Focus: History of Science in the Anthropocene

Introduction: Rethinking History of Science in the Anthropocene

Lukas M. Verburgt, *Netherlands Institute for Advanced Study in the Humanities and Social Sciences (NIAS) and Leiden University*
Elske de Waal, *Utrecht University*

Abstract: The process of thinking through the implications of the Anthropocene for the humanities, including history, is well under way. The time has come for historians of science to take stock of the situation in Anthropocene scholarship and collaboratively reflect on how we want to situate our field toward that scholarship. It will involve taking up such fundamental questions as *why* and *how*, as well as *for* and *with whom*, we do the history of science. This introduction to the Focus section "History of Science in the Anthropocene" presents the Anthropocene as both a challenge and an opportunity, opening up new avenues of research and widening spatial, temporal, and topical boundaries while giving rise to urgent problems, dilemmas, and choices that will need to be faced. The aim of this Focus section is to put these challenges and opportunities on the history of science's agenda and, thereby, to start a discipline-wide dialogue.

"When we think about the past, we think about history. When we think about the future, we think about science." This pithy statement appears in a recent piece by James Secord that asks, "What Is the History of Science?"[1] We find it a particularly fruitful entry point

Lukas M. Verburgt is a Fellow of the Netherlands Institute for Advanced Study in the Humanities and Social Sciences (NIAS) and a guest researcher at Leiden University. His research focuses on interactions between the history of science and history of philosophy in the period from the nineteenth to the twenty-first century. Netherlands Institute for Advanced Study in the Humanities and Social Sciences (NIAS), Korte Spinhuissteeg 3, 1012 GC Amsterdam, Netherlands; and Leiden University, Institute of Philosophy, P. J. Veth, Nonnensteeg 1–3, 2311 VJ Leiden, Netherlands. lukas.verburgt@nias.knaw.nl; l.m.verburgt@hum.leidenuniv.nl.

Elske de Waal is a Ph.D. candidate in history and philosophy of science at Utrecht University. Her project explores the history and epistemology of science and mathematics education research at the Freudenthal Institute. She is also interested in the interconnections between the politics, policy, and science of weather prediction, especially in nineteenth-century Britain. Utrecht University, Princetonplein 5 (Room 3.61), 3584 CC Utrecht, Netherlands; e.dewaal@uu.nl.

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[1] James A. Secord, "What Is the History of Science," 14 Jan. 2021, https://www.thebritishacademy.ac.uk/blog/what-is-the-history-of-science.

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for introducing the theme of this Focus section, as it draws our attention to the historian of science as someone particularly well placed to study links between the past and the future. As such, the statement also invites us to reflect on the historian of science's role in the present, where the Anthropocene is challenging the modern notion of history that has been with us since the late Enlightenment.[2] First, the Anthropocene problematizes history as a concept that encompasses past, present, and future in a temporal whole: not only is it creating new pasts and futures and questioning and destroying old ones; it is also forging novel understandings of how these temporalities are related. Second, it is arguably shaking the foundations of history as an institutionalized and professionalized scholarly practice of writing about and understanding the past. Since the timescales of the human and the geological are now inextricably linked, history becomes "the business of more than just historians."[3] Third, the Anthropocene calls on historians, not least historians of science, to reflect critically on the (a)historicity of the notion itself and on its role as a dominant way—at once scientific, political, and existential—of historicizing our times.

The process of thinking through the implications of the Anthropocene—both as a concept and potentially as a new geological epoch—for the humanities, including history, is now well under way. A lot of important work in this regard has been done in recent years—for instance, by environmental historians, as well as by scholars from many different fields involved in the formation of the environmental humanities.[4] Although history of science does feature in some of these contributions, historians of science are only just starting the process among themselves through discipline-wide reflection—though there are exceptions, of course, as several authors have recently charted ways in which the Anthropocene (as well as the climate emergency) is changing how history of science is, can, or perhaps should be done.[5] Also under way is the reverse but simultaneous process of showing what humanities disciplines like history have to offer when it comes to the timely effort of "documenting, understanding and responding to" the Anthropocene.[6] Indeed, historians are already involved in shaping Anthropocene historiography. For instance, the Anthropocene Working Group (AWG), established by the International Commission on Stratigraphy (ICS) in 2009 to gather evidence for the formalization of the Anthropocene as a geological time unit, counts a prominent environmental historian (John McNeill) and a prominent historian of science (Naomi Oreskes) among its members.[7] Furthermore, a growing number of studies and initiatives engage the Anthropocene from a history of science perspective—for example, in the form of

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[2] For this point see Zoltán Boldizsár Simon, *History in Times of Unprecedented Change: A Theory for the Twenty-First Century* (London: Bloomsbury, 2020), p. ix.

[3] Libby Robin and Will Steffen, "History for the Anthropocene," *History Compass*, 2007, 5:1694–1719, on p. 1694.

[4] See, e.g., Paul Warde, "Social and Environmental History in the Anthropocene," in *History after Hobsbawm: Writing the Past for the Twenty-First Century*, ed. John H. Arnold, Matthew Hilton, and Jan Rüger (Oxford: Oxford Univ. Press, 2018), pp. 184–199; and Noel Castree, "The Anthropocene and the Environmental Humanities: Extending the Conversation," *Environmental Humanities*, 2014, 5:233–260.

