014; Morrison 2015).

Humans, of course, do not modify global environmental systems by acting as an undifferentiated and homogeneous web, network, or species. They do so as socially, culturally, ecologically, and geographically situated and differentiated actors that have long been documented by archaeologists, cultural anthropologists, ecologists, and geographers (e.g., Bauer 2015a; Bauer and Bhan 2016, 2018; Crumley 1994; Ellis 2015; Witmore 2014). Moreover, there can be little debate that humans who facilitated the production of greenhouse gases and global warming that originally inspired the Anthropocene designation have done so unequally and in different ways in different times. Crutzen (2002:23) himself recognized this early on: "these effects have largely been caused by only 25% of the world population." This remains equally true today, with recent US per capita carbon dioxide emissions a full order of magnitude greater than those of India, for example (17 vs. 1.7 metric tons; World Bank 2015). Moreover, human-related climate change likely has early roots in land clearance and fire use in the early Holocene and perhaps even in the mass extinctions of megafauna across continents through the actions of late Pleistocene hunter-gatherers (cf. Braje and Erlandson 2013; Doughty 2013; Ruddiman et al. 2015, 2016). Though a recent Anthropocene periodization might call needed attention to humans as agents of contemporary climate change, it does so while potentially obscuring historical processes and social differences related to the production of environmental changes at local, regional, and global scales over multiple time horizons.

Anthropocene narratives also risk downplaying the many nonhuman materials, things, and organisms that people are entangled with and that also contribute to climate and other global environmental changes through a variety of relationships. As the historian Dipesh Chakrabarty (2009) reminds us, humans have always been "biological" agents who shaped their environments, both collectively and as individuals. What sets the Anthropocene apart from previous periods for many scholars is that humans are now historiographically geophysical or "geological" agents. Yet, the distinction between humans as "biological" agents of ecology versus humans as "geological" agents

of climate that arguably warrants the designation Anthropocene needs critical discussion, as it imagines a realm of geophysics somehow disconnected and separate from the biological world in the past. Ironically, the functional interconnections among humans—and all living organisms—and “the spheres” is a fundamental precept of ESS (Schellnhuber 1999).

Differences between humans as agents of “biology” and “geology” are not clearly differences in kind. There should be no doubt that people utilizing contemporary fossil-fuel technologies are transforming Earth’s climate, marking them as geophysical actors when considered within the broader assemblage of material relationships that affect greenhouse gases. Yet this should not preclude other people, dependent largely on human labor in clearing land and releasing carbon, for example, from being considered “geological” actors, relegating them to mere “biological” or ecological roles. It is not difficult to see such a position slipping into the problematic historiographical divide between “modern” and “primitive” people, differentiating people that are now capable of transcending the confines of nature to alter their environmental circumstances from those of previous times (Bauer and Bhan 2016). Moreover, such a distinction between biological and geological agents ignores basic ESS, in which the dynamics of diverse bacteria, plants, and other species are coupled with and alter the composition and functioning of Earth’s atmosphere, lithosphere, and climate systems (Ruddiman et al. 2016; Schellnhuber 1999). To identify any one of these as a geophysical agent to the exclusion of others is to ignore the numerous interactions among Earth’s organisms that constitute the biosphere and their coproduction of atmospheric conditions and climate. Thus, to address when any organism, human or nonhuman, affects geophysical conditions is to also address how they are enmeshed historically within the material relationships of ecologies and geographies that contribute to atmospheric conditions. Humans—and other species—began altering greenhouse gas concentrations in the atmosphere long before the invention of the steam engine (e.g., Ruddiman et al. 2016).

The Historical Ecology of Geophysical History

ESS is founded on the principle that interactions among the atmosphere, lithosphere, hydrosphere, and biosphere together with the external forcings of solar irradiance form a complex system that contributes to the processes of climate change, the global biogeochemical cycling of many elements, and other dynamics of the Earth system (Schellnhuber 1999). Actively growing trees, for example, sequester carbon dioxide from the atmosphere that on release through combustion or decomposition contribute to greenhouse gas concentrations and therefore alter climate and the growth of other trees through feedback interactions (Archer and Rahmstorf 2010; Barford et al. 2001; Flannery 2005; Vavrus, Ruddiman, and Kutzbach 2008). On geologic timescales, the oxygenation of the atmosphere during the Proterozoic eon (ca. 2.5 bya) by cyanobacterial photosynthesis

profoundly and permanently altered Earth’s atmosphere and climate over hundreds of millions of years—a geophysical and geochemical state shift produced by biological relationships and an example of niche construction; atmospheric oxygenation produced the ozone layer, shielding Earth’s surface from harmful ultraviolet radiation, making Earth’s land habitable to multicellular organisms for the first time (Erwin 2008). This process also reduced concentrations of methane and triggered a period of global glaciation (cf. Frei et al. 2009; Kopp et al. 2005). These examples demonstrate that biological agents inherently also function as geophysical and geochemical agents in the Earth system, as the term biogeochemical implies.

Early members of the genus *Homo* arguably developed abilities to alter the atmosphere with the use of fire hundreds of thousands of years ago when set within the context of biogeochemical assemblages (cf. Albert 2015; Roebroeks and Villa 2011). Moreover, human activities were likely related to mass extinctions of a range of land animals with a cascade of profound consequences for ecosystem functioning across Australia around 50,000 years ago and later elsewhere in the world (cf. Barnosky 2008; Boivin et al. 2016; Braje and Erlandson 2013; Grayson 2001; Kirch 2005; Miller et al. 2005; Rule et al. 2012). In the Holocene, intensified forms of land use associated with agriculture, animal husbandry, and human population and settlement growth reshaped animal populations, vegetation communities, and the ecological and geomorphic trajectories across large regions of the globe (e.g., Alizadeh et al. 2004; Bauer 2014; Boivin et al. 2016; Casana 2008; Conolly et al. 2012; Ellis 2011; Ellis et al. 2013; Erlandson and Braje 2013; Fuller et al. 2011; Morrison 2009; Rosen et al. 2015; Wilkinson 2003). These data alone have supported multiple suggestions that the Holocene has “long been the Anthropocene” (Morrison 2013:23; see also Braje 2016; Certini and Scalenghe 2015; Erlandson and Braje 2013; Smith and Zeder 2013). While archaeological research has focused on humans’ roles in local and regional ecological and geographical histories, as opposed to a global role as geophysical agents in a coupled “human-Earth” system, a few examples from the archaeological literature amply demonstrate the significance of assemblages of humans and nonhumans in creating climatic and other environmental conditions at global scales, problematizing claims of a newly emergent “geophysical” effect associated only with industrialization.

Prehistoric expansion of rice agriculture, irrigation, and pastoralism likely caused a reversal in atmospheric levels of methane, a greenhouse gas that decreased in the first half of the Holocene but then increased after ca. 5000 years ago (cf. Fuller et al. 2011; Ruddiman and Thomson 2001; Ruddiman et al. 2008, 2016; Vavrus, Ruddiman, and Kutzbach 2008). Fuller et al. (2011) have argued that archaeologically estimated increases in rice cultivation and livestock pastoralism in South and East Asia correlate with rises of atmospheric methane documented in Greenland ice cores. This correspondence has allowed a growing cadre of climate scientists to convincingly argue that “the anthropogenic greenhouse era began thousands

of years ago,” as per Ruddiman’s increasingly well-supported “Early Anthropogenic” hypothesis (Ruddiman 2003).

