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Dear Colleagues,

Thank you for reading this (very) rough draft of the first chapter of *The Historian's Task in the Anthropocene*. For the past few years, I've been writing intensively with the geologists, paleobiologists, and Earth System scientists trying to conceptualize the Anthropocene. The learning curve has been steep and the details complex. I've loved it because I've learned so much and hated it because the more I know, the more terrified I am. With this new book project, I ask what the Anthropocene means for the practice of history, especially the kind of critical history that works to make the past speak to future possibilities.

The term "Anthropocene" has been floating around for two decades and much of the discussion among historians (and humanists generally) is unmoored from the sciences. I don't think that's a good idea. Foundationally we need to understand how our altered planetary reality is being described by the Earth sciences so that we can ask how this new reality changes historical practices and political hopes. This first chapter counterposes Marc Bloch's marvelous sense of history against the findings of the Anthropocene sciences to show that the relationship between history and science is primarily one of disjuncture. We have not yet developed frameworks to put historical experiences and Earth System occurrences in conversation. In short, the problem we as historians face is that our practices are inadequate to address the new reality of the Anthropocene.

This chapter lays the groundwork for several of the book's themes. I stress how recent our understanding of the Earth System is; how the twentieth-century emergence of the "anthroposphere" produced an unwieldy new historical agent that we have yet to incorporate (if indeed it can be incorporated) into historical narratives, and how Anthropocene histories differ from environmental histories and climate change histories as well as mainstream protocols. One of my great worries is the tendency of many to confuse the Anthropocene with climate change due to their desire to frame the crisis as a solvable problem rather than as a systemic challenge that requires systemic transformation both in the production of knowledge and in society.

A couple things to note. Concision and lucidity in explaining the science is important to me. If there are arcane passages, please let me know. Also, I've gone out of my way to cite the work of women scientists and thinkers; people joke about the "Manthropocene." It doesn't have to be that way.

Again, my thanks to you all and my apologies for the rough prose and patchy footnotes.

Julia

Overview of the book's chapters:

The Historian's Task in the Anthropocene

Chapter 1 The Historian's Task on a Transformed Planet (Marc Bloch and the Earth System)
The disjuncture between History (both as lived experience and as a disciplinary practice) and the Anthropocene as understood through Earth System Science, Stratigraphy, and Planetary Boundaries Models.

Chapter 2 Event, Origins, and the Multiple Levels of Anthropocene Agency
Nominating "the Anthropocene" as a Historical Event and Understanding our New Earth System Agency alongside Individual and Collective Agencies

Chapter 3 Anthropocene Justice and the Bonds of Nature

Chapter 4 Cycles of Regeneration and the Imperfect Worlds of Early Modern Japan
A Non-Utopian Depiction of the regenerative Political, Social, and Economic Practices that produced Two Centuries of relative Peace, Health, Prosperity, and Population Density/Stabilization in early modern Japan. Argue Regeneration of Local Ecological and Social Systems is Key to Slowing Earth System Destabilization.
The Tokugawa system against the Technosphere

Chapter 5 Muted Hopes (Contemporary Japan and Societies of Trust/Shared Sacrifice)

Draft, Chapter 1

The Historian's Task in the Anthropocene

The Historian's Task on a Transformed Planet

“It is not necessary to be one of the foremost mystics to be grossly mistaken about those realities which should seemingly be the best known to us.”

Marc Bloch

In dark days of 1941, French historian Marc Bloch (1886-1944) began *Apologie pour l'histoire* by acknowledging that his country and all who “worked together for a wider and more human history . . . were vanquished, for a moment.”¹ Yet gaiety dances through his pages as he connects understanding the dead with hope for the living. Wit buoys his insistence on a “useful history.” He assures us that the past and present can speak to one another “to aid us to live better” and for the sake of “the full flowering of *homo sapiens*.”² Bloch’s defense of history’s value is stirring, but is his case for a useful history still useful?

Today we too are all but vanquished, whether “we” means humanity or historians, not by an external enemy but by the careless, escalating destruction of Earth's bounty and also by forms of

¹ *Apologie pour l'histoire* (The Defense of History, published in French in 1949) is better known by its second title *Métier d'historien*, the basis for the English-language translation's title *The Historian's Craft*. This quotation is from the note to Lucien Febvre (“A Lucien Febvre: En manière de dédicace”). Marc Bloch, translated by Peter Putnam, *The Historian's Craft: Reflections on the Nature and Uses of History and the Techniques and Methods of Those Who Write It*, (New York: Random House/Alfred A. Knopf, 1953), v. Putnam's “for a moment” sounds a bit awkward in English. Geoffrey Parker suggests that “for *the* moment” or “for the time being” might be a better translation of Bloch's original “Longuement nous avons combattu de concert, pour une histoire plus large et plus humaine. La tâche commune, au moment où j'écris, subit bien des menaces. Non par notre faute. Nous sommes **les vaincus provisoires** d'un injuste destin.”

² Bloch, *ibid.* 10. The French here is “L'histoire dût-elle être éternellement indifférente à *l'homo faber* ou *politicus* qu'il lui suffirait, pour sa défense, d'être reconnue comme nécessaire au plein épanouissement de *l'homo sapiens*. (p. 23) My thanks to Professor Parker.

I find the reference to our species in scientific language enchantingly strange in a book otherwise so humanistic. If anyone has ideas as to why Bloch uses the phrase, I'd love to hear them. From my years working with paleobiologists, I've grown pedantic about using the scientific convention of capitalizing the “H” in the genus of *Homo sapiens* which is what I'll do below. That Bloch's translator Peter Putnam felt no similar compunction is an example of how the sciences and humanities don't speak quite the same language.

understanding and practices honed for a more stable and hospitable world. A gulf has opened up between past and present wider than any in recorded history, much wider than the one Bloch points to between the moderns with their electricity and airplanes and those who came before.³ In fact, we've entered a world in many respects unlike anything in the more than 230,000-year history of *Homo sapiens* and in some ways stranger than anything in the more than two-million-year history of humans.⁴ Terms like “thresholds” and “tipping points” denote an increasingly unstable Earth System.⁵ Our rapid, recent mutilation of the tree of life is lopping off not just species but whole genera, “changing the trajectory of evolution globally and destroying the conditions that make human life possible.”⁶ In the twentieth century, we breached planetary boundaries; now we are well beyond Holocene norms for six out of the “nine processes that are critical to the stability and resilience of Earth system as a whole.”⁷ Earth System scientists and geologists have proposed a new

³ It is of course true that the changes at the end of the Pleistocene were also a great shock to the approximately ten million human beings living then. Bloch writes, “Successive technological revolutions have immeasurably widened the psychological gap between generations. With some reason, perhaps, the man of the age of electricity and of the airplane feels himself far removed from his ancestors. With less wisdom, he has been disposed to conclude that they have ceased to influence him.” (p. 36) The psychological shock of the Anthropocene is two-fold: 1) first that human pressures caused it, an unprecedented occurrence, and comparable only to the impact of cyanobacteria emitted deadly oxygen over some 200 million years (check) until they transformed Earth’s atmosphere and biota. 2) Many of the human activities, attributes, and creations that have been described as good—collaboration, exploration, curiosity, inventiveness, agriculture, cities, writing systems, hopes for abundance for all, individual liberty, democracy, medicine, sanitation systems, washing machines—are now seen as tarnished by some commentators.

⁴ Although there have been intimations that *Homo sapiens* might be as old as 300,000 years, the evidence is still being examined. According to science writer Dyani Lewis, “the oldest *H. sapiens* fossils, which date to 230,000 years ago, are from sites in Ethiopia” citing Vidal, C. M. *et al. Nature* 601, 579–583 (2022). Either date makes us a very recent species. See Dyani Lewis, “A new human species? Mystery surrounds 300,000-year-old fossil,” *Nature* (18 September 2023) doi: <https://doi.org/10.1038/d41586-023-02924-8>.

⁵ See Will Steffen, et al., “The Emergence and Evolution of Earth System Science,” *Nature Reviews Earth & Environment* 1, 54–63 (2020). <https://doi.org/10.1038/s43017-019-0005-6>. This book follows the convention of capitalizing both “Earth” and “System” to make it a proper noun, as explained by Will Steffen in “The Evolution of Earth System Science,” blog post, *Future Earth* (December 14, 2015): <https://futureearth.org/2015/12/14/the-evolution-of-earth-system-science/>

⁶ Gerardo Ceballos and Paul R. Erhlich, “Mutilation of the tree of life via mass extinction of animal genera,” Vol. 120 No. 39 e2306987120 *PNAS* (2023) <https://doi.org/10.1073/pnas.2306987120>

⁷ Katherine Richards, *Science Advances* p. 1 [Full citation needed] The Holocene Epoch is the ratified geological time-interval beginning 11,700 years before “the present” by which scientists mean 1950. See, for instance, William Fletcher, et. al., “Introduction to the Holocene Climate,” in David Palacios, Philip D. Hughes, Vincent Jomelli, and Luis M. Tanarro, eds., *European Glacial Landscapes: The Holocene*, (Elsevier, 2024) <https://doi.org/10.1016/B978-0-323-99712-6.00001-5>

epoch called the “Anthropocene.”⁸ The range of challenges ahead “is no longer bound to the patterns of the past. Communities all over the planet are falling forwards into a future for which history is probably not a useful guide.”⁹ Worst yet, so much is unknown and perhaps unknowable since our forms of knowledge were created for a far more stable and probabilistic planet. For historians aspiring to be being more than antiquarians with no contemporary purchase, this rupture between past and present poses a fundamental challenge.¹⁰ In these novel conditions, what is the use of history? Can the past speak to the present, let alone the future? How do we go about developing new disciplinary tools to leap across this chasm in human experience?

The notion of a “usable past” with Bloch's political and humanistic import rested on the presumed continuity underlying our lives. This continuity was fundamental to historical practice in the Holocene, yet rarely acknowledged. Bloch, however, parses it with some care. He sweeps away the contention that man is “changeless,” dismissing the assumptions of Machiavelli, Hume, and Bonald. Instead, he says, “we have learned that man, too, has changed a great deal in his mind and, no less certainly, in the most delicate organs of his body.” Literacy, hygiene, and diet have altered us. The uneducated yokel is not to be confused with the sophisticate, nor the medieval peasant’s body, shaped by agricultural labor, rough food, and little in the way of a good wash, with that of a modern

⁸ Earth System science approaches Earth as a single, integrated system where geosphere and the biosphere—and very recently the anthroposphere—regulate planetary environmental conditions. See Will Steffen, et al., “The Emergence and Evolution of Earth System Science,” *Nature Reviews Earth & Environment* 1, 54–63 (2020).

<https://doi.org/10.1038/s43017-019-0005-6>. There are three ways to capitalize this phrase: Earth System science, Earth System Science, and Earth system science. This book follows the convention of capitalizing both “Earth” and “System” to make it a proper noun, as explained by Earth System scientist Will Steffen in “The Evolution of Earth System Science,” blog post, *Future Earth* (December 14, 2015): <https://futureearth.org/2015/12/14/the-evolution-of-earth-system-science/>. See also Will Steffen, “Earth System Science: Gravity, the Earth System, and the Anthropocene,” in Julia Adeney Thomas, ed. *Altered Earth: Getting the Anthropocene Right* (Cambridge: Cambridge University Press, 2022).

⁹ Geoff Mann, “Treading Thin Air: On Uncertainty and Climate Change,” Vol. 45, No. 17 *London Review of Books* (7 September 2023), 17.

¹⁰ For the idea of antiquarianism as opposed to useful history, see Friedrich Nietzsche, *On the Uses and Disadvantages of History for Life*. The problem is not the study of the old or the arcane but studying the past in such a way that it is presented to the present as limp and dead, like a field mouse in the cat’s mouth. For the idea of rupture, see Clive Hamilton, “The Anthropocene as rupture,” *The Anthropocene Review*, 3(2) (2016) 93-106. <https://doi.org/10.1177/2053019616634741>

Parisienne. “However,” Bloch insists, “there must be a permanent foundation in human nature and in human society, or the very names of man or society become meaningless.”¹¹ This “permanent foundation” allows for what he calls the “solidarity of the ages.” It is the key to history’s value to society for Bloch and for all useful Holocene histories, and justifiably so. If human nature has been fundamentally transformed by new chemicals and intelligence-dampening particulates invading our brains, it will be impossible to think the thoughts of others long dead which R.G. Collingwood assumed to be the very essence of history.¹² If the challenges of past societies bear no resemblance to the challenges of present and future societies, the discipline can no longer perform the political function at the core of Reinhart Koselleck’s critical history filled with “anticipatory content.”¹³ Break this permanent foundation of human nature and society, and the past will no longer serve the present or the future.

Later, Bloch’s colleagues among the *Annales* school would locate the necessary “foundation” not as Bloch did in human nature and society, but in the natural environment itself. Fernand Braudel (1902-85) famously envisioned the *longue durée* of nearly changeless cycles of nature producing timeless social cycles of life, death, and rebirth.¹⁴ This enduring environment secured the “solidarity of the ages” by rooting the activities of most people in seasonal rhythms. This view of nature is less fashionable now, but nature still serves to secure the connection between past and present in many histories through ideas of its linear unfolding. Instead of the constancy of cycles,

¹¹ Marc Bloch, *The Historian’s Craft: Reflections on the Nature and Uses of History and the Techniques and Methods of Those Who Write It*, Translated by Peter Putnam (New York: Vintage Books/Random House, 1953) 42. There are, of course, many other works of Marc Bloch that might be brought to bear on this discussion were this a book about Bloch and the Anthropocene. One is tempted to dwell in his company alone, but he serves, instead, as a touchstone to a wider conversation.

¹² R.G. Collingwood. I discuss this issue in “History and Biology in the Anthropocene: Problems of Scale, Problems of Value,” vol. 119, no 5 (December 2014) *American Historical Review* drawing on the research on hormones and anthropogenic chemical compounds by xxx.

