# 7 Scales
## From Shipworms to the Globe and Back

*Dániel Margócsy*

> Flesh and blood animals also go about their business all around us, at all times and scales, without interaction or thought about our world of ideas.[1]

Let me start with one of the less widely cited masterpieces of global history: Julian Barnes's *A History of the World in 10 1/2 Chapters* from 1989. Written by a highly erudite writer at the moment when microhistory was asserting its challenge to global histories well beyond its original Italian context, *A History of the World* offered a shrewd and penetrating critique of the dichotomy between the micro–macro distinction that preoccupied scholars during those years. While professional historians argued with each other about whether to focus on large-scale societal transformations or on the experiences of individuals and small communities, Barnes sidestepped these debates by reimagining the history of the world from the perspective of animals. In the first chapter of Barnes's book, a woodworm tells the story of Noah's Ark, the first historical event to put a brake on globalisation. And from the perspective of the woodworm, the accounts of humans, familiar to us from the Old Testament, are put into serious doubt. The narrator writes: 'Now, I realize that accounts differ. Your species has its much repeated version, which still charms even sceptics; while the animals have a compendium of sentimental myths.'[2]

According to the woodworm, God is almost absent from the story of the Flood because he operates at a scale that is barely perceptible from below and, more generally, because things rarely go according to divine plans foisted upon the Earth from above. Human agency is also dislodged when viewed from below. The woodworm presents Noah as an incompetent leader who barely makes it through the calamities, losing much of the crew on the way. In contrast, the woodworm becomes a real agent of its own fate. It was not meant to be on the Ark (or, to be more precise, in the Ark): "I was a stowaway. I too survived; I escaped." Like the microhistorians of the period,

[1] Iwona Blazwick and Mark Dion, 'Mise-en-scène', in Mark Dion (ed.), *Theatre of the Natural World* (London: Whitechapel Gallery, 2019), 10–22, here 17.
[2] Julian Barnes, *A History of the World in 10 1/2 Chapters* (London: Cape, 1989).



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Barnes resists the danger of telling stories from above. The connection to microhistory is probably not coincidental, and not only because the worm is also featured prominently in the title of Carlo Ginzburg's seminal *The Cheese and the Worms*.[3] Echoing Ginzburg's work, a later chapter of Barnes's book uses the narrative frame of an early modern trial to recover the forgotten voices of those who were put on trial, except that the accused happen in this case to be a number of insects. Yet *A History of the World in 10 1/2 Chapters* goes further than most microhistorians. While Barnes never trivialises the importance of recounting stories of human suffering, he does insist on acknowledging animals as agents and subjects of history.

*A History of the World in 10 1/2 Chapters* did not appear in a vacuum. Barnes was inspired by the work of Italo Calvino, the prolific writer and translator who introduced the term *microstoria* into Italian.[4] Like *A History of the World*, Calvino's *Cosmicomics* offered a whirlwind history of the cosmos from the Big Bang to the late twentieth century from the perspective of a narrator who was at once a sub-atomic particle, a variety of prehistoric animals and a human being. Like Barnes's book, Calvino's work challenged historians to include in their accounts agents that cannot be classified as human.[5] The late 1980s and early 1990s, when Barnes's book appeared, also saw the heyday of a post-modernist interest in replaying and recontextualising historical processes, as well as an important wave of works in art, literature and humanistic scholarship that put animals and the environment at the centre of interest, questioning the necessary centrality of humans in stories about our globe. The epitome of this interest is Mark Dion's *Scala naturae* (and his whole oeuvre), which critically reconstitutes and puts under erasure the Enlightenment's hierarchical understandings of nature (see Figure 7.1). Available in several variants, the *Scala naturae* presents us with a staircase or ladder (the literal meaning of *scale*, datable back to the fifteenth century), which organises natural organisms on ten different levels, with a bust of the great comparative anatomist Georges Cuvier on top. In this work, Dion emphasises the visual appeal and moral dangers inherent in hierarchical, human-centred models of the universe that do not fully acknowledge the various, alternative forms of life the Earth is replete with. Like Barnes, Dion puts all sorts of lifeforms in conversation with the work of humans to ponder how our globe is full of agents that could have a story to tell, and how, at the same time, these animals 'are emblematic of the different types of human driven extinction causes – overharvesting, habitat loss, intentional extermination, over collecting of eggs or specimens and

[3] Carlo Ginzburg, *The Cheese and the Worms* (Baltimore: Johns Hopkins University Press, 1980).
[4] Carlo Ginzburg, 'Microhistory: Two or Three Things That I Know about It', *Critical Inquiry* 20, 1 (1993), 10–35.
[5] Italo Calvino, *Cosmicomics* (New York: Harcourt Brace, 1968).

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Figure 7.1 Mark Dion. *Scala Naturae*, 1994. Painted wooden structure, artifacts, plant specimens, taxidermy specimens and bust, 297.2 x 100 x 238.1 cm. Courtesy of the artist and Tanya Bonakdar Gallery, New York/Los Angeles.

poaching', too.[6] For Dion, the history of human globalisation is the history of the deglobalisation of many animal and plant species by human agents.

I began this review of the current historiography of scale with literature and art to highlight alternatives to the human-centred approaches of history and the other social sciences. The works of Barnes and Dion reveal to us scales of existence that historians rarely engage with: for example, those of worms, microscopic viruses or nuclear particles. While the concept of scale could be

[6] Petra Lange-Berndt, 'A Natural History That Glows in the Dark', in Mark Dion (ed.), *Our Plundered Planet* (London: Hugh Lane Gallery, 2019), 10–23, here 12. See also Ruth Erickson, *Mark Dion: Misadventures of a 21st-Century Naturalist* (New Haven: Yale University Press, 2017).

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used to explore how history can be written from the sub-atomic level to the level of galaxies, historians who engage with the concept of scale use this engagement primarily to stake out their claims to one, two or three levels of observation at the most. The first half of the chapter will review the human-centred debates on micro- and macrohistory that have dominated discussions in recent decades. The second half will challenge this historiography first from the perspective of geography, and then return to animal and environmental studies to plead for a historical understanding of scale that incorporates concerns about globalisation, environmental transformation and non-human agencies.

## Scale in History

Scale is a word with many meanings, ranging from the step of a ladder to the ratio between the distance measured on a map and the distance measured on the ground. In this chapter, and in the larger historical literature, scale often refers to the idea that, like a nested sphere, humans, society and the world are organised in a hierarchical manner, with distinct levels of action, such as the level of the individual, the urban, the national, the supranational and the global.[7] The idea of scale sometimes simply refers to the historian's chosen focus of observation – for example, that they study the English Civil War as it played out in the county of Kent. Alternatively, historians may use the concept of scale because they believe that it is a useful explanatory tool to understand how society and the world are organised. In this chapter, I adopt this concept of scale because it is heuristically useful when it comes to describing complex hierarchies with some regular patterns of behaviour. As I later discuss in more detail, human geographers make a convincing case that scale-based conceptual frameworks are especially helpful in understanding the functioning of unequal power structures.