Yet crucial to our broader point, both prehistoric and contemporary environmental transformations and their effects cannot be attributed equally to all members of these societies. Neolithic and Iron Age inhabitants of South India, for instance, differentially participated in agropastoral activities that produced methane and large-scale geomorphological transformations, such as soil erosion, and these differences were related to the development of status distinctions and social inequalities (e.g., Bauer 2014, 2015a, 2015b; Sinopoli 2013). Moreover, early irrigated rice cultivation across large areas of South and East Asia was likely a highly politicized practice; there is strong evidence that not all inhabitants had access to irrigation facilities for growing rice and that irrigated and dry-farmed cultigens had differences in productivity, value, and symbolic uses in many precolonial contexts (e.g., Bauer and Morrison 2008; Ellis and Wang 1997; Huang 1990; Morrison 2009). Thus, even in these preindustrial periods, the historical ecology of geophysical history was also a political ecology, a point that is critical to recognize if we are to understand and engage actively with the long-term entanglements between cultural practices, social relationships, and the material workings of Earth. To understand the historical degree to which human activities have altered Earth systems thus requires that the full assemblage of processes and actors be considered and, equally important, the differences among them.

Discussion: The Anthropocene Divide and the Social Environment

Different designations of the Anthropocene direct scholarly attention toward different things—a stratigraphic marker (GSSP), a global historical event indicating a new “age” (GSSA), and the historical behavior of relationships among Earth’s various “spheres” of interaction (ESS). Only the latter, the Anthropocene formulation of Earth system scientists, is primarily concerned with understanding long-term relationships among humans and the workings of Earth’s climate and other systems. In that sense, it is also the only Anthropocene designation that speaks directly to the concerns of humanities and social science scholars for the period’s dissolution of natural history and human history or for assessing the species as a geophysical actor. Yet, as we demonstrated above, humans have been participants in Earth’s biogeochemical processes for thousands of years, and their influence on geophysical and climatic conditions likely significantly predates the most common chronological proposals for the Anthropocene. In short, there is not, and could never be, a clear date at which humans became “geophysical.” To be biological is also to be geophysical. Thus, the degree to which humans have influenced climate must necessarily be considered as a dynamic long-term process, a process that we have argued above and elsewhere is also deeply enmeshed in a political ecology—that is to say, how social affiliations, differences, and inequalities are also produced and reconstituted.

For these reasons, proposals for an Anthropocene periodization—for a geological divide between the “recent age” of humans and that which preceded it—significantly constrain historical understandings of human-environment relationships, including the recent processes and histories that have shaped contemporary contexts and the increase in human effects on global warming over the last few centuries. Thus, we are in agreement with other scholars who have recently sought to supplant the designation Anthropocene with other terms that critically represent the sociohistorical processes that are related to contemporary global warming. Jason Moore (2015), for example, has suggested an alternative “Capitalocene” to highlight relations of power in the production of social and environmental conditions over the last five centuries that underlie contemporary carbon dioxide emissions under capitalism. The “Plantationocene” has also been proposed to stress the “transformation of diverse kinds of human-tended farms, pastures, and forests into extractive and enclosed plantations, relying on slave labor and other forms of exploited, alienated, and usually spatially transported labor” that might also critically frame the current connections between human history and global warming (see discussion in Haraway 2015).

Critiques of the Anthropocene that call attention to how the designation silences underlying social relationships and inequalities could also be applied to many treatments of “anthropogenic” environments that fail to differentiate social actors (Sayre 2012), including those of archaeologists, historians, and ecologists who argue for a pre-Industrial origin of the period as well as Earth system scientists who view humanity as a homogeneous geophysical force following industrialization. To reiterate an earlier example, cattle pastoralism and irrigated rice agriculture associated with mid- to late Holocene land use in South India had well-attested political effects (e.g., Bauer 2015a, 2015b; Bauer and Morrison 2008; Morrison 1995, 2009). In short, prehistoric environmental transformations within Asia that altered atmospheric conditions (e.g., Ellis and Wang 1997; Fuller et al. 2011; Huang 1990; Ruddiman et al. 2015, 2016) were tightly linked to the production of social relationships and institutionalized forms of inequality and in that sense were similar to those of contemporary capitalism.

These archaeological and historical cases demonstrate the need to comprehend the politics and social processes of environmental production in the past as well as the present if we are to understand the development of global warming and other changes in the Earth system that articulate with social conditions (see also Ribot [2014] on the “sociocene”). For instance, many large irrigation reservoirs that were constructed in southern India within highly politicized contexts during the period of Vijayanagara imperial rule (ca. 1330–1565) continue to hold water, irrigate crops, and contribute to atmospheric methane today (cf. Bauer and Morrison 2008; Morrison 1995, 2009). These features illustrate the diachronous character of human-related landscapes and their multiple temporalities in contributing to socio-environmental conditions at various scales (see also Bauer and Bhan 2018; Crumley 1994; Morrison 2009). Reframing the Anthropocene as the Capitalocene or the Plan-

tationocene (e.g., Haraway 2015; Moore 2015) places much-needed focus on the social relations of production and consumption that have produced alarming increases in the magnitude of humans' effects on the Earth system. Both terms also cogently supplant the Anthropocene by focusing on historical sociopolitical processes through which humans have come to dramatically alter Earth, emphasizing social conditions that preceded the invention of the steam engine or the atomic bomb. Even so, we should not forget the fact that humans contributed to geophysical conditions well before the emergence of capitalism.

Land use and its accompanying social relations have long been related to environmental histories and their concurrent contribution to planetary changes. By no means does this minimize the role of capitalist forms of production in understanding the current phenomenon of intensified global warming. Nor does it produce an evolutionary scheme that suggests that an Anthropocene was an "inevitable outcome of human becoming" (Witmore 2014:129; see also Crossland 2014). To the contrary, it is an explicit call to historicize socio-material conditions that have resulted in environmental transformations at multiple scales and to resist progressive evolutionary narratives that imply a distinction in the externality of humans in relation to nature—the "civilized" and the "savage" sensu Morgan (1964 [1878]).

Despite the explicit emphasis that many Anthropocene advocates place on disrupting the concept and ideology of nature, many Anthropocene narratives silently reproduce it by distinguishing a recent time when the Earth system was external to or unaffected by humans from a more recent period in which it is not. In our view, a critical role of archaeology and other historically oriented disciplines is not to push back the start of the Anthropocene; rather, it is to call attention to the historicity of nature, so that we might more fully expose and discuss assumptions about what socio-environmental conditions are desirable, for whom, and how those might be achieved or disturbed. Calling attention to this history unsettles a teleological sense of "the species" as a singular geophysical "force." It also suggests reconsideration of "business as usual" environmentalist approaches that historically have been structured by the nature-society divide (e.g., Latour 2004) and that, ironically, maintain the ideological basis for global warming deniers to frame climate change as a strictly "natural" process rather than a social-environmental one. To be clear, profound and pervasive planetary changes cannot be attributed equally to the entirety of the *anthropos*, and it is essential that social relationships and material conditions be investigated among the different institutions, cultural practices, and material processes that produce them; yet, the development of capitalism cannot be the entirety of our account, even as we agree that it is critical to call attention to its importance in underlying alarming and ongoing environmental transformations (see also Bauer and Bhan 2018).

Conclusion

To reinforce the notion of a historical binary, of an "Anthropocene divide," by precisely dividing the history of Earth

into a time in which human social engagement with the production of environments is globally consequential from a time in which it is not flows strongly against contemporary understandings of both human-environment relations and the coupling of human activities with Earth systems from prehistory to present. It is time to put aside concerns for locating an Anthropocene divide. It is our concern that the Anthropocene narratives produced by the stratigraphic formalization of a new geological epoch will form a barrier to developing recognition of the history and diversity of social and environmental entanglements, as well as their contribution to the (re)production of undesirable conditions as the effects of global warming are differentially experienced. If the Anthropocene divide is to be dissolved, as we argue it should be, anthropology must provide theory, critique, and empirical accounts of the historical entanglements of social relationships, cultural practices, and material conditions that recursively shape socio-environmental outcomes embedded within the Earth system. To accomplish this, anthropology cannot walk alone but must work to teach, guide, and collaborate with other scholarly disciplines concerned with humanity and its role in shaping Earth's past, present, and future.

