

Let's Not Talk About the Anthropocene

Jay Foster

Preview

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The Anthropocene: A New Paradigm or Mob Psychology?

The Hungarian philosopher of science Imre Lakatos once complained that Thomas Kuhn had reduced scientific research to “mob psychology.” In *The Structure of Scientific Revolutions* (1962), Kuhn famously suggested that scientific communities organized their inquiry around particular paradigms of successful research, like Copernicus’ heliocentrism, Lavoisier’s mass chemistry or Faraday’s field theory. Kuhn’s paradigms have a family resemblance with Lakatos’ research programs, so it’s likely not this feature of Kuhn’s account that irritated Lakatos. The irritation was Kuhn’s further suggestion that scientists changed paradigms or research for reasons that were basically arational if not entirely irrational. The community of researchers is guided less by reason and logic and more by a psychological impulse to chase after specific scientific successes or potential successes. This impulse was colourfully described as a “contagious panic.”¹ Whatever the specific merits of Lakatos’ characterization of Kuhn, it would seem difficult to deny that, for better or worse, there is at least a little mob psychology at work in academic research. The recent stampede towards “the Anthropocene” may be an apt example.

This relatively new term began to work its way into the academic lexicon in 2002 when the Nobel prize-winning atmospheric chemist Paul Crutzen published a “concepts” piece in the journal *Nature* with the title

¹ I. Lakatos, “Falsification and the Methodology of Scientific Research Programs” in I. Lakatos and A. Musgrave, *Criticism and the Growth of Knowledge* (Cambridge: Cambridge University Press, 1970), 178.

“Geology of Mankind.”² The one-page article proposed that the Earth had passed from the Holocene into a new geological era which he dubbed “the Anthropocene.” The concept really caught on. By about 2010, what Jedediah Purdy calls “Anthropocene fever” was sweeping through not just the geosciences but also the humanities.³ Between 2010 and now, a bevy of books on the Anthropocene have been published in disciplines ranging from STS to environmental history, and from environmental ethics to gender studies. Arguably, it has become *the* hot topic of humanities research. The Anthropocene may have appeared in the humanities along with a noteworthy flurry of activity and excitement, but in most respects, it has been academic business as usual. The newly published volumes work on a recognizable model: rehash a well-established topic in the humanities or social sciences and add the phrase “in the Anthropocene.” Long-standing concerns and well-worn paths of analysis are thus momentarily re-invigorated. The critique of capitalism, the nature-culture distinction, cybernetic post-humanism, the domination of nature, ecological stewardship and virtue ethics are all familiar topics, and all have been re-venerated by the Anthropocene.

Just in case an accusation of cynicism is raised, let’s sample some topics and titles. First, the Anthropocene as a matter of life and death: *Learning to Die in the Anthropocene: Reflections on the End of a Civilization* (2015), *Defiant Earth: The Fate of Humans in the Anthropocene* (2017), and *Future Remains: A Cabinet of Curiosities for the Anthropocene* (2017). Next, the Anthropocene as the moment of reckoning for the contradictions of capitalism: *Anthropocene or Capitalocene?: Nature, History and the Crisis of Capitalism* (2016), and *Facing the Anthropocene: Fossil Capitalism and the Crisis of the Earth System* (2016). And, the Anthropocene as an outcome of systemic oppression and domination: *Anthropocene Feminism* (2017), and *Anthrozoology: Embracing Co-Existence in the Anthropocene* (2016). Finally, the Anthropocene as a new moment for thinking about long-standing ethical issues: *The Anthropocene Project: Virtue in the Age of Climate Change* (2015), *Stray: Human-Animal Ethics in the Anthropocene* (2017) and *The Next Social Contract: Animals, the Anthropocene and Biopolitics* (2017). The cybernetic dimension of this ethical discussion appears in: *Love Your Monsters: Post-environmentalism and the Anthropocene* (2011), and *Staying With the Trouble: Making Kin in the*

² P. Crutzen, “Geology of Mankind,” *Nature* 415 (3 January 2002), 23.

³ J. Purdy, “Anthropocene Fever,” *Aeon Magazine* (31 March 2015).
<https://aeon.co/essays/should-we-be-suspicious-of-the-anthropocene-idea>. Retrieved 2 October 2016.

Chthulucene (2016). This is, of course, not an exhaustive list. It is merely a sampling of books (never mind journal articles) to show how the Anthropocene is being discussed in terms of familiar concerns. I still may be accused of being cynical. My only further reply is to quote Sir Humphrey Appleby: “A cynic is what an idealist calls a realist.”⁴

Although humanists and scientists have been quick to trade on the Anthropocene, there is, perhaps unsurprisingly, no clear consensus about the meaning of the term. As Amelia Moore remarks in the editorial introduction of a special edition of the journal *Environment and Society* dedicated to the Anthropocene, there are already “multiple Anthropocenes to grapple with,” each perhaps reflecting a different subtype of “ecological anxiety disorder.”⁵ At its most general, the Anthropocene is an informal term that gestures towards the extensive effects of human action on the global environment. In this general sense, the Anthropocene is just an expression of the present state of our environmental anxiety, just as “the population bomb” and “sustainable development” were in their times. In other contexts, the Anthropocene is sometimes raised as a flag for the so-called “environmental humanities,” an agglomeration of environmental history, environmental ethics, ecofeminism, and ecocriticism with significant contributions from physical and cultural geography and cultural anthropology. In still other places, the Anthropocene is allied with “integral ecology.” The basic idea here is that human degradation is inseparable from environmental degradation, so social justice and environmental justice cannot be addressed separately.

Despite these vagaries, in the humanities and social sciences engagements with the Anthropocene are very often attempts to clarify the concept of nature and the relationship between nature and culture. This line of discussion generally takes as its starting point anthropogenic climate change or human-produced reductions in global species diversity. From this starting point, it follows that if human culture has changed nature globally, then nature has in an important sense become culture. Nature is remade in the image of culture. The line of argument also flows in the other direction. Humans do not just domesticate some parts of nature for their use, rather they wholly transform nature. Domestic animals and hybrid plants, among other things, are arguably cultural

⁴ Jonathan Lynn and Anthony Jay, *Yes, Minister* (1982), “The Moral Dimension,” Season 3, Episode 4.

⁵ Amelia Moore, “The Anthropocene: A Critical Exploration,” *Environment and Society: Advances in Research* 6 (2015), 1-3 at 1. See also Amelia Moore, “Anthropocene Anthropology: Reconceptualizing Contemporary Global Change,” *Journal of the Royal Anthropological Institute* 22 (2015), 27-46 at 32-34.

artifacts. Culture is remade in the image of nature. If the nature-culture distinction is suspect, then arguably a series of other distinctions become suspect: *physis/nomos*, natural/artificial, wild/domesticated, wilderness/cities, description/prescription, fact/value, modern/premodern. Unsettling these distinctions very likely has knock-on consequences for the methods of the humanities and social sciences, though exactly what those consequences are is open to dispute.

For example, the philosopher and anthropologist of science Bruno Latour argues that the arrival of the Anthropocene confirms an argument that he has been making for many years now. What defines modernity, Latour argues, is the claim that political and moral difference might be arbitrated by scientific matters of fact. In other words, that nature might settle human disputes. This, of course, presupposes that human disputes do not themselves modify nature, that nature is independent of the human. The arrival of the Anthropocene clearly shows that the natural and the human could never be separated in the way that moderns promised. In the age of the Anthropocene, Latour argues, we turn to face James Lovelock's Gaia and find ourselves relevant to the geohistory of the Earth in ways disavowed by orthodox Copernicanism and Darwinism. As Latour grand-eloquently states, "we witness the step-by-step destruction of the Galilean idea of the Earth as one body among other spatial bodies. We are forced to turn our gaze back to sub-lunar Gaia, so actively modified by human action that it has entered a new period that geologists-turned-philosophers propose to label the Anthropocene."⁶

Much like Latour, the historian of post-colonialism Dipesh Chakrabarty has also argued that the arrival of the Anthropocene, indicated by anthropogenic climate change, calls for a revised understanding of human history and politics that is more tightly enmeshed with nature as it appears in geology, zoology and chemistry. Unlike Latour, Chakrabarty does not take the Anthropocene to signal the exceptionality of the human-modified-Earth. "We do not represent any point of culmination in the story of the planet," he writes.⁷ Instead, Chakrabarty argues that the human can no longer be explained using methods and techniques special to the humanities and social sciences. For example, the notion that human history should aim at greater and human

⁶ Bruno Latour, "Telling Friends from Foes in the Time of the Anthropocene," Clive Hamilton, Christophe Bonneuil and Francois Gemenne, eds., *The Anthropocene and the Global Environmental Crisis: Rethinking Modernity in a New Epoch* (New York: Routledge), 145-155 at 145.

⁷ Dipesh Chakrabarty, "Humanities in the Anthropocene: The Crisis of an Enduring Kantian Fable," *New Literary History* 47 (2016), 377-397 at 394.

autonomy and freedom will no longer work without significant qualification. The problem is that, “The mansion of modern freedom stands on an ever-expanding base of fossil-fuel use. Most of our freedoms so far have been energy intensive”⁸ This point is just the tip of the iceberg, however. Historical methods in the humanities have tended to emphasize the *contingency* of human history. Humans might have chosen otherwise, and so history could have been different. The belief that there is freedom in history is also carbon intensive, as Chakrabarty argues. Even if history had been different and, say, global inequality had been confronted, then there still would have been anthropic climate change. No matter how wealth is distributed, its production depends on fossil fuel. A socialist utopia would have been just as energy intensive as capitalist dystopia, perhaps even more so. Thus, anthropic climate change confronts the humanities with a serious case for a new kind of determinism in human history.⁹

Whereas Latour’s Anthropocene takes human agency in geohistory to call for an anti-Copernican turn, Chakrabarty’s Anthropocene calls for a rethinking of human freedom as part of a deterministic natural environment. This kind of disagreement about human exceptionalism is not restricted to informal discussions of the Anthropocene in the humanities. Assumptions and claims about human exceptionalism are at work even in formal discussions of the Anthropocene carried out largely in the scientific community. The main aim of this paper is to show how these assumptions are often implicit in the discussions and debates that are focused on evaluating the Anthropocene as a formal geological unit. Whether or not the Anthropocene epoch is nominated as a designation in geochronology ultimately will be decided by a series of ballots within the International Commission on Stratigraphy (ICS). The Anthropocene Working Group (AWG) within the ICS is presently evaluating the evidence for nominating the Anthropocene. The AWG recently held a preliminary vote on a number of key questions about the Anthropocene. The results of that vote are interesting for what they say about how the Anthropocene is being defined. But, as the first section of the will paper will suggest, from a philosophical vantage point, the very fact of voting on definitions by

⁸ Dipesh Chakrabarty, “The Climate of History: Four Theses,” *Critical Inquiry* 35 (2009), 197-222 at 208.