For historians, at each level of the scale, interactions between actors are governed by a separate set of rules.[8] In addition, the hierarchical nature of scale often means that events at higher levels can directly influence actions on the lower rungs of the hierarchy – for example, decisions made by a national government have a role in shaping urban policies and the lives of individuals. Curiously, the scholarship that engages with the concept of scale has focused less on how bottom-up processes may be explained in such a hierarchical order: for example, how individuals or cities may influence events and actions at the national or global level. After a discussion of the emergence of the historical

[7] For a good discussion of defining scale, for geography but also applicable to history, see Nina Siu-Ngan Lam and Dale A. Quattrochi, 'On the Issues of Scale, Resolution, and Fractal Analysis in the Mapping Sciences', *Professional Geographer* 44, 1 (1992), 88–98.

[8] For a non-historical exploration of scale in the humanities, see Joshua DiCaglio, *Scale Theory: A Nondisciplinary Inquiry* (Minneapolis: University of Minnesota Press, 2021).

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debates on scale, the bulk of this chapter will be devoted to reconceptualising scale by taking seriously the issue of bottom-up organisation and action, and to exploring how the concept of scale can help historians move beyond the dichotomy of the micro and the macro.

As Deborah Coen has argued, the modern concept of scale emerged in the nineteenth century.[9] By then, the early modern concept of the *scala naturae*, a variant of the idea of a chain of being that reached from the lowly worm to God up in heaven, had been put out of use.[10] The advent of deep time – that is, the discovery of Earth's long geological past – dispelled the belief in the divine and the eternal order of fixed species, opening the door to a variety of proto-evolutionary theories. The old hierarchical understanding of nature was replaced by a new, complex, yet equally orderly understanding of the global environment as proposed by Alexander von Humboldt, whose work partly relied on indigenous helpers, mining professionals and colonial Latin American scholars.[11] Scale turned from a concept of vertical hierarchy to a descriptor of spatial differentiation. Humboldt's global vision emphasised universal laws that ensured broad regional similarities across the globe, while not neglecting to explore how small regions could diverge from each other based on their local microclimates. As Coen posits, however, it was in the multilingual, multinational and multiregional Habsburg Empire that the concept of scale developed even further and achieved its fullest expression, as Habsburg scientists began to provide models of the complex reasons why local regions in the Karst had drastically different weather patterns from other regions nearby. Unlike Humboldt, these geographers partially dispensed with a global vision of climate and environment because climate patterns at lower levels of observation tended to depend on their own, more local sets of laws. At different scales, phenomena on Earth depended on different sets of rules.

The historians who came after the geographical revolution freely acknowledged their debt to this tradition in their understanding of the different scales of historical action, even if they reintroduced the concept of vertical hierarchy to their discussions. The Annales school's self-proclaimed break with *histoire événementielle*, and Braudel's focus on the putatively more important medium

[9] Deborah Coen, *Climate in Motion: Science, Empire, and the Problem of Scale* (Chicago: University of Chicago Press, 2018).

[10] Arthur O. Lovejoy, *The Great Chain of Being: A Study of the History of an Idea* (Cambridge: Harvard University Press, 1936); E. M. W. Tillyard, *The Elizabethan World Picture. A Study of the Idea of Order in the Age of Shakespeare, Donne and Milton* (London: Chatto and Windus, 1943).

[11] Nicolaas A. Rupke, *Alexander von Humboldt: A Metabiography* (Chicago: University of Chicago Press, 2008); Patrick Anthony, 'Mining as the Working World of Alexander von Humboldt's Plant Geography and Vertical Cartography', *Isis* 109, 1 (2018), 28–55; Jorge Cañizares-Esguerra, *Nature, Empire, and Nation: Explorations of the History of Science in the Iberian Worlds* (Stanford: Stanford University Press, 2006).

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and longue durée developments of history, owed much to the lessons they had learned from the geography of the years around 1900.[12] As Braudel programmatically explained, 'I would freely declare that the *Tableau de la géographie de la France*, published in 1903, just before Ernest Lavisse's great history of France, is a major work not only of geography but also in the canon of the French school of history.'[13]

A social and economic historian who adhered fairly strongly to environmental determinism, Braudel acknowledged three different levels of historical action, each with its own specific sets of laws and regularities. At the top level, the geographic landscape provided the environmental constraints for human activity while, one level below, cyclical economic patterns and social movements paved the way for the emergence of modern society. Even further below that scale, the history of events revealed the activities of individual humans that, frankly, did not amount to much. The achievements of a single person could never be more than the foam on top of a single wave in a vast ocean. For Braudel, even the French Revolution was a blip in human history, barely worth the attention of a real scholar. Talking of his colleague Ernest Labrousse in his inaugural lecture at the Collège de France, Braudel could barely contain his shock that Labrousse focused his attention on explaining the causes of the French Revolution, a diversion from more important developments in long history.[14] This was because Braudel emphatically believed that the direction of influence primarily flowed in one direction. While geography shaped the economy and society, and all these influenced the lives of individuals, individuals could make little difference to economics and society, and society could influence the shape of the land only to a limited degree. Braudel's world was not one in which humans could easily induce climate change on a global scale.[15]

Braudel's views had important repercussions that went well beyond the borders of France. The Annales school strongly shaped the development of

[12] Robert J. Mayhew, 'Historical Geography, 2009–2010: Geohistoriography, the Forgotten Braudel and the Place of Nominalism', *Progress in Human Geography* 35, 3 (2010), 409–21; Samuel Kinser, 'Annaliste Paradigm? The Geohistorical Structuralism of Fernand Braudel', *American Historical Review* 86, 1 (1981), 63–105; William Rankin, 'How the Visual Is Spatial: Contemporary Spatial History, Neo-Marxism, and the Ghost of Braudel', *History and Theory* 59, 3 (2020), 311–42.

[13] Fernand Braudel, *On History*, trans. Sarah Matthews (London: Weidenfeld and Nicolson, 1980), 17.

[14] Braudel, *On History*, 30.

[15] 'Through variations in the climate a force external to man is asserting itself and claiming its part in the most everyday explanations. Today such variations are accepted.' Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II*, 2 vols. (London: William Collins, 1972), vol. 1, 272. For a nuanced reading of Braudel, which shows the French historian's willingness to consider how humans shaped their environment to some extent, see Jason W. Moore, 'Capitalism as World-Ecology: Braudel and Marx on Environmental History', *Organization and Environment* 16, 4 (2003), 431–58.