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Comments

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Although I generally agree with Bauer and Ellis and their supposition that the designation of an Anthropocene epoch obscures rather than clarifies our understanding of social-environmental change, I believe that the fundamental importance of recognizing an age of humans is lost in their argument. I am in favor of debate about the Anthropocene, as it produces dialogue across disciplines and with the public about how humans have helped create the global environmental crisis and why we need to do something about it.

Bauer and Ellis mirror the position of the Anthropocene Working Group (AWG) that the "anthropocene" and the "Anthropocene" (lowercase vs. uppercase) are very different con-

cepts (Zalasiewicz et al. 2017:219). The AWG is concerned with the uppercase Anthropocene as potentially a formally designated unit of the Geological Time Scale. Their Anthropocene is a chronostratigraphic unit that must have a fixed point in time (with some error bar range, as is common with other chronostratigraphic boundaries), tied to hard rock stratigraphy or a golden spike. General discussions and debates centered on other “anthropocenes” (according to the AWG) are viewed through the disciplinary lenses of their authors (Zalasiewicz et al. 2017:219). These place different emphases on the motives, material evidence, human activities, Earth system processes, and so on, and the AWG argues that they are separate concepts. The anthropocene in regard to Earth system science (ESS), the identification of anthropogenic strata, historical events that propelled changes in Earth system functions, and environmental processes are, according to Bauer and Ellis, “the only Anthropocene designation that speaks directly to the concerns of humanities and social science scholars.” This position is presumably why Ellis can advocate for an Anthropocene focused on the social, political, and historical contingencies of human-environmental ecodynamics and argue that we should “put aside concerns for locating an Anthropocene divide” while at the same time coauthoring several high-impact manuscripts with AWG members supporting a recent Anthropocene boundary marker (e.g., Waters et al. 2016a; Zalasiewicz et al. 2015, 2017). Bauer and Ellis argue that we need to put aside concerns for locating an Anthropocene boundary marker and propose that archaeologists and other social scientists should adopt the Capitalocene or the Plantationocene, focusing on the “historicity of nature.”

The mountain of Anthropocene publications over the last several years, in my opinion, has been both positive and negative. It has fostered conversations across academic disciplines about how different scientists think about natural versus anthropogenic, human-environmental ecodynamics, and the future of our planet. It has sparked interest and high-profile articles in numerous media outlets. The Anthropocene has become a powerful environmental education tool at a time when climate change and climate science are highly politicized, especially in the United States. The Anthropocene encompasses not only anthropogenic climate change but also exploding human populations, pollution, accumulations of plastics in our oceans, accelerating extinction rates, and much more, and perhaps offers talking points that may permeate the defenses of climate change deniers. Unfortunately, conversations about the Anthropocene in the scientific community seem to be turning to academic siloing, following arguments similar to those presented by Bauer and Ellis that the different Anthropocenes should be carved up and controlled by specific disciplines or that we need different terminology to describe, at the broadest level, the same problem—humanity’s impact on Earth (Zalasiewicz et al. 2017). What is lost is Crutzen’s underlying message (in my opinion the only one that really matters) in proposing an Anthropocene nearly 20 years ago, drawing attention to the accelerating modern environmental crisis and guiding “society to-

ward environmentally sustainable management” (Crutzen 2002: 23; Crutzen and Stoermer 2000). The Anthropocene, for the public at least, has become a rallying cry to raise awareness about the growing human footprint on Earth. We risk losing this as we quibble over boundary markers, anthropocenes, and the usefulness of the Anthropocene versus the Capitalocene or the Plantationocene. Must we fiddle while Rome burns?

As a historical scientist, I, for one, am comfortable with ambiguity. I realize that I will never be able to completely reconstruct the incredible complexity of the ancient human experience from the shell middens I excavate and analyze. It is past time that the larger scientific community becomes comfortable with, or at least accepts, some level of similar ambiguity with the Anthropocene. I agree with Bauer and Ellis that ESS and the historical processes that helped create the Anthropocene are of fundamental importance, but so is its adoption in our scientific lexicon and our communication with the public. Why replace the Anthropocene with another term or terms and lose all the momentum built toward educating the public and stimulating interdisciplinary dialogues? As I have proposed previously, a merged Holocene/Anthropocene epoch would force us to think about the long-term impacts of humans, which have been variable across time and space, and offer a clear message to scientists and the public about humanity’s role in our growing environmental crisis (Braje 2016). A Holocene/Anthropocene would offer no starting point for humanity’s significant influence on Earth systems but would recognize the long-term, variable processes at work. This turns the conversation from the effects to the causes of the Anthropocene, calls attention to the “historicity of nature,” and concentrates attention on the conceptual merits of the Anthropocene. The Holocene/Anthropocene would function similarly to other previously designated geological epochs (Zalasiewicz et al. 2011: 837), as a way to frame interdisciplinary, scientific inquiry of coupled human-natural systems in a practical and meaningful way (Smith and Zeder 2013:12).

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“The Anthropocene Divide” by A. M. Bauer and E. C. Ellis provides very cogent reasons for not formally defining a beginning to an “Anthropocene epoch” yet fails in its explanation of the formal basis for a new interval in the Geologic Time Scale. As with most presentations on the Anthropocene, it ignores the true nature, purpose, and history of the chronostratigraphic units (system, series, stage) approved by the International Commission on Stratigraphy (ICS) and ratified by the International Union of Geological Sciences, which serve as the material basis for the geochronologic units (period, epoch,

age) of the Geologic Time Scale. The primary argument of “The Anthropocene Divide” is that the human impact on the Earth system has spread episodically over the Earth through space and time and that to demark the now global impact with the term Anthropocene ignores a long history of intensification and dispersal of human impact. The primary purpose was not to describe the nature of chronostratigraphic units. Nevertheless, the authors do, and they do so in a manner promoted in the publications of members of the Anthropocene Working Group of the ICS Subcommittee on Quaternary Stratigraphy, for example, that of Zalasiewicz et al. (2015). Finney and Edwards (2016, 2017) challenged the misrepresentation that only a lower stratigraphic boundary must be proposed, approved, and ratified for the Anthropocene epoch to be formally recognized. Yet, what ICS establishes are chronostratigraphic units, which are intervals of stratified rock. A boundary between successive units is materially defined as a stratigraphic horizon in a single stratigraphic section, what is called a Global Stratotype Section and Point. It serves as the global reference on which the boundary is correlated to other stratigraphic sections worldwide. But the key concept is that the boundary is used only to set stratigraphic limits to the chronostratigraphic unit. ICS, the commission on stratigraphy, defines stratigraphic units, specifically, global chronostratigraphic units that are the material basis for the units of the Geologic Time Scale. Numerous recent publications propose stratigraphic markers for the beginning of the Anthropocene, but none provides documentation of the proposed units itself, which would be the Anthropocene series. Waters et al. (2016*b*) do illustrate the Anthropocene in a lake core, but it consists of only 2 cm of unconsolidated organic matter. It is unfortunate that Bauer and Ellis chose to ignore the nature of the units approved by ICS and instead continue with the serious misrepresentation. Bauer and Ellis cite Waters et al. (2016*a*) and Zalasiewicz et al. (2015) as providing evidence that “humans’ global physical environmental impacts produce an unambiguous and permanent signature in Earth’s lithological and sedimentary records.” They seem to not realize that stratigraphic documentation, from stratigraphic logs with sample levels and analysis, is not presented in those publications whatsoever, except for the 2 cm of unconsolidated organic matter in a lake core.