⁹ Chakrabarty, “The Climate of History,” 217-218. The details of this line of argument are developed and discussed elsewhere. Dipesh Chakrabarty, “Climate and Capital: On Conjoined Histories” *Critical Inquiry* 41 (2014), 1-23. Dipesh Chakrabarty, “The Politics of Climate Change Is More Than the Politics of Capitalism” in *Theory, Culture & Society* 34 (2017), 25-37.

stratigraphers and other scientists is itself interesting. It highlights that at least some areas of scientific classification are a nominalist enterprise in both a literal and philosophical sense. The second section of the paper discusses the stratigraphic and geochronological criteria that the AWG must meet in order to make a persuasive case for the Anthropocene to the ICS as a whole.

To make its case, the AWG must show that the Anthropocene is stratigraphically manifest, persistent and salient. Human effects are already manifest in the Earth's stratigraphy, and some of those effects are expected to persist in the rock record for millennia. But, as will be argued, the case for salience is much harder to make. It is less clear why distinctively human stratigraphic effects deserve special geochronological recognition. The issue is that many other species have transformed the Earth and have left enduring marks in the geological record. None of these species, however, receive quite the same recognition that humans will receive should the Anthropocene be formally recognized. This human exception is usually explained by a variety of direct and indirect appeals to the uniqueness of human self-awareness. Humans are different because they are the first species to know that they are changing the Earth's environment. The specific difference that is being taken to define the Anthropocene is not geological but largely Cartesian and a little Hegelian. The AWG, and eventually the ICS, might be happy nominating the Anthropocene as a formal unit of geochronology on the basis of human self-awareness. But before that vote is cast, the question of self-awareness needs to become an explicit part of the Anthropocene debate since it has not yet been made clear how human self-awareness is itself manifest in the Earth's stratigraphy.

Voting for the Anthropocene

The term "Anthropocene" was coined independently by biologist Eugene Stoermer and atmospheric chemist Paul Crutzen as early as the 1980s. The pair began to popularize the term "Anthropocene" in a jointly-authored article published in a newsletter by the International Geosphere-Biosphere Programme (IGBP) in 2000. According to Stoermer and Crutzen, humans have begun to transform the Earth on a "telluric scale." They argued that key to the geological transformation of the Earth by human activity is the release of carbon dioxide, sulphur dioxide and nitrous oxide from coal and oil burning, the transformation of 30-50% of the Earth's land surface, and de-speciation by the destruction of habitats. These and other human activities have altered conditions on the planet to such an extent that we

have created a new geological epoch. The previous epoch, the Holocene (which dates back to the end of last glacial period 11,700 years ago), has been surpassed.¹⁰ A much condensed form of the IGBP piece appeared as a “concepts” article in the eminent science journal *Nature* in early 2002 under the sole authorship of Paul Crutzen. That piece opened by suggesting that, “it seems appropriate to assign the term ‘Anthropocene’ to the present, in many ways human-dominated geological epoch supplementing the Holocene—the warm period of the past 10-12 millennia.”¹¹

The Anthropocene remains an informal designation for the current geological epoch. It is not a formally defined geological unit in the Geological Time Scale maintained by the International Commission on Stratigraphy (ICS), the largest scientific organization within the International Union of Geological Sciences (IUGS). In 2009, the ICS formed the Anthropocene Working Group under the stewardship of geologists Jan Zalasiewicz and Mark Williams. Thirty-three other members were added to the Working Group, mostly men and mostly from Europe and North America. Many group members have expertise in “paleo” research, like paleobiology and paleoclimatology, while several others are climate scientists and specialists in terrestrial, atmospheric or ocean geochemistry. Perhaps unusually, historian of geology Naomi Oreskes and environmental historian J.R. McNeill along with *New York Times* environment journalist Andrew Revkin are also members. Revkin had proposed the term “anthrocene” in 1992 though the term did not become fashionable.¹² While Oreskes is now well-known for *Merchants of Doubt* (2010) coauthored with Erik Conway, she has also written on the history of continental drift and plate tectonics. J.R. McNeill is the son of William H. McNeill who wrote *Plagues and Peoples* (1976), a pioneering work of environmental history in the *longue durée*. McNeill Jr. continues that tradition. In recent work, he argues that the twentieth-century has seen a “Great Acceleration” in human economic activity which has left distinct anthropic marks on the environment.¹³

¹⁰ Paul J. Crutzen and Eugene F. Stoermer, “The Anthropocene” in *Global Change Newsletter* 41 (May 2000), 17-18.

¹¹ Crutzen, “Geology of Mankind,” 23.

¹² Will Steffen, Jacques Grinevald, Paul Crutzen and John McNeill, “The Anthropocene: Conceptual and Historical Perspectives,” *Philosophical Transactions of the Royal Society A* 369 (2011), 842-867 at 843.

¹³ McNeill traces the origin of the term to a 2005 Workshop which was attended by himself, Paul Crutzen and Will Steffen among others. He credits Steffen with popularizing the term in the “global change science community.” J.R. McNeill and Peter

In their initial recruitment letter to prospective members, Zalasiewicz and Williams remarked that the group's work, "should not be onerous, nor costly (as with most ICS business, we envisage that most interchange will take place by e-mail)." Given the rapid proliferation of the Anthropocene, one wonders if this prediction and promise held true. As of 2017, the interdisciplinary Working Group has made no formal recommendation to the ICS. Yet, in 2016 at the 35th International Geological Congress in South Africa it presented its "summary of evidence and provisional recommendations" to a regular session on the congress simply titled "Anthropocene: Utility and Definition." On behalf of the group, Colin Waters, the AWG Secretary, presented the paper, "The Anthropocene: Overview of Stratigraphical Assessment to Date." The paper outlined the extent to which the AWG had reached consensus that stratigraphical signals indicated the geological onset of the Anthropocene.

To establish the scientific consensus the 35 AWG members voted on six key questions.¹⁴ The first question was, "Is the Anthropocene stratigraphically real?" This question asks whether anthropogenic changes to the earth system are genuinely manifest in the permanent rock record, not merely in changes to ocean and atmospheric chemistry and to the distribution of flora and fauna. Thirty-four members voted "for" and just one abstained indicating that the AWG are in near-unanimous agreement that there are clear signals of human induced geological change. The next question was: "Should the Anthropocene be formalized?" This question asks whether the manifest geological change should be understood as a part of an already recognized geological time scale, or whether the Anthropocene should be recognized as a new and unique unit of geological time. Again, the result of the vote was overwhelming: 30 votes were in favour of formal recognition, three against and one abstention.

The third question was "Hierarchical level of the Anthropocene?" When Crutzen and Stoermer first proposed the Anthropocene they suggested that it was a new geological Epoch, but neither were professional geologists and the Epoch is only one possible geological time scale. The Anthropocene might also be categorized as a longer geological Era or Period or as a shorter geological Sub-epoch or Age. The categorization is not arbitrary but depends on the extent and kind of

Engelke, *The Great Acceleration: An Environmental History of the Anthropocene since 1945* (Cambridge, Mass.: Harvard, 2014), 213-214.

¹⁴ These questions appear to have been formulated by the AWG and define the focus of its work on "what might be regarded as narrow technical aspects." C. Waters and J. Zalasiewicz, "Report of Activities 2012," *Newsletter of Anthropocene Working Group 4* (2013), 1-16 at 2.

available evidence in the rock strata. The Anthropocene will be classified as being a Period, Epoch or Age in geological time, depending on whether there is geological evidence for a system, series or stage of geological strata. When asked “Hierarchical level of the Anthropocene?,” 20.5 votes were cast in favour of it being classified as an Epoch indicating that a strong majority of the AWG thought that the Anthropocene could be well-enough identified by a stratigraphic series. Just 3.5 votes were cast in favour of the Anthropocene being a long Era or Period, and just 3 votes were cast in favour of the Anthropocene being a shorter Sub-epoch or Age. There were 3 votes cast in favour of the timescale being “uncertain,” one in favour of the Anthropocene not having a time scale, and 4 abstentions.

Two of the voting questions posed to the AWG members were closely related. The fourth question: “Base/beginning of the Anthropocene” asks when the Anthropocene might be said to begin. The “base” being the bottom of Anthropocene strata, and the beginning being a chronological starting point. The six and last question was: “What is the primary signal?” This is to ask what physical or chemical feature of the strata marks the beginning of the Anthropocene. The questions are related because to ask a question about the stratigraphic “base” of the Anthropocene is also to ask a question about what features or “signals” characterize that base. 28.3 members were in favour of marking 1950 as the starting date of the Anthropocene. They also voted in favour of characterizing the Anthropocene with a GSSP—a Global Boundary Stratotype Section and Point or colloquially “a golden spike”—which is a specific point on the Earth where the stratigraphy that characterizes the epoch is visible and accessible.