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the discipline in Italy, Latin America, Eastern Europe and even in the Anglo-American world. To give one famous example, the tripartite structure of Lawrence Stone's influential *Causes of the English Revolution* owes much to the model of the Annales school, though without the emphasis on geography.[16] Stone proposed that causation could be distributed between the socio-economic preconditions of change that accumulated over a good hundred years, the precipitates of the two decades before 1640 and the triggers that made the event an actuality as opposed to a probability. Unlike Braudel, Stone eventually acknowledged that socio-economic structures were not unaffected by changes at the level of the individual, and some of his articles proposed a more multidirectional flow of influence between socio-economic, cultural and narrative approaches:

> Economic and demographic determinism has not only been undermined by a recognition of ideas, culture and even individual will as independent variables. It has also been sapped by a revived recognition that political and military power, the use of brute force, has very frequently dictated the structure of the society, the distribution of wealth, the agrarian system, and even the culture of the elite.[17]

While Stone's interest in social history never waned, the late 1970s also saw the emergence of revisionist historians of the English Civil War who challenged the primacy of preconditions of change over triggers, arguing that there was little that was pre-determined about the Civil War until it finally happened.[18] And, within the broader discipline, the coming of microhistory, developed first in Italy as a reaction to the dominance of the Annales school, refocused attention back on the histories of individuals.

Never united, microhistorians took a variety of contradictory approaches to the question of scale. For many, the essence of microhistory was to uncover the voices of those who fell through the sieves of official statistics and quantitative data. Some scholars simply turned their back on history written on a large scale and used the experiences of individuals to show how the historiography of larger societal structures failed to reveal how events on the global or national scale played out on the ground. This preference for recovering lost voices did not always imply the rejection of the importance of larger societal structures,

[16] Stone himself acknowledged his debt in a debate: 'Koenigsberger is correct in interpreting my arrangement of the data under the tripartite headings of preconditions, precipitation, and triggers as a more complicated version of the *structure/conjoncture* dichotomy.' Lawrence Stone, 'Early Modern Revolutions: An Exchange: The Causes of the English Revolution, 1529–1642: A Reply', *Journal of Modern History* 46, 1 (1974), 106–10, here 106.

[17] Lawrence Stone, 'The Revival of Narrative: Reflections on a New Old History', *Past and Present* 85 (1979), 3–24, here 10.

[18] Mark Kishlansky, *The Rise of the New Model Army* (Cambridge: Cambridge University Press, 1979); Conrad Russell, *Parliaments and English Politics 1621–1629* (Oxford: Oxford University Press, 1979); John Morrill, *Revolt of the Provinces: Conservatives and Radicals in the English Civil War, 1630–1650* (London: Allen and Unwin, 1976).

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however. Carlo Ginzburg, for instance, used his *Cheese and the Worms* not only to give voice to the Italian miller Menocchio, an exceptional individual, but also to examine how the coming of the printed book interacted with the longue durée history of Eurasian popular culture. *The Cheese and the Worms* used the figure of Menocchio to tell a large-scale story of the socio-political emergence of confessionalisation that obliterated the popular culture that our miller was coming from. For Ginzburg, the story of Menocchio could be interpreted at both levels and did not invalidate the macro-level narratives of societal change. Importantly, some other Italian microhistorians went even further, using fine-grained studies to point out how macro-level phenomena could be described as the result of individuals organising themselves into larger hierarchical groups. These microhistorians did not take larger societal structures as given in advance. Instead, they explained how these hierarchical structures emerged thanks to the self-organisation of individuals into networked groups.[19]

Inspired partly by the influential writings of Fredrik Barth, Edoardo Grendi claimed that microhistory's aim was to 'reconstruct the evolution and dynamics of social comportments', and Giovanni Levi even argued that a focus on Catholic cultural structures could explain the formation of modern Italian-style states.[20] Such proposals found resonance on the other side of the Atlantic as well. If Grendi relied on Barth, the sociologist and historian Charles Tilly suggested that the reconciliation of micro- and macrohistory must be performed by relational realism, 'which concentrates on connections that concatenate, aggregate and disaggregate readily, form organisational structures at the same time as they shape individual behaviour'.[21] To some, the solution of aggregating individuals into social groups through the study of relational networks seemed an acceptable way of bringing together micro- and macrohistorians. Yet significant differences remained as macrohistorians accused microhistorians of using outdated models of the state and other concepts, while microhistorians challenged the actual commitment of macrohistorians to understanding microstructures.

Viewed from a French perspective, the culminating theoretical statement on the encounter between micro- and macrohistory was Jacques Revel's edited

[19] Edoardo Grendi, 'The Political System of a Community in Liguria: Cervo in the Late Sixteenth and Early Seventeenth Centuries', in Ed Muir and Guido Ruggiero (eds.), *Microhistory and the Lost Peoples of Europe* (Baltimore: Johns Hopkins University Press, 1991), 119–58.

[20] Edoardo Grendi, 'Micro-analyse et histoire sociale', *Ecrire l'histoire* 3 (2009), 67–80, here 80; Giovanni Levi, 'The Origins of the Modern State and the Microhistorical Perspective', in Jürgen Schlumbohm (ed.), *Mikrogeschichte – Makrogeschichte: Komplementär oder inkommensurabel?* (Göttingen: Wallstein, 1998), 53–82; see also Giovanni Levi, *Inheriting Power: Story of an Exorcist* (Chicago: University of Chicago Press, 1988). On Barth, see Paul-André Rosental, 'Construire le macro par le micro: Fredrik Barth et la microstoria', in Jacques Revel (ed.), *Jeux d'échelles: La micro-analyse à l'expérience* (Paris: Seuil, 1996), 141–60.

[21] Charles Tilly, 'Micro, Macro, or Megrim?', in Schlumbohm, *Mikrogeschichte – Makrogeschichte*, 33–52, here 41.

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volume *Jeux d'échelles*, which brought together a number of historians and anthropologists to reconcile the Annales's approach with the attacks of the Italians.[22] For Revel, microhistory's major benefit was to defamiliarise the historical structures that the Annales school had taken for granted, but it did not do away with these structures in the end.[23] Both approaches provided an interesting perspective on history, and neither had epistemological primacy over the other. The level of the individual was by no means more empirical or more concrete than the level of societal interactions. The best historical move was to oscillate constantly and playfully between the two levels of analysis. In the process, Revel chose to ignore the more serious challenges of microhistorians who called into question the validity of standard categories of social and economic history. It also remained unclear whether the microscopic and the macroscopic perspectives provided views on the same reality, or whether they were fundamentally irreconcilable. As Revel noted, some microhistorians, such as Sabina Loriga, explicitly modelled their writing on Akira Kurosawa's *Rashomon*, the iconic film showing how the same event could be told from different, contradictory perspectives without a resolution.[24] Consequently, Revel had very little to say on how events at one level could have repercussions on events at another level. The *jeux d'échelles* shed new light on history, but they did not imply that there would necessarily be well-defined interactions between the micro and the macro.

Despite the breath of fresh air that microhistorians brought to the discipline, their programmatic statements on the issue of scale remained trapped in the terminology and framework set by the *Annales* school. Unlike the physical geographers of climate around 1900, and unlike contemporary literary authors, microhistorians kept on understanding scale as an organisational feature limited to humans alone. Ginzburg, for instance, considered worms only to the degree that people turned them into a cosmological metaphor, and never treated them as independent agents of history. As a result, microhistorians reduced scale to a simple binary dichotomy between the micro and the macro – a dichotomy that has persisted in the discipline ever since.[25] To some degree, the rise of transnational history, in its different guises from

[22] Revel, *Jeux d'échelles*.