[5] See, e.g., Amanda Rees, "Animal Agents? Historiography, Theory, and the History of Science in the Anthropocene," *BJHS: Themes*, 2017, 2:1–10; and Jürgen Renn, "The Anthropocene and the History of Science," in *The Anthropocenic Turn: The Interplay between Disciplinary and Interdisciplinary Responses to a New Age*, ed. Gabriele Dürbeck and Philip Hüpkes (New York: Routledge, 2020), pp. 37–58. Another example, dealing with the methods rather than the theory of the history of science, is Jo Guldi, "The Climate Emergency Demands a New Kind of History: Pragmatic Approaches from Science and Technology Studies, Text Mining, and Affiliated Disciplines," in this issue of *Isis*.

[6] Frank Oldfield, Anthony D. Barnosky, John Dearing, Marina Fischer-Kowalski, John McNeill, Will Steffen, and Jan Zalasiewicz, "*The Anthropocene Review*: Its Significance, Implications, and the Rationale for a New Transdisciplinary Journal," *Anthropocene Review*, 2014, 1:3–7, on p. 3.

[7] For an example of the Anthropocene Working Group's multidisciplinary output see, e.g., Jan Zalasiewicz, Colin N. Waters, Mark Williams, and Colin P. Summerhayes, eds., *The Anthropocene as a Geological Time Unit: A Guide to the Scientific Evidence and Current Debate* (Cambridge: Cambridge Univ. Press, 2019).

geoanthropology.[8] On the other hand, the question of what and how the history of science can contribute to Anthropocene debates still awaits systematic reflection, though here again there are valuable exceptions.[9]

Other historical subdisciplines have already started to wrestle with the Anthropocene, and indeed history is currently being "de-disciplined," as scientists studying the Anthropocene are assuming the role of historians. We believe that the time has come for historians of science to take stock of the situation in Anthropocene scholarship and reflect on how we want to situate our field toward that scholarship. This is, of course, necessarily a collaborative and long-term endeavor. The same goes for the broader, ongoing project of addressing the "big picture" of the history of science in the face of ever-growing disciplinary fragmentation—which, however fruitful, comes with the loss of the kind of shared ground or purpose needed for meta-disciplinary dialogue.[10] Importantly, for historians of science to address the concept of the Anthropocene means exactly to take up and, thereby, underline the significance of such fundamental questions as *why*—for what reason and with what ambition—and *how*, as well as *for* and *with whom*, we do the history of science. This at least is what the four essays in this Focus section show. They present the Anthropocene as both a challenge and an opportunity for historians of science, opening up exciting and urgent new avenues for research while problematizing long-held and deeply ingrained historiographical assumptions and spatial, temporal, and topical boundaries.

Each essay in this Focus section confronts the challenge and the opportunity in its own way; these are sometimes divergent and sometimes mutually supportive. Indeed, the authors offer a fascinating range of interestingly different perspectives. We think of this plurality as a strength rather than a weakness. It captures the complexity and many-sidedness of the history of science's grappling with the Anthropocene. At the same time, it also brings to the fore some of the most pertinent problems, dilemmas, and choices historians of science will have to face. Should the history of science be lined up more with science itself, as Jürgen Renn suggests in his essay ("From the History of Science to Geoanthropology")? Or should it keep a critical distance, perhaps even committing itself to developing full-blown alternatives to scientific histories of the Anthropocene, as Iva Peša argues ("A Planetary Anthropocene? Views from Africa")? Can scientists and historians work together in harmony and for mutual benefit, as Zoltán Boldizsár Simon and Julia Adeney Thomas write ("Earth System Science, Anthropocene Historiography, and Three Forms of Human Agency")? Or are their approaches to the Anthropocene antagonistic, as Deborah Coen and Fredrik Albritton Jonsson insist ("Between History and Earth System Science")? How can the history of science reconcile the planetary outlook of the Anthropocene as a geological epoch and the lived experiences of individuals and communities that need to be

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[8] For work on the Anthropocene from a history of science perspective see, e.g., Paul N. Edwards, "Knowledge Infrastructures for the Anthropocene," *Anthropocene Rev.*, 2017, *4*:34–43; and Giulia Rispoli and Doubravka Olsáková, "Science and Diplomacy around the Earth: From the Man and Biosphere Programme to the International Geosphere-Biosphere Programme," *Historical Studies in the Natural Sciences*, 2020, *50*:456–481. Regarding geoanthropology see Christoph Rosol, Benjamin Steininger, Jürgen Renn, and Robert Schlögl, "On the Age of Computation in the Epoch of Humankind," *Nature Outlook*, 2018, 563.7733:1–5.

[9] See, e.g., Jürgen Renn, "The Evolution of Knowledge: Rethinking Science in the Anthropocene," *HOST—Journal of History of Science and Technology*, 2018, *12*:1–22; and Libby Robin, "Histories for Changing Times: Entering the Anthropocene," *Australian Historical Studies*, 2013, *44*:329–340.