Despite this agreement there was, at least on the surface, much greater disagreement about the primary stratigraphic signal marking the onset of the Anthropocene. 10 votes were cast for Plutonium fallout. Most isotopes of plutonium, the 94th element on the periodic table, are not found in the rock record before extensive atomic bomb development and detonations began in about 1950. Another four votes were cast in favour of marking the Anthropocene with the “radiocarbon bomb spike” also tied to the development of nuclear weapons. The atmospheric testing of nuclear weapons in the 1950s and 1960s dramatically increased the abundance of the carbon-14 isotope in the Earth’s atmosphere. The relative abundance of atmospheric carbon-14 is also changed by fossil-fuel carbon dioxide emissions since carbon-14 deposited about 300 mya in the Carboniferous period has long since decayed to nitrogen-14. Two group members voted in favour of the stratigraphic effects of this shift in carbon

isotopes being the relevant signal of the Anthropocene. Other candidate signals receiving votes were: plastics (three votes), fuel-ash particles (two votes), atmospheric carbon dioxide concentrations (three votes) as well as lead, persistent organic pollutants, and technofossils (three votes). Two members were uncertain and six abstained.¹⁵

This distribution of votes might be taken to suggest that there is no clear consensus about the “primary signal” for the Anthropocene, and that the marker for the proposed epoch remains controversial among AWG members. However, the voting pattern may suggest greater disagreement than in fact exists. The various rock signals that might mark the Anthropocene boil down into three clusters. The signals “fuel ash particles,” “carbon dioxide concentration” and “carbon isotope change” are all markers that are an outcome of the use of fossil fuels. Together they receive seven votes. Similarly, “plastics” and “lead, persistent organic pollutants and technofossils” are outcomes of advances in industrial and organic chemistry after about 1880 and mainly in the twentieth century. Together these received six votes. The signals “radiocarbon bomb spike” and “plutonium fallout” are both consequences of the atmospheric testing of nuclear weapons. Together they received 14 votes. There is certainly no majority consensus but it may be reasonably inferred that the AWG is leaning towards the development of nuclear weapons and nuclear power marking the Anthropocene’s onset. Fossil-fuel emissions and the residues of industrial and organic chemistry remain in the running. If there are future votes, a change of mind by the eight group members who have abstained or are uncertain could shift the AWG consensus to the nuclear option or make fossil-fuels and chemical remains the stronger candidate. Much might change in the run-up to the AWG’s final recommendations. Once the AWG makes its recommendation on defining a formal Anthropocene unit it will be referred to the Subcommittee on Quaternary Stratigraphy (SQS) whose members will vote on the proposal and must approve it by a 60% supermajority. In turn, once the SQS gives approval then the formal definition will need to be ratified by a further supermajority vote by the members of the ICS.¹⁶

The very idea of voting on the Anthropocene may seem peculiar, perhaps even unscientific. What has prevailing opinion, even among a

¹⁵ University of Leicester, “Media Note: Anthropocene Working Group (AWG),” (29 August 2016). <https://www2.le.ac.uk/offices/press/press-releases/2016/august/media-note-anthropocene-working-group-awg>. Retrieved 13 October 2016.

¹⁶ Richard Monastersky, “Anthropocene: The Human Age,” *Nature* (11 March 2015). <https://www.nature.com/news/anthropocene-the-human-age-1.17085>. Retrieved 10 May 2017.

group of experts, to do with truth and falsity, right and wrong? A majority opinion does not constitute a justified true belief, the *locus classicus* of epistemology. Doesn't the scientifically and epistemically responsible way of going about identifying the Anthropocene demand putting aside opinions and letting the facts speak for themselves? If there are matters of fact that determine whether or not we are in a new geological period, then surely "scientific consensus" should be reached by deliberating about the matters of fact. And, if the facts do speak for themselves, then the expectation would be that scientists (as rational agents) would be in agreement about the signals and chronology of the Anthropocene. That is, if scientists by virtue of being scientists share a common scientific view of rationality, then there would be no room or opportunity for disagreement about matters of fact or inferences from those facts. All well-trained scientists would reach a common conclusion because they proceeded reasonable, methodically and perhaps even algorithmically from established matters of fact to the conclusion. On such a model, there would be no need to have votes. If there were a completely unnecessary vote, then the vote really should be unanimous.

This model or "image of science" clearly does not reflect the practices of the AWG which (rightly) takes voting to be a perfectly normal and respectable part of their deliberations about the geological status of the Anthropocene. The very idea that there are different "images of science" was hinted at in the opening line of Kuhn's *Structure of Scientific Revolutions*. There Kuhn suggested that being attentive to the history of science would "produce a decisive transformation in the image of science by which we are now possessed." Kuhn's point was that we tend to become fixed on science as a "constellation of facts, theories, and methods collected in current texts." Attention to accepted scientific knowledge gives us a different image of science than the image we get when we pay attention to how new scientific knowledge gets made, how old scientific knowledge gets dismissed, and in general, how science actually gets done. Exploring science in action was crucially important to Kuhn, and those inspired by Kuhn, because the facts and theories present in current science textbooks rarely stays current for long. This isn't just true at the cutting, bleeding edge of research. Even settled science may not stay settled. Thus, for Kuhn and many subsequent science studiers, it is how scientists reach at least some modest consensus about appropriate and inappropriate lab practices, canons of evidence, good and bad reasoning, relevant matters of fact and a host of other issues that are constitutive of the sciences. Scientific communities no less than any other community must have a way of resolving disagreements about "incompatible modes of community

life,” to use Kuhn’s words. Voting is one way a scientific community may reach a consensus or settle disagreements.¹⁷

Voting is not merely a peculiar practice of stratigraphic science and geochronology. It is a practice common to the sciences. On 24 August 2006 at a meeting in Prague, the International Astronomical Union (IAU) voted on four resolutions on the “Definition of a Planet,” the “Definition of a Classical Planet,” the “Definition of a Pluto-class object” and the “Definition of Plutonian Objects.” Voting took place at a plenary session held in an auditorium, and it was conducted by IAU members indicating their support for a resolution by holding up a yellow card printed with the IAU logo and the word “VOTE” in the centre (Figure 1) . The IAU’s votes passed the resolutions defining a planet (“by a great majority”) and a Pluto-class objects (237 for, 157 against and 17 abstentions.) The Union did not pass resolutions on the definitions of a classical planet (“many more against” than for) or on Plutonian objects (183 for and 185 votes against). As a result of the vote, the IAU adopted a new definition of a planet as a celestial body that is: “(a) in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round shape, and has cleared the neighbourhood around its orbit.” In the newly adopted nomenclature, Pluto became a dwarf planet and became “the prototype of a new category of trans-Neptunian objects." Pluto’s change in status meant it was no longer a planet in our solar system. The solar system no longer had nine planets. As a result, schools everywhere had to order new wall charts, murals had to be repainted, and armillary spheres needed retooling.

¹⁷Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago, 1970), 94.



Figure 1: IAU 2006 General Assembly Vote¹⁸

By the IAU's vote, Pluto ceased to be a planet just as by voting the ICS will decide whether the Earth has entered a new era of geochronology. Of course, the IAU vote changed nothing about Pluto itself, just as the ICS vote will change nothing about the Earth. When scientists vote, they vote about definitions for categories of things, and obviously, voting doesn't change things in the world. These votes are quite literally voting for, or better *nominating*, an essence for a category. What properties are essential for something to be a planet? What properties essentially characterize the Anthropocene? There need be no unanimity about nominal essences, majority opinion in a community of relevant experts is quite sufficient. And, on different days with different members of a scientific community present, votes might go different ways. Pluto might still be a planet, if a different definition of planet were nominated. That would mean that our solar system would have ten or more planets. The asteroid Ceres might qualify as a planet by some definitions, as might a number of icy-dark Kuiper belt objects orbiting beyond Pluto: Eris, Haumea, Makemake, and possibly but not probably a Planet Nine.¹⁹ Similarly, if the AWG were comprised of a different

¹⁸ <https://www.iau.org/news/pressreleases/detail/iau0603/>. Retrieved 8 June 2017.

¹⁹ Not to be confused with Planet X.

membership, then the outcome of the preliminary AWG vote may have been different. The AWG might have voted that there have been insufficient evidence to warrant demarcating the Anthropocene from the Holocene. This need not involve any oversight or neglect of evidence. The working group might have simply suggested that all potential evidence of the Anthropocene should be included in an enlarged notion of the Holocene. As it happens in its preliminary vote, the AWG agreed that there is evidence for the Anthropocene. But clearly individual group members did not reach this consensus for the same reason. Different voters had different reasons for voting for the Anthropocene. There is, as yet, no clear majority consensus about which evidence essentially characterizes the Anthropocene. Some point to the residues of fossil fuels, others point to persistent organic pollutants and others to technofossils, while a slender majority point to the lingering isotopes of nuclear weapons and power. Ultimately which essence is nominated will be decided by further votes by the AWG, the SQS and the ICS.

Naming Without Necessity

The notion that the AWG and IAU nominate the essences of categories in their voting practices harkens back to John Locke. It isn't clear if any member of AWG or the IAU ever had Locke in mind as they went about electing definitions. I will bet that they didn't. Nevertheless the process by which groups of scientists in a discipline or field nominate a definition is strikingly reminiscent of Locke's account of a nominal essence. In his discussion of sorting and classification in *The Essay Concerning Human Understanding* (1690), Locke famously distinguished between nominal essences and real essences. For most philosophers prior to Locke, an essence was that part of the substance of a thing that makes it what it is. Individual things were of a common kind because they shared an essence. Locke was rightly suspicious of such "real essences." It wasn't clear where the essence came from when things were created or disappeared to when things perished. In an atypically ecological moment, Locke observed: "that which was grass to-day is to-morrow the flesh of the sheep; and within few days after becomes part of a man."²⁰ His sensible, loam-footed alternative was to suggest that many sorts of things or kinds are created by people in their practices of classification. Essences of these kinds were nominal, made by people when they agreed upon definitions. The upshot of this position is that the world need not be pre-sorted into

²⁰ John Locke, *An Essay Concerning Human Understanding* (1691), bk.3, ch.3, sec.19.

natural kinds which we discover. Instead, decisions are made about how to divide up the world. The world is divided not at its pre-established joints but according to conventional definitions. The emphasis on convention that follows from Locke's nominalism could be taken as a rejection of real essences. If essences are nominal, then essences cannot also be real. Locke never quite says this. His position was just that when we observe sheep, minerals, planets or geological epochs we never *see* the real internal, "constitution of things, whereon their discoverable qualities depend."²¹ Given that we never experience the way things really are, we can never know with absolute certainty that the essence we have nominated is actually the real essence. It may be right but we just can't know for sure. So, Locke didn't reject real essences, he merely questioned their knowability.

One outcome of claiming that real essences are unknowable is that in the sciences and elsewhere there may be very different ways of categorizing the world that are equally legitimate and not merely notational differences. On some definitions, Pluto is a planet along with Eris, Haumea and Makemake, and on other definitions, Pluto is not a planet but a trans-Neptunian object. Both definitions are empirically adequate which means that the choice among definitions will be made on the basis on non-empirical criteria, like simplicity, historical precedent, the organization of current research or other interests.²² Even though non-empirical criteria decide between definitions, the adoption of one definition rather than another changes the truth or falsity of some statements. Before 24 August 2006, "Pluto is a planet" and "There are nine planets in the solar system" were both true statements. Both statements were false afterwards. This implies that at least some features of a truthful science are contingent. They are contingent not in the cosmic or metaphysical sense that nature might have unfolded in a different order. They are contingent in the humdrum epistemic sense that people might elect to define kinds or sorts of things differently. Humdrum contingency should not be confused with capriciousness, however. That a definition of a kind or sort is conventional does not mean that it is arbitrary. For example, in Canada we drive on the right hand side of the road whereas people in England and Japan drive on the left. These are different conventions that are equally adequate at dealing with the chaos of arbitrarily driving on either side of the road. The choice of which

²¹ Locke, *Essay*, bk.3, ch.3, sec.15.