[23] 'Le changement d'échelle a joué, on l'a dit, le rôle d'un estrangement, au sens des sémioticiens: d'un dépaysement par rapport aux catégories d'analyse et aux modèles interprétatifs du discours historiographique dominant.' Jacques Revel, 'Micro-analyse et construction du social' [The changing of scale played, as has been said, the role of an estrangement, in the sense of the semioticians: of a change of scenery in relation to the categories of analysis and the interpretive models of the dominant historiographical discourse], in Revel, *Jeux d'échelles*, 15–37, here 34.

[24] Revel, 'Micro-analyse et construction du social', 32; Sabina Loriga, *Soldati: L'istituzione militare nel Piemonte del Settecento* (Venice: Marsilio, 1992).

[25] Matti Peltonen, 'Clues, Margins, and Monads: The Micro-Macro Link in Historical Research', *History and Theory* 40, 3 (2001), 347–59.

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connected and entangled histories to *histoires croisées* and histories of circulation and mobilities, has seemed to confirm that networks offer a way out of the dichotomy of micro- and macrohistory.[26] Here was an attempt that aimed to break free from the focus on partially restricted locales to cover large distances on the globe. Some versions of transnational history were simply a sub-genre of world history that integrated into its macroanalysis structures that were supranational or bypassed national boundaries, such as international organisations. Yet an important segment of this literature focused on individuals or small groups of people whose travels across the world revealed how distant places may have an unexpectedly strong influence on each other. While some transnational microhistorians continued to focus on Italy, others devoted themselves to giving voice to the subaltern and the dispossessed in other places on the globe as well. They helpfully recentred the historiography by bringing to life the experiences and connections of enslaved Africans across the Atlantic or Indian migrants in China and beyond.[27]

When it comes to the issue of scale, the literature on global microhistory has tended not to use network theory to analyse how structures at different scales may interact with each other. Instead, the aim is either to see how seemingly local events are actually influenced by complex global forces, as proposed by proponents of glocalism, or to explain how individuals are able to bypass urban and state-level structures and operate at multiple locales at the same times.[28] Such studies have made it clear that the level of the individual is not seamlessly nested in the meso- and macro-level scales of city and nation, and have proposed alternative social systems that structure the formation of communities. Yet it often remains rather opaque how traditional macro-level concepts could be reconciled with these new, alternative social structures. For instance, Michael Werner and Bénédicte Zimmermann claim both that *histoire croisée* emphasises the 'inextricable interlinking' of the micro and the macro and that 'the notion of the scale does not refer to the micro or macro but to the different

[26] Sanjay Subrahmanyam, 'Connected Histories: Notes towards a Reconfiguration of Early Modern Eurasia', *Modern Asian Studies* 31, 3 (1997), 735–62.

[27] For some recent examples of how historians explicitly rely on microhistory to deal with issues of race and gender across the globe, see Cao Yin, 'The Journey of Isser Singh: A Global Microhistory of a Sikh Policeman', *International Journal of Punjab Studies* 21, 2 (2014), 325–53; Lara Putnam, 'To Study the Fragments/Whole: Microhistory and the Atlantic World', *Journal of Social History* 39, 3 (2006), 615–30; Julia Roos, 'An Afro-German Microhistory: Gender, Religion, and the Challenges of Diasporic Dwelling', *Central European History* 49, 2 (2016), 240–60; and Dale Tomich and Michael Zeuske, 'Introduction, the Second Slavery: Mass Slavery, World-Economy, and Comparative Micro-Histories', *Review (Fernand Braudel Center)* 31, 2 (2008), 91–100.

[28] Francesca Trivellato, 'Is there a Future for Italian Microhistory in the Age of Global History?', *California Italian Studies* 2, 1 (2011), https://escholarship.org/uc/item/0z94n9hq; see also Maxine Berg, Global History of the Global and the Local, a special issue of the *Journal of Early Modern History* 27, 1–2 (2023). On globalism as the solution to scale, see Sebastian Conrad, *What Is Global History?* (Princeton: Princeton University Press, 2016).

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spaces in which the constitutive interactions of the process being analysed are inscribed', leaving it unclear whether one should discard the concepts of the micro or the macro.[29]

In less programmatic statements, the concept of the transnational has served to reveal alternatives to state- and city-based explanations that are already well-established historical categories. In *The Familiarity of Strangers*, for instance, Francesca Trivellato showed how the Sephardic diaspora of Livorno relied partly on the urban and state structures of the early modern Mediterranean, and partly on networks based on kinship and religion that connected different parts of the Mediterranean.[30] Yet even Trivellato's account of the Sephardic diaspora did not quite explain how interpersonal relationships aggregate into urban and state structures, let alone discuss how shipworms, or the seeds of plague and other infectious diseases, shaped maritime trading networks in the Mediterranean. *The Familiarity of Strangers* instead often offered top-down explanations of how the Livorno authorities posed constraints on the lives of Sephardic Jews within their walls, implying a simple model in which macro-structures shape but do not determine actions at the individual level. As Bernhard Struck, Kate Ferris and Jacques Revel wrote in 2011, the same issues that prompted the editing of *Jeux d'échelles* twenty years earlier are also present in debates about transnational histories. These authors argued that one could not simply discard the nation-state, and that the transnational is simply a spatially extended variant of the microhistorians' idea of the local individual. Transnational history did not help decide whether it was possible to reconcile the perspectives presented by different scales and if there were ways to explore how they interacted.[31]

From today's vantage point, there is widespread agreement that, for a fruitful global history, it would be crucial to finally understand how the interplay of different scales of analysis unfolds in practice, or at least in theory. In a recent special issue of *Past and Present*, John-Paul Ghobrial writes that the literature 'could do more to explain exactly how one should play the *jeux d'échelles*', but he does not actually offer an answer, and Jan de Vries's contribution to the special issue confirms that, at least from the perspective of some social and economic historians, the dichotomy may be

[29] Michael Werner and Bénédicte Zimmermann, 'Histoire Croisée: Between the Empirical and Reflexivity', *Annales* 58, 1 (2003), 7–36, here 28.

[30] Francesca Trivellato, *The Familiarity of Strangers: The Sephardic Diaspora, Livorno, and Cross-Cultural Trade in the Early Modern Period* (New Haven: Yale University Press, 2009). For a recent discussion of microhistory and the acknowledgement of the global turn, see Thomas Robisheaux et al., *Microhistory and the Historical Imagination: New Frontiers, a special issue of The Journal of Medieval and Early Modern Studies* (2017), 47, 1.

[31] Bernhard Struck et al., 'Introduction: Space and Scale in Transnational History', *International History Review* 33, 4 (2011), 573–84. See also Etienne Anheim and Enrico Castelli Gattinara, 'Jeux d'échelles: Une histoire internationale', *Revue de Synthèse* 130, 4 (2009), 661–77.

