

To what extent can environmental history provide a persuasive critique of the economic dimensions of the Anthropocene?

Louis Penkett, History (MA)

Introduction

Working in the shadow of the post-1945 'great acceleration' of global capitalism, early twenty-first century natural scientists proposed that human activity had disrupted the geophysical cycles of the Earth's climate system to such an extent that there was a need for a new geological epoch of 'the Anthropocene'.¹ Arguably beginning in the later eighteenth-century due to analyses of methane and carbon dioxide concentrations in polar ice cores, this would denote the era from which humanity itself had become a stratigraphically measurable geological agent.² In the past decade of record-breaking wildfires, intensifying typhoons and climate emergency declarations, the concept of the Anthropocene has accelerated to the forefront of both public and academic discourse as the environmental consequences of centuries of increasing interference with the Earth System become clear. Whilst ecomodernists continue to frame such events as the result of a 'climate crisis' that can be solved through technological development, the concept of the Anthropocene must be seen as a reminder that climate change is just one facet of historical human activity inciting what David Wallace-Wells terms unpredictable 'climate cascades'. Subsequently, this new epoch calls for a complete transformation of the global economic systems, and conducive political systems, that have destabilised the Earth System to cause such cascades of destruction to both human and nonhuman nature.³ This essay will address the extent to which the field of environmental history can provide a persuasive critique of the economic dimensions of the Anthropocene, thereby answering Sutter's

¹ Will Steffen et al., 'The Anthropocene: Conceptual and Historical Perspectives', *Philosophical Transactions of the Royal Society*, 369 (2011), pp. 842-67.

² Paul J. Crutzen, 'Geology of Mankind', *Nature*, 415 (2002), p. 23.

³ For a succinct summary see Julia A. Thomas, 'Why the 'Anthropocene' Is Not 'Climate Change' and Why It Matters', *Asia Global Online*, 10 January 2019, <<https://www.asiaglobalonline.hku.hk/anthropocene-climate-change/>> [Accessed 11 November 2020].

call for a return to the moralising, materialist grand narratives of scholars such as Donald Worster, whilst taking on board some new developments in hybridity and complexity that have emerged in the field since the turn of the 1990s.⁴ Chapter One will focus on developments in new materialism and neo-materialism, demonstrating how such approaches provide a framework for understanding the true power of fossil fuels beyond the conventional modernist understandings of coal and oil as passive economic resources. Chapter Two will outline the more traditional ecological Marxist approach, which shows that ecological destruction is inherent to any attempts by capitalist states and multi-national corporations to pursue economic growth. Chapter Three will then assess the persuasiveness of these critiques against their relative utility for inspiring activism and response within the climate movement and the general public. Consequently, it will be found that environmental history offers innovative theory, but only provides a persuasive critique of the economic dimensions of the Anthropocene when in conversation with ecological Marxism.

Before this is undertaken, it is important to recognise that in recent years extensive scholastic energy has been expended upon debates regarding the politicisation of the term 'Anthropocene' and its related periodisation.⁵ Whilst it can be accepted that the term problematically reifies modernist connotations of humanity's domination over nature, this essay continues to use the term due to alternative propositions by environmental historians and social scientists resulting in now circular debates, thus failing to develop upon the key issue of historicising the role of the economic system in the new epoch.⁶ Furthermore, it is accepted that the natural science definition of the Anthropocene is simply a marker of human global interference

⁴ Paul S. Sutter, 'The World with Us: The State of American Environmental History', *The Journal of American History*, 100 (2013), pp. 94-119.

⁵ Notable examples include: Simon Lewis and Mark Maslin, 'Defining the Anthropocene', *Nature*, 519 (2015), pp. 171-180.; Andreas Malm and Alf Hornborg, 'The Geology of Mankind? A Critique of the Anthropocene Narrative', *The Anthropocene Review*, 1 (2014), pp. 62-69.; Timothy J. LeCain, 'Against the Anthropocene. A Neo-Materialist Perspective', *International Journal for History, Culture and Modernity*, 1 (2015), pp. 1-28.; Jason W. Moore, 'The Capitalocene, Part I: on the nature and origins of our ecological crisis', *The Journal of Peasant Studies*, 44 (2017), pp. 594-630.