Also most pertinent to any discussion of formalization of an Anthropocene epoch is consideration of the usefulness of the term, particularly its stratigraphic application. Since the beginning of recorded human history, many geologic events are recorded in and referred to by years in the Gregorian calendar, and timing and history of all human impact is expressed with the Gregorian calendar. This applies to the lava flows in Hawaii, where individual flows are referred to specific dates (Poland et al. 2016). In geology textbooks, notable volcanic eruptions and earthquakes are listed in tables by the year in which they occurred. The lahar that devastated Armero, Colombia, deposited a thick, extensive blanket of sediment filled with human debris. It is referred to as the Lahar of November 13, 1987. It overlies another extensive lahar deposit that is referred to as

the 1845 Lahar. Referring to the Anthropocene and Holocene lahars would be of no value. Throughout southern Europe, human artifacts discovered in soils and on the surface are referred to as Roman. Referring to them as Holocene would be of no value. It is of concern that many who publish on the Anthropocene as a new unit of the Geologic Time Scale fail to understand the basis of the units of the Geologic Time Scale. It is of further concern that they do not realize that the human calendar has replaced the Geologic Time Scale when giving the ages of geologic events and human events (impact) that have long been recorded by humans as they occurred.

Although Bauer and Ellis state that the Anthropocene “designation has been taken up vociferously across the academy,” they fail to recognize that it has not been so within the geoscience and stratigraphic communities. Presentations on the Anthropocene are rare at national and international geoscience meetings, other than by repeated presentations by a few members of the Anthropocene Working Group.

Bauer and Ellis state that “the claim that humans are altering the functioning of Earth as a whole has now been confirmed,” yet they ignore the fact that major changes to the Earth system have been controlled by internal tectonic and magmatic processes and extraterrestrial processes over which humans have no impact and no control and that, in turn, can catastrophically change the Earth system.

Unfortunately with discussions of the Anthropocene, those who are not geological scientists and particularly those who are not stratigraphers too often misrepresent the nature of the Geologic Time Scale, appear ignorant on the nature of stratigraphy, and do not fully understand the Earth system. Further, they seem not to recognize that today we use the human time scale, not the Geologic Time Scale, when dealing with human impact on the Earth system as well as expressing the age and timing of geologic events. Thus, there is no geological/stratigraphic need for an Anthropocene series. And if not formalized as a unit of the Geologic Time Scale, “Anthropocene” can have whatever meaning one wants it to have.

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The Importance of Reference Frame

The Anthropocene was not originally introduced as a stratigraphic concept (Crutzen and Stoermer 2000) but rather as a philosophical idea meant to highlight the magnitude of human action in the Earth system. Recently, a group of scientists led by stratigraphers has been considering whether or not it would be valuable to formalize a stratigraphic definition of the Anthropocene, and if so, when and how to define its formal beginning—this is a requirement of all geologic epochs. Such an

uppercase “A” Anthropocene would be recognized only after a process of definition, consultation, and ratification of a body largely comprised of Earth scientists.

As colleagues and I argued earlier (Ruddiman et al. 2015) however, the uppercase Anthropocene is an unnecessary concept. The Geologic Time Scale was a triumph of nineteenth-century scientific endeavor but has been rendered largely obsolete by the advent of radiometric dating. Radiocarbon and other techniques allow us to precisely estimate when certain events took place and can in large part trace the diachronous evolution of human-environment interactions around the world since our emergence as a species. We argued then, and continue to argue, for a lowercase “a” anthropocene, a recognition that we live on a planet largely transformed by the actions of our species, even to the point where our actions have become as important as changes in the Earth’s orbit around the sun or plate tectonics in influencing the state of the Earth system. We are also well aware of the problem of a stratigraphic definition of the age of humans, precisely for the reasons cited in this paper: human influence on the Earth system is a process with a long and variable history that emerged with the dispersal and migrations of humans across the planet, had different expressions in different places and times, and was by no means a unidirectional process but rather one that is marked by accelerations, decelerations, and even reversals in the sign of human influences over time on landscapes, plants, animals, and even the chemical composition of the atmosphere.

Given this long and diverse history of the anthropocene, one of the major issues currently limiting our understanding of the processes is the lack of reference frame. The “great acceleration” of anthropogenic activity (Steffen et al. 2011) clearly distinguishes the late twentieth century from earlier periods in Earth and human history, but the period immediately prior to this era or even a few centuries beforehand was also indisputably distinct from the “world without us.” Identifying a world without us surely requires examining the period before the beginning of the Holocene, but as we look into the past Ice Age, the Earth system in its glacial state was so different from the contemporary era that it is extremely difficult to use, say, 50,000 BP as a point of comparison. The global, rapid, and massive climate and environmental changes that occurred during the Pleistocene-Holocene transition are one of the reasons why it is very difficult to disentangle anthropogenic from other factors in explaining the extinction of the Pleistocene megafauna. To identify a period with climate analogous to that of the last several millennia but without substantial human influence, we would need to consider the last interglacial era, around about 125,000 BP, although even at this time anatomically modern humans were present throughout Africa. Perhaps the penultimate interglacial, 200,000 years ago at the dawn of human evolution, would be an appropriate time to consider the “natural” state of the Earth system. Unfortunately, extremely few terrestrial paleoenvironmental archives such as lake sediments—it is on land where we expect to see human influence—have records that extend so far back in time. We are therefore

faced with the problem of lack of direct evidence for the evolution of human influence on the Earth system over time.

By the end of the glacial period, at the beginning of the Holocene 11,700 years ago (Walker et al. 2009), humans had spread to occupy even the extremes of all of the continents except Antarctica. On the other hand, many oceanic islands, large and small, were occupied by people only later in the Holocene. While imperfect in many ways, we may use reconstructions and observations of human influence on islands as an analogy for what may have happened on the continents earlier in Earth history (e.g., Boivin et al. 2016; Rolett 2008). Another way to understand how, when, and where humans influenced the Earth system is to employ process models of coupled human-environment interactions; in a hypothesis testing mode, it is possible to contrast model simulations of “the world we had” with the “world without us” (e.g., Kaplan et al. 2016). While it might ultimately be difficult to unequivocally prove that human agency was the cause of changes to landscapes, flora, and fauna, modeling experiments illustrate what could have happened and provide a valuable impetus for further, targeted paleoenvironmental and archaeological investigations.

As Bauer and Ellis point out in this article, the social sciences and humanities are largely concerned with the process (Earth system science) definition of the anthropocene. Many Earth system scientists themselves, however, continue to perpetuate the myth of a planet largely free of human influence in the latest preindustrial Holocene, and this perspective has had a large influence on the discussion surrounding a formal stratigraphic definition of the anthropocene. On the other hand, it is obvious to many archaeologists and historians that the state of the Earth system one or two centuries ago was clearly modified through anthropogenic activities. There is, therefore, an urgent need for social scientists to be engaged in the discussion around the anthropocene and to bring their evidence more clearly in front of the global change community. For many practitioners, this requires a leap of faith; few archaeologists or historians are comfortable with drawing general conclusions beyond their locality or period of expertise. But their synthetic viewpoint is invaluable and, combined with process modeling, will provide a powerful illustration of the state of the Earth system and improve our ability to put things into perspective, that is, to provide a reference frame for the anthropocene.