²² This is not to suggest that no vote would be needed if there were "adequate empirical evidence, since the very criterion of empirical adequacy is not *prima facie* and must itself be agreed upon.

convention to observe likely emerged gradually for various historical reasons in different countries, but driving practices could be re-decided by a vote, as might the definition of a planet or existing geochronology.²³

The twentieth-century arch-nominalist Nelson Goodman amplified these broadly Lockean points in his book *Ways of Worldmaking* (1978). Goodman also resisted charges that nominalism made truth a purely arbitrary affair. He countered by suggesting that: “Willingness to accept countless true or right world-versions does not mean that everything goes, that tall stories are as good as short ones, that truths are no long distinguished from falsehoods, but only that truth must be otherwise conceived than as correspondence with a ready-made world.”²⁴ In the last pages of the book, Goodman tells us, “rightness of categorization, which enters into most other varieties of rightness, is rather a matter of fit with practice” and “without the organization, the selection of relevant kinds, effected by evolving tradition, there is no rightness or wrongness of categorization.”²⁵ Goodman’s nominalism puts the work of the AWG in a specific and interesting light. From a Goodmanian point of view, the members of the Anthropocene group are engaged in a process of evaluating the ways in which the Anthropocene is a “relevant kind” *not* whether it is a natural kind. Perhaps it seems obvious that the Anthropocene is relevant in light of the evidence for anthropogenic climate change. But, the issue is geological not climatological. The AWG must consider whether or not the stratigraphic evidence for the Anthropocene is commensurate with the evidence for other geological eras. In making its case, the AWG must, in a Goodmanian fashion, strike a balance between showing that the Anthropocene fits within established practices of geochronology and making a case for “evolving tradition” to accommodate the new era. Assessing whether the Anthropocene is a relevant kind is more complex than simply determining whether there is a new “joint” in geochronology. It involves debating practices of stratigraphy and geochronology.

²³There is no magic or special sauce that makes a convention. Conventions are where we find them, which is to say that they are simply regularities. If there is a difference to be made between a convention and a regularity, then it isn’t yet clear how to make it. As David Lewis has observed in the context of a discussion in the philosophy of language: “the conventions of language are a myth. The sober truth is that our use of language conforms to regularities—and that is all.” See David Lewis, *Convention: A Philosophical Study* (Oxford: Blackwell, 2002), 2.

²⁴ Nelson Goodman, *Ways of Worldmaking* (New York: Hackett, 1978), 94. I would prefer to say something like, “not all truths need be conceived as correspondence with a ready-made world.”

²⁵ Goodman, *Worldmaking*, 138.

The AWG's preliminary vote was strongly in favour of nominating the Anthropocene as a new geological era, though this might be expected. It is, after all, the *Anthropocene* Working Group and there may be a selection bias inherent in having sufficient expertise to be invited to join the group and in having sufficient interest in the Anthropocene to accept the invitation.²⁶ The AWG notwithstanding, not all Earth scientists are happy with the new unit of geochronology. As should be expected in the sciences, a variety of arguments have been mustered questioning the Anthropocene by arguing that adopting the proposed epoch would require significant departures from established conventions of geochronology. Geologists Stanley Finney and Lucy Edwards suggest that the Anthropocene is a "political statement" insofar as "human impact on the Earth must be officially recognized, if for no other reason than to make the public and governmental agencies aware of that impact."²⁷ On behalf of the AWG, Zalasiewicz et al. have responded by affirming that the Anthropocene is a geologically relevant kind not just a politically relevant kind. The two positions smack of no-longer fashionable distinctions between facts and values. Indeed, it isn't clear if a separation between science and politics is possible, necessary or even desirable in establishing whether the Anthropocene is a "relevant kind." These are large and difficult issues about the nature of scientific inquiry, but fortunately the AWG's issue is much narrower. The Group just needs to show that their evidence for the Anthropocene is drawn from clear stratigraphic evidence, and that the kinds of evidence on offer are not extraordinary. The case for the Anthropocene must be shown to be sufficiently in-keeping with the traditions of decision-making that have informed the adoption of other units in the ICS's geochronology.

The AWG notes that the ICS uses "a variety of criteria" to decide whether a stratigraphic "system, series or stage is different from one another, and warrants a distinct name."²⁸ In the case of the Anthropocene, the AWG acknowledges that, "Not all the signals that may be used to help trace an Anthropocene boundary within these deposits are clear-cut."²⁹

²⁶ Michael Walker who contributed to the formalization of the Holocene by the ICS in 2008 resigned from the AWG in 2014. While Walker praises the work of the AWG, he comments: "There is a sense in some quarters that this is something of a juggernaut... Within the geologic community, particularly within the stratigraphic community, there is a sense of disquiet." Walker quoted in Monasterksy, "Anthropocene."

²⁷ Stanley Finney and Lucy Edwards, "The 'Anthropocene' Epoch: Scientific Decision or Political Statement," *GSA Today* 26 (2016), 4-10 at 9.

²⁸ Zalasiewicz, Waters, et al., "Making the Case," 217.

²⁹ Zalasiewicz, Waters, et al., "Making the Case," 213.

While a “variety of criteria” may be used to establish whether a stratigraphic marker deserves recognition as a distinct geochronological unit, Zalasiewicz et al. also clearly affirm: “the key issue in determining whether or not the Anthropocene has begun” is “whether the geological record that allows characterization and correlation of the Anthropocene is already sufficiently distinct and whether its distinctive features and stratigraphic consequences will persist for at least many millennia.”³⁰ The point here is that while there are a variety of criteria used to identify a new unit of geochronology, there are also two traditional criteria that must be met. The stratigraphic signals must be *manifest*, they must be *persistent*. For a new unit of geological time, there must be clear *stratigraphic* evidence—clear signals in the rock record—that could be taken to mark the change. Anticipations of what the rock record might hold in the future is insufficient to formalise the Anthropocene given present ICS standards of evidence. Furthermore, whatever stratigraphic signals are taken to be relevant to the Anthropocene, there must be some reasonable expectation that those rock signals will persist on a geological scale, for “millennia,” into the future. In addition to being manifest and persistent, the evidence for the any new geochronological unit must be *salient*. The evidence for a proposed epoch or other time unit must be by criteria that do not already define an existing geological era. In this particular case, the Anthropocene must be distinguished by criteria that do not already define the Holocene. That said, a proposed unit of geological time should be defined by criteria that are not so different that would make the new time unit a unique or special case. To make the case that the Anthropocene is a relevant kind involves a delicate balance between tradition and novelty. To be formalized as a new era, the Anthropocene must be shown to be a novel geological moment but, at the same time, the criteria that define the Anthropocene must be consonant with the criteria that have been used to define other epochs.

Showing that the Anthropocene is manifest is the easiest and least controversial of the three conditions. At least some human activities are clearly transforming the Earth’s environment, and very likely even the present state of the Earth’s system. Agriculture has changed the distribution of biological species, and clearing land for agriculture has and continues to increase the rate of species extinction. Atmospheric emissions from using coal, oil and other fossil fuels is increasing levels of atmospheric carbon dioxide beyond 400 ppm and raising global mean temperatures. The rate of temperature rise has been offset, if only in the

³⁰ Zalasiewicz, Waters, et al., “Making the Case,” 214.

short term, by ocean absorption, and the expansion of warmer water is the main cause of rising ocean levels.

Oceans have also absorbed additional carbon dioxide from the atmosphere, shifting their pH levels towards the acidic. Micro-particles of plastic are now superabundant in the oceans and on land. All human-produced changes in the global environment are well-documented in a variety of sources, yet none of them formally indicate the geological arrival of the Anthropocene. From a geological perspective, none of these changes have left manifest signals in the rock record. They may eventually but they haven't as yet. What is presently manifest in the stratigraphy are plastiglomerates, concrete rubble and other technofossils, changes in lake sedimentation from changes in runoff following glacial retreat, layers of fuel ash particles from the combustion of fossil fuels, and a scattering of radioisotopes from the production and refinement fissile materials and nuclear weapons testing.

From among these manifest anthropogenic changes to the stratigraphy, the AWG must select from among the manifest signals a signal that will be persistent. As noted above, Zalasiewicz et al. state: “the key issue in determining whether or not the Anthropocene has begun is not how long the epochs are, but whether the geological record that allows characterization and correlation of the Anthropocene is *already* sufficiently distinct and whether its distinctive features and their stratigraphic consequences will persist for at least many millennia.”³¹ Evaluating the persistence of a rock signal clearly involves much more guesswork than establishing that a signal is manifest. There is always a chance, no matter how slight, that long standing features of stratigraphy might become indistinct or indistinguishable by some future cataclysmic geological event. The issue is even trickier where the Anthropocene is concerned since most indicators of the proposed era are only one or two hundred years old, a span of time that is atypical in geology. Whether or not a signal will persistent in the superficial stratigraphy that has only been recently deposited—as must be the case for the signals that characterize the Anthropocene—is inevitably an open question. Decisions about persistence clearly involve an anticipation of nature's future course, rather than a careful interpretation of extant evidence.

Fossil evidence once formed tends be both manifest as well as persistent, which accounts for the frequent use of fossils as markers for stratigraphic boundaries. For example, the beginning of the Tremadocian Stage of the Ordovician Period is marked by the first appearance of the

³¹ Zalasiewicz, Waters, et al., “Making the Case,” 214 [original emphasis].

conodont (toothy eel) *Iapetognathus fluctivagus* in strata close to Green Point in Western Newfoundland. Human activities have increased extinction rates between 10 and 100 times their norm in the Holocene, and some fossil marker might be expected to arise from increased extinction rates arising from human activities beginning in the twentieth -century.³² Some have conjectured that a layer of ossified chicken and beef bones and corn cobs eventually will be distinctive fossil markers of the present.³³ That said, the Anthropocene, if it is said to originate between 1800 and 1950, is too recent for fossilization to have happened. The AWG resists a “wait and see” approach to characterising the Anthropocene: “Waiting until further effects become clear would be in essence an appeal to the future, a path we are trying to avoid in documenting extant geological evidence.”³⁴

Instead of waiting for the future, the AWG points to “changes already imprinted on the stratigraphic record” like changes in the ratios of carbon-12 to carbon-14, depositions of technofossils, and post-Los Alamos radioisotopes. Although these signals are already manifest, estimating their persistence as markers involves some prudent guesswork. Plastics are expected to take upwards of 1,000 years to degrade, hardly a moment in geological time, though admittedly the persistence of the decay components of various plastics are little understood. Thus, radioisotopes released from nuclear reactors and atmospheric nuclear tests becomes the favoured signal for the Anthropocene. Yet, many of the radioisotopes that make up the signal have a short half-life. Cesium-137 has a half-life of about 30 years, while plutonium-238 decays in about 88 years. The half-life of other isotopes of plutonium is much longer (plutonium-240 is 6,560 years and plutonium-239 is 24,100 years). These isotopes make up an ever-diminishing signal that will persist for “millennia.” It remains to be discussed if the signal will be sufficiently persistent, given that the isotopes are present in trace amounts that will diminish over time as they decay.³⁵

³² Elizabeth Kolbert, *Sixth Extinction: An Unnatural History* (New York: Picador, 2015). Norman McLeod, *The Great Extinctions: What Causes Them and How They Shape Life* (Richmond Hill, Ont.: Firefly, 2013).