⁶ Such debates have substantially enhanced our understanding of the Anthropocene, but they must now be exited. See Pasi Heikkurinen et al., 'The Anthropocene Exit: Reconciling Discursive Tensions on the New Geological Epoch', *Ecological Economics*, 164 (2019), pp. 1-33.

as opposed to a politically motivated historical framework. On a related note, this essay will not directly engage with debates addressed within such literature surrounding the ecomodernist concept of a 'good Anthropocene'. The fact that the leading think-tank on this issue is funded by the Koch family, significant beneficiaries of fossil capitalism, leaves little criticism to the imagination, and any such criticism has arguably already filtered into the consciousness of the popular climate movement.⁷

Chapter One: The True Power of Fossil Fuels

With global atmospheric CO₂ concentrations having risen from 280 ppm since before the industrial revolution to over 410 ppm as of 2019, any analysis of the Anthropocene must begin with interrogating the global economic systems that have allowed such a rapid alteration of the earth's carbon cycle through the combustion of fossil fuels.⁸ This involves scrutinising the modernist beliefs within conventional economics and Marxism that have historically formed the basis of all global economic systems. Environmental history provides a persuasive critique in this aspect, as its contextualisation of geological time, and attribution of agency to the dynamic, unpredictable material world, brings the true power of fossil fuels to the fore by complicating economic understandings of coal and oil as passive natural resources to be used as factors of production. For example, Timothy LeCain has built upon recent scholarship in both biology and environmental history to assert a theory of 'neo-materialism' that gives agency to matter, and thus fossil fuels themselves.⁹ Utilising research of microbes in the human body, LeCain outlines the plasticity of the human body and brain in response to environmental conditions, indicating that the human mind is 'embodied'

⁷ In what has become the manifesto of climate activism, Naomi Klein closes the debate on the techno-optimism of scholars such as Bruno Latour. Latour, in turn, has written for the Koch-funded Breakthrough Institute. See Naomi Klein, *This Changes Everything: Capitalism vs. the Climate* (New York: Alfred A. Knopf, 2014) pp. 240-41.

⁸ Mirindi E. Dusenge et al., 'Plant carbon metabolism and climate change: elevated CO₂ and temperature impacts on photosynthesis, photorespiration and respiration', *New Phytologist*, 221 (2019), p. 32.

⁹ Timothy J. LeCain, *The Matter of History: How Things Create the Past* (Cambridge: Cambridge University Press, 2017).

within nature.¹⁰ In this aspect the malleable nature of humans means that '[c]oal shaped the humans who used it far more than humans shaped coal'.¹¹ In turn, neo-materialism points to the global warming facet of the Anthropocene being the result of a complex co-evolution of humans with fossil fuels. Moreover, due to the nature of this relationship, humans will not be able to break from fossil fuel use unless economic abstractions are ended, and humanity's relationship with fossil fuels is delineated to the extent that we can understand how to bend the relationship into a positive one. LeCain's thesis is the most metaphysically developed critique of the Anthropocene by an environmental historian. However, scholars working with the less metaphysical approach of 'new materialism' also fit within this theme of attributing agency away from humans. Such works more directly critique the modernist conceptions of fossil fuels at both the macroeconomic and microeconomic level.

At a more microeconomic level focusing on the worker, this overlooked power of fossil fuels is enlightened within Thomas Andrews' revisionist account of the Southern Colorado coalfield labour wars that culminated in the 'Ludlow Massacre'.¹² In the first chapter Andrews puts the half-decade period of labour struggle into its context of geological time, explaining in detail the 'coalification' process of Southern Colorado's coal deposits through seventy million years of energetic infusion via different biological and chemical processes since the Late Cretaceous period.¹³ This effectively sets up coal as an agent in the story, allowing Andrews to overcome anachronistic social histories of a heroic labour struggle. By taking environmental factors into account, Andrews demonstrates that industrialist and surveyor William Jackson Palmer's plan to resolve the region's economic decline and community conflict through mining coal deposits failed due to his economic thinking, as he failed to predict the wild interconnectedness between the natural world, workers, and markets. In turn, the power of coal in shaping humans is made clear as Andrews outlines a growth of class-consciousness as workers negotiated the workplace hazards and demanding extractive processes that resulted from the material nature of

¹⁰ Ibid., p. 6.