¹³ Reinhart Koselleck, “On the Need for Theory in the Discipline of History,” in Koselleck, *The Practice of Conceptual History: Timing History, Spacing Concepts* (Stanford: Stanford University Press, 2002), 5 and 7-8.

¹⁴ [Find quote in Fink separating Bloch from these later developments.]

environmental historians focus on evolving biomes, disease patterns, coastlines, climates, and much else. These writers weave evolutionary and historical change together as a new story of co-evolution or even consilience.¹⁵ In these evolving versions, nature is neither constant nor cyclical, but unfolds in probabilistic ways, impacting people and being impacted by people. Changes over time are also changes in the land.¹⁶ Historian Daniel Lord Smail refers to the assumed continuity in these forms of history as “the biological substrate.”¹⁷ Most environmental histories written today, even while attuned to ecological changes, assume continuities.

Whatever it is, *something*, often unnamed or ill-defined, has served historians as Ariadne’s thread served Theseus, guiding us from the dark bowels of the Labyrinth to the light of the living, providing the solidarity that allowed the past to speak to the present and to the future.¹⁸ This wasn’t madness. In fact, the planetary reality in the Holocene backed up this assumption. The almost 12,000 years of relative planetary stability and relative warmth, of oscillations around a happy mean of biogeochemical fluctuations supportive of human thriving, meant that the foundation of our lives was legible from one period to the next despite extraordinary advances such as the invention of agriculture, states, and writing; countless migrations, wars, and revolutions, and so much else. There was something in human nature, human society, and the environment that developed legibly across the millennia. In these ways, nature—human, social, and environmental—was, I have argued, the “unconscious of history,” the seldom interrogated substrate confirming the value of the discipline’s practices by securing continuity in some form.¹⁹ If the Anthropocene has rent the biological

¹⁵ Edmund Russell, Kyle Harper uses the word consilience in *The Fate of Rome* (Princeton: Princeton University Press, 2017), p. 19, McCormick E.O. Wilson

¹⁶ Cronon

¹⁷ Smail, *Deep History and the Brain*

¹⁸ Reinhart Koselleck

¹⁹ Thomas *Reconfiguring Modernity: Concepts of Nature in Japanese Political Ideology* (2001)

substrate, sundered time, and snapped these threads of legibility connecting us with the past, does history still have anything to offer the present let alone the future?²⁰

This question is central to the Anthropocene histories that are beginning to emerge. In some quarters, the answer is flatly “no” and reasonably so.²¹ At some scalar levels—and my argument will pay careful attention to scale—we’ve slammed the door in the face of Clio and all the light she might once have shed. Zoltán Boldizsár Simon is perhaps the historian most insistent on this point. He argues that “the tendency to invoke modern historical thinking in trying to make sense of the Anthropocene amounts to an untenable, self-contradictory, and self-defeating enterprise. There is a fundamental contradiction between the prospect of unprecedented change as entailed by the Anthropocene and the deep continuity of a processual historical change.”²² He insists that “future prospects increasingly seem likely to render previous modes of existence inconsequential.”²³ According to this view, Bloch’s solidarity of the ages has been rent in two—the histories of the Holocene proceeding legibly though time and space yet distant from all contemporary concerns and useless—and the Anthropocene where the world dances wildly with the

²⁰ This sense of history’s uselessness has practical implications as the fall in history majors demonstrates, a source of widespread handwringing. Robert B. Townsend, “Has the Decline in History Majors Hit Bottom? Data from 2018–19 Show Lowest Number since 1980,” *AHA Perspectives* (23 February 2021) <https://www.historians.org/research-and-publications/perspectives-on-history/march-2021/has-the-decline-in-history-majors-hit-bottom-data-from-2018%E2%80%9319-show-lowest-number-since-1980> Daniel Bessner, “The Dangerous Decline of the Historical Profession,” *New York Times* (14 January 2023) <https://www.nytimes.com/2023/01/14/opinion/american-history-college-university-academia.html> Bessner notes, “the A.H.A. released a “Jobs Report” that makes for grim reading: The average number of available new “tenure track” university jobs, which are secure jobs that provide living wages, benefits and stability, between 2020 and 2022 was 16 percent lower than it was for the four years before the pandemic. The report further notes that only 27 percent of those who received a Ph.D. in history in 2017 were employed as tenure track professors four years later.” John Arnold, *History a Very Short Introduction* (Oxford University Press,)

²¹ Zoltán Boldizsár Simon, “Does the Past Still Matter?” In Paul M. Dover (ed.), *Engaging with the Past and Present: The Relationship between Past and Present across the Disciplines* (London and New York: Routledge, 2023), 43-55, here 52. See also, Simon, *The Epochal Event: Transformations in the Entangled Human, Technological, and Natural Worlds* (Palgrave, 2020); Simon, *History in Times of Unprecedented Change: A Theory for the 21st Century* (2019); Simon and Lars Deile, *Historical Understanding: Past, Present, and Future* (2022); Simon and Marek Tamm, *The Fabric of Historical Time (Elements in Historical Theory and Practice)* (2023).

²² Zoltán Boldizsár Simon, “Why the Anthropocene has no history: Facing the unprecedented,” Vol. 4(3), *The Anthropocene Review* (2017) 239–245, here 239 DOI: 10.1177/2053019617742170 This view echoes W.B. Gallie’s idea that an “event” if it is truly an event renders connections between past and present untenable.

²³ Expand this section drawing on Simon and Tamm’s argument against any continuity in history?

devils of rupture that neither our sciences nor our humanistic branches of knowledge can tame. History, then, is a thing of the past in Simon's terms. It is a practice with no purchase on our lives, no utility except as entertaining escape for the oddballs who enjoy that sort of thing.²⁴ It certainly has nothing to say to the present. I think we need to take this challenge seriously.

At best, by these lights, history is a declensionist narrative bringing us to the cliff edge of the Anthropocene. One of the greatest of these declensionist story tellers—and the most prescient—is global historian John McNeill whose *Something New under the Sun* appeared in 2000, the very same year that “Anthropocene” was coined in the Earth System science context. Toward the end of the book, McNeill describes the human past as a long succession of unsustainable societies rising and falling over millennia. As he points out, some earlier unsustainable societies vanished completely, but many “changed their ways and survived. They changed not to sustainability but to some new and different kind of unsustainability.” He warns, however, that an “unsustainable society on the global scale may be another matter entirely.” Earlier societies benefitted from “ecological buffers – open land, unused water, unpolluted spaces,” which today we no longer have. In our near future, “the most difficult passages will probably (or better put, least improbably) involve shortage of clean fresh water, the myriad effects of warmer climate, and of reduced biodiversity.” It is even possible, warns McNeill, that “collapse looms.”²⁵ Few Anthropocene histories written since 2000 dispute these findings fundamentally. *Avant la lettre*, his was the first Anthropocene history.

²⁴ The view of history's uselessness is held, unfortunately, by many university administrators, state legislators, and students. Bloch and many others argue that pleasure is an important reason for pursuing historical research. For instance, the first reason for doing history urged by John H. Arnold is simply enjoyment. See Arnold, *History: A Very Short Introduction* (Oxford: Oxford University Press, 2000), 122. One might ask whether pleasure is subversive in which case it might also be useful in a world of catastrophe.

²⁵ John R. McNeill, *Something New Under the Sun: An Environmental History of the Twentieth Century* (New York and London: W.W. Norton and Company, 2000) 358-359.

The declensionist story has dimensions beyond the tales of physical degradation. Ideals, particularly modern concepts of justice and liberty, are also at risk in the Anthropocene. The very possibility of distributive justice and freedom of choice assumed resources sufficient to people's needs without harming future generations. It was taken for granted that these principles held even as populations grew because abundance would grow as well. However, with the soil itself "under threat" according to presidential science adviser Jo Handelsman, certainty of sufficiency, let alone growing abundance for growing populations, is no longer possible.²⁶ 95% of global food production depends on soil and that once-thick mantle is being blown away, leached into rivers and oceans, salinized, and "fertilized" in ways that destroy microbes essential to nutritious plants.²⁷ Without soil, no food; without food, modernity's promises are sterile too. When the environment was fairly predictable, governments and individuals could be expected to have a fair sense of the results of their actions. Only in a probabilistic world can plans be made and responsibility be assigned. If we've destabilized the Earth System, what happens to our concepts of justice? If, as historian Dipesh Chakrabarty suggests, "the mansion of modern freedoms stands on an ever-expanding base of fossil-fuel use," what becomes of our freedoms should fossil fuel use be ended?²⁸ Yet the converse is equally pressing: what becomes of our freedoms should fossil fuel use *not* end? Without the ecological buffers mentioned by McNeill and planetary stability, can we still conjure Benedetto

²⁶ Jo Handelsman, *A World without Soil: The Past, Present, and Precarious Future of the Earth Beneath our Feet* (New Haven: Yale University Press, 2021), 2. Also on agriculture *The Lentil Revolution*, Vandana Shiva, . Dave Goulson's work on insects, another key factor in the viability of the food supply, includes a *Silent Earth: Averting the Insect Apocalypse* (New York: Harper Collins, 2021), XXX, XXX. On food from the sea, see Chris Armstrong, *A Blue New Deal: Why We Need a New Politics for the Ocean* (New Haven: Yale University Press, 2022); Patrik Svensson, *The Book of Eels: Our Enduring Fascination with the Most Mysterious Creature in the Natural World*, translated from the Swedish by Agnes Broomé (New York: Harper Collins, 2020) XXX

²⁷ "Humans are disrupting natural 'salt cycle' on a global scale, new study shows," *PNAS* (2023, October 31) retrieved 8 November 2023 from <https://phys.org/news/2023-10-humans-disrupting-natural-salt-global.html>. See also "The anthropogenic salt cycle," *Nature Reviews Earth & Environment* (2023). DOI: 10.1038/s43017-023-00485-y

²⁸ Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* (2009) 208.

Croce’s “story of liberty” from the past?²⁹ These are the right questions, and the answers point to a steep downhill slide. It may seem that Anthropocene histories can only be declensionist.

Nevertheless, in what follows, my aim is to make a case for new forms of historical practice that might still be useful in Bloch’s sense, despite wrenching changes of unprecedented magnitude. As an intellectual and political project, Anthropocene history is as galvanizing and exciting as it is daunting. While the “full flowering” of our species and “a better life” look very different today than they did in Bloch’s time, I will argue that critical Anthropocene histories can operate in his spirit of willed, non-utopian, humanistic hopefulness. History can still serve the present—but only if it accounts for our radically changed circumstances by engaging with the Earth sciences and only if it lowers its sights from modernity’s vision of abundance and liberty to the far more modest hope of regenerative resilience with decency.³⁰

The Anti-Utopian Imperative: Bravery and Realism

Marc Bloch is hardly alone in making a valiant case for history’s usefulness, but I turn to him for many reasons—his bravery, his moderate hopes, his sense of agency, his disdain for the “idol of origins,” his interest in statistical evidence and history’s relation to science, and the deep, pluralistic humanism that infuses his thought.³¹ He will show up as a touchstone and guide in several of the chapters to come.

²⁹ Chapter 4 discusses the problem of justice in Anthropocene histories drawing on the work of historians and theorists Sebastiano Timpanaro, Andre Gorz, John Law, Marisol de la Cadena, Mario Blaser, Duncan Kelly, John Dryzek and Jonathan Pickering. Most environmental histories still function as Holocene histories in their ways of defining justice: see the special forum in *Environmental History* on “Narrative, Place, and Environmental Justice,” Volume 28, Number 1 January 2023.

³⁰ Do I need to say more here about the challenge to historical categories of agency, event, narrative, and meaning? Agency on different scales, different forms of eventfulness, suspicion of linear narratives for forms of circularity and mutualism, elevation of many local worlds against one worldism in the cause of resilience, and a stress on the fragility of large-scale projects which suppose a predictable planet.

³¹ I might have chosen other guides. Friedrich Nietzsche, *On the Uses and Disadvantages of History for Life*, “I hate everything that merely instructs me without augmenting or directly invigorating my activity.” William J. Bouwsma, *A Usable Past: Essays in European Cultural History* (Berkeley and Los Angeles: University of California Press, 1990), p. 1: “History, in this view, much like water and electricity, is a public utility.”

Let me begin with his courage in confronting the collapse of his world. In 1939, as the German army swept into France, this greying, bespectacled Sorbonne professor volunteered for military service. At 53, Bloch was well past the normal age of combatants, and suffered from rheumatism and polyarthritis that were probably after-effects of fighting in the trenches in World War I.³² He could have bowed out altogether or sought a post far from the frontlines. Instead, he fought and in 1941 was evacuated from Dunkirk to Dover in Operation Dynamo. Shortly after, he returned to France still full of fight, but France had laid down its arms. Vichy was in the ascendency.

Given Bloch's Jewish heritage, his position was precarious, and he knew it. In late 1940 and into 1941, he contemplated accepting the offer of an associate professorship from the New School for Social Research in New York. Leaving for America would have saved him, his wife, and his four younger children, but he would have been forced to leave behind his older daughter and son, his eighty-two-year-old mother,³³ and, importantly, France itself.³⁴ He chose not to go.³⁵ For a brief period, Bloch (along with a handful of other Jewish professors) was granted an exclusion from Vichy's racial laws so he could continue to teach, but this dispensation did not last long. During this time, he finished *L'étrange défaite* [Strange Defeat: A Statement of Evidence Written in 1940³⁶] analyzing the collapse of the Third Republic, worked intermittently on what would become *The Historian's Craft*, and feuded with Lucien Febvre about the direction of their journal *Annales d'Histoire Sociale*. In Lyon, he and his family struggled with increasingly dire food shortages.³⁷

³² Peter Schöttler, "Marc Bloch in the French Resistance," translated by Jane Caplan, 93 *History Workshop Journal* (2022), 4. I owe much to Schöttler's essay and to the very fine biography by Carole Fink, *Marc Bloch: A Life in History* (Cambridge: Cambridge University Press, 1989)

³³ His mother would die on April 27, 1941 after he'd decline the New School position.