³³ For example, Anthony Barnosky, “Palaeontological Evidence for Defining the Anthropocene,” *Geological Society, London, Special Publications* 395 (2013).

³⁴ Zalasiewicz, Waters, et al., “Making the Case,” 217.

³⁵ Jonathan R. Dean, Melanie J. Leng and Anson W. MacKay, “Is there an isotopic signature of the Anthropocene?” in *The Anthropocene Review* 1 (2014), 276-287. The article concludes: “While there *is* an isotopic signature of the Anthropocene, and isotope geochemistry can play a role in the decision of the International Commission on

A reasonable case can be made for the formalization of the Anthropocene epoch in terms of manifest effects of human activity in the Earth's lithosphere as well as educated guesses about the persistence of those signals in the geological record. The Anthropocene becomes more tendentious as a formal concept when conditions for its salience are explored. The main issue is explaining why geological changes made by the human species are to be marked in geochronology while enormous changes produced by other species are not. The unprepossessing cyanobacteria have been bound up with the Earth's geological history on more than one occasion. As a species they receive no mention in the geological time even though they have had stratigraphic effects that are both manifest and persistent. Up to about two billion years ago the Earth was anoxic, the atmosphere contained little or no oxygen in the atmosphere. To be more precise, there was oxygen in the atmosphere but oxygen there was bound with carbon in the form of carbon dioxide. In addition to carbon dioxide, the atmosphere of the very ancient Earth was abundant with water vapour, ammonia, methane, sulphur dioxide and hydrogen sulphide. In the absence of free oxygen, the dominant life forms on Earth were anaerobic archaea and bacteria which sustained their metabolisms by one of a number of chemical processes. Some archaea and bacteria were chemotrophs, who could live in darkness, powering their cells by electrons captured from the reduction of sulphur, iron or manganese. Other archaea and bacteria were phototrophs, powering their cells by using solar energy to oxidize iron. Still other bacteria engaged in anoxygenic photosynthesis using bacteriochlorophylls to absorb photons and synthesize cellular energy. These organisms would make adenosine triphosphate (ATP)—the basic form of metabolic energy—with sulphate or ferric iron as by-products rather than oxygen.³⁶

Roughly between 2.4 and 2.0 billion years ago the atmospheric *status quo* on Earth began to change with the onset what is now often

Stratigraphy regarding whether to define a new geological epoch, it is not clear from isotopes alone *where* to set the Holocene-Anthropocene boundary.”

³⁶ For an accessible summary see: Donald E. Canfield, *Oxygen: A Four Billion Year History* (Princeton: Princeton University Press, 2014), 15-25. It seems controversial whether methanogenesis, another anaerobic metabolism, emerged before or after free oxygen appeared in the Earth's atmosphere. Technical details of anaerobic metabolisms are usefully discussed in: Don E. Canfield, et al, “Early Anaerobic Metabolisms” in *Philosophical Transactions of the Royal Society of London: Biological Sciences* 361 (2006), 1819-1836; and in M. Muller, et al., “Biochemistry and Evolution of Anaerobic Energy Metabolism in Eukaryotes” in *Microbiology and Molecular Biology Review* 76 (2012), 444-495; and, Friedrich Widdel, et al., “Ferrous Iron Oxidation by Anoxygenic Phototrophic Bacteria” in *Nature* 362 (1993), 834-836.

called “the Great Oxidation Event.”³⁷ The “simplest” explanation of the emergence of atmosphere O₂ at concentrations greater than 2 ppm is the evolution of cyanobacteria. These bacteria generated metabolic energy, and O₂ as a by-product, by extending the photosynthetic capacity of earlier bacteria. The production of O₂ by cyanobacteria led to the formation of a greater variety of oxides in Earth’s atmosphere and oceans, but it did not lead immediately to the formation of abundant free atmospheric O₂. In order to begin producing free oxygen at levels of many thousands of ppm (at present, atmosphere O₂ is about 200,000 ppm and has been higher in the Earth’s prehistory), the operation of the Earth system underwent a number of significant changes. Initially, the free oxygen produced by cyanobacteria reacted with free hydrogen producing water. Oxygen was also transported into the oceans as sulphates (SO₄²⁺) and precipitated as pyrites (FeS₂) and gypsum (CaSO₄), and it moved slowly into the deeper oceans as phosphates (PO₄³⁻). In addition, oxygen reacted with ferrous oxide (FeO) to produce ferric oxide (Fe₃O₄). The deposited iron is evident in the stratigraphic record as widespread banded-iron formations (BIFs) along with deposits of pyrites and gypsum. The formation of pyrites from ferric oxide releases significant quantities oxygen, but that oxygen is likely react to form carbon dioxide unless carbon is sequestered. Marine creatures with calcium carbonate exoskeletons provide a common form of carbon burial. Calcium carbonate has low solubility in water, so when the creature dies much of its skeleton is interred on the ocean floor. Cyanobacteria do not have a calcium carbonate exoskeleton like other phytoplanktons, but they contribute significantly to carbon mineralization and precipitation.³⁸ As ever more carbon was sequestered, the balance between the rate of O₂ production and the rate of oxygen removal begin to

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³⁷The term is Holland’s. See Heinrich D. Holland, “The Oxygenation of the Atmosphere and Oceans” in *Philosophical Transactions of the Royal Society B* 361 (2006), 903-915. But, as Holland immediately acknowledges the claim is controversial. For reasons see, for example, Noah J. Planavsky, et al., “Evidence for Oxygenic Photosynthesis Half a Billion Years Before the Great Oxidation Event” in *Nature Geoscience* 7 (2014), 283-

³⁸ Tingting Zhu and Maria Dittrich, “Carbonate Precipitation through Microbial Activities in Natural Environment, and Their Potential in Biotechnology: A Review,” *Frontiers in Bioengineering and Biotechnology* 4 (2016), 1-12. Jürgen Schneider and Thérèse Le Campion-Alsumard, “Construction and Destruction of Carbonates by Marine and Freshwater Cyanobacteria,” *European Journal of Phycology* 34 (1999), 417-426.

swing so that the atmosphere might become oxygen rich. That was between about 0.85 billion years ago and 0.54 billion years ago.³⁹

Cyanobacteria were entangled in at least two other significant events in the natural history of the earth. About 1.5 to 2 billion years ago, cyanobacteria—which are prokaryotes lacking a cell organelles with membranes and nucleus—began to symbiotically cohabit with newly-evolved proto-eukaryotes. These prokaryote-eukaryote symbiotes would become plants, chloroplast organelles being the photosynthetic residue of the cyanobacteria. By a little less than one billion years ago, an oxygen-rich atmosphere had emerged. This point roughly corresponds with (but may not been the cause of) an explosion of evolutionary diversity, including the emergence of animals, near the Cambrian-Precambrian boundary.⁴⁰ Cyanobacteria have been overwhelmingly significant players in the natural history of the Earth from the oxygenation of the atmosphere to the evolution of plants and animals. Arguably, no organism has done so much at several significant events in Earth’s natural history.

While we now discuss whether to call the present “the Anthropocene,” we don’t simultaneously discuss whether to refigure our deep history of the Earth to include a Cyanobacteriocene. If we did, then given the enormous changes prompted by cyanobacteria, it is unlikely that the relevant geological unit would be the epoch. A much longer geological unit of time, perhaps the period or eon, might be more appropriate. A similar criticism of the Anthropocene concept has been advanced by Finney and Edwards. They point out that:

The evolution of vascular land plants and their spread across the continents from late in the Devonian to early in the Permian completely altered the Earth’s surface, left a significant stratigraphic record, and dramatically altered CO₂ and O₂ concentrations in the atmosphere and oceans far greater than humans are projected to do.... Yet there is no drive to name a unit in the ICS Chart that formally

³⁹ Holland, “The Oxygenation of the Atmosphere and Oceans,” 903-915. D.E. Canfield, “The Early History of Atmospheric Oxygen: Homage to Robert M. Garrels” in *Annual Review of Planet Earth Science* 33 (2005), 1-36.

⁴⁰ Daniel B. Mills and Donald Canfield, “Oxygen and Animal Evolution: Did a Rise of Atmospheric Oxygen Trigger the Origin of Animals” in *Bioessays* 36 (2014), 1145-1144. Mills and Canfield reject what they call the “oxygen control hypothesis.” They conclude: “a permissive account of oxygen is of course necessary, but it is not sufficient for explaining why and how—an perhaps even when—animals originated.”

recognizes that profound and irreversible change to the Earth system.⁴¹

Finney and Edwards' point is that between about 360 mya to 290 mya Euramerica and Gondwana collided resulting in the the uplift of mountains. Water runoff from the mountains made the lowlands of the newly formed supercontinent Pangaea swampy. Atmospheric CO₂ was at a highpoint of 4,400 ppm which made an effective greenhouse and, in turn, made much of Pangea's climate wet and humid. Plants flourished in these conditions, removing CO₂ from the atmosphere and dramatically increasing the abundance of atmospheric oxygen to about 35%. (Today's atmosphere is 21% oxygen.) When the plants died they formed peat which was protected from decomposition by the deposition of marine sediment. Over time the peat metamorphosed into seams of coal several meters thick, the very coal which began to power industry in the late eighteenth century. In short, the plant life of the late Devonian and early Permian Periods exercised a significant influence on the Earth system, not only by producing abundant free oxygen but also by sequestering atmospheric CO₂ in coal beds. That acknowledged, there is no proposal to make the Seedlessvascularplantocene a unit of geological time anymore than there is a proposal for the Cyanobacteriocene.

An Anti-Copernican Turn?