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irresolvable.[32] As de Vries damningly writes, 'microhistories do not, and are not intended to, aggregate to macro-level and global histories. There is no path, no methodology, no theoretical framework in the current repertoire of the microhistorian to make this move possible.'[33]

De Vries's argument hinges on his assumption that macrohistory is successful because of its alliance with the social sciences, and therefore the only microhistory that could aggregate to larger-level explanations is the controlled case study that reveals comparative differences. For de Vries, of course, the social sciences primarily mean economics and quantitative sociology. Yet, as we have seen, the first wave of microhistories was inspired by another social science: the anthropology of Fredrik Barth. Similarly, Tilly used 'relational realism' precisely to offer an alternative explanation for how microphenomena may aggregate to macrostructures without resorting to quantitative comparative research.[34] Curiously, microhistorians today rarely acknowledge this anthropological inspiration; even more curiously, the historical debate on global history and the problem of scale mostly ignores the parallel debates on scale that have been prevalent in the disciplines of science studies and geography.[35] If, in the middle of the twentieth century, Braudel was enthusiastic about a somewhat outdated version of geography, his enthusiasm has disappeared from the discipline completely.

### Flat Ontologies and Scale Jumping

If scale means that, at different levels of analysis, agents can act according to different sets of laws, the basic question is how actions at one level could affect agents at another level. In the classic formulation of the concept of scale, with its nested hierarchies, the answer is that developments at a higher rank of hierarchy can affect events at a lower rank of the scale in a top-down manner, but not vice versa. Yet once the concept of nested hierarchies is at least partially abandoned, the solution to this issue becomes much less clear. If the actions of nation-states are governed by the rules of political economy at the macro level, for instance, can individuals affect how states develop or change?

[32] John-Paul A. Ghobrial, 'Introduction: Seeing the World like a Microhistorian', *Past and Present* 242, supplement 14 (2019), 1–22, here 16. For similar debates in the French historiography, and an acknowledgement that they are not new, see Romain Bertrand and Guillaume Calafat, 'La microhistoire globale: affaire(s) à suivre', *Annales* 73, 1 (2018), 1–18 and the articles in that issue.

[33] Jan de Vries, 'Playing with Scales: The Global and the Micro, the Macro and the Nano', *Past and Present* 242, supplement 14 (2019), 23–36, here 29.

[34] For a useful reminder of Barth's importance, see Giovanni Levi, 'Frail Frontiers?', *Past and Present* 242, supplement 4 (2019), 37–49.

[35] For an acknowledgement of the debate, see Christian G. De Vito, 'History without Scale: The Micro-Spatial Perspective', *Past and Present* 242, supplement 14 (2019), 348–72.

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In recent years, human geographers have proposed answering this fundamental question in the affirmative by emphasising the importance of bottom-up organisation and action. Microhistorians were interested in marginalised individuals who were nonetheless able to escape the constraints of such oppressive structures as the state without necessarily challenging it outright. Geographers are instead interested in revolutionary individuals and other agents who can change macrostructures such as the national state or global economy. They propose two alternative analytical approaches to accomplish this goal. First, the argument for flat ontologies posits that all macro-level phenomena can ultimately be described using only individual agents who form networks. Second, the argument for scale jumping argues that certain shape-shifting agents are able to 'make the leap' from one level of analysis to another, and thus affect outcomes both at the micro and the macro level.

In recent decades, geography has undergone a development that is not dissimilar to the transformation of the historical discipline.[36] Human geography has become detached, to some degree, from physical geography and, ever since Henri Lefebvre's groundbreaking work, geographers carefully distinguish 'the social space [that is] a social product' from the concept of physical space.[37] As a result, human geographers also refer to scale primarily to describe the hierarchical organisation of social life, with nature and non-human agents taking the role of epiphenomena. Yet the similarities with historical discourse go deeper and show parallel developments over the past forty years. Inspired by Immanuel Wallerstein, the geographer Peter Taylor conceptualised scale as a nested hierarchy with the global level as the more powerful in 1982, but the recent literature has moved away from this angle and towards interpretations that are not unlike the radicalised versions of the Barthian solutions offered by Italian microhistorians.[38] In a series of articles, Sally Marston has argued that, once the nested hierarchies of scales are rejected, scalar explanations become inferior versions of Deleuzian rhizomatic networks and therefore the concept of scale should be abolished.[39] If all agents are able to act upon all other agents (the individual on the state, and the state on the individual) and there is no pre-established hierarchy, the illusion of scale is the result of scholars mistaking certain powerful network nodes for reified and unproblematic entities. Unlike strong versions of Deleuzian network theory, Marston nonetheless points out that not all networks need to be about endless openness, flows and fluxes. There are blockages and spatial structures that give shape to the world, just as it is

[36] For an overview, see Andrew Herod, *Scale* (London: Routledge, 2010).
[37] Henri Lefebvre, *The Production of Space* (Oxford: Blackwell, 1991), here 26.
[38] Peter J. Taylor, 'A Materialist Framework for Political Geography', *Transactions of the Institute of British Geographers* 7, 1 (1982), 15–34.
[39] Sallie A. Marston et al., 'Human Geography without Scale', *Transactions of the Institute of British Geographers* 30, 4 (2005), 414–32.

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impossible to write a transnational history of circulation without presupposing certain nation-states or other entities between which circulation takes place. A great advantage of Marston's approach is to emphasise that a focus on scale can serve to highlight socio-economic hierarchies that overshadow alternative systems of inequalities (e.g. those based on gender).[40] A network-based analysis is better able to handle complex systems of inequalities where class, race, gender and other factors interact with each other.

Flat ontology leaves slightly unclear how unequal power structures can emerge within networks where all agents are similar at the outset.[41] For this reason, other geographers have been less enthusiastic about abandoning the concept of scale, which immediately foregrounds the structural role of inequality. These geographers have maintained the idea that partially nested hierarchies play a significant role in the organisation of society and in shaping the interaction of humans with their environments.[42] Scholars inspired by Marx, such as Neil Brenner and Neil Smith, agree that scale is a social construct, but this does not make it any less real. Scale is a useful explanatory tool because it provides a clearer understanding of unequal power structures than the somewhat vague concepts of blockages and spatial structures. While in principle somewhat malleable, scale structures can also be rigid and path-dependent, and a scale-based analysis can therefore explain why the nation-state or global economy have survived across several centuries.[43] Building on Brenner and Smith, Erik Swyngedouw has importantly argued that scales can be reconfigured at each new stage of history, with certain levels gaining particular significance in certain historical situations.[44] As Swyngedouw claims, for instance, the rise of capitalism was a key event in the emergence of the global as a separate level where power could be concentrated, with other levels (e.g. the national) losing some significance at the same time.[45] Following Neil Smith's earlier work, Swyngedouw suggests that power struggles and political upheavals play out in the construction of new scales that attempt to constrain certain actors to act at only one level of action. Much work and organisation are needed for other actors to become able to 'jump scales' and effect change.

[40] Sallie A. Marston, 'The Social Construction of Scale', *Progress in Human Geography* 24, 1 (2000), 219–42.