[10] Regarding the "big picture" of the history of science, these words of Andrew Cunningham and Perry Williams arguably still ring true: "When we define our research as part of the history of science, we implicitly invoke a big picture of that history to give identity and meaning to our specialism . . . even if we do not present a big picture explicitly." See Andrew Cunningham and Perry Williams, "De-centring the 'Big Picture': *The Origins of Modern Science* and the Modern Origins of Science," *British Journal for the History of Science*, 1993, *26*:407–432, on p. 407. For an overview of current approaches to the history of science see Lukas M. Verburgt, ed., *Debating Contemporary Approaches to the History of Science* (London: Bloomsbury Academic, forthcoming).

understood in order to account for Anthropocene inequalities? We recognize that some of these questions may sound familiar, either because they give new expression to older problems (e.g., global versus local) or because they have previously been taken up in another form or in other historical disciplines (e.g., environmental history, political ecology, philosophy of history). Not only does the Anthropocene give a renewed sense of urgency to asking them, however. It can be argued that the questions themselves require answers that are specific to the discipline of the history of science as it exists today. This, in a sense, is the fundamental premise of the Focus section.

Our goal in this introduction is twofold. First, taking a wide-angle view, we describe some of the key issues for the humanities, and especially for history, that emerge in addressing the Anthropocene, focusing on how these are influencing and changing the field's relation to the sciences.[11] Second, zooming in, we offer a brief overview of some of the Anthropocene's challenges and prospects for the history of science, exploring what new topics, themes, problems, dilemmas, and collaborations are currently emerging.

THE ANTHROPOCENE AND THE HUMANITIES

We know that changes in the present have often prompted historians to look at the past in new ways. It is perhaps not surprising, therefore, that the Anthropocene—the term was coined by Paul Crutzen and Eugene Stoermer in 2000 and has since spread rapidly, both scientifically and politically, across the globe—has come to be recognized as a matter of deep human concern, alongside capitalism, injustice, and inequality, to which it is in many ways intrinsically connected.[12] It is already being actively debated whether the humanities as a whole are experiencing an "anthropocenic turn," and the new field of environmental humanities is flourishing in bringing together different humanities perspectives on Anthropocene-related themes.[13] There are several reasons for this development, which together set the scene for the essays in this Focus section.

First, there seems no denying that a vague sense that "something is amiss with our planet and that this may have to do with human actions" is seeping into our everyday lives, if only through our daily diet of news.[14] It is a reality that needs to be confronted—and certainly by humanities scholars, who are after all experts on humans and their role in shaping the world. But what exactly is this new reality? That it has to do with anthropogenic and planetary climate change is clear. There is more to it, however. "The Anthropocene"—which is not the same as climate change—puts a widely though not formally used name to this intuition.[15] Subsuming a vast number of large-scale destructive events, and capturing an unprecedented geological state of affairs, it says that we have entered an epoch in which humans are profoundly transforming the planet, with

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[11] Three important introductions to the Anthropocene, discussed from the point of view of the humanities, are Jeremy Davies, *The Birth of the Anthropocene* (Berkeley: Univ. California Press, 2018); Eva Horn and Hannes Bergthaller, *The Anthropocene: Key Issues for the Humanities* (London: Routledge/Earthscan, 2019); and Carolyn Merchant, *The Anthropocene and the Humanities: From Climate Science to a New Age of Sustainability* (New Haven, Conn.: Yale Univ. Press, 2020). The key sources for reflection on the Anthropocene and history are Dipesh Chakrabarty, *The Climate of History in a Planetary Age* (Chicago: Univ. Chicago Press, 2021); and Jürgen Renn, *The Evolution of Knowledge: Rethinking Science for the Anthropocene* (Princeton, N.J.: Princeton Univ. Press, 2020).

[12] For useful overviews of the literature on the Anthropocene concept see, e.g., Yadvinder Mahli, "The Concept of the Anthropocene," *Annual Review of Environment and Resources*, 2017, 42:77–104; and Jan Zalasiewicz *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.

[13] See, e.g., Dürbeck and Hüpkes, eds., *Anthropocenic Turn* (cit. n. 5); and Serpil Oppermann and Serenella Iovino, *Environmental Humanities: Voices from the Anthropocene* (London: Rowman & Littlefield International, 2017).

[14] Chakrabarty, *Climate of History in a Planetary Age* (cit. n. 11), p. 1.

[15] For an account of why the distinction matters see Julia Adeney Thomas, "Why the 'Anthropocene' Is Not 'Climate Change' and Why It Matters," *Asia Global Online*, 10 Jan. 2019, www.asiaglobalonline.hku.hk/anthropocene-climate-change (accessed 1 Nov. 2021).

irreversible consequences. The Holocene was "the well-tempered cradle of civilization," and it is radically uncertain what the departure from its conditions means for human civilization and, in an even more fundamental sense, for humankind's relation to the world.[16] One consequence is that the planet or Earth System itself, rather than just the globe, is emerging as a "historical-philosophical entity" to which we now need to orient ourselves in thinking of human pasts and human futures.[17] Another implication is that the human starts to appear as a "double figure," both decentered and a single collective geological force, and that the timescales of the human and the Earth—with its deep prehuman past and possible posthuman future—have become inseparable. At the same time, the Anthropocene has catalyzed a host of pressing political, social, and economic challenges for humanity as a whole, though in a radically uneven way, linking environmental justice to the inequality crisis.[18] Taking up the Anthropocene as an object of study, therefore, requires that the humanities do their part in thinking through the historical specificity of our twenty-first-century present and creating new visions of sustainable futures—a task that is now more urgent than ever, with climate change's effect outpacing the human ability to adapt.[19]