As part of their response to criticisms of the Anthropocene, the AWG agrees that other species have changed to the Earth system, but it replies that a significant change to the Earth system need not be the same as a significant change in geochronology. Changes to the Earth system are sometimes accompanied by a significant geological marker and at other times not. Likewise, sometimes there are significant changes in stratigraphy marked in geochronology that do not correspond with the any noteworthy change in the Earth system.⁴² Yet, in the case of cyanobacteria and seedless vascular plants, it is clear that these species caused major changes in the Earth system and that these changes are manifestly and persistently marked in the stratigraphic record. Cyanobacteria are manifest in the rock record as banded-iron formations along with deposits of pyrites and gypsum. Prolific plant growth preserved in peat layers is manifest in the rock record as layers of coal. There is no plan to give these species a

⁴¹ Finney and Edwards, "The 'Anthropocene' Epoch," 9.

⁴² Zalasiewicz, Waters, et al., "Making the Case," 217.

special place in geochronology. While they did not discuss cyanobacteria explicitly, the AWG has argued that the role of plants in the geological formation of coal deposits is acknowledged in geochronology as the Carboniferous Period extending from about 360 mya to 300 mya. Zalasiewicz et al. argue that the name Carboniferous is a formal recognition of the geological role of plants: “the Carboniferous is named after the coal deposits that resulted from the vegetational change that was triggered by an Earth System change...to the extent of inserting the plant-produced carbon into the name of the unit.”⁴³

While the name “Carboniferous Period” obviously mentions carbon, the Period’s formal definition refers to neither coal nor “the characteristic diversification of land plants.” Rather, as Zalasiewicz et al. themselves acknowledge the Carboniferous is defined by the lowest occurrence of the fossil conodont *Siphondella sulcata* in the stratigraphy. Zalasiewicz et al. suggest that the mention of carbon in the Period name is an acknowledgement of the role of plant life in the production of carbon. But this response ignores a small but interesting philosophical difference between the established Carboniferous and the proposed Anthropocene. The Carboniferous does not directly name the *cause* of the carbon deposits that are distinctive in the period’s strata. It only names the *effect* of the Period’s superabundant plant life, specifically, the layers of coal and other carbon-rich deposits. In contrast, the Anthropocene explicitly names the *cause* of various manifest stratigraphic effects, specifically, the anthropos, the human. If the nomenclature for the proposed new epoch were to stick with the tradition of mentioning only *effects*, then the anthropos should receive no explicit mention. Assuming that the radioisotopes from atomic energy are elected as the significant stratigraphic signal, the epoch might be more appropriately named the Plutoniumocene or, as some have suggested, simply “The Atomic Age.”⁴⁴ Either name would be more in-keeping with the nominalist spirit of geochronological nomenclature. The human agency that is producing changes in the Earth system will itself not be manifest in the rock record millions of years from now, just as the agency of Carboniferous plants is itself not evident in the geological record. Agency, like causes and real essences, is never directly observable in empirical evidence, but rather is *imputed* to the evidence. From a carefully nominalist stance, as David Hume once remarked: “These

⁴³ Zalasiewicz, Waters, et al., “Making the Case,” 217.

⁴⁴ Finney and Edwards, “The ‘Anthropocene’ Epoch,” 9.

ultimate springs and principles are totally shut up from human curiosity and enquiry.”⁴⁵

This small philosophical observation about the Anthropocene naming the cause of change in the stratigraphic record, rather than merely pointing to the effects of that change, is indicative of a more general propensity in the Anthropocene literature. Since its beginning, Anthropocene literature has emphasized the causal efficacy of humans as the salient feature of the epoch. When Crutzen and Stoermer first proposed the Anthropocene in the IGBP *Global Change Newsletter* of May 2000, they began by stating that in the Holocene “mankind’s activities gradually grew into a significant geological, morphological force.” They concluded that piece with the claim that in the absence of a catastrophe: “mankind will remain a major geological force for many millennia, maybe millions of years, to come.”⁴⁶ Much the same sentiment was reiterated by Crutzen in the 2002 *Nature* article. There he began by pointing to the, “in many ways human-dominated, geological epoch” and concluded by saying that, “mankind will remain a major environmental force for many millenia.”⁴⁷ The claims are much the same but note there is a move from an emphasis on mankind being a “geological force” to being an “environmental” force.

As already seen, the AWG has made explicit that just because humans are an “environmental force” changing the Earth system that does not mean that they are geologically relevant. Since Stoermer and Crutzen, Anthropocene advocates have emphasized how the environmental influence of humans has surged since the late eighteenth century when the use of coal became increasingly common. Before the late eighteenth century the global average concentration of atmospheric CO₂ is estimated to have been 280 ppm, and that climbed to 400 ppm in 2016. The 400 ppm point was reached in September, typically the global low-point in the annual CO₂ cycle given CO₂ uptake by plants during summer in the Northern hemisphere.⁴⁸ While the threshold is symbolic, it has not been passed in the last 4 million years, well before the evolution of hominins.

⁴⁵ Hume continues: “Elasticity, gravity, cohesion of parts, communication of motion by impulse; these are probably the ultimate causes and principles which we shall ever discover in nature.” David Hume, *An Enquiry Concerning Human Understanding* (1748), sec.4, pt.1, para.25.

⁴⁶ Crutzen and Stoermer, “The ‘Anthropocene,’” 17.

⁴⁷ Crutzen, “Geology of Mankind.”

⁴⁸ Brian Kahn, “Earth’s CO₂ Passes the 400 PPM Threshold—Maybe Permanently,” *Scientific American* (27 September 2016). <https://www.scientificamerican.com/article/earth-co2-passes-the-400-ppm-threshold-maybe-permanently/> Retrieved 11 October 2016.

Less anecdotally, that humans are an environmental force is extensively supported by the ongoing work of the Intergovernmental Panel on Climate Change (IPCC). The IPCC has provided overwhelming evidence for anthropogenic climate change in its succession of five assessment reports. While human-driven climate change is undeniable and needs greater political action than it has received, the reasons for its historical emergence may be differently understood and situated.

In a frequently cited paper, Will Steffen, Paul J. Crutzen and John R. McNeill make a case for the Anthropocene by linking anthropogenic climate change and the history of industrialization. In a mere eight pages, they offer a history of humanity from the neolithic era to the present day of which any Hegelian would be proud. An originary Promethean moment leads inexorably to industrialization, and then to the (literally) world-historical Anthropocene. The teleological arc begins when: “The mastery of fire by our ancestors provided humankind with a powerful monopolistic tool unavailable to other species, that put us firmly on the long path towards the Anthropocene.”⁴⁹ Although preindustrial societies “influenced their environment in many ways” they “did not have the technological or organizational capability to match or dominate the great forces of nature.”⁵⁰ Prometheus became unbound with the onset of industrialization: “What made industrialization central for the Earth System was the enormous expansion of the use of fossil fuels, first coal and then oil and gas as well.” The mid-twentieth century saw a “Great Acceleration,” a surge in human population and productivity which significantly amplifies the effects of industrialization of the Earth system⁵¹ As Steffen et al. observe: “Nearly three quarters of the anthropogenically driven rise in CO₂ concentrations has occurred since 1950 (from about 310 to 380 ppm), and about half of the total rise (48 ppm) has occurred in the last 30 years.” The paper concludes with a broad prognostication that can now be identified as the Crutzen-mantra: “Humankind will remain a major geological force for many millennia, maybe millions of years, to come.”⁵²

There is no question that humans using fossil fuels from coal to oil is changing the Earth’s climate. It is an intuitive enough proposition that if the Earth’s climate changed when atmospheric carbon was sequestered during the Carboniferous, then re-releasing that carbon into the

⁴⁹ Will Steffen, Paul J. Crutzen and John R. McNeill, “The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature” in *Ambio* 36 (December 2007), 614-621 at 614.

⁵⁰ Steffen et al., “The Anthropocene,” 614 and 615.

⁵¹ Steffen et al., “The Anthropocene,” 616.

⁵² Steffen et al., “The Anthropocene,” 618.

atmosphere would again bring about change now. That said, some caution should be exercised in linking the use of fossil fuels in a simple or straightforward way to industrialization. Early industrialization was focused on the production of household goods and cleaners. Only in the twentieth century did industrial output become mainly discretionary goods.⁵³ Moreover, North Americans and Europeans have been the principal consumers of industrial output, and so, regardless of the geographic location of the production, they deserve whatever blame is to be apportioned for the ill-effects of industry. As Jean-Baptiste Fressoz has observed: “a quick glance at carbon emissions data reveals that, up to 1980, the *anthropos* of the Anthropocene seems to have a very strong English accent.”⁵⁴ Steffan, Crutzen and McNeill perhaps overlook consumerism and cupidity because they offer a much more ambitious claim. They go so far as to link both climate change and industrialization to human exceptionality. They explain that there is a “power minimal in other species” but present in humans to develop “an impressive catalytic process, involving many human brains and their discoveries and innovations” The same technological imperative led us to the Anthropocene “must also play a strong role in reducing pressure on the Earth System” along with “changes in societal values and individual behaviour.”⁵⁵ The emphasis on human exceptionality is highlighted even in the title of the paper which asks: “Are Humans Now Overwhelming the Great Forces of Nature?” Humans are not being thought of as an integral part of nature but are being conceived as a power external to nature that itself must have become great to overwhelm such a great force as nature.⁵⁶

This focus on human exceptionalism both accepts and strangely overlooks the ways in which a variety of species, not just human beings, ongoingly change the Earth system—indeed, very plausibly maintain homeostatic states of the Earth system—at various scales and levels. There is, for example, evidence to suggest that phytoplankton produce dimethyl sulphide which promotes cloud condensation when it is oxidized in the

⁵³ Raymond Williams, *Problems in Materialism and Culture* (London: Verso, 1980), 170-195. Gary Cross, *An All-Consuming Century* (New York: Columbia University Press, 2000), 67-110.

⁵⁴ Jean-Baptiste Fressoz, “Losing the Earth Knowingly: Six Environmental Grammars Around 1800” in Hamilton, Bonneuil and Gemenne, eds., *The Anthropocene and the Global Environmental Crisis*, 70-84 at 71.

⁵⁵ Steffan, Crutzen and McNeill, “The Anthropocene,” 619.