[41] For a somewhat more detailed critique of flat ontologies, see Dániel Margócsy, 'A Long History of Breakdowns: A Historiographical Review', *Social Studies of Science* 47, 3 (2017), 307–25.

[42] For a review of the debates on scale, see Andrew E. G. Jonas, 'Pro Scale: Further Reflections on the "Scale Debate" in Human Geography', *Transactions of the Institute of British Geographers* 31, 3 (2006), 399–406.

[43] Neil Brenner, *New Urban Spaces: Urban Theory and the Scale Question* (Oxford: Oxford University Press, 2019), here 107–8.

[44] Erik Swyngedouw and Mustafa Dikeç, 'Theorizing the Politicizing City', *International Journal of Urban and Regional Research* 41, 1 (2016), 1–18.

[45] For a parallel historical analysis of the emergence of the global, see Sujit Sivasundaram, 'Sciences and the Global: On Methods, Questions, and Theory', *Isis* 101, 1 (2010), 146–58.

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From the late 1980s onwards, Smith was one of the major theorists of scale in geography. Just like Swyngedouw, Smith claimed that scales were powerful but unstable constructions 'produced as part of the social and cultural, economic and political landscapes of contemporary capitalism and patriarchy'. As malleable political constructs, different scales of action, though hierarchically organised, were nonetheless inherently connected, which led Smith to the realisation that 'the importance of "jumping scales" lies precisely in this active social and political connectedness of apparently different scales, their deliberate confusion and abrogation'.[46] If capital structured hierarchies in such a way that those without power were pushed to a less privileged level of action, these dispossessed agents could nonetheless use a variety of jumping strategies to regain their agency and power at a level of high importance.[47] Bottom-up organisation was difficult but not impossible. To give an example, Smith brought up the New York artist Krzysztof Wodiczko's political project of the *Homeless Vehicle*. The *Homeless Vehicle* was a mobile unit that combined a shopping cart with an upper, sheltered compartment for sleeping and also included a washbasin for daily ablutions. Through its rocketlike design, it stood out from the urban environment where it was exhibited and put into action. It made visible at the urban level those masses of homeless people that the politicians of gentrification wanted to render invisible.

Following Smith, Swyngedouw has similarly reinterpreted the history of late-twentieth-century globalisation as an issue of scale jumping. In Swyngedouw's version, the contemporary network flows that Marston has studied are therefore not simply an ahistorical given.[48] They are the result of the post-Bretton Woods era in which the welfare state is hollowed out and global markets increasingly operate at the local and individual level. It is this recent historical process that Swyngedouw calls 'glocalisation'. For Swyngedouw, glocalisation is not the microhistorical study of global forces, it is the result of global markets' late-twentieth-century reorganisation of scales. It offers an example of market forces jumping scales from the global to the local without passing through the national.

While Swyngedouw's and Smith's arguments and examples come from a determinedly Marxist interpretation of history, their claims about the construction of scale resonate with the points made by the French social theorist

[46] Neil Smith, 'Contours of a Spatialized Politics: Homeless Vehicles and the Production of Geographical Scale', *Social Text* 33 (1993), 54–81, here 66; see also Neil Smith, 'Spaces of Vulnerability: The Space of Flows and the Politics of Scale', *Critique of Anthropology* 16, 1 (1996), 63–77; John Paul Jones et al., 'Neil Smith's Scale', *Antipode* 49, S1 (2017), 138–52.

[47] On a recent review of the role of capitalism in history, see Andrew David Edwards et al., 'Capitalism in Global History', *Past and Present* 249, 1 (2020), e1–e32.

[48] See also Bob Jessop, 'Crisis of the National Spatio-Temporal Fix and the Tendential Ecological Dominance of Globalizing Capitalism', *International Journal of Urban and Regional Research* 24, 2 (2000), 323–61.

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Bruno Latour. While Actor–Network theory has often been associated with flat ontologies, Latour was clear that his aim was to deconstruct, but not to do away with, modern hierarchical structures. Throughout Latour's work, his double aim was not only to explain how 'we have never been modern', but also how the rise of Western science brought in unequal power structures and developments between societies.[49] Actor–Network theory relies on associations in networks to explain unequal development and the establishment of hierarchies of power.[50] The difference between Marxist geographers and Latour is that Latour focuses primarily on how micro-level agents build up higher-level networks, while Smith and Swyngedouw privilege capital over micro-level agents in their explanations of the emergence of scalar hierarchies. Yet even when one acknowledges this important difference, scale jumping nonetheless finds its counterpart in Actor–Network theory and its concept of immutable mobiles. At least for the early Latour, powerful networks gained their potency from the paper tools of scalable immutable mobiles, such as maps and diagrams, that allowed modern scientists to jump scales with ease.[51] Immutable mobiles reduced the globe to the level of the individual scientist and made it possible to recreate the world in one centre of accumulation, such as the city of Paris. As Latour explained, scale models were at once scientific facts and religious fetishes (a 'factish'), as they came with the promise that their manipulation in a small laboratory could effect changes at a larger level, across the globe, leading to Western domination in modernity. More recently, John Tresch has offered a decentred, and less triumphalist, version of the factish in his studies of cosmograms across history, investigating how different societies built themselves reduced, and often hierarchical, models of the cosmos to understand and manipulate it at a reduced scale.[52] Tresch's cosmograms are at once a powerful example of how people use a variety of tools to jump scales, and they also reveal how agents other than twenty-first-century historians and geographers develop complex theories about scale and levels of action.

For historians, the geographers' perspective on scale has a number of significant advantages. First of all, it points out that scale is a political construct and, as a result, it is because of historical struggles that certain levels on the

[49] Bruno Latour, *We Have Never Been Modern* (Cambridge, MA: Harvard University Press, 1993); Bruno Latour, *An Inquiry into Modes of Existence: An Anthropology of the Moderns* (Cambridge, MA: Harvard University Press, 2013).

[50] For a Latourian criticism of Marston along these lines, see Chris Collinge, 'Flat Ontology and the Deconstruction of Scale: A Response to Marston, Jones and Woodward', *Transactions of the Institute of British Geographers* 31, 2 (2006), 244–51.

[51] Bruno Latour, 'Drawing Things Together', in Michael Lynch and Steve Woolgar (eds.), *Representation in Scientific Practice* (Cambridge, MA: MIT Press, 1990), 20–69.

[52] John Tresch, 'Cosmopragmatics and Petabytes', in Simon Schaffer et al. (eds.), *Aesthetics of Universal Knowledge* (London: Palgrave Macmillan, 2017), 137–68; John Tresch, 'Technological World-Pictures: Cosmic Things, Cosmograms', *Isis* 98, 1 (2007), 84–99; see also Christoph Markschies et al. (eds.), *Atlas der Weltbilder* (Berlin: Akademie-Verlag, 2011).

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scale, such as the global, gain particular importance at particular moments. Consequently, there is no foundational and transhistorical level of analysis that reveals the true workings of society; moreover, neither the local nor the global are necessary, transhistorical givens. Similarly, it is also entirely possible that neither a traditional micro- or macro-level analysis is the best tool for understanding all historical events, as there may be other scales of action that are rendered invisible by capital or the archival practices of political powers.