As a proposed new geological epoch—or chronostratigraphic unit of the Geologic Time Scale coming after the Holocene—the Anthropocene also stands as a great challenge to the humanities themselves—and perhaps especially to history.[20] This is not only because, as Dipesh Chakrabarty has influentially argued, it deeply problematizes some of the humanities' most fundamental long-standing ideas (e.g., about history, modernity, and globalization) and assumptions (e.g., about the dichotomy between nature and culture), but also because it makes a call for groundbreaking new research across the sciences/humanities divide that will require humanities disciplines like history to "change and adapt to [a] pressing, historic task."[21] There is another, more direct, way of putting this. The debates on the Anthropocene invite humanities scholars, and social scientists with them, to show why and how their knowledge and expertise matter to the definition and potential formalization of the Anthropocene and, more specifically, to the central question of when human activities started to affect the Earth System.[22] This kind of multi- or transdisciplinary research, of which the work of the AWG is perhaps the most prominent example, has been going on for several years. It is a rather complex affair, with fault lines running across the sciences/humanities divide as well as through the sciences and humanities themselves. There are scientists who advocate formalizing the Anthropocene and hold that the causes of Earth's transition are human and social. Some of them are in favor of working with scholars from the humanities.[23] Other scholars, some of whom work in the humanities, reject the attempt to formalize the

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[16] Horn and Bergthaller, *Anthropocene* (cit. n. 11), pp. 2–3.

[17] This point was made for the first time in Chakrabarty's groundbreaking 2009 essay. See Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry*, 2009, 35:197–222.

[18] For discussions of these issues see, e.g., Jedediah Purdy, *After Nature: A Politics for the Anthropocene* (Cambridge, Mass.: Harvard Univ. Press, 2015); and Bram Büscher and Robert Fletcher, *The Conservation Revolution: Radical Ideas for Saving Nature beyond the Anthropocene* (London: Verso, 2020).

[19] This is one of the conclusions from the Working Group II contribution to the Intergovernmental Panel on Climate Change's Sixth Assessment Report, released in February 2022.

[20] For an overview of some aspects of this challenge see, e.g., Helmuth Trischler, "The Anthropocene: A Challenge for the History of Science, Technology, and the Environment," *NTM: Zeitschrift für Geschichte der Wissenschaften, Technik und Medizin*, 2016, 24:309–335; and Grégory Quenet, "The Anthropocene and the Time of Historians," *Annales: Histoire, Sciences Sociales*, 2017, 72:267–299 (this essay was translated from the French by Katharine Throssell).

[21] Gisli Palsson *et al.*, "Reconceptualizing the 'Anthropos' in the Anthropocene: Integrating the Social Sciences and Humanities in Global Environmental Change Research," *Environmental Science and Policy*, 2013, 28:3–13, on p. 3.

[22] See, e.g., T. Toivanen *et al.*, "The Many Anthropocenes: A Transdisciplinary Challenge for the Anthropocene Research," *Anthropocene Rev.*, 2017, 4:183–198.

[23] For a discussion see Kyle Nichols and Bina Gogineni, "The Anthropocene's Dating Problem: Insights from the Geosciences and the Humanities," *Anthropocene Rev.*, 2018, 5:107–119. Relatedly, in the context of climate change reports, attempts have

Anthropocene—dismissing the scientific notion as ideological (or as "pop culture"), criticizing the dominant role of natural sciences in its definition, or else fearing a narrowing down of Anthropocene research to technoscientific approaches.[24] Still others—some from the humanities among them—accept its formalization by scientists, emphasizing that a geological time period should simply not be expected to be based on motivations of, and account for factors relevant to, the humanities.[25]

The Anthropocene challenges the humanities. But the humanities also challenge the Anthropocene. Over the past few years, humanities scholars have actively developed "Anthropocenes" of their own, which criticize, pluralize, or provide alternatives to the Anthropocene as the "master narrative" of our age.[26] This work has shown that, far from being one thing, there are in fact "many Anthropocenes," with some demanding that there should be "a thousand Black Anthropocenes or none" and others insisting on replacing "Anthropocene" with "Capitalocene."[27] As a result, the Anthropocene has started to live "two lives": as a singular scientific or geological notion; and as a plural humanities- and social sciences–driven concept.[28] Or—perhaps more accurately—three lives, since the plural concept is often made to bear on, or contrasted with, the singular, so as to bring out its problems and its many different meanings and implications, ranging from the social and political to the historical and philosophical. The first two lives are lived largely at different institutions and in different journals, but more recently there have arisen outlets where they come together, such as the *Anthropocene Review* (which started in 2014), or where they are deliberately combined, as, for instance, in *The Anthropocene: A Multidisciplinary Approach*.[29] It is interesting, in this regard, that a recent paper in the scientific journal *Earth's Future* compared the geological meaning of the Anthropocene with alternatives put forward both

been made to include different kinds of knowledge. For an example see James D. Ford *et al.*, "Including Indigenous Knowledge and Experience in IPCC Assessment Reports," *Nature Climate Change*, 2016, *6*:349–353.