³⁴ Bloch's family had long been French patriots, fighting for their country. His grandfather (check) fought Prussians. The family was from Strasbourg.

³⁵ Fink, *Marc Bloch*, 241-260.

³⁶ *L'étrange défaite* was published in 1946 in Paris and in 1949 in London as *Strange Defeat: A Statement of Evidence Written in 1940*.

³⁷ Check timing and provide footnote.

All this, in itself, would have been courageous enough. Few of us, even those who don't rely on walking sticks, would volunteer for the front lines. Many would embrace safety in New York as did the anthropologist Claude Lévi-Strauss. Most, then and now, cloak themselves in passivity, keeping their heads down, privately grumbling, pushing ahead along their accustomed paths and hoping for the best. Marc Bloch was bolder. In late 1942, the year the Nazis had absorbed all of France, or possibly in early 1943, he slipped over the line of legality to join the Resistance. The story of his arrest, the torture he suffered, and his murder by firing squad has often been told. And honored.³⁸ He was executed by firing squad on June 16, 1944.

As we confront the Anthropocene, Bloch's courage is bracing for several reasons. Most starkly, it highlights the valor of those who bodily resist further environmental destruction.³⁹ Examples include Amazonian groups who fight cattle ranchers wanting to destroy forests to feed livestock; elderly Okinawan women swimming offshore to try to prevent construction of a coral reef-destroying American military base; and Extinction Rebellion activists gluing themselves to the desks and floors of the UK headquarters of Shell Oil company. Some environmental defenders have been murdered.⁴⁰ For instance, in 1985 primatologist and conservationist Dian Fossey was murdered at her mountains research site in Rwanda. It is widely believed that she was killed because of her relentless campaign against wildlife poaching. The numbers of environmental martyrs are high, especially in Latin America.⁴¹ On the other hand, Bloch's courage shows up the fatalism that's

³⁸ The legend that Bloch remained "definitely silent" under Gestapo interrogation is not quite true. In true Blochian fashion, Peter Schöttler ponders the genuineness and purport of a strange document finally released from the NATIONALP archives in October 2000. This document claims to be a copy of the interrogation transcript signed by Bloch on 23 May 1944 after weeks of torture. In it, Bloch names names—but only of people whom he knew to be already in Gestapo hands or safely out of France. As Schöttler puts it, "All in all, this interrogation transcript does not alter our picture of Bloch as a courageous Resistance fighter. It does not conceal any kind of scandal, nor—as far as we can tell to date—even the trace of a betrayal." (16) According to the code of the Resistance, knowing that all captured fighters would eventually break, the goal was to endure cruelty for two days to protect others. Bloch endured far longer.

³⁹ Lots of footnotes..

⁴⁰ Rob Nixon's forthcoming work on environmental martyrs.

⁴¹ According to the National Public Radio, Global Witness counted 177 environmental activists killed in 2022, the majority in Latin America. Carrie Kahn, "All Things Considered," (13 September 2023)

fashionable in some academic and media circles. Writers Jonathan Franzen, Timothy Morton, and Roy Scranton are frequently fingered as members of the “we’re doomed” brigade, urging us to “embrace death” not in resistance struggles but as a philosophical position.⁴² Bloch’s example also shames complacency, both individual and institutional. While a few try to shape their lives in accord with the four most efficacious ways to lessen their environmental impact (having one fewer child; living car free; avoiding air travel; and, eating a plant-based diet), most avoid taking even these mild measures which can seem socially awkward or even confrontational.⁴³

Bloch himself seems to have spent little time worrying about the affect of those around him. Nor does he appear to have spent his energy chiding colleagues who did not choose to confront the Nazis as he did. Underlying both his own commitment to the Resistance and his realization that few compatriots would make his choices is a wry acceptance of life’s inevitable imperfection and a deep sense of human complexity. Bloch did not fight for a flawless world; he did not foresee a perfect postwar society. Victory, the victory he believed in, would be an opportunity to continue to work for the values he held dear. To Febrve, he says he is certain only that “the time will come” when their “collaboration can again be public, and again be free.”⁴⁴ To himself, he considers the prospect that he might not live to see that time. In entries in *Mea*, the private notebook he kept in his final years, he quotes Félicité Lammenais (1782-1854) the priest, philosopher, and political theorist who

<https://www.npr.org/2023/09/13/1199324605/most-of-the-177-environmental-activists-killed-last-year-were-in-latin-america>

⁴² Jonathan Franzen *The End of the End of the Earth: Essays* Picador (edition Reprint) 2020. Roy Scranton, *We're Doomed. Now What?* (2018) and *Beginning with the End: Climate Change, the Limits of Narrative, and Ethical Pessimism* (under contract, Stanford University Press) Timothy Morton poured out *Hyperobjects: Philosophy and Ecology After the End of the World* (University of Minnesota Press, 2013) in just 15 days, urging us to “embrace death.” See, Laura Hudson, “At the End of the World, It’s Hyperobjects All the Way Down,” *Wired* (16 November 2021) <https://www.wired.com/story/timothy-morton-hyperobjects-all-the-way-down/>

⁴³ Seth Wynes and Kimberly A Nicholas, “The Climate Mitigation Gap: Education and Government Recommendations Miss the most Effective Individual Actions,” *Environmental Research Letters*, 12 (2017). In 2023, a seven-country European survey showed some adoption of these measures, particularly among those under 34, but not by a majority in any age group. See Jon Henley and Michael Goodier, “Young Europeans more likely to quit driving and have fewer children to save planet,” *The Guardian* (25 October 2023) https://www.theguardian.com/world/2023/oct/25/young-europeans-quit-driving-fewer-children-save-planet-climate-crisis?CMP=Share_iOSApp_Other

⁴⁴ Bloch, *The Historian’s Craft*, v.

declared that a good life will always lack something “if it doesn’t end on the field of battle, on the scaffold, or in a dungeon.”⁴⁵ For modest hopes, Bloch faced fearsome consequences. In this, his attitude contrasts not only with today’s fashionable environmental pessimism, but also both with the techno-optimists’s Whiggish certainty of perpetual green growth and with the equally utopian vision of global ecosocialists sure that the time of salvation through revolution is nigh.⁴⁶

Courage of the will was a quality that Bloch shared with his near contemporary Antonio Gramsci (1891-1937). Their resoluteness despite their realism about the situation stands in contrast to Stefan Zweig (1881-1942) and Walter Benjamin (1892-1940), both of whom despaired and took their own lives. Zweig’s mourning for European (and specifically Viennese) civilization’s golden age is apparent in his last book, *The World of Yesterday*, written when he was safely in exile.⁴⁷ As for Benjamin, most of what we know about his final days is found in Lisa Fittko’s extraordinary memoir of leading him and others across the Pyrenees beyond the reach of the Nazis.⁴⁸ Whatever hopes Benjamin may have had for the future, his famous Angel of History sees the past as nothing but “one single catastrophe which keeps piling wreckage upon wreckage and hurls it in front of his feet.”⁴⁹ Likewise, the Angel of Environmental History often sees a similar story: an ever more

⁴⁵ Quoted in Schöttler, “Marc Bloch in the French Resistance,” 16.

⁴⁶ See, for instance, Bill Gates, Al Gore, Paul Hawken, ed., *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming* (New York: Penguin Books, 2017). In a review in *Science*, Duchin writes, “The reader is told several times that the *Drawdown* project is based on measurement, mathematics, and rigorous modeling by scientists and researchers, but this is a case that remains to be made. . . . The *Drawdown* team multiplies a handful of numbers by a scale factor for each action and scenario; then the results for all 80 actions are (essentially) added together to represent the scenario. However, this approach to scaling up ignores the profound differences among regions. The all-important physical and economic interdependencies among the 80 actions also require attention.” Faye Duchin, “Climate Optimism gets a Road Map,” Vol 356, Issue 6340 *Science* (26 May 2017) p. 811 DOI: 10.1126/science.aan2293 Footnotes to global ecosocialism.

⁴⁷ Stefan Zweig, *The World of Yesterday*, translated by Anthea Bell (Lincoln, Nebraska: University of Nebraska Press, Reprint edition, 2013)

⁴⁸ Lisa Fittko, *Escape through the Pyrenees* (Evanston, IL: Northwestern University Press, 2000). See also Fittko, translated by Roslyn Theobald in collaboration with the author, *Solidarity and Treason: Resistance and Exile, 1933-1940* (Evanston, IL: Northwestern University Press, 1992)

⁴⁹ Walter Benjamin, “Theses on the Philosophy of History,” in *Illuminations: Essays and Reflections* (New York: Schocken Books, 1969), 257. “A storm is blowing from Paradise; It has got caught in his wings with such violence that the angel can no longer close them.” There is much discussion about whether Benjamin’s view of the future owes more to messianism or materialism and what the end goal was, but it is certain that he rejected the conventional ideas of

powerful bipedal primate masters fire, invades every continent killing off the megafauna, and eventually, with the relative stability of the Holocene, domesticates animals and plants, invents agriculture, the state, and social hierarchies extending their dominion over lands and seas. The result is a species that achieves planetary dominance threatening its own existence and much of the biosphere along with it.⁵⁰ This declensionist narrative is not wrong. Often pitched at large temporal and spatial scales, it becomes, like its Benjaminian Angel, the story of a single catastrophe. Bloch does not venture onto this scale; his histories are not single catastrophes. Instead, he works in the middle ground beneath the stratospheric declensionist view and above the mud-bound who see only one detail after another. In this turbulent middle zone, life finds its way in all the messiness with moderate hopes of better lives and “a full flowering.”

If Voltaire with his “pessimistic activism” might be considered Bloch’s philosophical ancestor,⁵¹ writer and public intellectual Rebecca Solnit might be called his philosophical successor. Solnit proposes an antic Alternative Angel of History in contrast to Benjamin’s pinioned victim. Her angel is focused on human survival in the interstices of disaster. In contrast to tragedy, which she calls seductive and beautiful, producing the greatest art, “survival is funny.”⁵² These momentary evasions of disaster, whether by luck or wily maneuver, often fall out of standard histories. “After all,” Solnit says, “most environmental victories look like nothing happened; the land wasn’t annexed by the army, the mine didn’t open, the road didn’t cut through, the factory didn’t spew effluents that didn’t give asthma to the children who didn’t wheeze and panic and stay indoors on beautiful days.

progress. One of the aims of the *Arcades Project* was “to demonstrate a historical materialism which has annihilated within itself the idea of progress.” Walter Benjamin, *The Arcades Project*, Translated by Howard Eiland and Kevin McLaughlin, (Cambridge, MA and London: Belknap Press, 1999) [N2,2] 460. CHECK entry for Benjamin in Stanford Encyclopedia of Philosophy See also Vera Schwartz

⁵⁰ Stephen Pyne, *Pyrocene*, James Scott, *Against the Grain*, Vaclav Smil *Growth*. Ian Morris, Jason Moore (?), Each has a different starting point but the powerful declensionist story is the same.

⁵¹ Deidre Dawson, “In Search of the Real Pangloss: The Correspondence of Voltaire with the Duchess of Saxe-Gotha,” Yale French Studies No. 71, *Men/Women of Letters* (1986), pp. 93-112.

⁵² Rebecca Solnit, *Hope in the Dark: The Untold History of People Power* (revised edition, Edinburgh: Canongate, 2005), 101

They are triumphs invisible except through storytelling.”⁵³ As she puts it, “Benjamin’s angel tells us history is what happens, but the Angle of Alternative History tells that our acts count, that we are making history all the time, because of what doesn’t happen as well as what does.”⁵⁴ In reconstructing a useful past for the Anthropocene, excavating the causes of what didn’t happen will become as important as understanding the causes of what occurred. Exploring regenerative cycles that took us nowhere will be as valuable as narratives moving to the beyond. As we shall see in looking at early modern Japan in Chapter 4, the wars that did not erupt, the population growth and migrations that did not materialize, and the ruling samurai class that failed to maximize its economic advantage are crucial to understanding reduced or slowed environmental harm. The point is not the perfection of these arrangements (they were far from that) but their contribution to creating mutualistic cycles that allowed social ties and natural environments to regenerate, not perfectly but enough, with each passing generation at least in some sectors.⁵⁵ A modest standard of “success.”

With her Alternative Angel, Solnit, like Bloch, also posits a useful history. As she tells us, “The Angel of History says, ‘Terrible,’ but this angel says, ‘Could be worse.’ They’re both right, but the latter angel gives us grounds to act.”⁵⁶ Towards the end of the Holocene, many historians rejected “could be worse” for the sake of “must be better” or even “must be perfect” from a variety of political positions. The failure of humanity to make good on modernity’s high-flown promises is a recurrent and understandable theme. These failures give substance to despair as we come up against environmental limits and realize that the current abundance enjoyed by the rich and the level of consumption in rich countries cannot be globalized. As the Anthropocene unfolds, “could be

⁵³ Solnit, *Hope in the Dark*, 102.

⁵⁴ Solnit, *Hope in the Dark*, 103.

⁵⁵ Mutualism is a term borrowed from biology to describe systems where materials and energy are recycled without waste or loss. For its application to human systems, see Mark Williams, et al., “Mutualistic Cities of the Near Future,” in Thomas, ed., *Altered Earth: Getting the Anthropocene Right* (Cambridge: Cambridge University Press, 2022).

⁵⁶ Solnit, *Hope in the Dark*, 104.

worse” will, by most measures, be a triumph. One imagines that Bloch would see the sense of “could be worse.” It was, after all, what he was fighting for.