Second, the concept of scale jumping offers historians a tool that is better equipped than Revel's *jeux d'échelles* to explain how individuals can act on the macro-level on certain occasions. Smith's ideas allow us to focus on how, once established, the different scales at which agents operate can be connected – the major issue faced by both micro- and macrohistorians both before and after the transnational turn. A categorisation of different strategies of scale jumping, from the artwork of the *Homeless Vehicle* through Latourian factishes to cosmograms, may well be the best tool to help historians of the local and historians of the global join forces. Here, for lack of space, I will only offer a few such strategies from historical writings to explain how scale jumping can be used to describe the kinds of work that need to be done for entities to occupy positions of power at a variety of levels.

While scale jumping is a relatively new concept, the phenomenon itself has long been known to writers of history and historical anthropology. These historians also acknowledged that scale jumping is not always a strategy of resistance: it can also be a tool for assuming power. Ernst Kantorowicz's classic *The King's Two Bodies* is only the most prominent example of the legal and religious work that enables an individual human to become the state.[53] As Kantorowicz explained, modern kingship emerged from the Christological literature that attempted to explain how Christ united two natures in one person and how, after Christ's ascension to heaven, Christ was present on Earth both in the host and in the church. The secularised concept of kingship discussed in similar terms how to distinguish and unite the individual person and the state-level role they play in the body of the king, only to fall apart during the English Civil War when parliamentary forces fought the king in the name of the King. It was at this moment that Thomas Hobbes appeared on the scene, offering his own analysis of how 'a multitude of persons natural are united by covenants into one person civil or body politic'.[54] Once the traditional concept of the king was truly dead, a new legal system needed to be established to make states out of people. Importantly, the double nature of kingship was not only a Western idea, as Marshall Sahlins's *Islands of History* showed for the Pacific. As Sahlins explained in terms of

[53] Ernst Kantorowicz, *The King's Two Bodies: A Study in Mediaeval Political Theory* (Princeton: Princeton University Press, 1957).

[54] Thomas Hobbes, *Human Nature and De Corpore Politico* (Oxford: Oxford University Press, 1994), here 109.

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structural anthropology, in the Fijian case the levels of the individual, the state and the divine are united through their 'hierarchical encompassment in the projects of kingship'. The divine king as an individual expresses the general will and 'every day, the king recreates the world'.[55] As Sahlins himself explicitly acknowledged, his interest in kings was not a revival of the 'great-man theory of history', but lay rather in understanding how microhistorical actions map onto the canvas of macrohistory.[56] As such, it was one more example of scale jumping.

It would be rash to assert, though, that only kings have the ability to move across scales from the individual to the national level in actual history. As Kantorowicz explained, his inspiration for *The King's Two Bodies* came from the realisation that the Benedictine monastic order was an "Inc." – an incorporated business organisation in the legal landscape of the United States.[57] The formation of corporations, from medieval guilds to twenty-first-century multinational companies, is a prominent example of efforts aimed at making entities visible at ever larger scales. Arguably, an important strand of the Italian microhistorians' studies of labour organisation, often inspired by E. P. Thompson, can be similarly described as attempts to see how individual workers can come together and form a union and how they come to make a class.[58] And, in a similar manner, a major focus of contemporary geographers of scale is understanding twentieth-century labour movements and early twenty-first-century urban protests.[59] Yet, if we pay heed to Kantorowicz's point, we need to remember that the aggregation of people into agents at the macro level cannot be exclusively described by the laws of Barthian networks; we also need to pay close attention to the legal and scalar solution of incorporation that constructs a political body out of a multitude.

## Back to the Worms

As the previous examples have suggested, scholars and historical actors have proposed many ingenious solutions to the problem of shifting from one level of historical action to another, and many more examples could be adduced before the list is exhausted. By way of conclusion, I would like to extend our discussion of jumping scales by considering it at levels that transcend the entrenched micro–macro dichotomy of the discipline and reach out to the less visible scales

[55] Marshall Sahlins, *Islands of History* (Chicago: University of Chicago Press, 1985), 36.
[56] Sahlins, *Islands of History*, 35; Marshall Sahlins, 'Structural Work: How Microhistories Become Macrohistories and Vice Versa', *Anthropological Theory* 5, 1 (2005), 5–30.
[57] Kantorowicz, *The King's Two Bodies*, xvii.
[58] E. P. Thompson, *The Making of the English Working Class* (London: Gollancz, 1963); Maurizio Gribaudi, *Itinéraires ouvriers: Espaces et groupes sociaux à Turin au début du XXe siècle* (Paris: Éditions de l'EHESS, 1987).
[59] Swyngedouw and Dikeç, 'Theorizing the Politicizing City'; Brenner, *New Urban Spaces*.

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at which politics and nature operate. The aim is to avoid the limitations of the post-Braudelian focus of both micro- and macrohistorians on those levels of analysis that prioritise humans, answering Dipesh Chakrabarty's recent call to open up history to radically new approaches.[60] This section is an attempt to understand how the social spaces historians and geographers have explored interact with the physical space of the environment that humans share with plants, animals and lower lifeforms. The plea for extending our understanding of scale by considering levels that contain microscopic entities, insects or trees is to understand how human individuals and social action shape and are shaped by their engagement with nature.[61] Twenty years ago, Timothy Mitchell famously asked the question: 'Can the mosquito speak?' Inspired by Marxian analysis, Mitchell argued that one could not understand Egyptian history without examining how colonial technology brought in both political and natural disasters.[62] Historians have only selectively engaged with Mitchell's approach, but the 2020 pandemic has provided ample evidence that the history of globalisation cannot be written without considering the role of viruses, bacteria and other vectors of disease. And while this chapter has focused primarily on the realm of the living, the geographical concept of scale can also help incorporate in its analysis a variety of tangible and intangible material agents, from mineral resources and oceans to radio waves and nuclear or cosmic radiation.[63]

I started my chapter with Mark Dion's ladders because they are a considered exploration of how scales are political constructs even at levels that include only non-human agents at first sight. The point is not simply that the 'Great Chain of Being' is a human construct of the Renaissance world picture, but rather the environmentalist realisation that human activities, including the

[60] Dipesh Chakrabarty, 'The Climate of History: Four Theses', *Critical Inquiry* 35, 2 (2009), 197–222. For a history of globalisation that discusses its ecological consequences, see Manfred B. Steger, *Globalization: A Very Short Introduction* (Oxford: Oxford University Press, 2017); see also Tyson Retz, *Progress and the Scale of History* (Cambridge: Cambridge University Press, 2022).

[61] For Latour's fascination with these issues, see Bruno Latour, *Down to Earth: Politics in the New Climatic Regime* (Cambridge: Polity Press, 2018).

[62] Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002).