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Ontologies of Occlusion in the Anthropocene

In this superb article, Bauer and Ellis explain how the “species” framing of “Anthropocene” occludes socially stratified causes and effects of climate change. Thus, it is logical that

this framing also hides differentiated responsibilities for both cause and care. However, they later merge nature and culture in a manner that can also erase the very possibility of moral judgment and thus responsibility and response. They argue that “Anthropocene narratives . . . risk downplaying the many nonhuman materials, things, and organisms that people are entangled with and that also contribute to climate and other global environmental changes through a variety of relationships.” Indeed, climate-oriented explanations of weather-related damages are known to occlude the multiple causes of the vulnerabilities that place people at risk (Ribot 2014). Hazards (climate or otherwise) without vulnerability do not cause damage—they work together. With any given hazard, some people are damaged while others are not; that difference is vulnerability, not climate.

But the authors also evoke a different, Latourian-style occlusion—although their nature-culture discussions belie a more nuanced stance. Like Latour, they emphasize the need to attend to (ostensibly ignored) nonhuman things that shape outcomes, despite the fact that attention to these things is already present in any rigorous analysis of causality. Indeed, who ever said that the material world and material objects do not have effects? Was this ever in question? Thus, this object-oriented “turn” (ironically labeled “new materialism”) occludes the long history of analyses of social and material causes of climate crises. All thorough analysts—from Sen (1981) to Watts (1983) onward—bring in human and nonhuman factors.

Unfortunately, Latour goes further. He calls these nonhuman things “agents”—attributing this most-human quality to them. This introduces another occlusion, an occlusion of the role of agency in responsibility; by equating humans with objects, equating agency to any mere force, and thus flattening the relation between human and nonhuman influence—a flat ontology merging subject and object.

Objects can, of course, contain human agency. But they have no agency. Humans contribute to making the world. They influence it. They shape it. They are shaped by it. That relationship still does not give agency—a uniquely human attribute—to things. Things have force. Forces have effects. Effects have consequences. Consequences can, when humans are involved, have meaning. Human agency, like dead labor, is in things and shapes outcomes. This does not (without distinctly human fetishism) give things agency. Nevertheless, the forces that drive and shape things take on particular meaning when we can trace their origin back to humans. It is not agency of the objects that carry it. It is human agency that articulates through them. It is human agency that establishes blame, liability, and responsibility (see Calabresi 1975; Harte and Honoré 1959).

To attribute responsibility, a major reason that imagining an “Anthropocene” (of socially differentiated cause and effect) is worthwhile, we need to maintain the distinction between object and subject, nature and culture. For effective response (my goal), we need to know three things: (1) the human actions and nonhuman forces damaging the environment we depend on (whether or not we generate that environment or influence its

nonhuman forces), (2) how we can reduce effects (regardless of their human or nonhuman origins) that undermine our environment, and (3) where to locate responsibility—what society judges can and should be done and who should do it. This responsibility—like blame or liability—cannot be located in the nonhuman forces. The force-agency distinction matters if response is to follow.

Since “should” shapes human action and thus outcomes, it must be within the scientific study of causality within any social system. Yet Latour (2014) tells us there is no history or theory (his irreducibility principle) nor therefore morality (due to his flat nonhierarchical ontology); this framing will miss those things that depend on “should”—social judgment that creates a hierarchy of value. Latour’s radical empiricism blinds us to all of the acts that did not happen (and are thus not visible) but that society judges as necessary or moral. These must be historicized and theorized to discern. In short, the normative is central to any scientific analysis of the multiple causes of disasters—such as the causes of vulnerabilities that turn climate events into crises (Ribot 2014).

“Shoulds” are necessary for the framing of any research that involves humans and that asks “why” something happened. This is because human (in)action is based on judgment. The inaction is visible only through knowledge of judgment—whereas action is manifest. Within a social world there is no asking why without asking about what is socially expected. Hierarchy (of human values), not flatness, guides action. We cannot know what was “not” done unless we know what could and “should” have been done.

This brings us full circle. “Should” is morality. It is located in the unique human characteristic called agency. It is in the will, predicated on the ability to think (à la Arendt 2003). If we view agency as everywhere, including objects, then everything, and therefore no one, is responsible. Tracing cause to an object’s force is fine. Yet, we must continue the search for agency, which is human, to establish the relations of responsibility and the possibility of response.

The Earth moves but is not moved. The Earth is a force without agency. Along with nonhuman forces, it carries in its movement the forces introduced by the agency of humans. That agency is part of causality. It leads us back to responsibility and basis for action—although responsibility can also come from mere knowledge of potential damages (knowledge, the apple, a good starting point for the Anthropocene?). The agency in the Earth is not of or from the Earth. It is ours, purely ours—no matter how it manifests and whether we can control it. True, “the traces of our action are visible everywhere” (Latour 2014: 9). But it remains our agency since it is the antecedent that establishes responsibility for the movement that troubles us. We should be moved. We should consider what we do and how it affects others—the golden rule applies (see Arendt 2003).

Further, our being “subjected” to Earth’s vagaries does not give earth subjectivity (à la Latour 2014:9). The Earth remains object, shaped by our agency, but as much object as a table or chair. Placing it on the same plane with me, a subject, is tan-

tamount to war—it is the objectification of humans. This flat ontological object-subject conflation is a frame of war that enables those of us who are subjects and have subjectivity to be reduced to the nongrievable equivalent of an object (Butler 2009). It is the equivalence, the erasure of difference, that reduces us. It is distinctly unethical. Humans are not equivalents of objects. Being is hierarchical—we live in a round world.

Once we distinguish humans from objects and recognize them as the locus of agency, then responsibility can be attributed and response can begin. I see no utility in asking whether humans are nature, since human nature, the ability to think and judge, is nature and is what distinguishes us from the remainder of the nature of which we are a part.

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The Geological and Earth System Reality of the Anthropocene

“A word means what I choose it to mean, no more and no less.” This pronouncement by Humpty Dumpty in Lewis Carroll’s *Through the Looking Glass* might be recalled in considering Bauer and Ellis’s contention that the “Anthropocene” as a sharply delineated geological term does not serve anthropology well and therefore should be more generally rejected. Their contention and accompanying assertions, though, are widely open to question.

Bauer and Ellis begin by saying that any such sharp delimitation (“periodization”) is invalid because the relationship of humans to the Earth reflects a complex continuum (paradoxically, they do not reject the Holocene and Late Pleistocene even though these cut across the same continuum). We emphasize here that scientists working in the framework of geology and Earth system science (ESS) see all Earth history as comprising complex, continuous, and pervasively diachronous change and yet they regard the “periodization” given by formal geological time units as essential to their work. This is because these precise, synchronous, internationally agreed boundaries lead to unambiguous communication and enhance interpretation and understanding. They intermesh effectively with a wide and varied array of other time-related units (litho-, bio-, cyclo-, magnetostratigraphic, etc.) to build a detailed picture of Earth

history. Earth system scientists find such “periodization” exceptionally useful because it provides a consistent way to discern and communicate significant changes in the structure and functioning of the Earth system from a very large amount of useful data, including data from archaeology and anthropology.

The Anthropocene concept and term indeed originated with Paul Crutzen (Crutzen 2002; Crutzen and Stoermer 2000) explicitly as a geological epoch/series to succeed the Holocene and was soon widely adopted by the ESS community. As interest in this concept grew, the term was also noticed by stratigraphers, with initial evaluation suggesting that it “had merit” as a potential formal geological time unit and should be investigated further, an extensive technical process initiated in 2009 by the Anthropocene Working Group (AWG) of the Subcommission on Quaternary Stratigraphy, part of the International Commission on Stratigraphy (ICS). In this context, the Anthropocene is being examined as a potential unit in the parallel chronostratigraphic/geochronologic “dual hierarchy” (i.e., as both a potential series and epoch) of the International Geological Time Scale.