¹¹ Ibid., p. 323.

¹² Thomas G. Andrews, *Killing for Coal: America's Deadliest Labor War* (Cambridge, MA: Harvard University Press, 2008).

¹³ Ibid., pp. 29-31.

coal. Thus, causing the Southern Colorado United Mine Workers union to make 'greater strides toward interethnic and interracial solidarity than any other major union prior to the New Deal'.¹⁴ Significantly, Andrews indicates that the sheer scale of the labour war was not just due to colliers developing LeCainian bonds due to their encounters with coal in the workplace, but it was due to a growing awareness of the centrality of the fossil fuel to the entire functioning of the economic system of Southern Colorado and beyond. For example, union man Sam Chambers is cited as having stated that strikers 'could not help the crippling of other industries' when visitors begged them to consider 'the people who labored in Pueblo's smelters, steel mills, and other coal-burning factories'.¹⁵ Rather than continuing their complaints, Andrews outlines how workers in other industries similarly began to recognise the coal mines as the beginning of the energy flow of the economy, resulting in the industrial dispute expanding to industries that were linked to the mines through transportation networks of the heavy substance of coal.

Similarly, Timothy Mitchell points to this recognition by the Southern Colorado working class as just one example of how the blockading of energy flows by workers connected to the energy flow of coal was the foundation of democracy in the United States and Northern Europe.¹⁶ Furthermore, Mitchell frames the post-war transition of Europe's energy system from coal to oil as a learned process by those with power and influence. In what can be judged as the result of their co-evolution with fossil fuels, Mitchell explicates how the capitalist class aimed both to keep an energy system based on hydrocarbons, and 'to interrupt the flow of energy that had given organised labour the power to demand the improvements to collective life that had democratised Europe'.¹⁷ In this view the liquid and lighter nature of oil allowed for a less labour-intensive extraction process, combined with a less labour-intensive transportation process via pipelines. Resultantly, the ruling classes reclaimed the political agency that working-class coevolution with coal had inferred, as the energy flows of oil 'flowed along networks that often had the properties of a grid, like an electricity network, where there is more than one possible path and the flow of energy can switch to avoid

¹⁴ Ibid., p. 179.

¹⁵ Ibid., p. 191.

¹⁶ Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London: Verso, 2013).

¹⁷ Ibid., p. 61.

blockages or overcome breakdowns'.¹⁸ Mitchell's analysis, therefore, fits with that of LeCain and Andrews within a framework for understanding the climate change facet of the Anthropocene by replacing the conventional models of political economy and historical materialism with an energetic materialism that takes into account the true power of the chemical and geophysical forces of fossil fuels.

By contrast, this emphasis on the agency of coal and oil is deterministic, underestimating the extent of social forces within the economic system in driving the energy transitions that were a prime cause of the Anthropocene. For instance, Andreas Malm's Marxist account of Britain's transition from water power to steam power, and thus coal, demonstrates that it was not the vast energetic nature of coal that drove the transition, but that 'steam gained supremacy in spite of water being abundant, at least as powerful, and decidedly cheaper'.¹⁹ Rather, the use of coal allowed more regulated working-hours, and settlements in congested areas around a vertical mine that disassociated the energy source from space.²⁰ Thus, the beginning of the industrial revolution was caused chiefly for social reasons, by capitalists within the economic system aiming to easily exploit labour power. This analysis shows similarities with Mitchell's account of the transition of the energy systems of Europe and North America from coal to oil, however, it interrupts LeCain's continuous co-evolutionary framework of human interactions with fossil fuels, thereby reducing the utility of neo-materialist and new materialist approaches alone in critiquing the modernist economic dimensions of the Anthropocene. However, the significant gains in studies of the materiality of energy should not be eschewed as a result, approaches merely require more nuance through interacting with more economic Marxist accounts. As Christopher Jones asserts, energy transitions are 'slow, messy, and require a great deal of human effort to take place, and the materiality of energy shapes the resulting patterns in important ways'.²¹ With this required nuance in mind, Chapter Two will outline approaches that place the human causes of the Anthropocene at the forefront of their analysis.

¹⁸ Ibid., p. 74.

¹⁹ Andreas Malm, 'The Origins of Fossil Capital: From Water to Steam in the British Cotton Industry', *Historical Materialism*, 21 (2013), p. 31.