Bloch and the Emerging Anthropocene

But Bloch was, in one fundamental way, stone blind. For all his political and moral clarity, for all he has to teach us about courage and realistic action, he failed to see the central danger escalating in the early twentieth century. During his lifetime, the speed and magnitude of the human impact on the Earth System intensified. Looking back, John McNeill calls this “screeching acceleration of so many processes” the real story of the twentieth century, dwarfing such things as “World War II, the communist enterprise, the rise of mass literacy, the spread of democracy, or the growing emancipation of women.”⁵⁷ McNeill tells us, “The human race, without intending anything of the sort, has undertaken a gigantic uncontrolled experiment on the earth.”⁵⁸ Bloch sees none of this. I say this not to blame him, but to emphasize how extraordinary Earth’s recent, rapid transformation has been and how crucial new scientific concepts have been to making this reality visible. Even now the most brilliant and attentive among us, even those who are politically astute, attuned to the state of the world, and capable of grasping scientific warnings, can easily fail to recognize catastrophe as it looms. Conventions, customs, and business-as-usual blind us still. Were Marc Bloch with us today, he might laugh at the notion that he should have been expected to add “prophet” to the portfolio of his achievements. Unlike us, he did not have sufficient information; like historians today, he lacked the concepts and protocols to make Earth’s transformation a historical event.

⁵⁷ McNeill, *Something New Under the Sun*, 2000, p. 4.

⁵⁸ *Ibid.*, 4

Bloch was hardly alone. Only a very few scientific visionaries, notably the great Ukrainian⁵⁹ biogeochemist Vladimir Vernadsky (1863-1945) and the French paleontologist and Jesuit priest Pierre Teilhard de Chardin (1881-1955), had begun to conceptualize the planet as a single integrated system. A fuller sense of Earth not only as interconnected but perilously fragile in the face of human onslaughts would begin to emerge in 1948, after Bloch's death, with the publication of William Vogt's *The Road to Survival* and Fairfield Osborn's *Our Plundered Planet*.⁶⁰ In the 1970s, chemist James Lovelock and microbiologist Lynn Margolis would advance the idea of *Gaia*, presenting Earth as a gracious, even-tempered deity balanced by organic and inorganic forces.⁶¹ But the key concept, the one crucial to making the Anthropocene visible, would not crystallize until the 1980s. That key concept is the Earth System, the approach that conceives of the planet as a single, integrated system with adequate measurements and powerful computers to model it.⁶²

This concept is fundamental to understanding the Anthropocene. According to Earth System science and related Earth sciences, the Anthropocene began when human impacts accelerated to the point of pushing the Earth System beyond normal Holocene oscillations into the destabilized state that's still unfolding. That happened in the mid-twentieth century. Some environmental historians confuse the Anthropocene with humanity's global environmental impact. For instance, Paul Warde defines the "Anthropocene" as "the concept of the period of history from

⁵⁹ Ukraine was then part of Russia.

⁶⁰ William Vogt, *The Road to Survival* (New York: William Sloane Associates, 1948); Fairfield Osborn, *Our Plundered Planet* (Boston: Little, Brown and Company, 1948); Paul Warde, Libby Robin, and Sverker Sörlin, *The Environment: A History of the Idea* (Baltimore, Johns Hopkins University Press, 2018), 9-11

⁶¹ Lovelock and Margolis, XXX James Lovelock, *Gaia: A New Look at Life on Earth* (Oxford: Oxford University Press, 1979) and James Lovelock, *The Revenge of Gaia* (London: Penguin, 2006)..

Tim Lenton argues that the Gaia Hypothesis as the key insight underlying the concept of the Earth System, see Tim Lenton, Oxford: Oxford University Press. Leah Aronowksy Paul Crutzen rejected the Gaia Hypothesis, see Crutzen (2004) 'Anti-Gaia', Box 2.7. In: Steffen W, et al. (eds) *Global Change and the Earth System: A Planet Under Pressure*. New York: Springer, p. 72. Toby Tyrrell, *On Gaia: A Critical Investigation of the Relationship between Life and Earth* (Princeton, NJ: Princeton University Press, 2013).

⁶² Paul Edwards, etc.

which human activities have had global effects on the environment.”⁶³ This is inaccurate. By many measures, *Homo sapiens* has had global impacts for thousands of years, but these impacts have never been, until very recently, enough to impact the Earth System. During the Pleistocene, we colonized every continent except Antarctica, coinciding with megafauna die-offs and the extinction of other hominins. Even then we transformed landscapes and changed ecosystems all over the globe. During the 11,700 year Holocene, *Homo sapiens* were even more successful in making global impacts, but before the twentieth century, all our impacts were within Holocene norms. Only very recently has the Earth System been knocked off kilter. Without the Earth System concept, it is unlikely that the idea of the Anthropocene would have emerged as it did. Today, despite the advantage of very powerful computers and many more measurements, Earth System scientists have only tentatively begun to understand the interacting forcings on this system, and as they often underscore, there is still much that is simply unknown.

Bloch’s blindness to this coming planetary upheaval is completely understandable. Historians share his blindness even now although science has made great strides, and the Anthropocene has begun. The disjuncture between this reality and our practices raises the question of whether the Anthropocene is in fact an “event” as understood by historians or, perhaps better put, in what way the Anthropocene might become a historical event if it is approached persuasively. Those of us schooled by E.H. Carr and his gingerbread man (who will be discussed in Chapter Two) will argue that occurrences are not events until they are framed as such.⁶⁴ One of the central questions of Anthropocene histories is how this can be usefully done given that its scale far exceeds historians’ normal range. Historian Martin Jay defines an event as an occurrence which breaks patterned regularities. As Jay explains it, an event is a particular instance that escapes the confines of

⁶³ Paul Warde, “Social and Environmental History in the Anthropocene” in John H. Arnold, et al. ed., *History after Hobsbawm: Writing the Past for the Twenty-First Century* (2017) 184 <https://doi.org/10.1093/oso/9780198768784.003.0010>

⁶⁴ E.H. Carr, *What is History?*

its initial context to become "world-establishing." True events "radically upend their contexts" and inaugurate "their own history."⁶⁵ Events, in other words, break continuity. By this measure, the Anthropocene qualifies as a world-establishing break for the Earth sciences. The work of historians is to ask if it can function that way given our usual scales, our middle ground. In medias res, as seconds pass with metronomic regularity, it can be hard to gauge just when the quotidian becomes the extraordinary. An occurrence revealed most cogently through models produced only once high-powered computers become available, even one that is almost literally Earth shattering, can be hard for humanists to discern.

Bloch himself is keenly aware of how easy it is for people to miss the obvious, particularly if it is part of the everyday. In *The Historian's Craft*, he considers the complex psychology of recognition. As he points out, first-hand accounts in the archives need to be read critically since everyday things may leave no imprint either at the time or in memory. Therefore "many witnesses deceive themselves in good faith."⁶⁶ Bloch gives us the example of St. Bernard who was surprised to learn that the chapel where he worshipped daily opened onto the chevet by three windows. This saint was renowned for his inattentiveness not only to his daily surroundings but even to unusual ones. To his hagiographers' delight, he managed to travel "along the shores of Lake Geneva for an entire day without being aware of it." Oblivion, apparently, can be a sign of holiness. Bloch assures us, however, that "it is not necessary to be one of the foremost mystics to be grossly mistaken about those realities which should seemingly be the best known to us."⁶⁷

Bloch understands our incapacity to absorb the full reality of a situation as part of the human condition. His biographer Carole Fink describes his low opinion of our abilities: "In motion, the

⁶⁵ Martin Jay, "Historical Explanation and the Event: Reflections on the Limits of Contextualization," 42, *New Literary History* (2011) 557–571. Here p. 564.

⁶⁶ Bloch, *Craft*, 100.

⁶⁷ Bloch, *Craft*, 100-101.

human intelligence, like a leaky vessel, loses the memories it has stored, and when still, faced with the facts themselves, it can perceive only a small part of the whole.”⁶⁸ Since people “were lazy and all too ready to accept opinion as fact,” historians needed to prepare themselves, first and foremost, to guard against the ease of joining the flock and baaing along with the rest. As Fink puts it, historians necessarily “developed the critical method to impose a ‘constant discipline’ on themselves in the struggle against complacency, overwork, fatigue, and uncertainty over results.”⁶⁹

Yet as Bloch would be the first to acknowledge, our critical method fails to steel-plate us against failures of observation and analysis. It is entirely possible not to see a catastrophe even as one lives through it.⁷⁰ Bloch and most of his generation of historians—and those to follow—failed to notice the crucial ways in which the planet was changing because “planet” was not a historical category, because very few scientists thought in terms of anything resembling an integrated Earth System, because fascism and war were enormous distractions, and because, frankly, it was and still is very hard to grasp what has happened. On the face of it, it is highly improbable that puny, almost hairless creatures who just a century ago were a relatively minor factor among the great forces of nature have now collectively acquired enough power to constitute an “anthroposphere” (as the scientists put it) joining the geosphere and the biosphere in controlling Earth’s environmental conditions. In short, the advent of the Anthropocene was easy to miss. And it still is. The Anthropocene remains a doubtful guest in the house of history, an awkward visitor from arcane realms of science.

Three Scientific Frameworks for the Anthropocene

⁶⁸ Fink, 52.

⁶⁹ Fink, 51.

⁷⁰ See Auden’s “Musée des Beaux Arts.”

For historians trying to understand the Anthropocene today, it is important to grasp that it is a conceptual framework distinct from concepts such as “the environment” and “climate change.” Three major over-lapping but distinctive scientific approaches have emerged in the effort to conceptualize Earth’s very rapid, recent transformation: the Earth System approach, the stratigraphic approach, and the Planetary Boundaries approach. Each has a different lineage within the Earth sciences. In the end though, all three define the Anthropocene as the period after Earth entered a new state outside Holocene norms in the twentieth century. Some historians have rushed ahead without the “constant discipline” of Bloch’s critical method and without the effort to understand the discoveries of these sciences or all that remains unknown and disputed within them. If we are to question the usefulness or otherwise of the concept of the Anthropocene for history, these sciences need some unpacking.

Earth System Science

“Cene” is the suffix for the geological epochs within the Cenozoic Era, but “Anthropocene” did not originate, as sometimes thought, within geology. Perhaps if it had, there would be less bickering about the idea amongst geologists and less confusion about the concept’s relationship with climate change. Instead, “Anthropocene” emerged from a relatively new branch of science called Earth System science or ESS. ESS swaggered its way into being through a combination of scientific insight and NASA’s institutional imperatives and missteps. In the 1980s, faced with funding cuts after the enthusiasm for Moon landings waned, NASA was casting about for new frontiers.⁷¹ Some NASA scientists began to turn their attention Earthwards. They did not intend to think small, as historian of science Jenifer Barton explains, because thinking small meant

⁷¹ For an excellent cultural history of the Apollo program, which is the prehistory of this 1980s moment, see Neil M. Maher, *Apollo in the Age of Aquarius* (Cambridge, MA.: Harvard University Press, 2019)

small budgets. Instead, they envisioned a new “Earth science initiative to study the physical, chemical, and biological processes of the world’s lands, oceans, and atmosphere as a single, integrated system using a fleet of Earth observing satellites.”⁷² Their several goals included a better understanding of weather patterns and measurements of the poorly understood hydrological and biogeochemical cycles that they recognized as being impacted by human activities.⁷³ They hoped to answer the question of why Earth had life while Venus and Mars, already explored by the Mariner and Viking missions in the 1960s and ‘70s, did not. This project was dubbed “Global Habitability” and unveiled with fanfare at a United Nations space conference in 1982.

Global Habitability’s debut went badly, very badly. Rather than clamorously acceptance, NASA officials described the reception as “openly hostile” and “scathing.” Representatives from other countries rebelled against the idea of girdling the Earth with a network of silent satellites measuring environmental factors. Today, when many satellite networks are in private hands and often beyond government regulation, this reaction reminds us of a time in which national sovereignty was powerful, and indeed, in this instance, determinative. One of the NASA officials presenting the idea remembers that the rejection was total: “We were shot down! . . . No one accepted it. They would not buy into it. They thought it was the United States trying to take over the world, and that we were going to keep all of the data, and we were going to have all of the information on their countries, and they didn’t want that.”⁷⁴ The Americans were taken aback. Global Habitability was immediately shelved, leaving NASA officials momentarily without a plan.