[63] For an example of recent work in the scale jumping politics of material culture, see Jenny Bulstrode, 'Cetacean Citations and the Covenant of Iron', *Notes and Records of the Royal Society* 73, 2 (2019) 167–85; on oceanic history, see David Armitage et al. (eds.), *Oceanic Histories* (Cambridge: Cambridge University Press, 2018); for intangible materialities, see William Rankin, 'The Geography of Radionavigation and the Politics of Intangible Artifacts', *Technology and Culture* 55, 3 (2014), 622–74; Serhii Plokhy, *Chernobyl: The History of a Nuclear Catastrophe* (New York: Basic Books, 2018); Adriana Petryna, *Life Exposed: Biological Citizenship after Chernobyl* (Princeton: Princeton University Press, 2002); Gabrielle Hecht, *Being Nuclear: Africans and the Global Uranium Trade* (Cambridge, MA: MIT Press, 2012).

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development of taxonomical classification, have been actively transforming nature and the Earth for many centuries, if not millennia, and that anthropogenic global warming is only the latest act by which humanity attempts to reshape the Earth with problematic consequences.[64] That is why at its lowest rungs Dion's *Scala naturae* contains human artefacts made from natural materials, such as the wooden wheel, reminding us of the hidden presence of humans at all levels of natural organisation. While the bust of Cuvier is at the top of Dion's sculpture, the point is that humans can walk down the ladder and affect lifeforms on every step. This is the reason for Dion's fascination with debris, as manifested in his cupboards of the *Tate Thames Dig*, which used the framing device of early-twentieth-century geological cabinets to exhibit the results of his excavations of the detritus of plastic, ropes, bones and shells from the banks of the Thames in London.[65] From Dion's perspective, historians' focus on the scale of the human or the state obscures the interactions between humans, animals and plant life that is happening at other levels. While for Braudel the human could affect changes at the level of the environment only with much difficulty, for Dion (and for ecocriticism) the human is a crucial agent in the construction of the environment as we know it. Like Wodiczko's *Homeless Vehicle*, *Scala naturae* is an effort to challenge and resist the political structures, this time to prevent global environmental disaster. As Dion writes: 'My taxonomies often frustrate expectations and assumptions one may have about the nature and function of display. The point of this irritation and challenge to convention is to question the status of its objectivity and power. The authority of taxonomy is fragile, as was clearly understood by a number of Surrealists.'[66]

While Dion's *Scala naturae* focuses on the role of humans in environmental disaster, Barnes's ventriloquising history of the woodworm offers a poignant reminder about the agency of animals and other lifeforms when considering the interactions of the political and the natural, coming from the same decade that produced Latour's *Pasteurization of France*, which brought non-human actants to the fore in science studies.[67] Barnes's choice of the woodworm (or shipworm) is particularly relevant for historians of globalisation because

[64] Obviously, this point has also been made in the vast literature on ecocriticism and in environmental history, including Carolyn Merchant, *The Death of Nature: Women, Ecology and the Scientific Revolution* (New York: Harper and Row, 1980); Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600–1860* (Cambridge: Cambridge University Press, 1995); Donna Haraway, 'Teddy Bear Patriarchy: Taxidermy in the Garden of Eden, New York City, 1908–36', *Social Text* 11 (1984), 19–64; Neil Smith, *Uneven Development: Nature, Capital, and the Production of Space* (Oxford: Blackwell, 1984).

[65] Mark Dion, *Tate Thames Dig*, wooden cabinet and other materials (London: Tate Gallery, ref: T07669).

[66] Blazwick and Dion, 'Mise-en-scène', 11–12.

[67] Bruno Latour, *The Pasteurization of France* (Cambridge, MA: Harvard University Press, 1993). For a recent exploration of non-human responses to late capitalism's ruins, see

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shipworms posed the major infrastructural problem for European navies from Columbus to the coming of ironclad ships in the second half of the nineteenth century.[68] Shipworms entered the hulls of seafaring ships through barely visible holes and, once they were in the wood in sufficient numbers, they hollowed out the hull until it fell into pieces and the ship sank. While standard histories of the maritime expansion of Europe have tended to focus on naval battles and wars as the major obstacle for globalisation, a focus on scales below the level of humans reveals how lowly creatures, such as the shipworm, could multiply, jump from one plank to another, from one ship to another and from one scale to another, to shape and limit the circulation of humans and the vessels that carried them across the globe.

Like humans, shipworms travelled and propagated across the globe in the early modern period, in no small part thanks to the intensification of maritime contact across all the oceans. As these parasites migrated from one place to another, they caused epidemics of timber in a variety of novel and unexpected locations. As they quickly multiplied in these new places, they were able to jump scale, destroying the wooden infrastructures of ports to an alarming degree, thereby keeping globalisation at bay. The history of the early modern age of explorations is, at least in part, the history of the highly expensive and expansive infrastructural solutions that navies across the Earth developed to deal with the worm across the seas.

For shipworms, the 1730s were one particularly successful moment when they came to jump scale in the Netherlands. During these years, shipworms moved from the hulls of ships and decided to settle in the timber piles of the dikes of the Netherlands, causing the wood to rot and leaving the Low Lands especially prone to flooding. A worm that used to be the concern of the navy suddenly became an agent at the level of the nation and the state, together with the dikes that it attacked. News writers, natural philosophers and ministers across the country rushed to find an explanation for why shipworms were now so dangerous and how dikes could be rebuilt using new materials.[69] During the following decades, the Netherlands spent huge amounts of money and labour to repair dikes and keep the country safe. It was through these particularly significant actions that dikes became one of the symbols of Dutch nationhood.

As Abraham Zeeman's print from 1731 reveals, contemporaries already realised that the problem of shipworms was a problem of scale (see Figure 7.2). This

Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton: Princeton University Press, 2015).

[68] See Mary Brazelton and Dániel Margócsy, 'Techniques of Repair, the Circulation of Knowledge, and Environmental Transformation: Towards a New History of Transportation', *History of Science* 61, 1 (2023), 3–18.

[69] Adam Sundberg, 'An Uncommon Threat: Shipworms as a Novel Disaster', *Dutch Crossing* 40, 2 (2016), 122–38.

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Figure 7.2 Abraham Zeeman. *Paalwormen die de dijkbeschoeiingen aantasten,* 1731–3. Etching. 14.5 x 17.9 cm. Amsterdam: Rijksmuseum, RP-P-OB-83.674. Public Domain.

print shows artificially magnified images of the shipworm against the background of dikes and minuscule human observers. To accurately picture the danger of shipworms, the artist needed to adjust his representational scale. Zeeman used the optical illusion of art to accurately depict the scale effects of worms upon coast-based societies. And, like Zeeman, historians can tell similar stories of scale jumping across all levels only if they expand the standard toolkits of micro- and macrohistory with the help of geography, environmental studies and science studies, as well as with the creative inspiration of artists and writers. How else could global history survive in an era marked by pandemics and climate change? And, as I put the finishing touches to this chapter in March 2024, I also need to ask: how else could global history survive in an era that is marked again by the dangers that the explosive fission of nuclei, controlled by totalitarian leaders, pose to societies across the Earth?

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