[24] In response to the AWG's 2016 recommendation in favor of a formalization of the Anthropocene, some geologists argued that, if they went along, geology would *de facto* give up on itself as a science and surrender to politics or pop culture. See, e.g., Stanley C. Finney and Lucy E. Edwards, "The 'Anthropocene' Epoch: Scientific Decision or Political Statement," *GSA Today*, 2016, *26* (3):4–10. For worries about the role of the natural sciences in defining the Anthropocene and the focus on technoscientific approaches see, e.g., Andreas Malm and Alf Hornborg, "The Geology of Mankind? A Critique of the Anthropocene Narrative," *Anthropocene Rev.*, 2014, *1*:62–69; and Frank Biermann *et al.*, "Down to Earth: Contextualizing the Anthropocene," *Global Environmental Change*, 2016, 39:341–350.

[25] This seems to be Dipesh Chakrabarty's position—for instance, in "The Difficulty of Defining the Anthropocene," https://eos.org/articles/the-difficulty-of-defining-the-anthropocene.

[26] Bonneuil and Fressoz, among others, have dismissed the Anthropocene as providing a "master narrative" of humanity in the twenty-first century, which supports the idea "of a totalization of the entirety of human actions into a single 'human activity' generating a single human footprint on earth": Christophe Bonneuil and Jean-Baptiste Fressoz, *The Shock of the Anthropocene: The Earth, History, and Us* (London: Verso, 2017), p. 45. Similar critiques have been focused on the undifferentiated attribution of responsibility to the "anthropos"—to humanity in general as "stewards of the Earth system"—which, in turn, has been linked to the problematic notion of the "good Anthropocene." See, e.g., Malm and Hornborg, "Geology of Mankind?" (cit. n. 23). Instead, scholars have argued that the "'true' subject of the Anthropocene is only a minor—capitalist, European or western, wealthy, post-industrial, white and male—part of humanity": Gabriele Dürbeck and Philip Hüpkes, "Anthropocenic Turn? An Introduction," in *Anthropocenic Turn*, ed. Dürbeck and Hüpkes (cit. n. 5), pp. 1–23, on p. 4.

[27] Jan Zalasiewicz, "The Extraordinary Strata of the Anthropocene," in *Environmental Humanities*, ed. Oppermann and Iovino (cit. n. 13), pp. 115–132, on p. 124 ("many Anthropocenes"); Kathryn Yusoff, "Towards a Thousand Black Anthropocenes," keynote lecture presented at UNESCO conference "The Ethics of Decolonizing Nature and Culture," Maison de l'UNESCO, Paris; Yusoff, *A Billion Black Anthropocenes or None* (Minneapolis: Univ. Minnesota Press, 2018); and Jason W. Moore, *Anthropocene or Capitalocene? Nature, History, and the Crisis of Capitalism* (Oakland, Calif.: PM, 2016).

[28] Dipesh Chakrabarty, "Anthropocene Time," *History and Theory*, 2018, 57:5–32, on p. 9.

[29] Julia Adeney Thomas, Mark Williams, and Jan Zalasiewicz, *The Anthropocene: A Multidisciplinary Approach* (Cambridge: Polity, 2020). Another recent example is Francisco J. Carrillo and Günter Koch, eds., *Knowledge for the Anthropocene: A Multidisciplinary Approach* (Cheltenham: Elgar, 2021).

by "a small minority of AWG [Anthropocene Working Group] members and among several disciplines outside geology ranging from the natural and social sciences to the arts and humanities."[30] Such multi- or transdisciplinary endeavors, involving scientists, humanities scholars, and artists, sometimes draw large crowds, as the "Anthropocene Project" exhibit at the Haus der Kulturen der Welt in Berlin (2013–2014) and Bruno Latour's "Reset Modernity!" exhibit in Karlsruhe (2016) have shown.

Whether or not the Anthropocene is formalized as a geological time unit, there is no doubt that the big questions the notion raises are here to stay, if only because they bear on some of the most pressing and complex issues of our time.[31] In order to address, let alone answer, these questions, it seems crucial to bring the sciences and the humanities—and the forms and ways of knowledge they represent—into critical dialogue with each other. After all, the past is never over and the future needs to be kept open. Even if the Anthropocene is officially recognized and a starting point is formally agreed on, alternative anthropocenic temporalities and histories can still be explored. And we will still be standing at the start of finding out, collectively, "on what knowledge our future depends," in the twofold sense of finding out what knowledge comes with which vision of the future and which future needs what kind of knowledge to be envisioned and realized. Here we see an important role for historians, who seem particularly well placed, for instance, to compare periodizations of the past and map the "historical futures that constitute our current historical condition."[32]