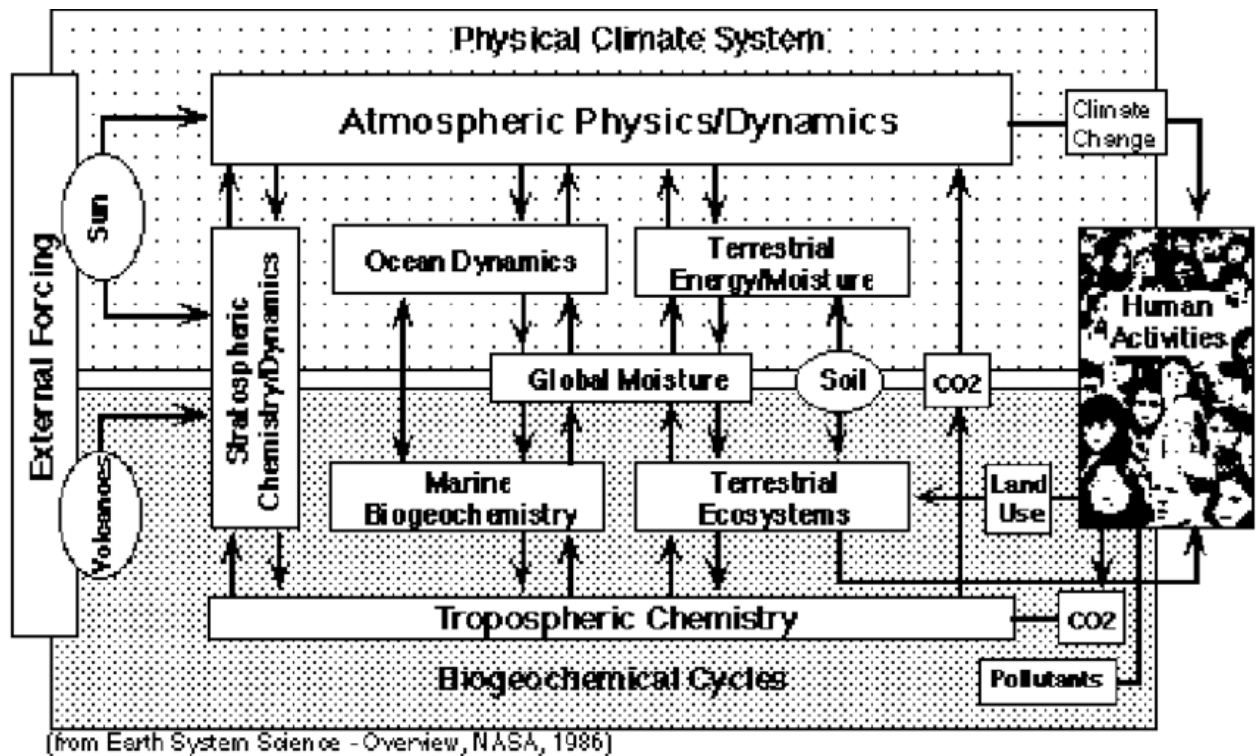
⁷² Jenifer Barton, “We were shot down!”: Earth Observing Satellites, Data Surveillance, and NASA’s 1982 Global Habitability Initiative,” *History and Technology* (2021) DOI: 10.1080/07341512.2021.1989127 See also, Barton, “Branding the Earth: Selling Earth System Science in the United States, 1983-1988,” Vol. 53(1) *Social Studies of Science* (2023): 49–80 and Jenifer Barton, “Wiring the World: A History of the Earth System Concept in the US Earth Sciences, 1982-1989,” Ph.D. Dissertation.

https://tspace.library.utoronto.ca/bitstream/1807/103621/1/Barton_Jenifer_Patricia_202011_PhD_thesis.pdf

⁷³ My thanks go to historian of science Angela Creager for pointing me to Hutchinson’s invention of the term “biogeochemical” and advances in the concept of biological niches. See George Evelyn Hutchinson “Circular Causal Systems in Ecology,” *Annals of the New York Academy of Sciences* 50 (1948): 221-246.

⁷⁴ Quoted in Barton, p. 9.

They quickly regrouped and by 1983, NASA’s Advisory Council gave birth to the approach called Earth System science, forming the “Earth System Sciences Committee (ESSC) to rebrand and rework Global Habitability into a global Earth science research program” studying the planet as a single, integrated whole.⁷⁵ In 1986, the committee headed by Francis Bretherton, a mathematician who contributed to the understanding of atmospheric and oceanic dynamics, provided a simplified sketch of these interactions, including an intriguing box marked “Human Activities.”⁷⁶ Although as Barton points out, Earth System science never attracted the popular imagination or the funding levels of the lunar landing projects, “this concept provides crucial theoretical scaffolding that unifies interdisciplinary Earth science research” today.⁷⁷



⁷⁵ Barton, (2021) p. 16.

⁷⁶ This schematic diagram became “an important driving force for the conceptualization of subsequent Earth system research programs” (Mooney et al. 2013, p. 3666).

⁷⁷ See also, Barton, “Branding the Earth: Selling Earth System Science in the United States, 1983-1988,” Vol. 53(1) *Social Studies of Science* (2023), 49. As ESS relates to the Anthropocene, see Thomas, Williams, Zalasiewicz, *The Anthropocene: A Multidisciplinary Approach* (Cambridge: Polity Press, 2020) x-xi. Also of interest, Perrin Selcer, *The Postwar Origins of the Global Environment: How the United Nations Built Spaceship Earth* (New York: Columbia University Press, 2017)

It was in this milieu, after fifteen years and an exponential increase in computing power making ESS far more sophisticated, that “Anthropocene” sprang to the lips of atmospheric chemist Paul Crutzen.⁷⁸ In 2000, at a conference of Earth System scientists in Mexico, Crutzen got agitated. What frustrated him was that paper after paper revealed measurements far outside Holocene norms although the presenters continued to refer to “the Holocene.” In this now iconic story, the Nobel Laureate galvanized the assembly by blurting out an objection: “Stop saying ‘Holocene’! We’re in the . . .” and here he paused for thought, “the ‘Anthropocene.’”⁷⁹ For the interdisciplinary scientists in the room, Crutzen’s term crystallized their own disquiet. The Earth System had changed. No longer was it operating within the normal range of Holocene oscillations.

Later that year, Crutzen and American paleoecologist Eugene Stoermer published a piece explaining the term “Anthropocene”; this initial paper was followed by Crutzen’s landmark single-page essay “Geology of Mankind” in 2002.⁸⁰ And here’s where the story gets interesting. In 2002, Crutzen proposed a late eighteenth-century origin of the Anthropocene—specifically, James Watt’s design of the steam engine in 1784 and the rise in CO₂ emissions—a date which spoke to his own research specialty of atmospheric chemistry and his reading of Western industrialization. It was also in accord with climate change as the primary problem as represented by NASA scientist James Hansen and many others. But Crutzen’s claim was on shaky ground. There was no data going back to the eighteenth century because the International Geosphere-Biosphere Programme (IGBP), set up in 1987 to facilitate “international research on global-scale and regional-scale interactions between Earth’s biological, chemical and physical processes and their interactions with human systems,” had only extended its reach to 1950.⁸¹

⁷⁸ On the rise in computing power, see Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA.: MIT Press, 2010)

⁷⁹ Check wording. Find footnotes.

⁸⁰ Paul J. Crutzen and Eugene F. Stoermer, “The ‘Anthropocene,’” *Global Change Newsletter*, 2000, 41:17–18; and Crutzen, “Geology of Mankind,” *Nature*, 2002, 415:23.

⁸¹ IGBP website <http://www.igbp.net/about.4.6285fa5a12be4b403968000417.html> The IGBP ran from 1987 to 2015.

Thanks to Crutzen’s galvanizing insight, the IGBP began to collect data extending back a further two centuries. Crutzen and others expected to see a gradual rise of pressures on the Earth System beginning in the eighteenth century, but, to their surprise, they were wrong. The IGBP research, published in 2004, revealed an abrupt and near-synchronous change in the mid-twentieth century, a change that would come to be known as the “Great Acceleration.”⁸² Before that time the Earth System had remained within Holocene norms; then, quite suddenly, the metrics on every dimension—from human population to shrimp farming, from paper production to ocean acidification—shot vertically upward. Both Earth System trends and socio-economic trends headed skyward. Paul Crutzen changed his mind. The Anthropocene had not begun in the late eighteenth century date; it was a twentieth-century phenomenon.⁸³

Stratigraphy

As “Anthropocene” gained currency among Earth System scientists, geologists looked on uneasily. After all, the term implied that a new epoch had been added to the Geological Time Scale (GTS), their fiercely guarded chart of Earth’s ~4.54 billion year existence, but they were on the sidelines. Understanding the preciousness of the GTS to stratigraphy is essential to understanding the procedures and debates surrounding the Anthropocene. Geology, unlike Earth System science, is an old discipline, often traced to Georges Buffon (1707-1788) and his struggle to discover the age

⁸² Will Steffen, et al., *Global Change and the Earth System: A Planet Under Pressure* (Berlin: Springer, 2004). See also Steffen et al., “The Trajectory of the Anthropocene: The Great Acceleration,” *Anthropocene Rev.*, 2015, 2:81–98.

⁸³ Paul Crutzen joined forces with Earth System scientist Will Steffen and global historian John R. McNeill to publish the landmark 2007 statement of the Great Acceleration, a term coined by McNeill in homage to Karl Polyani’s “Great Transformation.” Will Steffen, P.J. Crutzen, and John R. McNeill, “The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?” *Ambio*. **36** (8) (2007): 614–621. [doi:10.1579/0044-7447\(2007\)36\[614:TAAHNO\]2.0.CO;2](https://doi.org/10.1579/0044-7447(2007)36[614:TAAHNO]2.0.CO;2). [hdl:1885/29029](https://hdl.handle.net/1885/29029). [JSTOR 25547826](https://www.jstor.org/stable/25547826). [PMID 18240674](https://pubmed.ncbi.nlm.nih.gov/18240674/) Paul Crutzen would join the Anthropocene Working Committee and support the majority opinion. See, for instance, Zalasiewicz, J., Waters, C. N., Williams, C. N. M., Barnosky, A. D., Cearreta, A., Crutzen, P., and Ellis, M. A., et al. 2015. “When Did the Anthropocene Begin? A Mid-Twentieth Century Boundary Level is Stratigraphically Optimal.” *Quaternary International* 383: 196–203. [doi: 10.1016/j.quaint.2014.11.045](https://doi.org/10.1016/j.quaint.2014.11.045) and Zalasiewicz, J., Waters, C. N., Summerhayes, C. N. C. P., Wolfe, A. P., Barnosky, A. D., Cearreta, P., Crutzen, E., et al. 2017. “The Working Group on the Anthropocene: Summary of Evidence and Interim Recommendations.” *Anthropocene* 19: 55–60. [doi: 10.1016/j.ancene.2017.09.001](https://doi.org/10.1016/j.ancene.2017.09.001).

of the Earth.⁸⁴ This difficult task was not fully accomplished until nearly two hundred years later, in the 1950s, when geochemist Clair Cameron Patterson measured lead and uranium isotopes from a meteorite. His 1953 calculation of a 4.55 billion year existence was modified only slightly to the date now used.⁸⁵ This advance had allowed geologists to put actual dates on the sequences of changes in the rock layers that had hitherto been organized chronologically, but without specific years attached. The GTS maps Earth's history and has become the crucial tool for geologists working in the field to know when the mineral they are looking at was formed.

For practicing geologists, stratigraphic layers are anything but a neat index to time. Over the roughly four and a half billion years of our planet's existence, its crust has been violently contorted by volcanic eruptions, earthquakes, and metamorphism due to the enormous force of tectonic plates crashing together. Weathering and meteorites further molded and scarred the surface. The emergence of life more than 3.5 billion years ago initially made little difference Earth's mineralogy, but once photosynthesis evolved about 2.5 billion years ago emitting oxygen as a waste product, interactions between organisms and inorganic matter multiplied the number of minerals from about 1,500 to approximately 5000.⁸⁶ Since that time, this number has stayed more or less stable—until recently. In the last hundred years or so, human ingenuity added a further 216,000 inorganic compounds called the “Anthropocene mineralogy,” by Robert Hazen and colleagues.⁸⁷

⁸⁴ Georges-Louis Leclerc, Comte de Buffon, published *Les Époques de la Nature* in 1778. For an excellent English language translation, see Buffon, *The Epochs of Nature* translated by Jan Zalasiewicz (Chicago: University of Chicago Press, 2018).

⁸⁵ Claire Cameron Patterson, "Age of Meteorites and the Earth," *Geochimica et Cosmochimica Acta* 10 (1956), 230-237. Later he would worked very hard to draw attention to growing lead levels in the atmosphere due to gasoline additives, contributing ultimately to America's Clean Air Act of 1970. See Patterson, "Contaminated and Natural Environments of Man," *Arch. Environ. Health* 11, (1965), 344-360. See also ChemEurope.com: Claire Cameron Patterson, https://www.chemeurope.com/en/encyclopedia/Clair_Cameron_Patterson.html.

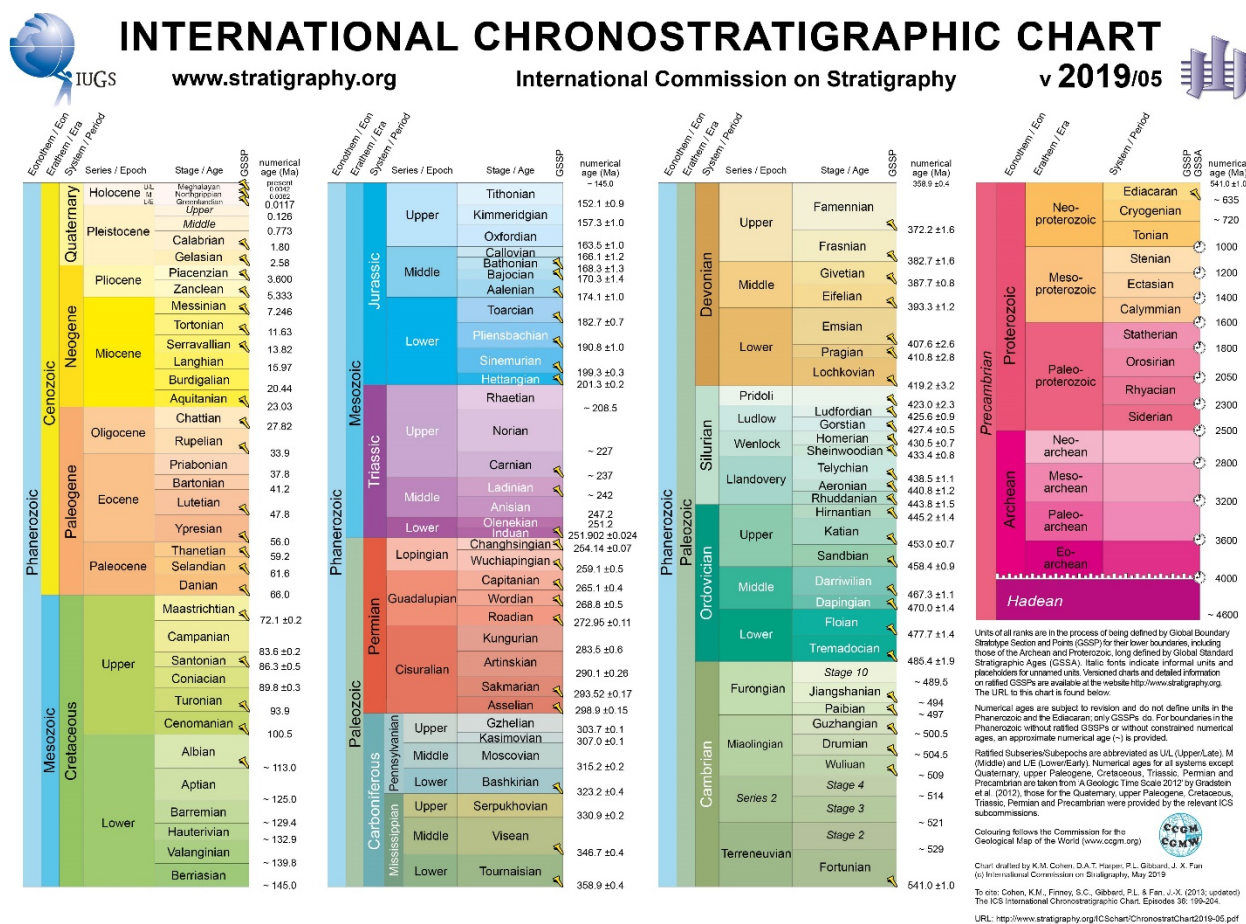
⁸⁶ Mark Williams and Jan Zalasiewicz, *The Cosmic Oasis: The Remarkable Story of Earth's Biosphere* (Oxford: Oxford University Press, 2022). Jan Zalasiewicz, Thomas, ed., *Altered Earth*