⁵⁶ Zalasiewicz, Waters, et al. suggest that the stratigraphic Anthropocene, “reflects humans as the dominant force driving marked and globally near-synchronous changes to some key Earth processes.” Zalasiewicz, Waters, et al., “Making the Case,” 208.

atmosphere. The extent of cloud cover affects planetary albedo and therefore surface temperatures.⁵⁷ There is also evidence that the ocean algae *Emiliana huxleyi* participate in the global regulation of carbon dioxide by trapping carbon in their calcium carbonate exoskeleton. When the algae dies, the carbon trapped in the skeleton sinks to the ocean floor. Since algae and other marine autotrophs tend to flourish when the ocean surface is warmer, more carbon is sequestered when global mean temperatures increase.⁵⁸ Algae and phytoplankton, along with terrestrial plant life are ongoing ecological actors significantly shaping and maintaining the Earth system. For Steffan, Crutzen and McNeill, it is presumably processes like these that are “the great forces of nature” that humans are on the verge of “overwhelming.” Apparently overlooked by the narrative is that these and other processes are themselves the outcome of major disruptions to past iterations of “the Earth system” by cyanobacteria and plant life. As it turns out, this was not an oversight but a further affirmation of human exceptionalism. Steffan et al. are not concerned with human changes to the Earth system *per se*. Their concern is that the Earth system may begin to change at a rate “mismatched with human decision-making or with the workings of the economic system.” As good Hegelians in the Francis Fukuyama school of world history, they suggest that there is “growing awareness” of this risk because of research, the Internet, “the spread of more free and open societies” and “the growth of democratic political systems.” Because of the world historical emergence of freedom so loved in many Hegelian narratives, “Humanity is, in one way or another, becoming a self-conscious active agent in the operation of its own life support system.”⁵⁹ Strains of Richard Strauss’ *Also Sprach Zarathustra* are all but present.

In Anthropocene literatures, the emphasis on human exceptionality is not limited to Steffan, Crutzen and McNeill. Since so many organisms ongoingly shape the Earth’s environment and adjust the Earth system, making a case for the Anthropocene requires giving a solid reason for giving humans a titular place in this particular moment of geological history. Many of the Anthropocene’s proponents take an approach that is more Cartesian than Hegelian by emphasizing the significance of human

⁵⁷ R.J. Charlson, J.E. Lovelock, M.O. Andreae, S.G. Warren, “Oceanic Phytoplankton, Atmospheric Sulphur, Cloud Albedo and Climate” in *Nature* 326 (1987), 655-661. This is often called “the CLAW hypothesis,” an acronym drawn from the last names of the authors.

⁵⁸ M.E. Marsh, “Regulation of CaCO₃ formation in Coccolithopores” in *Comparative Biochemistry and Physiology B* 136 (2003), 743-754.

⁵⁹ Steffan, Crutzen and McNeill, “The Anthropocene,” 619.

self-awareness and self-consciousness. The general claim is that while many species have changed the Earth's environment and adjusted the Earth system, only human beings are self-aware or self-conscious of the changes that they are making. This line of argument takes its cue from Descartes' claim in the Second Meditation and elsewhere that the human "I" is uniquely aware of itself as a thinking thing. It also follows Descartes by further suggesting that this self-awareness is an epistemological fulcrum. Will Steffan et al. picked up these themes of awareness and knowledge in a later paper. They write: "We are the first generation with the knowledge of how our activities influence the Earth System, and thus the first generation with the power and the responsibility to change our relationship with the planet."⁶⁰ This is the takeaway message since it is made again in the conclusion, immediately after the Anthropocene is described as "a new phase of human experience." The point is then repeated: "We are the first generation with widespread knowledge of how our activities influence the Earth system, and thus the first generation with the power and the responsibility to change our relationship with the planet."⁶¹

This Cartesian theme is picked up elsewhere in the Anthropocene literatures, particularly when it is explored outside the sciences. The same idea has been suggested by Andrew Revkin, New York Times reporter and member of the AWG: "Two billion years ago, cyanobacteria oxygenated the atmosphere and powerfully disrupted life on Earth.... But they didn't know it. We're the first species that's become a planet-scale influence and is aware of that reality. That's what distinguishes us."⁶² But the same idea is also becoming a commonplace in academic humanities. For example, anthropologist Gisli Pálsson and a cohort of sociologists and historians tells us: "the most striking feature of the Anthropocene is that it is the first geological epoch in which a defining geological force is actively conscious of its geological role. The Anthropocene therefore really commences when humans become aware of their global role in shaping the earth." Pálsson et al. go on to suggest that this awareness represents, "a new human condition" *pace* Hannah Arendt in which there is "a new fusion of the natural and ideational." They further claim that this new condition is "not just a new geological epoch; it also potentially changes

⁶⁰ Will Steffen, Asa Persson, et al., "The Anthropocene: From Global Change to Planetary Stewardship," *Ambio* 40 (2011), 739-761 at 749.

⁶¹ Steffen, Persson, et al., "The Anthropocene," 756 and 757.

⁶² Revkin quoted in Joseph Stomberg, "What is the Anthropocene and Are We in It?" in *Smithsonian.com* (January 2013). <http://www.smithsonianmag.com/science-nature/what-is-the-anthropocene-and-are-we-in-it-164801414/>. Retrieved 13 April 2017.

the very nature of the geological by clearly marking it as a domain that includes intentionality and meaning” and also is “a transformative moment in the history of humanity as an agent, comparable perhaps to the development of technology and agriculture.”⁶³ The ethicist Clive Hamilton captures the spirit of Cartesian dualism when he writes: “It is precisely because humans are not like other animals that the new epoch has arrived. The human has always been the anomaly, the creature both natural and unnatural.”⁶⁴

In his *Introductory Lectures on Psychoanalysis* (1889), Sigmund Freud suggested that “the naïve self-love of men has had to submit to two major blows at the hands of science.” The first blow was Copernicanism which showed that “the earth was not the centre of the universe but only a tiny fragment of the cosmic system of scarcely imaginable vastness.” The second blow was Darwinism which “destroyed man’s supposedly privileged place in creation and proved his descent from the animal kingdom.”⁶⁵ Freud’s remarks should not be taken as an authoritative analysis of the history of science, but they poignantly highlight two of the ways the sciences have undercut claims about human exceptionality. Some discussions of the Anthropocene would seem to reverse this trend in a way that is both surprising and curious. These kind of arguments are surprising since they are made in full awareness of the role that other species have played and continue to play in making and modifying the Earth system. Advocates of the Anthropocene frequently make the point that this new epoch means the end of the divide between nature and culture, or the separation between the Earth’s history and human history.⁶⁶ This much seems obviously right. It seems fully in accord with a sensible scientific and philosophical naturalism that says reality, including everything human, is exhausted by nature. Yet curiously, as shown above, the Anthropocene’s advocates often argue for just these naturalistic positions by drawing on conceptual resources that are implicated in creating the divisions of “humans” and “nature” in the first place. Self-awareness and

⁶³ Gisli Palsson, Bronislaw Szerszynski, Sverker Sorlin, John Marks, Bernard Avril, Carole Crumley, Heide Hackmann, Poul Holm, John Ingram, Alan Kirman, Mercedes Pardo Buendía, Rifka Weehuizen, “Reconceptualizing the ‘Anthropos’ in the Anthropocene: Integrating the Social Sciences and Humanities in Global Environmental Change Research” in *Environmental Science and Policy* 28 (2013), 3-13 at 8.

⁶⁴ Clive Hamilton, “Human Destiny in the Anthropocene” in Hamilton et al. eds., *The Anthropocene and the Global Environmental Crisis*, 32-43 at 35.

⁶⁵ Sigmund Freud, *Introductory Lectures on Psychoanalysis*, trans. and ed. J. Strachery (New York: Live Right, 1979), 284-285.

⁶⁶ For example, Latour and Chakrabarty as cited above.

the teleological unfolding of unique intellectual capacities were once taken to separate humans from brute nature. At the end of day, it is not technofossils, plastiglomerates or radioisotopes that define the new geological epoch. These all exemplify the era but do not define it. What strikingly defines the epoch is the human capacity for self-awareness and self-realization.

Human, All Too Human

On 2 November 2014, the Intergovernmental Panel on Climate Change (IPCC) released its Synthesis Report, the final component of its Fifth Assessment Report. In it, the IPCC succinctly states: “Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.”⁶⁷ Beyond claiming a “95 percent” certainty that human activities are the “main cause of current global warming,”⁶⁸ the report also introduces a new emphasis on climate change adaptation (rather than simply prevention or mitigation). Human activities, notably the burning of fossil fuels, have already reached such levels and have affected the Earth system so widely that, even if we were to (miraculously) stop the burning of all fossil fuels immediately, there is a certain amount of global warming that can no longer be prevented. Current estimates suggest that, even with “stringent mitigation,” the Earth will experience average temperatures between 1.5 °C and 2 °C warmer by the year 2100. Even this seemingly small temperature increase will probably produce many of the adverse effects that even higher temperatures would bring, including extremes in weather, rising sea levels, and ocean acidification.⁶⁹ Hence the IPCC recommends a shift in attention to include *adaptation* to climate change. Even before the release of the IPCC’s Fifth Assessment Report, various levels of

⁶⁷ Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: IPCC, 2014), 40.

⁶⁸ Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: IPCC, 2014), v.

⁶⁹ In the “stringent mitigation” scenario, atmospheric concentration of CO₂ is kept to between 430 and 480 parts per million through 2100, and are characterized by “net negative emissions,” where more carbon is sequestered than released into the atmosphere. Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: IPCC, 2014), 56-57.

government in Canada and other nations had begun integrating adaptation strategies into their policies and legislation.⁷⁰

This emphasis on adaptation to climate change will likely mark a new chapter in the scientific and political discussion of anthropogenic climate change. It charts a course for future action, but it also speaks to present and past inaction. The Paris Climate Agreement, which entered into force on 3 November 2016, has the goal of keeping global temperature rise, “well below” 2 °C, and hopefully even as low as 1.5 °C, above pre-industrial levels. Ratifying these targets, even without the support of the United States, is a significant step in the right direction. Nevertheless the Agreement has a melancholy hue. Even with those ambitious targets, the Agreement anticipates the need for adaptation to the effects of climate change. It states the goal of, “enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change.”⁷¹ “Resilience” is the euphemism *du jour* to describe how agriculture, aquaculture, water provision and health services will need to be bunkered as part of adaptation to an Earth that is on-average warmer and climatically more tumultuous. Less adaptation, less mitigation and less resilience might have been required if more actions had been taken sooner. What if the first IPCC Report in 1990 had brought about a broad international consensus? What would be our situation if the 1992 Kyoto Protocol had been successful? Or, if the Brundtland Report *Our Common Future* (1997) had motivated a genuine move towards sustainable development? Or, if as an electorate we had all reacted more vehemently in the face of political inaction? Getting started sooner would almost certainly not have prevented climate change altogether, but it may have shifted the scope and scale of the tasks that lie ahead.