²⁰ Ibid., pp. 40-47.

²¹ Christopher F. Jones, 'The Materiality of Energy', *Canadian Journal of History*, 53 (2018), p. 388.

Chapter Two: The Ecological Logic of Growth

Moving away from approaches that attribute responsibility to non-human materials in causing the Anthropocene, this section will outline the persuasiveness of the more traditional materialist approach by environmental historians. By continuing the modernist separation between nature and society, materialist approaches allow the logic of human modes of production to be delineated, resultantly explaining why economic systems have allowed ecological destruction to go unchecked for centuries. The most successful approach in this area is based on the concept of commodity frontiers, which, in turn, is underpinned by the ecological Marxist theory of 'metabolic rift'. Developed by John Bellamy Foster, metabolic rift is based upon Karl Marx's notion that capitalist production creates an 'irreparable rift in the interdependent process of social metabolism', as it 'only develops the techniques and the degree of combination of the social process of production by simultaneously undermining the original sources of all wealth—the soil and the worker'.²² The commodity frontier approach takes such assertions and directs them towards frontiers at the edge of capitalist expansion, thereby demonstrating how capitalism is founded upon, and driven by, ecological destruction through its inherent expansionary logic to commodify land and resources, and to a lesser degree labour. Through focusing on capitalism's frontiers, the role of the economic system as the primary cause of the Anthropocene becomes most visible, as this is where capitalist attitudes, and their consequential environmental damage, are most apparent and least checked. This approach is exemplified by the early work of Jason W. Moore on the logic of the expansion of the global sugar trade from the Americas in the long-seventeenth century, and by Corey Ross on the 1870s-1930s Southeast Asian tin frontier.²³ Significantly, both historians

²² See Brett Clark and John Bellamy Foster, 'Ecological Imperialism and the Global Metabolic Rift Unequal Exchange and the Guano/Nitrates Trade', *International Journal of Comparative Sociology*, 50 (2009), pp. 311-334.; Karl Marx, *Capital*, vol. III, ed. by Ernest Mandel (London: Penguin Classics, 1991), p. 949.; Karl Marx, *Capital*, vol. I, ed. by Ernest Mandel (London: Penguin Classics, 1990), p. 638.

²³ Jason W. Moore, 'Sugar and the Expansion of the Early Modern World-Economy: Commodity Frontiers, Ecological Transformation, and Industrialization', *Review (Fernand Braudel Center)*, 23 (2000), Vol. 23, pp. 409-433.; Corey Ross, 'The Tin Frontier: Mining, Empire, and Environment in Southeast Asia, 1870s-1930s', *Environmental History*, 19 (2014), pp. 454-479.

support the aforementioned notions by Malm and Jones of human capitalist activities as the driving force behind the Anthropocene; this is achieved by their explication of the irrational 'efficiency' of production methods at the frontier.

For example, Moore outlines how frontier producers only accepted developments in furnace technology as a necessity due to the pressures of environmental exhaustion, even when such developments would have clearly made their modes of production more 'efficient'. Switching methods to exploit the more 'efficient' fuel of bagasse (milled cane stalks) instead of firewood should have been rational to contemporaries, as mass deforestation had crippled the local ecosystem of Barbados by the end of the seventeenth century, causing droughts, and insect and vermin plagues.²⁴ However, sugar producers in Cuba and northeast Brazil did not switch away from timber as their main fuel source until the mid-nineteenth and early-nineteenth century respectively. Instead, they waited en masse until their surroundings had been completely deforested, and the related multiplier effects of ecological damage were felt.²⁵ Similarly, Ross demonstrates how attempts by European firms to break the Chinese domination of extraction at the tin frontier were overcome by resource-intensive methods when capital or labour intensive methods had failed. In this aspect, techniques of hydraulic cutting and gravel pumping moved entire hillsides in order to pursue lower-grades of mineral ore at the frontier. The ecological consequences were known, with hydraulic mining having been banned in California in 1884 due to the mass environmental destruction caused by the technique during its gold rush.²⁶ However, driven by capitalist competition, and an ethos of ecological imperialism that was not seen first-hand in the capitalist centre, hydraulic miners defended their production process when threatened with regulation, using racialised notions of the failure of Chinese production methods.²⁷ Moreover, this defence of production methods was underpinned by economic attitudes at the frontier that defined waste as 'a failure to convert a potential resource into cash', and efficiency as representing 'a maximization of output regardless of the collateral effects'.²⁸ Both

²⁴ Moore, 'Sugar and the Expansion of the Early Modern World-Economy', p. 423.