⁸⁷ R. M. Hazen, E. S. Grew, M. J. Origlieri, and R. T. Downs, "On the Mineralogy of the 'Anthropocene Epoch'," *American Mineralogist* 102 (2017): 595–611. Hazen and his coauthors noted the existence of a Karlsruhe-based Inorganic Crystal Structure Database, which then had records of more than 180,000 such inorganic compounds! (As of November 2019, there were more than 216,000 listed). While biodiversity has been radically reduced, geodiversity has been radically

The GTS serves as an index of Earth time as evidenced in its contorted crust. It is a way of locating any particular mineral compound in the vast sequence of time no matter how disrupted and overturned these strata are at a particular location. As the primary tool of geology, the GTS is carefully guarded by a formidable bureaucracy that scrutinizes any potential addition. To add a new unit requires a supermajority vote at four levels of the hierarchy. There are strict rules for what counts as evidence: distinct strata⁸⁸ laid down nearly synchronously and globally. Without that, there is no new time interval. Obviously, these criteria are not the same as Earth System science criteria, and yet, as we will see, they reveal the same reality.

increased, at least in terms of number of types of “minerals” which are not true minerals in that the lithographers stopped including human-made compounds in their official list. The number of “minerals” on Earth more than 40-fold, mostly over the last hundred years or so.

⁸⁸ Check the strata/statum requirement.



Cohen, K.M., Harper, D.A.T., Gibbard, P.L. 2023. ICS International Chronostratigraphic Chart 2023/06. International Commission on Stratigraphy, IUGS. www.stratigraphy.org (visited: 19 October 2023)

In defense of the GTS, the International Commission on Stratigraphy (ICS) launched an investigation in 2009 into whether or not the Anthropocene met their standards. The formation of the Anthropocene Working Group (AWG) that year was the first toehold of the long climb to the formalization of the new time interval and its placement at the top of the GTS—assuming sufficient evidence and sufficient support among feisty stratigraphers.⁸⁹ The paleobiologist put in charge of the committee was initially doubtful, both about the evidence and about managing colleagues. In fact, Jan Zalasiewicz describes himself as a reluctant recruit. Having dedicated his life to studying

⁸⁹ For a study of the AWG, see Johannes Lundershausen, "The Anthropocene Working Group and its (Inter-)Disciplinary," *Sustainability: Science, Practice and Policy*, 14:1, (2018), 31-45, DOI:10.1080/15487733.2018.1541682

the deep fossil record partly to avoid the *Sturm und Drang* of human exchanges, he has been immersed in fifteen years of drama with no end in sight. “When I started geology, it was very much an escape from the complications of the world. You learn to live in the past,” he told Marlowe Hood, a science reporter for *Physics World*. Being made AWG chair meant hitting “all of this messy, complicated human life. It’s a very abrupt change, and it's not a comfortable one.” As Zalasiewicz sums it up, “I was ambushed by the Anthropocene, and then kidnapped without hope of release.”⁹⁰ The unfunded, volunteer committee included a range of specialists, most of them geologists, but there were also members from geography, archeology, history, law, and Earth System science. Indeed, both Paul Crutzen and the remarkable Earth System scientist Will Steffen (1947-2023), so central to creating interdisciplinary connections, joined the team.

⁹⁰ Marlowe Hood, “How the weight of the world fell on one geologist's shoulders” (2023, July 10) retrieved 17 October 2023 from <https://phys.org/news/2023-07-weight-world-fell-geologist-shoulders.html> Zalasiewicz is not chair of the SQS or the Subcommission on Quaternary Stratigraphy which is the next level in vetting the Anthropocene after the AWG.



Paul J. Crutzen (1933-2021) and Jan Zalasiewicz at a meeting of the AWG. Source: Newsletter of the Anthropocene Working Group, Vol. 10, Report of Activities 2020 (December 2020) <http://quaternary.stratigraphy.org/workinggroups/anthropocene/>

By 2014, evidence locked in ice cores, sediment cores, coral skeletons, and stalactites began to mount.⁹¹ According to analyses of these materials, an unmistakable, recent, near-synchronic stratum was evident in the mid-twentieth century.⁹² By 2019, after a decade of evidence-gathering and debate, a binding vote by 88 percent of the AWG confirmed its consensus that Earth entered a new phase in the mid-twentieth century.⁹³ For most of the committee, the evidence was

⁹¹ Colin N. Waters, et al. *A Stratigraphical basis for the Anthropocene* (London: Geological Society, London, Special Publication 395, 2014) 321pp; Jan Zalasiewicz, Colin N. Waters and Mark Williams, “Human Bioturbation, and the Subterranean Landscape of the Anthropocene,” 6 *Anthropocene* (2014): 3-9; and, Jan Zalasiewicz, Mark Williams, and Colin N. Waters, et al., “The Technofossil Records of Humans,” 1(1) *Rev.* (2014) 34-43.

⁹² Zalasiewicz J, et al., “When did the Anthropocene begin? A mid-twentieth century boundary level is stratigraphically optimal,” 383 *Quaternary International* (2015) 196–203. Colin N. Waters, et.al., “Global Boundary Stratotype Section and Point (GSSP) for the Anthropocene Series: Where and how to look for potential candidates,” vol. 178, *Earth-Science Reviews* (March 2018), 379-429.

⁹³ Francine McCarthy explains the process in this way: “The AWG selected plutonium-239 as the primary marker back in May 2019 and this proved to be the best chronostratigraphic marker across the studied sites - and exceptionally well recorded at Crawford Lake, which is in the path of prevailing winds from the test sites in the SW USA. However, this is

overwhelming; there were only four dissenters out of thirty-three votes. The committee still had a lot of work ahead to formalize a proposal meeting the GTS standards. Their 2019 press release described the “phenomena associated with the Anthropocene” as:

an order-of-magnitude increase in erosion and sediment transport associated with urbanization and agriculture; marked and abrupt anthropogenic perturbations of the cycles of elements such as carbon, nitrogen, phosphorus and various metals together with new chemical compounds; environmental changes generated by these perturbations, including global warming, sea-level rise, ocean acidification and spreading oceanic ‘dead zones’; rapid changes in the biosphere both on land and in the sea, as a result of habitat loss, predation, explosion of domestic animal populations and species invasions; and the proliferation and global dispersion of many new ‘minerals’ and ‘rocks’ including concrete, fly ash and plastics, and the myriad ‘technofossils’ produced from these and other materials.⁹⁴

In other words, the stratigraphic Anthropocene was not at odds with the Earth System science Anthropocene. Although the measurements and meaning of the term for these two approaches have different nuances, the underlying reality is the same.

Will Steffen’s work has been particularly instrumental in bringing the two approaches together—and, as we will see, Steffen was also instrumental in connecting the work of ESS and the AWG to the Planetary Boundaries Framework. In 2016, Steffen along with geologists Reinhold Leinfelder and Jan Zalasiewicz compared stratigraphic and Earth System approaches. This paper points out that “the overarching concept of the Earth as a single complex system” has been useful to both branches of science: “Stratigraphy has benefitted from an increase of methods, data, and conceptual and explanatory frameworks; Earth System science has consequently benefitted from new types of stratigraphical inputs.”⁹⁵ Their conclusion is that “The concept of the Anthropocene

NOT, strictly speaking, the best marker of the Great Acceleration, except in that Pu-239 is an anthropogenic material first produced (and disseminated) in the mid-20th C. Markers of fossil fuel combustion are the best markers of the proposed Anthropocene, and SCPs (fly ash) and nitrogen isotopes (delta N-15) are excellent proxies for that.... but since their presence predates the mid-20th C, they are not as useful as chronostratigraphic markers as Pu-239 where it is virtually presence/ absence as opposed to sharply increased abundance.” Correspondence November 9, 2023.

⁹⁴ Press Release, ICS and AWG, “Results of binding vote by AWG Released 21st May 2019,”

⁹⁵ Will Steffen, Reinhold Leinfelder, and Jan Zalasiewicz, et al. (2016). “Stratigraphic and Earth System approaches in defining the Anthropocene. *Earth’s Future*, 4, pp. 324–45, here page 34? Steffen, W., Leinfelder, R. J. Zalasiewicz, C. N. Waters, M. Williams, C. Summerhayes, A. D. Barnosky, A., et al., “Stratigraphic and Earth System Approaches to Defining the Anthropocene,” 4(8) *Earth’s Future* (2026), 324–345. doi: [10.1002/2016EF000379](https://doi.org/10.1002/2016EF000379) See also Jan Zalasiewicz,

has provided a trigger for the Earth System science and stratigraphic communities to integrate their knowledge, tools, skills, and rapidly growing masses of data in unprecedented ways. From both Earth System science and stratigraphic perspectives, the Earth has been pushed out of the pre-industrial Holocene norm by human activities” in the mid-twentieth century. The paper warned that Earth was on a trajectory that potentially was “no longer governed by the late Quaternary regime of glacial–interglacial cycles, and with far fewer species.”

Steffen’s increasing alarm about the Earth System’s trajectory led, in 2018, to a further paper, nicknamed “Hothouse Earth.” Here, again combining the insights of stratigraphy and ESS, he and his co-authors warned, “the Earth System may be approaching a planetary threshold that could lock in a continuing rapid pathway toward much hotter conditions—Hothouse Earth. This pathway would be propelled by strong, intrinsic, biogeophysical feedbacks difficult to influence by human actions, a pathway that could not be reversed, steered, or substantially slowed. Where such a threshold might be is uncertain, but it could be only decades ahead.”⁹⁶ There are dark hints about the unknowability of exactly where thresholds lie and what it would be like on the other side. The scientists, in their deadpan way, say only that transgressing the threshold is “likely to produce uncontrollable and dangerous conditions.”⁹⁷

According to Steffen et al, the best hope is to restabilize Earth System. This restabilized state would be far from ideal. Despite unrealistic demands that we “repeal the Anthropocene,” there is no going back.⁹⁸ Instead, “stabilized Earth will likely be warmer than any other time over the last 800,000 years at least” and probably won’t avoid the activation of some triggers that would

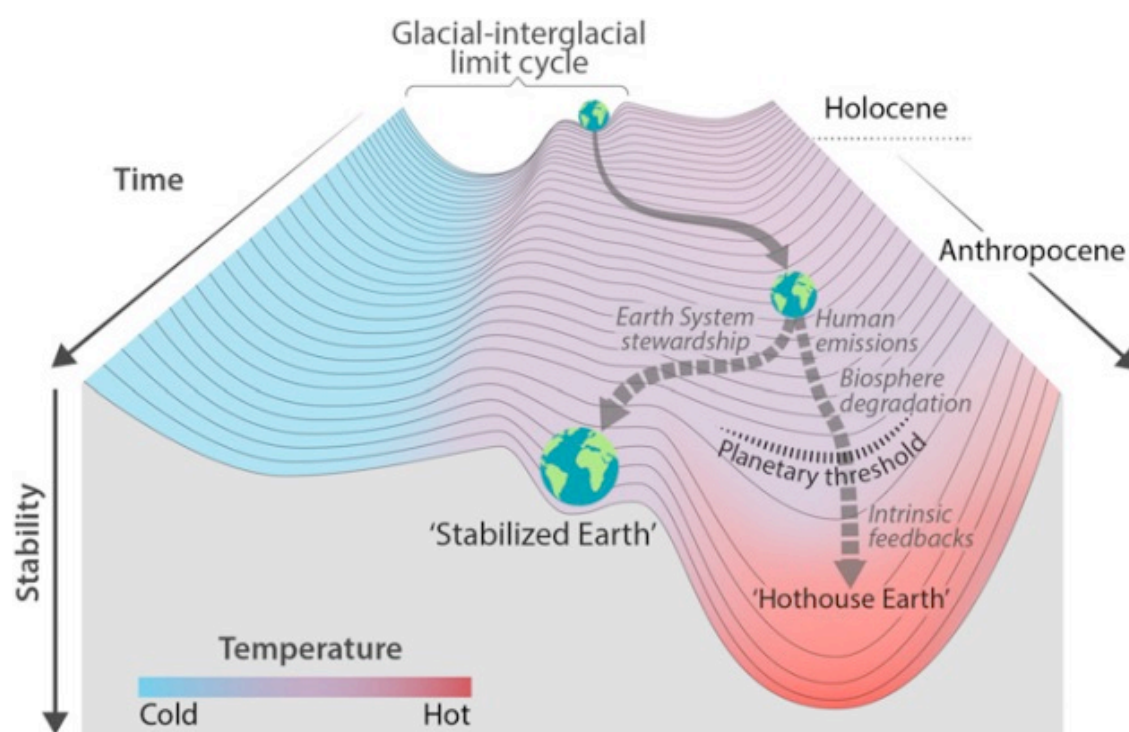
et al., “The Anthropocene: Comparing Its Meaning in Geology (Chronostratigraphy) with Conceptual Approaches Arising in Other Disciplines,” *Earth’s Future*, 2021, 9(3):1–25, <https://doi.org/10.1029/2020EF001896>

⁹⁶ Will Steffen, et al, “Trajectories of the Earth System in the Anthropocene,” Vol. 115, No. 33 *PNAS* (14 August 2018) p. 8257.