HISTORY AND THE ANTHROPOCENE

The most obvious reason why the Anthropocene should interest the historian is the Anthropocene's historicity. This holds true whether the Anthropocene is approached from a natural science or a humanities perspective, and it does so on several levels. A few illustrations must suffice here. "Anthropocene" is the potential name for a new geological epoch whose start would mark the end of the Holocene, which began about 11,700 years ago. As an epochal threshold it is historically unusual, as it would be established without a delay of millennia but within living memory of its mid-twentieth-century emergence—the mid-twentieth century being the only boundary now under consideration by the AWG. On the other hand, "alternative" Anthropocenes criticize the singular Anthropocene notion precisely for failing to capture the historical specificity of facing the twenty-first-century reality of a large-scale, human-induced threat to humanity and the Earth. In fact, historicization as such can be criticized as unamenable to the widespread demand for immediate action.[33] At the same time, the Anthropocene opens up entirely new registers of historical objects, scales, and time frames, going far beyond modern history's traditional outlook, and blurs and scrambles the categories and divisions by which modern historians have long studied the past—from processual change and progress to historicism and presentism, from natural versus cultural

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[30] Zalasiewicz *et al.*, "Anthropocene" (cit. n. 12).

[31] In May 2019 the Anthropocene Working Group (AWG) of the Subcommission on Quaternary Stratigraphy (SQS) of the International Commission on Stratigraphy (ICS) voted in favor of submitting a formal proposal to the ICS. This formal proposal is currently being crafted with all the accompanying evidence. It is scheduled to be voted on by the AWG in December 2022 and sent to the SQS in January 2023.

[32] Renn, *Evolution of Knowledge* (cit. n. 11), Pt. 5; and Zoltán Boldizsár Simon and Marek Tamm, "Historical Futures," *Hist. Theory*, 2021, *60*:3–22, on p. 3.

[33] Cf. Stephen J. Pyne, *The Pyrocene: How We Created an Age of Fire, and What Happens Next* (Oakland: Univ. California Press, 2021); J. R. McNeill and Peter Engelke, *The Great Acceleration: An Environmental History of the Anthropocene since 1945* (Cambridge, Mass.: Harvard Univ. Press, Belknap, 2014); Simon, *History in Times of Unprecedented Change* (cit. n. 2); and Julia Adeney Thomas, ed., *Altered Earth: Getting the Anthropocene Right* (Cambridge: Cambridge Univ. Press, 2022).

to global versus planetary, and so on.[34] Other prominent reasons why the Anthropocene should interest historians today include the fact that they have a lot to offer to the scientific understanding of why there is such a thing as the Anthropocene and that it provides an unusual opportunity to make their work bear on the future.[35]

The Anthropocene is a historical phenomenon that historians should, therefore, engage, in at least three broad, partly overlapping, senses: first, as a potential addition to the geological timescale with a specific starting point in the not-so-distant past, a mere seventy or so years ago–according to the official dating; second, as a concept or discourse that can help us make sense of our present human condition; and third, as a temporal or epochal event that calls for a new historiographical agenda. In recent developments in Anthropocene debates we can observe a fraught battle between and among scientists and historians over what factors created the Anthropocene and who writes its past, on what basis and with what motivations. Importantly, in the process it has become clear that there are many different ways in which the Anthropocene, as both a geological and a nongeological concept, can be dated.[36] Moreover, each possible dating comes with broader views as to how the Anthropocene can be historicized, which in turn frame the kinds of historical or future-oriented narratives that are deemed possible. That is to say, "each account of 'How did we get here?' makes assumptions through which we frame 'What to do now?'"[37]

One by now well-known example deals with the "official narrative" of "awakening" constructed by scientists around the original Anthropocene notion as introduced in 2000. Another, slightly more complex, example concerns different datings of the Anthropocene. Although it is perhaps true that the divide between the sciences and the humanities "melts in the heat of global warming," historians' history does not always sit well with scientists' history.[38] A striking case in point is that of the "scientific historiography" advocated by the Integrated History and Future of People on Earth (IHOPE) initiative.[39] This initiative takes as its starting point the idea that, in the Anthropocene, history no longer belongs solely to professional historians. Instead, it holds that scientists should take the lead in writing a global history, and historians are invited to join in. What is striking is that IHOPE's Anthropocene historiography seems to be premised on certain ideas that historians take to be challenged by the Anthropocene. For instance, the Anthropocene of geology and the Earth sciences is chronicled in terms of stages, new time intervals, tipping points, thresholds, and state shifts, whereas the Anthropocene of historians takes many narrative forms, continuous or asynchronous, with disparate points of emergence or as an unprecedented

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[34] On these and other historiographical themes see, e.g., Chakrabarty, "Climate of History" (cit. n. 17); Julia Adeney Thomas, "History and Biology in the Anthropocene: Problems of Scale, Problems of Value," *American Historical Review*, 2014, *119*:1587–1607; Marek Tamm and Zoltán Boldizsár Simon, "More-Than-Human History: Philosophy of History at the Time of the Anthropocene," in *Philosophy of History: Twenty-First-Century Perspectives*, ed. Jouni-Matti Kuukkanen (London: Bloomsbury, 2021), pp. 198–215; and Stephen W. Sawyer, "Time after Time: Narratives of the *Longue Durée* in the Anthropocene," *Transatlantica*, 2015, *1*:1–17.