²⁵ *Ibid.*

²⁶ Ross, p. 462.

²⁷ *Ibid.*, p. 472.

²⁸ *Ibid.*, p. 473.

scholars, therefore, outline the ecologically destructive, myopic attitudes inherent in capitalists at the frontier in their drive to meet increasing demand for commodities such as sugar and tin cans in the metropole, with consumers spatially and temporally distanced from the ecological effects. The consequence was an opening up of a 'metabolic rift' between humanity and the rest of nature, whereby the extent of unequal ecological exchange between the frontier and the metropole increasingly expands with the expansion of global capitalism. As Moore asserts, 'the contemporary global ecological crisis is not rooted in the so-called Industrial Revolution *per se*, but in the logic of capital itself - with or without Satanic Mills'.²⁹ In other words, the fallacious definitions of waste and efficiency utilised by actors at commodity frontiers are evident over centuries in myriad modes of capitalist production, and environmental historians can outline the series of metabolic rifts that contributed to the eventual destabilisation of the biosphere in the Anthropocene.

Chapter Three: Activism and Responding

The previous two sections have outlined two different approaches for critiquing the economic dimensions of the Anthropocene by environmental historians. Those focusing on the materiality of fossil fuels and their energetic capacities have given agency to 'things' such as coal and oil in attempts to overcome the modernist hubris of human domination over nature implicated within predominant economic systems since at least the industrial revolution. Alternatively, materialist scholars have focused more on the damage of economic systems to the environment, which is incited by those in power simplifying nature in pursuit of flawed notions of growth as progress. It can be judged that the former approach provides a useful critique in the long-term for reshaping economic systems, however, its utility is overshadowed in the short-term by Marxist approaches that radically educate the public on the need to completely dismantle global capitalism in order to slow climate cascades. The dissolving of agency away from humanity may mitigate climate activism by alleviating the responsibility of the capitalist class for the epoch. For instance, LeCain states that '[c]apitalism may not be the wisest or fairest social arrangement for allocating the differential flows of power that benefit some and harm others, yet we are unlikely to

²⁹ Moore, 'Sugar and the Expansion of the Early Modern World-Economy: Commodity Frontiers, Ecological Transformation, and Industrialization', p. 413.

arrive at a more just and equitable system unless we begin by taking the material and energetic foundations of human power and culture seriously'.³⁰ It is hard to separate this contention from LeCain's position as a bourgeois, western academic whose first-hand experience of the material and energetic foundations of human power and culture is completely minimal compared to workers in the global south. To persuasively critique the economic dimensions of the Anthropocene in order to inspire collective resistance we must return to the separation of nature and society embodied within metabolic rift theory, as this allows us to map its primary cause of centuries of capital-induced ecological degradation in the periphery. As Andreas Malm states, accounts that dissolve agency '[blunt] their crucial normative edge directed against the capitalist class: you did this to enrich yourselves, and now we are paying with our lives', this is 'the foundation for ecological class hatred, perhaps the emotion most dearly needed in a warming world. Surely the capitalist class deserves... hatred for turning forces of nature into mass killers of poor people'.³¹

The differing utility of each approach becomes apparent when analysing NASA's Earth Observing System Data and Information System, which uses satellite imagery to depict the earth at night in 2016.³² This visual source of the distribution of artificial light across the globe shows the density of light, and thus corresponding socio-economic activity, as significantly higher in those countries in the global north that were leaders in the industrial revolution. The materialist approach would outline the reason for this as the centuries of unequal ecological exchange that allowed resource-intensive infrastructure investment, and a correspondingly higher level of average energy consumption per capita that continues to this day. In this aspect one can point to research findings that economically developed capitalist countries of the

³⁰ LeCain, *The Matter of History*, p. 324.

³¹ Andreas Malm, *The Progress of This Storm: Nature and Society in a Warming World* (London: Verso, 2018), pp. 188-9.