⁹⁷ Steffen et al. 2018 (Footnote 7), 8256

⁹⁸ Marcia Bjornerud pleads for a repeal in *Timefulness: How Thinking like a Geologist Can Help Save the World* (Princeton, NJ: Princeton University Press, 2018), 177.

lead to “abrupt shifts at the level of critical biomes that support humanity.”⁹⁹ But, such a state would not be lethally hot everywhere on the planet and biodiversity loss would be at least somewhat limited. In other words, the best we can hope for is a highly artificial, far-from-utopian state that “could have been worse,” far worse, as Rebecca Solnit would say. Currently, business-as-usual is taking us over the cliff.



From Will Steffen, et al, “Trajectories of the Earth System in the Anthropocene,” *PNAS* (2018)
 Fig. 2. Stability landscape showing the pathway of the Earth System out of the Holocene and thus, out of the glacial–interglacial limit cycle to its present position in the hotter Anthropocene. The fork in the road in Fig. 1 is shown here as the two divergent pathways of the Earth System in the future (broken arrows). Currently, the Earth System is on a Hothouse Earth pathway driven by human emissions of greenhouse gases and biosphere degradation toward a planetary threshold at $\sim 2^\circ\text{C}$ (horizontal broken line at 2°C in Fig. 1), beyond which the system follows an essentially irreversible pathway driven by intrinsic biogeophysical feedbacks. The other pathway leads to Stabilized Earth, a pathway of Earth System stewardship guided by human-created feedbacks to a quasi-stable, human-maintained basin of attraction. “Stability” (vertical axis) is defined here as the inverse of the potential energy of the system. Systems in a highly stable state (deep valley) have low potential energy, and considerable energy is required to move them out of this stable state. Systems in an unstable state

⁹⁹ Steffen et al. 2018, 8257.

(top of a hill) have high potential energy, and they require only a little additional energy to push them off the hill and down toward a valley of lower potential energy.

The AWG is continuing its work, putting the final touches on a formal proposal. The arcane requirements of geostatigraphy insist on locating a primary marker and secondary markers to serve as the reference for global fieldwork. In the summer of 2023, the AWG announced its decision to use cores from the bottom of Crawford Lake near Toronto as the primary signal. If committees higher up the geostatigraphic feeding chain approve, the Anthropocene would join the Eocene, the Pleistocene, and other such units on the great canvas of the Geological Time Scale charting the Earth's lifespan. It is unlikely that they will do so. Many geologists have a vested interest in business-as-usual through their connections with extractive industries. As geologist Iain Stewart explains, many went into oil and gas exploration thinking they were contributing to societal good, so it is hard to realize that their work has put the “planet in peril, along with enduring and deepening social and economic inequalities.”¹⁰⁰ More immediately, the guardians of the GTS are rightly conservative about this central tool of their profession. It is not to be tweaked with every passing fad. Their track record in this regard is quite extreme from the perspective of historians. A prime instance is the Holocene epoch, first proposed in 1867 (19 years before Marc Bloch's birth), formally submitted to the International Geological Congress in Bologna in 1885 (the year before Bloch was born) and ratified officially only in 2008 by the Committee of the International Union of Geological Sciences (IUGS). Officially, then, Marc Bloch did not live in the Holocene. As for the Anthropocene, if the pace of deliberation about the Holocene is any indication, we may have stratigraphic confirmation of the Anthropocene in 2141.

¹⁰⁰ Iain Stewart, I. (23 January 2023) “Geology for the Wellbeing Economy.,” *Nature Geoscience* (Nat. Geosci.). <https://www.nature.com/ngeo/news-and-comment?type=comment&year=2023>

For historians and people more generally, waiting for the International Commission on the Stratigraphy (ICS) before coming to terms with the reality of the Anthropocene would be unwise. Given its well-evidenced confirmation through Earth System science and, as we shall see, the work done to establish Planetary Boundaries, it is certain that Earth is changing. Even the dissenters on the AWG do not deny planetary instability.¹⁰¹ For many policymakers, humanitarians, and religious leaders, a ratified time interval on the GTS would, they say, be useful for the clarity and urgency it would provide.¹⁰² Should the ICS not confirm the Anthropocene, it may embolden those who tell us that our challenge is a relatively small matter of tweaking energy sources so that growth and the business-as-usual trajectory can continue.¹⁰³ For the practice of history, the practice of stratigraphy is not, I think, essential. Few historians core the Earth's crust; few of us would define events in relation to strata. More essential for historians is understanding the conjunction between stratigraphy and Earth System science in seeing the planet lurching beyond "patterned regularities." There has been an "event" in some sense, and the question is how to understand it as a historical event. Despite the difficulties, trying to frame human systems and the Earth system together can help us ask not just how we got here—a declensionist story of the first order—but also whether history can help in the task of creating a world that "could have been worse" rather than one that is unfathomably terrible. In 2018, Will Steffen called for a "deep transformation based on a fundamental reorientation of human values, equity, behavior, institutions, economies, and

¹⁰¹ Footnote Ellis, Edgeworth, Gibbard

¹⁰² The UN and the Vatican have adopted the Anthropocene as a critical category. UN Secretary General Antonio Guterres has approached the AWG, interested to learn about the confirmation process. For him, the Anthropocene adds more urgency to his already urgent pleas for action. Recent UN Human Development reports use the Anthropocene as a core tool of analysis: *The Next Frontier: Human Development and the Anthropocene* <http://hdr.undp.org/en/content/human-development-report-2020> In *Laudato si'* (2015) and since, Pope Francis has embraced the holistic planetary change as the central challenge of our time. In September 2024, the Pontifical Academy of Sciences in Rome is holding a conference on "Sciences for a Sustainable Anthropocene - opportunities, challenges, and risks of innovations."

¹⁰³ Bill Gates is a leader in narrowing the issue to "climate change" and suggesting that it is "solvable." See, for instance, Bill Gates, *How to Avoid a Climate Disaster: The Solutions We Have and the Breakthroughs We Need* (New York: Knopf, 2021)

technologies,” and acknowledged that creating this transformation is beyond the work of scientists alone.¹⁰⁴

Planetary Boundaries

The Planetary Boundaries Framework, a third way of conceptualizing Earth System change, emerged from interdisciplinary work done at the Stockholm Resilience Center, initially led Johan Rockström and the energetic Will Steffen, and now headed by Katherine Richardson.¹⁰⁵ The key concept here is “a safe operating space for humanity with respect to the Earth system.” By “safe operating space” they don’t mean the regenerative cycles of the Holocene. We’re already beyond that blessed 11,700 year epoch when the geosphere and the biosphere kept things humming along on a fairly even keel, a surprise perhaps to historians for whom the turbulent activity of these millennia is the bread-and-butter of our discipline if not the whole course from soup to nuts. Instead, the Planetary Boundaries Framework seeks to define safeguards for the “Holocene-like” conditions that allow large numbers of people to live in complex societies.¹⁰⁶ Go beyond the guardrails defined by their research, and even greater disturbances in the Earth System loom. Their work defines crucial planetary subsystems that are already buckling under human pressures, destroying even Holocene-like conditions.

Initially these scientists did not concern themselves with when the safe zone had been compromised. While stratigraphers are intent on locating strata indicative of a new time interval, the Planetary Boundaries team explored which boundaries were crucial, which had been breached, and

¹⁰⁴ Will Steffen, et al, “Trajectories of the Earth System in the Anthropocene,” Vol. 115, No. 33 *PNAS* (14 August 2018) p. 8258 www.pnas.org/cgi/doi/10.1073/pnas.1810141115

¹⁰⁵ Johan Rockström, et al., “A Safe Operating Space for Humanity,” vol 461/24 *Nature* 2009.

¹⁰⁶ Scientists often say their aim is to protect “civilization,” but most historians avoid this term given the heavy freight it carries in implying European or Western modes of living and Christian beliefs. Many nineteenth-century Japanese struggled to assert themselves and their society as civilized. Few forget the story, true or not, of a reporter asking Mahatma Gandhi what he thought of Western civilization, and him famously replied: “I think it would be a good idea.”

the extent of the danger. Their first paper appeared in 2009. With subdued alarm, they note that “although Earth’s complex systems sometimes respond smoothly to changing pressures, it seems that this will prove to be the exception rather than the rule. Many subsystems of Earth react in a nonlinear, often abrupt, way, and are particularly sensitive around threshold levels of certain key variables. If these thresholds are crossed, then important subsystems, such as a monsoon system, could shift into a new state, often with deleterious or potentially even disastrous consequences for humans.”¹⁰⁷ Measuring the boundaries that might lead to crossing these thresholds is extremely difficult, a matter of defining a critical value for one or more variables and making estimates as to whether they had been crossed. The scientists freely admitted the many gaps in their knowledge.

The resulting chart in 2009 is like a beginner’s cherry pie. Of the nine boundaries, seven are only tentatively quantified although even some of those are merely “best guesses.”¹⁰⁸ Nevertheless, Rockström and his team were able to present evidence that three boundaries had been definitively overstepped, and not by a small margin. It’s interesting to observe that biodiversity loss, first and foremost, forms the worst cherry-red wedge spilling beyond the edge; nitrogen, mostly from fertilizers spread to feed us, forms another brilliant stain on the pie chart. Climate change, the third

¹⁰⁷ Johan Rockström, et al., “A Safe Operating Space for Humanity,” vol 461/24 *Nature* (2009) 472.

¹⁰⁸ Johan Rockström, et al., “A Safe Operating Space for Humanity,” vol 461/24 *Nature* (2009) 475. It should be noted that there are many more cycles essential to our well-being than just these nine important one. Take for instance the salt cycle. In 2023, University of Maryland Geology Professor Sujay Kaushal published a piece in the journal *Nature Reviews Earth & Environment* where he and his co-authors “showed that human-caused salinization affected approximately 2.5 billion acres of soil around the world—an area about the size of the United States. Salt ions also increased in streams and rivers over the last 50 years, coinciding with an increase in the global use and production of salts. Salt has even infiltrated the air. In some regions, lakes are drying up and sending plumes of saline dust into the atmosphere. In areas that experience snow, road salts can become aerosolized, creating sodium and chloride particulate matter. . . . The study’s authors also called for the creation of a “**planetary boundary for safe and sustainable salt use**” in much the same way that carbon dioxide levels are associated with a planetary boundary to limit climate change. Kaushal said that while it’s theoretically possible to regulate and control salt levels, it comes with unique challenges.” *Physics News*, “Humans are disrupting natural ‘salt cycle’ on a global scale, new study shows” (2023, October 31) retrieved 1 November 2023 from <https://phys.org/news/2023-10-humans-disrupting-natural-salt-global.html>
See Kaushal, et. al., “The Anthropogenic Salt Cycle,” *Nature Reviews Earth & Environment* (2023). DOI: 10.1038/s43017-023-00485-y

crossed boundary, is small beside these other two because our perturbation of the global carbon cycle is small compared to our perturbation of the global nitrogen and phosphorous cycles.

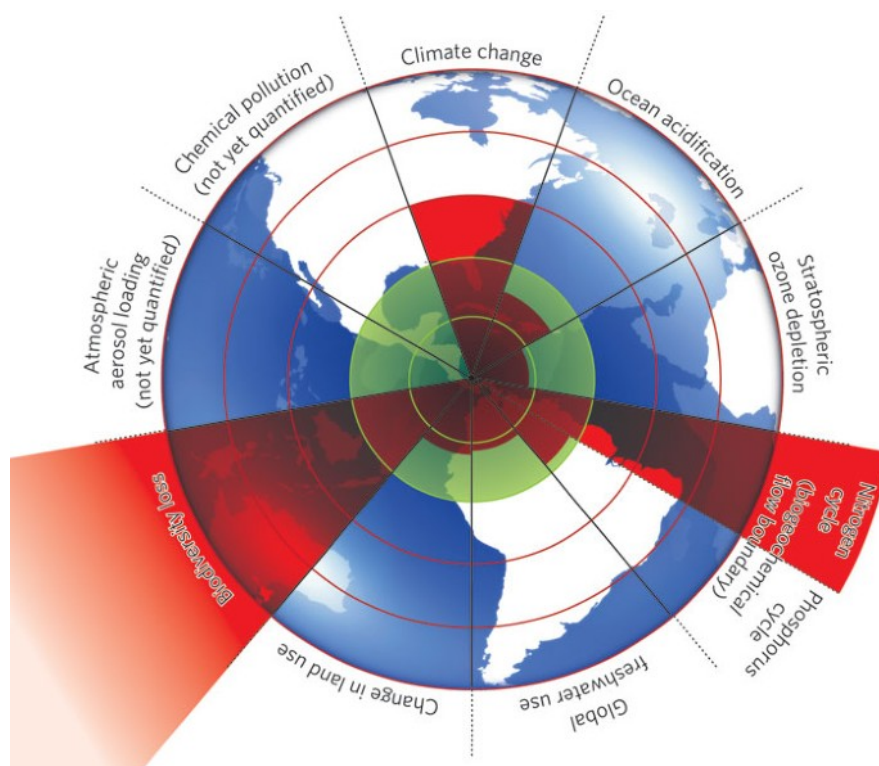


Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded. (p. 472)

A second paper in 2015 showed that four of the nine boundaries had been transgressed.¹⁰⁹

“Biosphere Integrity,” a more nuanced category than biodiversity, was still deemed the most compromised, followed by nitrogen and phosphorous examined together as biogeochemical flows. Holding third place in catalog of dangers was land use change, calculated on the basis of how much forest cover remains intact. This measurement accounts only indirectly for the way people have