[35] For these two points see John McNeill's remarks at the "Historians and the Anthropocene" event organized by the National History Center and the Woodrow Wilson Center's History and Public Policy Program (available at www.youtube.com/watch?v=xhrP1hZuW0M, 3:05–28:00). For examples of what historians can contribute to the Anthropocene debates see Robin, "Histories for Changing Times" (cit. n. 9), pp. 335–340. On future-oriented history see, e.g., Marek Tamm, "Future-Oriented History," in *Historical Understanding: Past, Present, and Future*, ed. Zoltán Boldizsár Simon and Lars Deile (London: Bloomsbury, forthcoming).

[36] For a number of years, members of the scientific community proposed and discussed widely different datings of the Anthropocene. These hypotheses have led to proposals to subdivide the periodization of anthropogenic change, with some talking about the "Paleoanthropocene" and others about the "Early Anthropocene." In 2019, twenty-nine members of the AWG supported the "Anthropocene" designation and voted in favor of starting the new epoch in the mid-twentieth century.

[37] Bonneuil and Fressoz, *Shock of the Anthropocene* (cit. n. 25), p. 4.

[38] *Ibid.*, Preface and Ch. 1; and Thomas, "History and Biology in the Anthropocene" (cit. n. 33), p. 1587.

[39] See Robin and Steffen, "History for the Anthropocene" (cit. n. 3).

rupture-like event.[40] For example, it can be argued that the Anthropocene does not have a history. As a "radical novelty" in time, it cannot be placed in long-term perspective or understood in terms of a historical narrative.[41] This thought-provoking idea puts the historian in a rather perplexing position, as it suggests that historicization is not always sufficient, and is sometimes even misplaced, when studying a temporal event historically.

So far, calls for an integrated or "totalizing" Anthropocene history have been both a blessing and a curse for historians. On the one hand, the idea fruitfully challenges the traditional separation between the sciences and the humanities—the (in)famous "two cultures"; asks for new kinds of collaboration; and actively involves historians in scientific discussion. The AWG is exemplary in this regard, as it includes not only stratigraphers and sedimentologists but also oceanographers, biologists, archaeologists, historians, and lawyers. And, as Simon and Thomas argue in this Focus section, historians are well advised to take Earth System science seriously in their own search for an Anthropocene historiography. On the other hand, concerns have been raised over the motivations behind, and indeed the very possibility of, bringing different historical outlooks together into one multi- or transdisciplinary framework, because the creation of consilience more often than not takes place on the ground of science, with historians' history being reduced to a subset of physics, and because scientific research on the Anthropocene has serious historiographical limitations for the work of historians, as Coen and Jonsson point out in their essay here. Indeed, an important task for historians seems to be exactly that of nuancing, pluralizing, and complicating dominant science-induced narratives about and visions of the Anthropocene—for instance, by emphasizing the imaginaries of Indigenous peoples whose present is much like the postapocalyptic future envisioned in the most-cited Anthropocene scholarship.[42]

The Anthropocene debates have a lot to offer historians. And historians arguably have a lot to contribute to those debates. But it is an open question how this mutual exchange can take place such that history engages the Anthropocene in the way it arguably does best—namely, "through critical engagement with it."[43]

HISTORY OF SCIENCE IN THE ANTHROPOCENE

This brings us back to where we began: the history of science. What does it mean for the history of science to address the Anthropocene? What challenges and opportunities, and what new problems and horizons, does it entail? What and how can the history of science contribute to Anthropocene debates? Should it make or instead be cautious about making an anthropocenic turn? These and other questions are taken up in this Focus section, which aims to put them firmly on the discipline's agenda. Drawing on the four essays—written respectively by Jürgen Renn, Iva Peša, Zoltán Boldizsár Simon and Julia Adeney Thomas, and Deborah Coen and Fredrik Albritton Jonsson—we conclude this introduction by offering some tentative suggestions, best understood as an invitation to future dialogue.

It is clear, first of all, that—as it does for general history—the Anthropocene opens up new research avenues for the historian of science, ranging from historical objects, scales, and time frames to historical actors, narratives, and historiographies. The most obvious yet very rich example concerns the Anthropocene concept itself. For instance, historians of science have started to

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[40] For an account of these different narratives see Julia Adeney Thomas, "The Anthropocene Earth System and Three Human Stories," in Thomas and Jan Zalasiewicz, *Strata and Three Stories* (RRC Perspectives: Transformations in Environment and Society, 2020, no. 3), http://www.environmentandsociety.org/perspectives/2020/3/strata-and-three-stories, pp. 46–53.

[41] Zoltán Boldizsár Simon, "The Limits of Anthropocene Narratives," *European Journal of Social Theory*, 2018, 23:184–199.

[42] See, in this regard, Kyle P. Whyte, "Indigenous Science (Fiction) for the Anthropocene: Ancestral Dystopias and Fantasies of Climate Change Crises," *Environment and Planning E: Nature and Space*, 2018, *1*(1–2):224–242.