This “dual” timescale is specific to geology but is just one of many means by which humans measure or subdivide time and is distinctive in simultaneously comprising synchronously bounded material units of strata (e.g., series) and their equivalent “pure” time units (e.g., epochs; Zalasiewicz et al. 2013). It is used to subdivide Earth history (not human history), which continues to the present and in recent times encompasses both human- and nonhuman-formed phenomena. We know of no equivalent timescale in anthropology, archaeology, history, or other cognate disciplines. It may of course be used in these or other disciplines when considered appropriate (see, e.g., Vidas, Zalasiewicz, and Williams 2016 regarding its relevance for international law), as with Bauer and Ellis’s use of Late Pleistocene and Holocene.

Key to the geological viability of the term is the distinctiveness of the stratal record, not least because this is the only means by which recent events can be related to the whole of Earth history. This record shows Holocene relative stability persisting even as substantial human civilizations rose and fell, leaving rich archaeological traces of their interaction with the environment. Plausibly, anthropogenic activities might have drip-fed greenhouse gases into the atmosphere for millennia to maintain CO₂ levels and therefore Holocene climate stability (Ganopolski, Winkelmann, and Schellnhuber 2016; Rudiman 2013). “Anthropogenic,” though, is not synonymous with “Anthropocene,” for which the key distinction is decisive and essentially synchronous impact at a geological scale.

Diverse stratigraphic markers indicate that strata from the mid-twentieth century onward can be clearly and widely distinguished from earlier strata (Waters et al. 2016a). These indicators belie Bauer and Ellis’s complaints (i) that the archaeological record has been ignored in the process, as they are commonly archaeological in nature (e.g., plastics, concrete, persistent organic pollutants, fly ash, artificial radionuclides), and (ii) that the currently suggested start of the Anthropocene

represents “an arbitrary break.” The accompanying perturbation to sedimentation has been large and global, producing pervasive stratigraphic records. For instance, humans have placed large dams on the main stems of ~2,500 rivers globally in less than a century, reducing sediment delivery to the coast such that coastal successions on every continent except Antarctica now record this near-synchronous event. Overall, since 1950, humans have been moving more sediment annually than wind, glaciers, and rivers combined. Earlier records of humans engaged in terracing, emplacing small check dams, or deforesting areas of Europe represent an important, indeed fundamental precursor to this phenomenon, but one that was patchy, diachronous over several millennia, and largely confined to land. These early records, for all their historical importance, cannot satisfactorily define a global and synchronous (chronostratigraphic) boundary that is geologically effective.

The stratigraphic record is congruent with the recognition of a major, ongoing perturbation of the Earth system (Steffen et al. 2016; Zalasiewicz, Waters, and Head 2017), including unprecedented change to the carbon, phosphorus, and nitrogen cycles and the biosphere, both marine and terrestrial. Energy consumption by humans since 1950 exceeds, by some 1.6 times, that of all of human history before 1950. One metric, the Anthropocene factor (Gaffney and Steffen 2017), over the last 65 years is orders of magnitude larger than for the entire Holocene interval prior to 1950. Such force multipliers show that humans have geologically very recently acquired the energy levels, the population, and the resource (engineering) application to significantly and globally change the Earth system: abundant evidence of this transformation now exists in the stratigraphic record (Waters et al. 2016a; see fig. 1).

Whether ultimately formalized or not, this is a major change in our planet’s history, considerably sharper than most other boundary intervals of the Geological Time Scale and capable of being precisely defined stratigraphically. It is a phenomenon also sharply distinct from the first evidence of, or early trends in, anthropogenic traces on land. It would be obfuscatory to conceal this change under the cover of “a complex continuum.”

This stratigraphic record represents a precise, clear, and valid definition of “Anthropocene”—but it is not an exclusive one, and it may not be relevant to all fields of human-dimension scholarship. The interpretation of the Anthropocene as presented by Bauer and Ellis bears scant relation to the one we have described above. Rather, it resembles the Anthropocene proposal of Ellis et al. (2016; although they do not mention this proposal nor responses to it [e.g., Zalasiewicz, Waters, and Head 2017]); this former proposal by Ellis et al. was similarly nonviable as a Geological Time Scale unit and similarly obscured the post-mid-twentieth-century changes. Ellis et al. (2016) had argued that the Anthropocene should not be rejected but rather removed from the ICS mandate and recast in social science terms.

In the English language, many words bear multiple, distinct meanings (“nature,” for instance). Naturally, this risks confusion, but nevertheless we would not presume to “supplant”

other interpretations of the Anthropocene. The remit of the AWG is understandably to frame the Anthropocene in a geological context.

If such terms as Capitalocene and Plantationocene are thought useful by social-science communities to describe human influence on Earth, then perhaps this will resolve the “many Anthropocenes” in current use. These terms do not, however, “supplant” the “geological” Anthropocene, as they represent different concepts, from different contextual backgrounds, with social science interest on the socioeconomic drivers of change rather than on resultant Earth system behavior and its petrified and strata-bound consequences. Social science investigations are not irrelevant to understanding Anthropocene stratigraphic and Earth system change; to the contrary, the dynamics of human/technology interactions are clearly crucial to this question. Similarly, the Ordovician-Silurian boundary may be satisfactorily and pragmatically defined in strata even as the Earth system dynamics that drove this period-scale change remain unresolved, intensely debated—and hugely important.

The main thrust of Bauer and Ellis’s paper is captured by their claim that the stratigraphic and ESS definitions of the Anthropocene are based on “distinguishing a recent time when the Earth system was external to or unaffected by humans from a more recent period in which it is not.” This is obviously not true. The ESS definition is based on the evidence that the planet is on a strong trajectory out of the Holocene (and indeed out of the glacial-interglacial cycling of the late Quaternary) and that human activities are the primary driver of this trajectory (Steffen et al. 2016). This does not imply that there was inconsequential human influence on the Earth system before the Anthropocene. Of course there was, as the Bauer and Ellis paper shows in some detail. However, it was only since the mid-twentieth century that Earth system scientists can say with some confidence that a trajectory out of the Holocene clearly began. For them, placing a Holocene-Anthropocene boundary there seems natural and incontrovertible given the evidence. This parallels the stratigraphic perspective, where the putative Anthropocene series, although clearly characterized by a range of novel proxy signals (e.g., Waters et al. 2016a), negates Bauer and Ellis’s argument that the Anthropocene somehow represents a black-white divide between no human influence and massive human influence. The Holocene already accommodates the rich evidence of human environmental imprint (Gibbard and Walker 2014).

Bauer and Ellis fail to acknowledge the complex-system nature of our ocean-dominated planet and this importance for the Earth system definition of the Anthropocene. Complex systems have many definitions, but two features are common to all of them: (i) emergent properties at the level of the system as a whole that cannot be aggregated up from subsystems or individual components of the whole system and (ii) attractors or reasonably well-defined states that are characteristic of the system as whole. The Anthropocene is on a rapid trajectory away from the Holocene/interglacial attractor (or more appropriately, away from the glacial-interglacial limit cycle of