The Anthropocene concept seems to have emerged in the first decade of the twenty-first century as a gesture in response to a lack of coordinated action on climate change. Early notes and essays motivate the concept by pointing to “global change” in “the Earth system” and mentioning anthropogenic climate change caused largely by CO₂ emissions from the use of fossil fuels. Stoermer and Crutzen (2001), Crutzen (2002) and Steffan et al. (2007) all suggest that the Anthropocene “epoch” began in the late eighteenth-century when coal began to be used

⁷⁰ For example, see British Columbia, Ministry of the Environment, *Preparing for Climate Change: British Columbia's Adaptation Strategy* (Victoria, BC: Ministry of Environment, February 2010).

⁷¹ UN, *Paris Agreement* (2015).
<https://sustainabledevelopment.un.org/frameworks/parisagreement>. Retrieved 17 May 2017.

to power steam engines. None of the early proponents were geologists, so it may have been a surprise that stratigraphers insist that geological time units are underwritten by quite specific stratigraphic criteria. The Anthropocene concept emerged from atmospheric chemistry and the sciences of the Earth system not geology. Showing that the concept might plausibly meet geological criteria would require additional work and some adjustment to the concept. The AWG was tasked by the ICS to do this work. As things stand, a near totality of the members of the AWG are agreed that stratigraphic evidence for the Anthropocene is sufficient, that it is distinct geologically and that it should be recognized as a formal unit of geochronology. A majority think that the “Epoch” is right unit of geological time, which is to say that it may be indicated by a stratigraphic series, i.e., rock layers co-deposited at a specific geological time. What is distinctive about the rock layers that characterize the Anthropocene is more controversial. Stoermer, Crutzen and Steffan focussed on anthropogenic climate change as a key indicator of the Anthropocene. Yet, signals associated with the human use of fossil fuels—“fuel ash particles,” “carbon dioxide concentration” and “carbon isotope change”—did not receive the broadest affirmation in the AWG’s preliminary vote. More favoured by Group members were signals that are consequences of the atmospheric testing of nuclear weapons—the “radiocarbon bomb spike” and “plutonium fallout.”

Among the issues being navigated by the AWG is that early development of the Anthropocene concept was shaped by Crutzen, Stoermer and Steffen’s focus on humans effecting global change to the Earth system. As the AWG has acknowledged, changes to the Earth system are not necessarily reflected in stratigraphic changes and *vice versa*. To make its case for the Anthropocene as unit of geochronology, the AWG must point to a feature of the rock record that is manifest, persistent and salient. That is, the feature must already be manifest in the rock record, the feature should persist millions of years into the future, and the feature should be salient insofar as it uniquely characterizes the new period. A (slim) majority of AWG members seem to hold that the deposition of new and rare radioisotopes in the recent strata is the salient indicator that a new geological epoch is underway. Those radioisotopes are manifest and their decay products will persist into the long term. If radioisotopes are selected as the signal for the Anthropocene, it would date the beginning of the Epoch to 1945. 5:29AM, 16 July 1945 to be precise. This is an unusually crisp date for the beginning of a unit of geological time. The year 1945 does not coincide with the rise in the use of fossil fuels, but it has the advantage of coinciding with what is arguably another

human wrought change to the Earth system, what McNeill and others have dubbed “the Great Acceleration” as an homage to Karl Polanyi's *The Great Transformation* (1944).⁷² The Great Acceleration begins, conveniently enough, in 1945 when human action became, “the most important fact governing crucial biogeochemical cycles, to wit, the carbon cycle, the sulfur cycle, and the nitrogen cycle. Those cycles form a large part of what is now called the Earth system, a set of interlocking global-scale processes.”⁷³

Critics of the Anthropocene as a formal concept for stratigraphy and geochronology reply that the Anthropocene is too much of an outlier, too much of a departure from the traditions of chronostratigraphy and geochronology in which the concept of the Earth system plays little direct part. In several respects, the Anthropocene seems to be an exceptional unit in geochronology. Its unusually precise dating to 1945 truncates the Holocene epoch at 11,784 years. Other epochs typically extend for millions of years. The Pleistocene which immediately preceded the Holocene lasted for about 2.6 million years. Such a truncation might be avoided, at the expense of the distinctiveness of the Anthropocene, if the beginning of anthropic effects on stratigraphy and the Earth system were traced to human agriculture (typically dated to 12,000 years ago though possibly beginning as early as 23,000 years ago) or human control of fire (conservatively dated to 230,000 years ago). Critics also point out that geological time units are often demarcated by distinctive fossil evidence, but the Anthropocene is less than one hundred years long and there has not yet been time for fossilization to occur. Since the Earth is in the midst of sixth great extinction event, arguably caused by humans, fossil evidence can be reasonably anticipated. As the AWG points out, such anticipations do not help their task. Nor is their task helped by waiting for fossilization to occur. More generally, the AWG can always explain the exception by arguing that all units of geochronology must be exceptional in some respect in order for them to meet the criteria of salience. The AWG may always reply that it is precisely the human exception that makes the Anthropocene noteworthy.

Ultimately, whether or not the Anthropocene becomes a formal unit of the Earth's geohistory will be decided by the a vote at a meeting of the ICS. Before that happens, the AWG must forward its recommendation to the SQS which also must vote on the proposal. Given that the AWG has yet to table a formal proposal, a decision about the Anthropocene is a long

⁷² McNeill and Engelke, *Great Acceleration*, 212.

⁷³ McNeill and Engelke, *Great Acceleration*, 4.

way off. Who knew that science could be so democratic, or that geology could be so bureaucratic? When members of the AWG, SQS and ICS vote on nominating the Anthropocene as a relevant kind they will be deciding on a number of issues. Not all the issues are purely matters of either stratigraphy or geochronology. If the argument here has been compelling, then among the factors being considered is whether human agency ought to be given special attention in the chronology of the Earth. As pointed out above, the Anthropocene departs from other units of geological time by naming not the stratigraphic effects of underlying geological forces but by naming the underlying cause of the change. Whatever human remains in the detritus preserved in the Earth's strata, human agency itself will not. Proponents of the Anthropocene might justify this novelty by pointing to the tremendous effects humans are having on the biogeochemical processes that make up the Earth system. This is true. It might not, however, justify the change in nomenclature. The fact that there is an Earth system at all is the consequence of the past and ongoing activity of a variety of species, notably phytoplankton and other algae. Over geological time, other species have radically changed the Earth system, overwhelming what were then the great forces of nature ultimately resulting in the current state of the Earth system. Cyanobacteria and seedless vascular plants are two clear examples. The changes made by these species are manifest and persist in the stratigraphic record as banded-iron formations, deposits of gypsum and pyrites and layers of coal. Apparently none of this is salient in geochronology, however. Neither of these species give their name directly to a geological time unit. Any reference is either absent or oblique.

Anthropocene discussions circumnavigate the role of other species in the Earth system by positing that humans are essentially different than other species. While plants, phytoplankton and cyanobacteria have played an ongoing role in the Earth system, only *Homo sapiens* have ever been self-aware of their effects and the rock signals they will leave behind. This Cartesian manoeuvre figures prominently in the Anthropocene literature. There is a parallel Hegelian strategy to emphasize how the uniqueness of the human unfolds to this specific moment of self-realization in world history. Since learning to control fire, this story goes, the history of humanity has been inexorably unfolding to the present at which it finally becomes self-conscious of its standing as a geological force. This moment of self-realization, the story continues, has been abetted by the unfolding of human freedom in the form of the growth of scientific research, Internet communication and free and democratic societies. Ironically, these Cartesian and Hegelian motifs point to the Janus-like character of the

Anthropocene discourse, one face towards human potency and the other face towards human impotence. On the one hand, the discourse suggests human potency and a new self-awareness of the geological destiny of humanity. On the other hand, the discourse is framed, in large part, by our utter inability to engage in meaningful collective action on climate change and any number of other environmental issues. The irony of the Anthropocene is neither ferric nor ferrous. We are not confronted with our unique potency and telluric destiny.⁷⁴ We are confronted with our impotence in the face of ossified stories about our putative self-awareness. Concerns about the environmental effects of post-War industrialism were voiced starting in the 1960s almost as soon as “the Great Acceleration” was underway. Rachel Carson’s *Silent Spring* (1962), Lynn White Jr.’s “The Historical Roots of Our Ecological Crisis” (1967), and *The Limits to Growth* (1972) are just three examples. In the *Shock of the Anthropocene* (2016), Christophe Bonneuil and Jean-Baptiste Fressoz compellingly argue, “We have not suddenly passed from unawareness to awareness, we have not recently emerged from a modernist frenzy to enter an age of precaution.”⁷⁵ They suggest that that people have been “aware” of their environmental and geological effects not just since the 1960s but at least since the early stages of industrialization in the 1700s.

So far as the environment is concerned the human inability to connect awareness and action is long standing. In the face this inaction, self-awareness doesn’t seem to count for much. Are plants, cyanobacteria and phytoplankton any less aware of their effects of the Earth system than *homo sapiens* in any relevant way? The humans finds itself among and with the many other species that ongoingly shape the Earth system and among the many species that leave geological marks. This is not a departure from either Copernicanism or Darwinism but a re-enforcement of the same message. In the past, the Earth system has had different states in the past sustained by different species, and in the future, the Earth will have other states sustained by other species. To be clear, this message should not be taken to imply environmental quietism. Is there anthropogenic climate change? Yes. Do industrialized economies place an unsustainable burden on planetary resources? Yes. Are humans responsible for despeciation? Yes. Will human actions leave marks in the Earth’s stratigraphy that will persist for millennia? Very probably, yes.

⁷⁴ In his last blog post, Andrew Revkin declared: “we are in a race between our potency and self-awareness.” See Andrew Revkin, “The Human Race (Between Potency and Self-Awareness),” *New York Times Blog* (1 December 2011).

⁷⁵ Christophe Bonneuil and Jean-Baptiste Fressoz, *The Shock of the Anthropocene*, trans. David Fernbach (New York; Verso, 2016), 290.

Does this mean that we have entered the Anthropocene? The ICS can answer that question at some future point. But, we should keep in mind that there is no “right” answer to the question. Whichever way the vote ultimately goes, we are left with anthropogenic climate change and despeciation and other real environmental problems. So, while we wait for the ICS to vote, let’s put aside the grand gesture of trying to reconceptualize human and geological history. Let’s give up the fanciful expectation that changing a geological name will provide the impetus for environmental action.⁷⁶ Instead, let’s focus on concrete and practical ways of mitigating, remediating and adapting to changes in the Earth system so that they do not entirely eclipse political and economic decision -making. While we wait for the ICS to vote let’s focus on making effective policies, and let’s not talk about the Anthropocene.

⁷⁶ It isn’t at all clear that the Anthropocene would be received in the same way by all concerned. One could imagine that a Donald Trump or a Ted Cruz using such a declaration to license business as usual.