[43] Thomas, "History and Biology in the Anthropocene" (cit. n. 33), p. 1587.

chronicle histories of "Earth System thinking"—the idea that the Earth has been fundamentally changed by human activities—and of "catastrophic thinking."[44] And, turning to recent and contemporary history, they have studied the emergence of the Anthropocene concept itself, focusing on the production of scientific knowledge of the Anthropocene and the multidisciplinary community formation that made it possible.[45] For this endeavor, the use of historical big data and, therefore, of methods and tools from the digital humanities seems crucial.[46] At the same time, traditional interpretative and comparative methods will remain valuable—for instance, to analyze various proposals for the beginning of the Anthropocene. This work will require the historian of science to contextualize the assumptions and identities of, as well as the boundaries between, scientific fields, some of which are still relatively young. Another, related, example of how the Anthropocene opens up new research avenues for historians of science concerns the need to come to terms with the eccentricity, so to speak, of the "Great Acceleration" that commenced in the mid-twentieth century—both as a dramatic event in the history of human existence and as the official starting point of the Anthropocene chosen by the AWG.

At the same time, and on a more abstract level, the Anthropocene is exploding the spatial and temporal boundaries of the history of science, forcing it to study the technological, societal, and economic developments that eventually enabled humans to change the Earth System as well as the history of their discovery of Earth's deep history and the possibility of their own extinction. This, in turn, suggests that historians of science are called on to write long-term, more-than-human histories, for which interactions with historical subfields like environmental and global history and with alternative historiographies such as "multi-species history" seem crucial.[47] Since the Anthropocene is also changing the nature of historical narrative, turning historicization into a way of apprehending the future, the same arguably holds for interactions with philosophers of history. Furthermore, on an emancipatory level, historians of science can play a role in identifying and gathering the kind of knowledge that can help us understand, cope with, and respond to the Anthropocene. For this search, they should direct their attention to alternative epistemic geographies and hierarchies, which would challenge them to study ways and forms of knowing suppressed and marginalized by globalized science. One consequence of such new orientations may be that the history of science is included in a broader history of knowledge or even a history of (embodied) cognitive interactions with the world of which knowledge is but one part.[48]

All in all, it is clear that, in addressing the Anthropocene, historians of science will face fundamental issues concerning the why, how, and what of their own discipline. These issues are likely to play a key role in its development in the 2020s and beyond.

Following up on this, historians of science should, and seem *prima facie* uniquely well placed to, play their part in ongoing multi- and transdisciplinary work on the Anthropocene. Perhaps more

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[44] Regarding Earth System thinking see, e.g., Giulia Rispoli, "Genealogies of Earth System Thinking," *Nature Reviews Earth and Environment*, 2020, *1*:4–5. On catastrophic thinking see, e.g., David Sepkoski, *Catastrophic Thinking: Extinction and the Value of Diversity* (Chicago: Univ. Chicago Press, 2020).

[45] See, e.g., Delf Rothe and Ann-Kathrin Benner, "Genealogies of the Anthropocene and How to Study Them," in *International Relations in the Anthropocene*, ed. David Chandler, Franziska Müller, and Rothe (Cham: Palgrave Macmillan, 2021), pp. 113–131; and Edwards, "Knowledge Infrastructures for the Anthropocene" (cit. n. 8).

[46] For a reflection see Manfred D. Laubichler, Jane Maienschein, and Jürgen Renn, "Computational History of Knowledge: Challenges and Opportunities," *Isis*, 2019, *110*:502–512.

[47] Regarding multi-species history see, e.g., the outputs of the project "Moving Animals: A History of Science, Media, and Policy in the Twentieth Century" at Maastricht University (Principal Investigator: Raf De Bont). See also Eva Domanska, "Animal History," *Hist. Theory*, 2017, *56*:267–287.

[48] See, e.g., Jürgen Renn, "From the History of Science to the History of Knowledge—And Back," *Centaurus*, 2015, *57*:37–53; and Renn and Manfred Laubichler, "Extended Evolution and the History of Knowledge," in *Integrated History and Philosophy of Science: Vienna Circle Institute Yearbook*, Vol. 20, ed. Friedrich Stadler (Cham: Springer, 2017), pp. 109–125.

than any other historical field, the history of science knows how to straddle and problematize the divides between the sciences and the humanities—for instance, by unearthing boundary work and disciplinary ramifications. Indeed, of the many sub-branches of history, it arguably embodies the most expertise on the sciences themselves. This makes historians of science likely partners for scientists working on the history of the Anthropocene, and they may well act as a welcome bridge in debates bringing the sciences and humanities together—for instance, by contributing to creating a common language for these debates. Moreover, the history of science itself has a lot of historical knowledge to offer, whether on past epistemic practices and their effects on the environments of humans, on the factors involved in the development of resource extraction technologies, or on the global dimensions of knowledge infrastructures. From the sciences of particular relevance to the study of the Anthropocene, like Earth System science, historians of science might draw valuable insights for developing new narratives relevant to putting our current condition in long-term perspective. At the same time, such work points to complex and sometimes uncomfortable issues that need to be confronted, as it could mean that scientific inquiry takes over the study of the past.

It is one thing to explore the history of science in the Anthropocene. It is yet another to envision what a history of science for the Anthropocene might look like. But both questions are informed by the same motivation, shared by all the contributors to this Focus section: namely, to find out what the historian of science's task and responsibility is in our twenty-first-century world. Today, an increasing number of historians, including historians of science, agree that the past matters to the future. Now is the time for us to know and to show why.