¹⁰⁹ Will Steffen *et al.*, “Planetary boundaries: Guiding human development on a changing planet,” vol. 347, Issue 6223, *Science* (13 February 2015) DOI:[10.1126/science.1259855](https://doi.org/10.1126/science.1259855)

been redirecting rivers, moving mountains, tunneling, creating concrete for buildings, allowing topsoil to be swept away by winds and water, and in general shoveling around Earth's crust like frantic moles. By 2022, Jaia Syvitski and her colleagues quantified land use change, reporting that "between 1950 and 2010, humans have transformed the mobilization, transport and sequestration of sediment, to the point where human action now dominates these fluxes at the global scale. Human activities have increased fluvial sediment delivery by 215% while simultaneously decreasing the amount of fluvial sediment that reaches the ocean by 49%, and societal consumption of sediment over the same period has increased by more than 2,500%."¹¹⁰ On the new pie chart, this boundary was overrun by more than the climate boundary. The 2015 paper again warned of the tentativeness of its findings and the difficulty of figuring out how these sectors interact in ways making the complex whole more vulnerable. In the press release accompanying the paper, they also clearly differentiated their research from the work of policy makers. As one co-author Katherine Richardson put it, "Planetary Boundaries do not dictate how human societies should develop but they can aid decision-makers by defining a safe operating space for humanity."¹¹¹

¹¹⁰ Jaia Syvitski, et al., "Earth's Sediment Cycle during the Anthropocene," *Nature Reviews Earth & Environment* (February 2022) DOI: 10.1038/s43017-021-00253-w

¹¹¹ Stockholm Resilience Centre, Stockholm University, "Planetary Boundaries - an update," (1 September 2015) <https://www.stockholmresilience.org/research/research-news/2015-01-15-planetary-boundaries---an-update.html>



In September 2023, worse news arrived. A new paper spearheaded this time by Katherine Richardson announced, “Earth beyond Six of Nine Planetary Boundaries.”¹¹² This paper included dates concurring with the findings of other Earth System scientists and the Anthropocene Working Group that the twentieth century had seen change of astonishing magnitude. For over 3 billion years, “interactions between the geosphere (energy flow and nonliving materials in Earth and atmosphere) and biosphere (all living organisms/ecosystems) have controlled global environmental conditions,” until very recently when a third forcing appeared: “human activities with planetary-scale effects.” This “anthroposphere” has “brought Earth outside of the Holocene’s window of

¹¹² My great thanks to Katherine Richardson for reading this section of the paper and helping me to understand her research.

environmental variability, giving rise to the proposed Anthropocene epoch.”¹¹³ With the note of restrained terror that is now a leitmotif of such papers, the scientists warn that while we’re still in a *Holocene-like* state, we are in danger of entering a “state without analogue in human history.” This message is repeated several times. Its import may be hard to discern for those outside the field. In saying that “all the biosphere-related planetary boundary processes providing resilience (capacity to dampen disturbance) of Earth system are at or close to a high-risk level of transgression,” they hint that the forcings at play may plummet Earth beyond the norms of the Quaternary period which began 2.58 million years ago. That, of course, would mean that the Anthropocene is not a “cene.” In other words, it would not be an epoch within the Quaternary, but potentially a transformation of even greater magnitude.

When did we venture into the planetary danger zone? In this third report, the Planetary Boundaries group calculates the timing of some boundary transgressions. For all of us, the news is chilling; for historians, there are a few dates to work with, although how these globally averaged abstractions might count as “events” in a historical sense is something to ponder. Expressing these calculated Earth System occurrences as taking place alongside what historians normally call “events” reveals the awkwardness of bringing the Earth System together with human systems.

Take, for instance, freshwater. In 1905, when Bloch was 19 and the Russo-Japanese War was ending, the boundary for “blue water” (defined as surface and ground water) was breached.¹¹⁴ In 1929, the Planetary Boundary for “green water” which is water available to plants was crossed as the American stock market crashed. That year, Bloch, at 43, founded the *Annales d'histoire économique et sociale* with his senior colleague, Lucien Febvre. Fresh water is naturally recycled but only at the

¹¹³ Katherine Richardson, et al, preprint, “Earth beyond Six of Nine Planetary Boundaries,” *Science Advances* 2458 (2023) DOI: [10.1126/sciadv.adh2458](https://doi.org/10.1126/sciadv.adh2458) first page.

¹¹⁴ Richardson, 7 out of 16. Each of these measures uses a proxy. For blue water the proxy is streamflow. For green water, the proxy is root-zone soil moisture.

rate of about 1% a year, but global demands far exceed this natural rate of replenishment. Ever since the early twentieth century, we've been relying on aquifers, some of which are now dropping at the annual rate of more than ten feet or using artificial means of recycling wastewater to make it potable.¹¹⁵ More than half of the world's aquifers are dangerously compromised.¹¹⁶

¹¹⁵ Singapore.

¹¹⁶ Pomeranz and others. A recent report noted that more than 50% of the world's major aquifers are already being depleted faster than they can be naturally refilled. If they dry up, entire food production systems are at risk of failure. United Nations University - Institute for Environment and Human Security (October 2023)
<https://interconnectedrisks.org/>

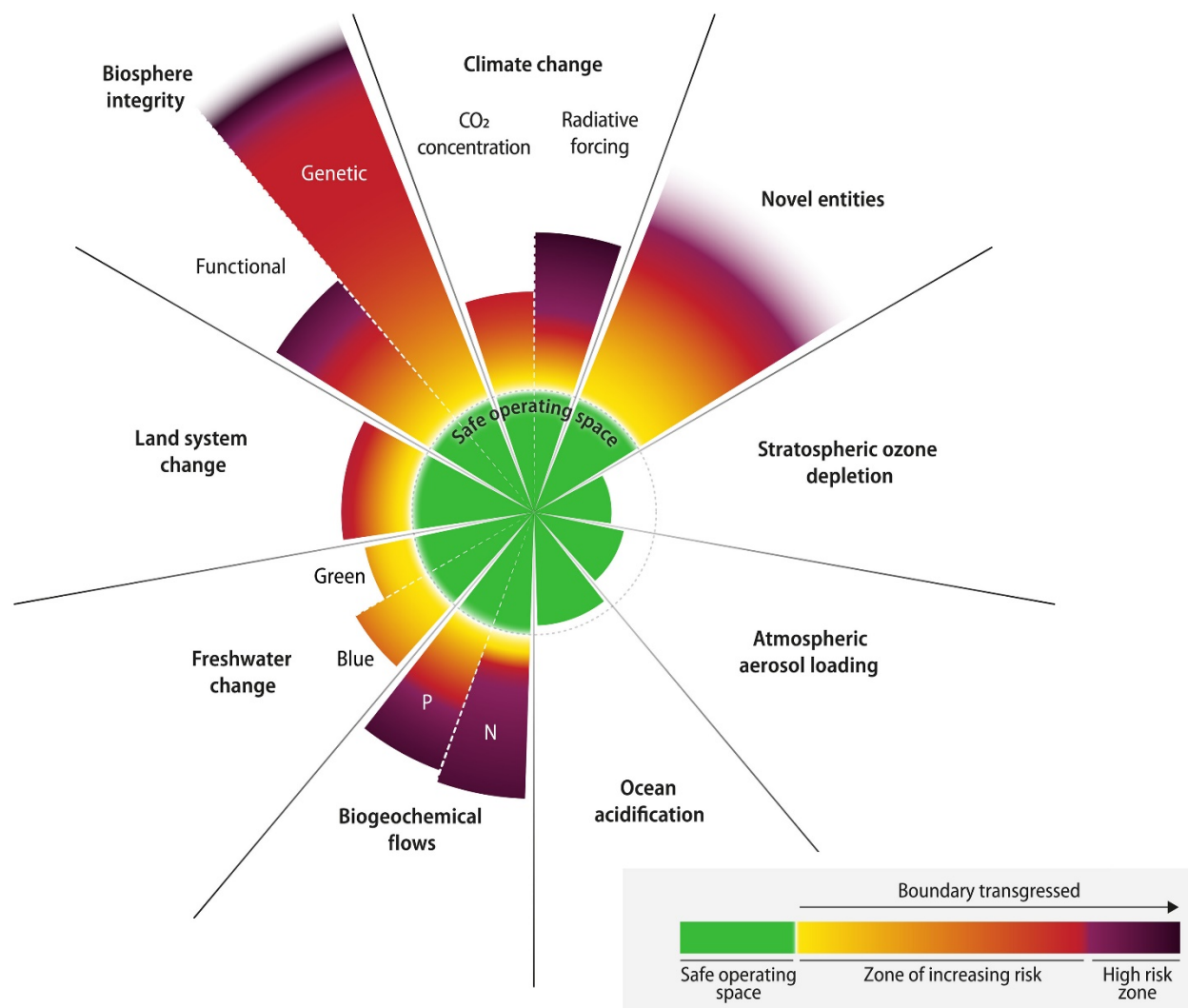


Figure 1 Current status of control variables for all nine planetary boundaries.

Six of the nine boundaries are transgressed. In addition, ocean acidification is approaching its planetary boundary. The green zone is the safe operating space (below the boundary). Yellow to red represents the zone of increasing risk. Purple indicates the high-risk zone where interglacial Earth system conditions are transgressed with high confidence. Values for control variables are normalized so that the origin represents mean Holocene conditions and the planetary boundary (lower end of zone of increasing risk, dotted circle) lies at the same radius for all boundaries (except for the wedges representing green and blue water, see main text). Wedge lengths are scaled logarithmically. The upper edges of the wedges for the novel entities and the genetic diversity component of the biosphere integrity boundaries are blurred either because the upper end of the zone of increasing risk has not yet been quantitatively defined (novel entities) or because the current value is known only with great uncertainty (loss of genetic diversity). Both, however, are well outside of the safe operating space. Transgression of these boundaries reflects unprecedented human disruption of Earth system but is associated with large scientific uncertainties.

The viability in other sectors was eroding during Marc Bloch's lifetime. About the year he was born in 1886, problems "in functional biosphere integrity due to human land use began."¹¹⁷ Genetic diversity was undermined as forests were flattened and creatures were exterminated. Things got worse two decades after Bloch's murder: in the 1960s, "growth in global population and consumption further accelerated land use, driving the system further into the zone of increasing risk."¹¹⁸ By 1988, when the Indian National Cricket team toured the West Indies and the Spanish publishing house Ediciones Akal issued Bloch's *La Sociedad Feudal*, biosphere integrity, land system change, and climate were definitively outside their "safe operating spaces."¹¹⁹

Juxtaposing what usually count as historical events with the science's revelations about planetary precipices tell us little. The moments of planetary boundary transgression are beyond our immediate senses. While we can say that Marc Bloch lived through several of them, he had no experience of them. Since his death, the pace has accelerated—and continues to accelerate. We too have lived through occurrences which we do not experience. According to the most recent Planetary Boundaries paper, since 2015 for "all of the boundaries previously identified as transgressed [climate change, biosphere integrity (genetic diversity), land system change, and biogeochemical flows (N and P)], the degree of transgression has increased."¹²⁰ How each sector impacts the others is still little understood. Scientists are still trying to measure "multiple anthropogenic impacts on the global environment in a systemic context rather than individually."¹²¹

¹¹⁷ Richardson, 4 of 16,

¹¹⁸ Richardson, 6 of 16.

¹¹⁹ Poignantly, the paper observes that had those two forcings remained at those 1988 levels (350 ppm of CO₂ in the atmosphere and 85%/50%/85% of tropical/temperate/boreal forest cover) "the simulations show that temperature over global land surface would not have increased by more than an additional 0.6°C in the subsequent 800 years." (p. 10 of 16) In other words, had we reigned in our appetites in response to the 1970s warnings of the Club of Rome and *Limits to Growth* and the urgency voiced in the 1980s by activist Bill McKibbin, NASA scientist James Hansen, and many others, the post-Holocene state would have been more manageable.

¹²⁰ Richardson, 9 of 16

¹²¹ Richardson, 9 of 16

Despite all that is still unknown, there can be no question that their pie chart is definitively disfigured. The filling, now squash yellow swelling toward sour cherry, is an engorged, overflowing mess.

Conclusion

The approaches of Earth System science, stratigraphy, and Planetary Boundaries converge. Each in their own way describes the transformation of our planetary system in the twentieth century and calls it the Anthropocene. Like a cleaver, the Anthropocene slices planetary time in two creating a gulf between our previous experiences and current ones, between previous modes of knowledge and what is needed now. As these sciences show, Marc Bloch's short life coincided with the Holocene's final years. He recognized the falling darkness of fascism, but not the twilight of planetary stability. It is easy to understand why. One reason is that the key concept of the Earth System would not crystallize until four decades after his death and it would be even longer before the transformation of the Earth System known as "the Anthropocene" was recognized. The other reason, one that hampers us still, is that the discipline of history, created during the relative stability and abundance of the Holocene to explain human affairs, has no means of framing our stories together with planetary time.

It is little wonder then that while Bloch hoped for the "full flowering of *homo sapiens*," he did not recognize that this entity, collectively and trans-generationally, was unfurling itself as a planetary forcing. While he understood much about individuals and societies, he could not see that *Homo sapiens* was gaining an unprecedented and uncanny form of agency. No longer was humanity just the geological and biological agent with second-order impacts on the geosphere and the biosphere it had always been. Instead, unwittingly, invisibly, and nearly inconceivably, *Homo sapiens* was emerging as an Earth System agent, constituting an anthroposphere alongside the geosphere and the biosphere in

impacting the planet. Such an entity has no place in historical thinking. It is absent from our theories of justice, our political structures, our laws and language. Many of us struggle against this idea. The first puzzle for historians is how to make the Anthropocene a historical event incorporating this new form of agency without losing the older forms of agency, both individual and social, that are still central to our politics and values. The second puzzle is how, in the shadow of the anthroposphere, to reanimate humanistic histories against its powerful trajectory rushing all of us over thresholds and tipping points.