³² NASA, 'Worldview', 16 December 2020, < <https://worldview.earthdata.nasa.gov/?v=-119.80365938673258,-92.29031498357429,71.72759061326742,101.49093501642571&t=2016-12-25->

T00%3A00%3A00Z&l=Reference_Labels(hidden),Reference_Features(hidden),Coastlines(hidden),VIIRS_SNPP_DayNightBand_ENCC(hidden),VIIRS_Night_Lights(hidden),VIIRS_SNPP_CorrectedReflectance_TrueColor(hidden),MODIS_Aqua_CorrectedReflectance_TrueColor(hidden),MODIS_Terra_CorrectedReflectance_TrueColor(hidden),VIIRS_Black_Marble> [Accessed 21 December 2020].

global north were responsible for 72.7 per cent of CO₂ emissions between 1850 and 2007, not accounting for subnational inequalities.³³ Thus, such an approach supports the climate movement's calls for climate justice and reparations to the global south in order to build infrastructural protection against climate cascades, as well as influencing western consumers to limit their carbon footprint. By contrast, scholars such as Andrews and Mitchell are limited to describing this unequal light distribution as the consequence of long-distance energy flows, and that workers at the beginning of those flows might attain political agency, and thus incite progressive change by disrupting them. Whilst LeCain's neo-materialist approach may treat this source as reason for individual consumers of the global north to change their carbon consumption patterns in order to co-evolve gradually away from being 'coal people'. In turn, demonstrating how approaches by environmental historians following historical materialism are far more capable of putting intra-species inequalities at the forefront of their analysis, thereby giving them more utility in inspiring climate justice activism.

Conclusion

Overall, it can be concluded that environmental history can only provide a persuasive critique of the Anthropocene to a great extent if it continues to develop in conversation with ecological Marxism. The innovative new materialist and neo-materialist approaches outlined in Chapter One persuasively critique the modernist assumptions of the world's economic systems by outlining the true power of fossil fuels, moving beyond economic abstractions of coal and oil as passive resources. Such work points to environmental history as essential for overcoming critiques of the Anthropocene by political economists and historical materialists that simply aim to internalise the negative externalities of fossil fuel combustion within existing economic systems, thereby continuing the problem. Moreover, these critiques may inspire a positive response by encouraging readers to respect fossil fuels more and limit their consumption. If following LeCain in particular, readers might undertake this task in

³³ J.T. Roberts and Bradley C. Parks, *A Climate of Injustice: Global Inequality, North-South Politics, and Climate Policy* (Cambridge, MA: MIT Press, 2007), cited in Andreas Malm and Alf Hornborg, 'The Geology of Mankind? A Critique of the Anthropocene Narrative', *The Anthropocene Review*, 1 (2014), p. 64.

order to gradually co-evolve away from these materials that have destabilised the biosphere. Alternatively, histories similar to those of Andrews and Mitchell may inspire activism, as they demonstrate how workers can heighten their agency by the targeting fossil fuel extraction industries that are the source of the entire energy flow of the economic system. However, the limitations of such approaches are clear in their failures to account for the solely human-induced factors of energy transitions. Although Jones asserts that a focus on energetic materialism can be more nuanced and less deterministic than accounts such as Mitchell's, environmental historians must work with the Marxist lens, found in Malm's account of the British transition from steam to coal power, in order to provide such nuance. Furthermore, the historical ecological destruction that has led to the global metabolic rift of the Anthropocene can only be effectively mapped by continuing the modernist separation of nature and society, as seen by the persuasive critiques of the ecological contradictions of capitalism asserted by scholars in Chapter Two. In addition, modern historiographical trends that dissolve the boundaries between society and nature can be judged to be alarming developments in a rapidly warming world. Attributing blame away from humanity in the economic dimensions of the Anthropocene attributes blame away from the capitalist class that incited the epoch, thereby failing to incite the level of hatred that is so needed for a successful climate movement to successfully dismantle global capitalism, and thus dismantle the systems of power that have prevented any working-class co-evolution with nature away from fossil capitalism for the past two centuries.