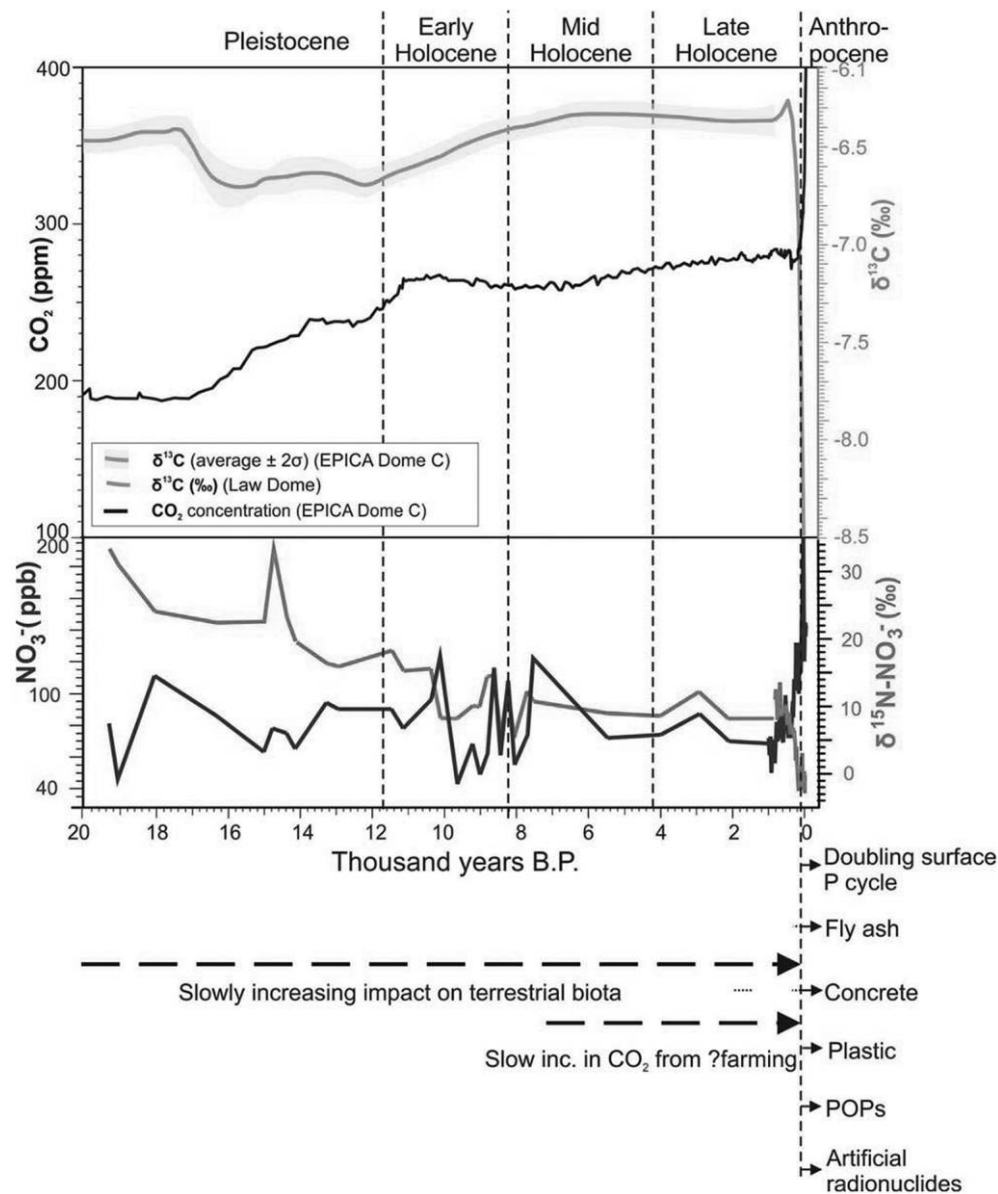


Figure 1. Geological identity of the Anthropocene: trends in key Earth system and stratigraphic indicators from the late Pleistocene to the present time. Note the largely gradual change (at this scale) across the Pleistocene/Holocene boundary, the general stability through the Holocene, the marked inflections, and the incoming of novel indicators that clearly demarcate a changed trajectory that we identify with the Anthropocene, most sharply defined from the mid-twentieth century. Adapted from Waters et al. (2016a) and sources therein. POPs = persistent organic pollutants. A color version of this figure is available online.

the late Quaternary) but is not yet an attractor in its own right. Bauer and Ellis detail the rich background to human development and influence on the Earth system but do not acknowledge our planet's shift as a complex system that began around the mid-twentieth century. The long anthropological story of human development occurred within the Pleistocene glacial-interglacial limit cycle (the Holocene being the latest interglacial) of the Earth system. In short, Bauer and Ellis confuse human influence on the Earth system with a change in state of the Earth system as a whole. This confusion has long

surrounded the Anthropocene concept and is not unique to their paper.

We emphasize that all these various approaches are non-exclusive and complementary, and we are puzzled as to why Bauer and Ellis should regard them as some kind of battlefield, with the Anthropocene as a singular trophy to be fought over and won or lost. Anthropologists and archaeologists, who search for and map out the early evidence of human activities and their patterns, offer much to the stratigraphic/ESS study of the Anthropocene (and, we trust, vice versa). Without the

evolving dynamics of human-Earth relations over the long term, the Anthropocene as we consider it here would not have happened. We note the genuine, wide-ranging, and generous interdisciplinarity that the Anthropocene has stimulated; this has been among the most positive features of this phenomenon. We dearly hope to see it continue and strengthen but note that interdisciplinarity does not mean an absence of disciplinary coherence.

Reply

Missing the Mark: On the Matter of Narrative and Social Difference

We are grateful to the commentators for engaging our essay and contributing to this forum. Their diverse perspectives emphasize the many distinct ways that the Anthropocene is being imported across the academy. Some see its utility as a political label, others stress its utility as a neutral geological period, and still others question its usefulness as either. While there is much agreement among the positions offered and the views we expressed in our essay, there are also significant points of misunderstanding or avoidance of our principal critiques of the Anthropocene periodization that deserve clarification in the interest of fostering productive interdisciplinary discussion.

The commentary of Zalasiewicz and colleagues of the Anthropocene Working Group was ostensibly the most critical of our position. Yet they also miscast our argument, evaded the more significant critiques that we foregrounded, and failed to acknowledge that the main Anthropocene narrative to which we and others are responding was in fact generated by Earth system scientists who promote the designation. To be clear, our essay does not challenge whether the Earth system is undergoing a state shift related to recent human activities or whether the magnitude of human impact has significantly increased. Rather, our essay problematizes the way in which geological systematics and the scientific narratives produced by Earth system scientists in accounting for this state shift frame historical processes and how that framing has been taken up by scholars.

Zalasiewicz et al. argue that we confuse “anthropogenic” for the “Anthropocene” (despite our explicit discussion of a tipping point and a recent state shift) and that we fail to recognize Earth as a “complex system.” Here they seemingly misunderstand our usage of the term “assemblage.” Similar to how natural scientists define “complex systems,” social scientists conceptualize assemblages as complexes of heterogeneous elements that, through their historical configurations and dynamic interactions, produce emergent outcomes—in other words, the whole is greater than the sum of its parts (cf. Bennett 2010; DeLanda 2006; Thomas 2015). We are aware that human activities do not simply add up to systemic change (cf. Turner et al. 1990), and

we are not denying that geological or historiographic periods have disciplinary utility—indeed, archaeologists make heavy use of periodizations, albeit primarily at regional scales (e.g., South Indian Iron Age). As Finney noted, our essay does not challenge the validity or usefulness of an Anthropocene chronostratigraphic unit to geological systematics, though as both Finney and Kaplan diligently point out, its utility remains far from certain (see also Ruddiman et al. 2015).

The thrust of our argument is that the Anthropocene divide, the separation of a pre-Anthropocene from the Anthropocene, neither represents a shift in human agency from being merely “ecological” to becoming fully “geophysical,” as many have argued (see below), nor helps us to understand the historical, cultural, and political processes through which humans contribute to and transform Earth’s functioning as a system. Zalasiewicz et al. reiterate the geological need for a globally isochronous marker for anthropogenic global change; our point is that such a marker would not capture the socially differentiated and diachronous character of historical human-environmental entanglements that have contributed to a state shift in the Earth system. While one might question the degree to which any periodization could reflect such historical processes—as Kaplan’s commentary lucidly addresses in considering the anachronism of the Geological Time Scale more generally—our concern is explicitly with how the Anthropocene periodization obscures connections between pre-Anthropocene/Anthropocene human-environmental relationships while also foreclosing socially differentiated understandings of human-environmental interactions with its emphasis on the species. Zalasiewicz et al. mistake our interests in the geophysical impacts of human activities in prehistoric periods and the previous call of Ellis et al. (2016) for broadening interdisciplinary discussion with an attempt to win the “Anthropocene as a singular trophy” and sidestep our actual concerns for how human-environmental relationships are understood and narrated, given the critical recognition that narratives, scientific or otherwise, have ideological and political consequences.