Bibliography

Primary Sources

NASA, 'Worldview', 16 December 2020, < [https://worldview.earthdata.nasa.gov/?v=-119.80365938673258,-92.29031498357429,71.72759061326742,101.49093501642571&t=2016-12-25-T00%3A00%3A00Z&l=Reference_Labels\(hidden\),Reference_Features\(hidden\),Coastlines\(hidden\),VIIRS_SNPP_DayNightBand_ENCC\(hidden\),VIIRS_Night_Lights\(hidden\),VIIRS_SNPP_CorrectedReflectance_TrueColor\(hidden\),MODIS_Aqua_CorrectedReflectance_TrueColor\(hidden\),MODIS_Terra_CorrectedReflectance_TrueColor\(hidden\),VIIRS_Black_Marble](https://worldview.earthdata.nasa.gov/?v=-119.80365938673258,-92.29031498357429,71.72759061326742,101.49093501642571&t=2016-12-25-T00%3A00%3A00Z&l=Reference_Labels(hidden),Reference_Features(hidden),Coastlines(hidden),VIIRS_SNPP_DayNightBand_ENCC(hidden),VIIRS_Night_Lights(hidden),VIIRS_SNPP_CorrectedReflectance_TrueColor(hidden),MODIS_Aqua_CorrectedReflectance_TrueColor(hidden),MODIS_Terra_CorrectedReflectance_TrueColor(hidden),VIIRS_Black_Marble)> [Accessed 21 December 2020]

Secondary Works

Altvater, Elmar, 'The Capitalocene, or, Geoengineering against Capitalism's Planetary Boundaries', in *Anthropocene or Capitalocene: Nature, History, and the Crisis of Capitalism*, ed. by Jason W. Moore (Oakland, CA: PM Press, 2016), pp. 138-152

Andrews, T.G., *Killing for Coal: America's Deadliest Labor War* (Cambridge, MA: Harvard University Press, 2008)

Angus, Ian, 'Do Seven Cheap Things Explain the History of Capitalism?', *Climate & Capitalism*, 10 January 2018, <<https://climateandcapitalism.com/2018/01/10/do-cheap-things-explain-capitalism/>> [Accessed 29 November 2020]

Angus, Ian, *Facing the Anthropocene: Fossil Capitalism and the Crisis of the Earth System* (New York: Monthly Review Press, 2016)

Black, Brian C, 'Oil for Living: Petroleum and American Conspicuous Consumption', *Journal of American History*, 99 (2012), pp. 40-50

Chakrabarty, Dipesh, 'The Climate of History: Four Theses', *Critical Inquiry*, 35 (2009), pp. 197-222

Clark, B., and John Bellamy Foster, 'Ecological Imperialism and the Global Metabolic Rift Unequal Exchange and the Guano/Nitrates Trade', *International Journal of Comparative Sociology*, 50 (2009), pp. 311-334

Cronon, William, 'The Uses of Environmental History', *Environmental History Review*, 17 (1993), pp. 1-22

Crutzen, Paul J., 'Geology of Mankind', *Nature*, 415 (2002), p. 23

Dudley, Marianna, 'The Limits of Power: Wind Energy, Orkney, and the Post-war British State', *Twentieth Century British History*, 31 (2020), pp. 316-339

Dusenge, Mirindi E. et al., 'Plant carbon metabolism and climate change: elevated CO₂ and temperature impacts on photosynthesis, photorespiration and respiration', *New Phytologist*, 221 (2019), p. 32-49

Hamilton, Clive, 'Getting the Anthropocene so wrong', *The Anthropocene Review*, 2 (2015), pp. 102-107

Heikkurinen, Pasi et al., 'The Anthropocene Exit: Reconciling Discursive Tensions on the New Geological Epoch', *Ecological Economics*, 164 (2019), pp. 1-33

Holmes, Katie, Andrea Gaynor and Ruth Morgan, 'Doing Environmental History in Urgent Times', *History Australia*, 17 (2020). pp. 230-251

Hornborg, Alf, 'Dithering while the Planet Burns: Anthropologists' Approaches to the Anthropocene', *Reviews in Anthropology*, 46 (2017), pp. 61-77

Jones, Christopher F., 'The Materiality of Energy', *Canadian Journal of History*, 53 (2018), pp. 378-394

Jonsson, Fredrik Albritton, 'The Origins of Cornucopianism: A Preliminary Genealogy', *Critical Historical Studies*, 1 (2014), pp. 1-18

Klein, Naomi, *This Changes Everything: Capitalism vs. the Climate* (New York: Alfred A. Knopf, 2014)

Klinge, Matthew, 'The Nature of Desire: Consumption in Environmental History', in *The Oxford Handbook of Environmental History*, ed. by Andrew C. Isenberg (Oxford: Oxford University Press, 2014), pp. 467-497

LeCain, Timothy J., *The Matter of History: How Things Create the Past* (Cambridge: Cambridge University Press, 2017)

LeCain, Timothy J., 'Against the Anthropocene. A Neo-Materialist Perspective', *International Journal for History, Culture and Modernity*, 1 (2015), pp. 1-28

Lewis, Simon L., and Mark A. Maslin, 'Defining the Anthropocene', *Nature*, 519 (2015), pp. 171-180

Malm, Andreas, *The Progress of This Storm: Nature and Society in a Warming World* (London: Verso, 2018)

Malm, Andreas, *Fossil Capital: The Rise of Steam-Power and the Roots of Global Warming* (London; New York: Verso, 2016)

- 'The Origins of Fossil Capital: From Water to Steam in the British Cotton Industry', *Historical Materialism*, 21 (2013), pp. 15-68

Malm, Andreas and Alf Hornborg, 'The Geology of Mankind? A Critique of the Anthropocene Narrative', *The Anthropocene Review*, 1 (2014), pp. 62-69

Marx, Karl, *Capital, vol. III*, ed. by Ernest Mandel (London: Penguin Classics, 1991)

Marx, Karl, *Capital, vol. I*, ed. by Ernest Mandel (London: Penguin Classics, 1990)

McNeill, John R. and Peter Engelke, *The Great Acceleration: An Environmental History of the Anthropocene since 1945* (Cambridge, MA: Harvard University Press, 2016)

Mitchell, Timothy, *Carbon Democracy: Political Power in the Age of Oil* (London: Verso, 2013)

Moore, Jason W., 'The Capitalocene, Part I: on the nature and origins of our ecological crisis', *The Journal of Peasant Studies*, 44 (2017), pp. 594-630

Moore, Jason W., 'Sugar and the Expansion of the Early Modern World-Economy: Commodity Frontiers, Ecological Transformation, and Industrialization', *Review (Fernand Braudel Center)*, 23 (2000), Vol. 23, pp. 409-433

Moore, Jason W. and Raj Patel, *A History of the World in Seven Cheap Things: A Guide to Capitalism, Nature, and the Future of the Planet* (London: Verso, 2017)

Morgan, Ruth Alice, 'Histories for an Uncertain Future: Environmental History and Climate Change', *Australian Historical Studies*, 44 (2013), pp. 350-360

Ross, Corey, 'The Tin Frontier: Mining, Empire, and Environment in Southeast Asia, 1870s-1930s', *Environmental History*, 19 (2014), pp. 454-479

Scott, James C., *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1998)

Steffen, William, et al., 'The Anthropocene: Conceptual and Historical Perspectives', *Philosophical Transactions of the Royal Society*, 369 (2011), pp. 842-67

Stoll, Steven, 'A Metabolism of Society: Capitalism for Environmental Historians', in *The Oxford Handbook of Environmental History*, ed. by Andrew C. Isenberg (Oxford: Oxford University Press, 2014), pp. 370-390

Sutter, Paul S., 'The World with Us: The State of American Environmental History', *The Journal of American History*, 100 (2013), pp. 94-119

Swyngedouw, E. and Henrik Ernstson, 'Interrupting the Anthro-obScene: Immunobiopolitics and Depoliticizing Ontologies in the Anthropocene', *Theory, Culture & Society*, 35 (2018), pp. 3-30

Thomas, J.A., 'Why the 'Anthropocene' Is Not 'Climate Change' and Why It Matters', *Asia Global Online*, 10 January 2019, <<https://www.asiaglobalonline.hku.hk/anthropocene-climate-change/>> [Accessed 11 November 2020]

Wallace-Wells, David, *The Uninhabitable Earth: A Story of the Future* (London: Penguin Books Ltd, 2019)

Worster, Donald, 'Transformations of the Earth: Toward an Agroecological Perspective in History', *The Journal of American History*, 74 (1990), pp. 1087-1106