When Zalasiewicz et al. sardonically dismiss the variable “meanings” of the Anthropocene to claim that a geological Anthropocene references the period in which the Earth has undergone its most recent state shift and little more with respect to historical processes or different kinds of human agency, they are reinforcing disciplinary divides and blatantly ignoring that many of the Anthropocene’s principal advocates, including Earth system scientists responsible for promoting the term, have explicitly provided narratives of human history to accompany the geological designation. Steffen, Crutzen, and McNeill (2007), for instance, state that the Anthropocene is “the current epoch in which humans . . . have become a global geophysical force” and that their “objective” is to examine the “evolution of humans and our societies from hunter-gatherers to a global geophysical force” (614). Such historical claims imply that humans did not have (global) geophysical effects prior to the Anthropocene. Thus, as humanities scholars have taken up the Anthropocene as a period when humans transitioned from being eco-

logical actors to being “geological” actors, or the “inception of humanity as a geophysical force” (cf. Chakrabarty 2009; Morton 2013:7), they are not “confusing” the writings of Earth system scientists on the Anthropocene; rather, they are carefully considering the implications for their respective disciplines, such as Chakrabarty’s (2012) lucid recognition of “disjunctive” forms through which historical agency might be understood.

A primary concern of our essay is how the Anthropocene periodization has been taken up in such terms (e.g., geophysical vs. biological) and the ways in which it may, as Kaplan cogently remarks, “perpetuate the myth of a planet largely free of human influence in the latest preindustrial Holocene,” a myth that has heavily influenced “discussion surrounding a formal stratigraphic definition of the anthropocene.” In contrast to the suggestions of others, we stressed that the Anthropocene periodization cannot be taken as the beginning of humans’ “geophysical” impacts, as Zalasiewicz et al. also acknowledged. Moreover, explanations for the recent state shift in the Earth system must address prior intervals, especially if we accept that many human-related landscape transformations of thousands of years ago, such as the creation of methane producing irrigated landscapes and widespread deforestation, continue to affect the functioning of Earth’s biosphere and climate system today.

We welcome calls for complementarity and collaborations with archaeologists. However, interdisciplinary collaborations on relationships between human activities and Earth’s systemic functioning should not only mean sharing data or borrowing models but also learning from the critical perspectives that others bring—and this is especially relevant to narratives of the Anthropocene periodization. As archaeologists and historians know well, historical narratives are powerful in what they affirm and silence, ideologically (re)produce, and constrain and allow in discursive practice. Archaeologists, for instance, have been actively concerned with how their claims risk naturalizing or perpetuating presentist ideological constructs, such as those of nation or individual, or framing some humans as passive objects of history and others as its active makers (e.g., Leone, Potter, and Shackel 1987; Meskell 1998; Trigger 1980). As Earth scientists begin to write human history with archaeologists (or without them), we hope that they will be similarly open to such critical introspection.

In this regard, we disagree with Braje’s comments that our critique of the Anthropocene is tantamount to “fiddl[ing] while Rome burns.” While Braje “generally agree[s]” with our assessment of the Anthropocene’s obscuring tendencies, he nevertheless embraces the Anthropocene for its political work and appears less concerned with its occlusions (aside from arguing that it be extended to all of the Holocene). Although the contemporary politics of climate change were not the primary concerns of our essay, we nonetheless suggested how an uncritical acceptance of the Anthropocene periodization might actually work against a more inclusive environmental politics to mitigate the deleterious environmental effects of human activities.

To start with: it potentially naturalizes a recent state shift as a teleological outcome of human evolution; it silences social differences and responsibilities with its emphasis on the species; it risks denying forms of historical agency outside of recent Euro-American innovation; and it effectively reproduces a society versus nature ideology that paradoxically enables “deniers” to maintain the position that climate change is purely “natural.”

We have noted several of these concerns before (e.g., Bauer 2015b; Ellis et al. 2016), and one of us has expanded on the Anthropocene narrative’s complex implications for environmental politics in considerably greater detail through other collaborations and mediums (see Bauer and Bhan 2018 for discussion). Here we will simply stress that to cast our critique as superfluous “quibbling” is to overlook an important point: that a critical framing of the historical process might enable ways of shaping both social relationships and environmental outcomes other than what is made possible by an emphasis on the emergence of the species as a singular “geophysical force” that recently came to “dominate” those of nature. This is why we have stressed the need for a political ecology (e.g., Biersack and Greenberg 2006; Robbins 2012) and are sympathetic to calls for a Capitalocene and other sociopolitical orientations, even while acknowledging that a critical history of capitalism cannot be the entirety of our account or the only alternative (see Bauer and Bhan 2018). Braje seems less bothered by the political implications of the silences (*sensu* Trouillot 1995) in the received Anthropocene narrative. We disagree with him regarding their importance (see also Bonneuil and Fressoz 2017).

Ribot agrees with us that the Anthropocene’s generalizing tendencies, in focusing on “the species,” mask important questions about social differences and responsibilities. Yet he equates our framing of the functioning Earth system as a dynamic assemblage to a “Latourian-style” merging of nature and culture that may erase the possibility for “moral judgment and thus responsibility and response.” Ribot’s concerns that posthumanist approaches that “distribute” agency (*sensu* Bennett 2010) foreclose important questions of ethics and intentionality dovetail with the positions of many others (cf. Martin 2014; Van Dyke 2015). We share these concerns and stress that our calls for a political ecology and emphasis on inequalities in the production of socio-environmental conditions are hardly a charge for “flattened” agency or responsibility. However, not forgetting the range of materials and other-than-human organisms that also give shape to Earth and through which human actions are entangled and realized is important for recognizing how humans partly shape social and environmental conditions simultaneously. There are many good reasons for rejecting the hubris of Anthropocene narratives that suggest humans now “dominate” nature, as Finney also effectively points out. In response to Ribot’s principled concerns, recognizing the social effects of things or that the production of climate is ontologically distributed does not mean that everything is an equal actor or the same kind of actor or even that the same “thing” will have the same effects in different contexts (e.g., Bauer and Kosiba 2016; Kipnis 2015). Hence, it does not ex-

clude important questions of ethics, intentionality, or responsibility in regard to climate change; rather, it calls them to the fore in political discussion (see Bauer and Bhan 2018).

As these commentaries exemplify, there are many reasons why interdisciplinary discussions on the concept and utility of the Anthropocene should continue. As most of us agree, there is need to understand the historical entanglements of social conditions, materials, nonhuman life, and Earth system functioning. Moreover, there is still much to clarify as scholars are progressively drawn into conversations that go beyond the comfortable confines of their home disciplines, given that human-related climate change and mass extinctions are increasingly recognized as some of the greatest political concerns of our time. We the authors (Bauer and Ellis) have different disciplinary training and research objectives and are not in full agreement about the usefulness of the Anthropocene (or an anthropocene) designation to our respective fields or social concerns. However, that has not stopped us from finding common ground and learning from the critical perspectives that we can offer each other.

Narratives matter. “That which is said to have happened” recursively affects that which happens (Trouillot 1995:2). And this is just as true for narratives written by anthropologists, archaeologists, ecologists, and historians as it is for those written by geologists and Earth system scientists.

—Andrew M. Bauer and Erle C. Ellis

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