Thermal Planetarity

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Introduction: 'Monsters of Energy'

'Now to live signifies for you not only the flux and fleeting play of light which are united in you, but the passage of warmth and light from one being to another, from you to your fellow being or from your fellow being to you' reflected social theorist Georges Bataille from the midst of World War II (1988 [1943]: 94). Perhaps unique in putting planet-scaled energetics at the heart of his social thought, Bataille attempts to both diagnose the deadly build-up of force that was then being unleashed and to imagine more generous, joyful ways in which such energies might be expended. In the process, he moves between the grand thermal dynamics of the Earth and cosmos and the warm-blooded intimacy of human relationships. But its notable that Bataille's aim was not simply to curtail excessive energy use, however catastrophic this had become in the modern world. It was also to explore, to revitalize, to elaborate upon a host of other activities – less accumulative, more 'glorious' – through which social beings make use of the warmth and heat their sunlit planet bestows upon them (see Bataille 1991[1949]: 19-26).

An incitement for Bataille was Nietzsche's view of the world as 'a monster of energy', a play of forces that effected ceaseless transformation (1968 [1901]: 550), especially his notion of the sun as endlessly gifting the Earth with heat and light while receiving nothing in return (1969 [1883]: 39). While Nietzsche was responding in part to the rising scientific field of thermodynamics – the study of heat, work and temperature – Bataille had access to other ways of understanding the thermal relations that characterise our planet. He was an early reader of geochemist Vladimir Vernadsky – who, in the 1920s, developed the concept of the biosphere. Vernadsky's notion of the biosphere hinged around the idea that solar energy is the ultimate source of a range of remarkable transformations of the Earth wrought by biological life: the biosphere being 'at least as much as a *creation of the sun* as a result of terrestrial processes' (1998[1926]: 44). So while Bataille took inspiration from Nietzsche's more philosophical sense of the Earth's relationship to its 'superabundant star' as one that defied any model of symmetry or closure, he merged this with Vernadsky's scientific understanding of a solar-powered sphere of prolific, Earth-transforming life – in which humankind, in its own fashion, was but another member (see Bataille 1991[1946]: 28-29).

The decades since Bataille was writing have been at once immensely productive for the Earth sciences and agitated by further threats of catastrophe. In the 1960s and 70s evidence from the study of plate tectonics brought a range of processes shaping the Earth's surface into a unified narrative (Brooke 2014: 27). Around the same time and resonating in certain ways with Vernadsky's earlier biospheric thinking, the Gaia hypothesis postulated that the outer Earth functioned as an interconnected system in which living things play a key role in maintaining the conditions they need in order to survive (Lovelock 1987: 11). By the closing decades of the 20th Century, the new interdisciplinary field of Earth system science had fused Gaia theory and a range of other insights into a vision of our planet as 'one single, complex, dissipative, dynamic entity, far from thermodynamic equilibrium' (Schellnhuber 1999: c20).

As geoscientists realized, the same tight couplings and feedback loops that integrated the Earth's sub-components into a unified system also make it possible for those component parts to reconfigure themselves into a novel operating state – something the Earth appears to have done many times over the course of its estimated 4.54-billion-year history. Escalating concern over human-induced climate change has galvanized research into the possibility of a relatively rapid and effectively irreversible reorganization of the global climate system propelled the extraction and setting to work of the intense energy of subterranean hydrocarbons – or what Vernadsky had earlier referred to, citing physicist Julius Robert Meyer, as 'fossilized sun rays' (1998[1926]: 147). Subsequently, the Anthropocene hypothesis has extended this idea of pushing complex physical processes across thresholds into new states or regimes to a number of key components of the Earth system (Steffen et al 2018).

Understandably, such concerns focus attention on the risks associated with certain kinds of human activity – or the actions of certain kinds of humans. In this regard, climate science and the even wider-angle lens of Anthropocene science have helpfully explored the ways that humans intervene in Earth systems, with particular attention to how our activities can serve as a kind of hinge or articulation between the relatively solid rocky layers of the Earth's crust and the more mobile or fluid aspects of the Earth system – such air, water, life, ice and fire (Steffen et al, 2016). It is not only by releasing fossil hydrocarbons from their lithic reservoirs, these scientists argue, but also by large-scale extraction of mineral phosphates, metallic ores, and many other near-surface or subsurface materials that human agency can compromise the workings of Earth systems.

But as the earlier reference to plate tectonics suggests, Earth-shaping processes go deeper than exchanges between the planetary crust or lithosphere and the outermost Earth system. As some Earth scientists have made clear, we need to think in terms of a second Earth system that operates at a remove from the sunlit, life-suffused exterior of our planet (see Lenton 2016: 54). For beneath the Earth's crust is another 'monster of energy', a vast domain of dynamic processes fuelled by the decay of radioactive elements in its constitutive rocky matter and by residual heat from the accretion of the Earth. Untouchable, unliveable, and defying most of the ways humans sense their world, the inner Earth – as many geoscientists stress – is every bit as important as the solar-powered outer Earth system in the long-term evolution of planet on which we find ourselves (see Schubert et al 2001: 586).

In this chapter I address the thermal at the 'grand' scale of the two prodigious sources of heat energy that shape and define our planet. Just as Anthropocene science has furthered an understanding of the mutual exchanges between the lithic strata that comprise the planet's crust and the flows or circulations of the outermost Earth system, so too have geoscientists – especially over the last decade and a half – made major advances in integrating the dynamics of the inner and outer Earth. As geophysicist Sabin Zahirovic and his coauthors explain, growing computational power and novel data-sharing practices have helped researchers generate complex reconstructions that are able to merge evolving surface and inner-Earth processes as never before:

> These time evolving 4D Earth models have … provided insights on the evolution of the plate-mantle system over supercontinent cycles, as well as shed important insights into the role of the churning planetary interior in vertical motion of tectonic plates and the continents they carry (Zahirovic et al 2019: 73).

Taking this ongoing body of 'entire Earth system' research as an incitement, I am interested in the implications of thinking of the Earth's crust as a juncture between the planet's superheated, high-pressure interior and its relatively cool, sunlit, life-suffused exterior. What does it mean that life has made a place for itself in this slender but lively contact zone? And what might it mean for human beings, as part of this life, to conceive of ourselves as dwelling between these two great thermal domains?

But then again, why should social scientists be interested in thermal workings of the Earth that stretch in time and space far beyond the sphere of collective human influence? Is it not a matter of more urgency to address those thermal changes of our own making that are in the process of rendering significant areas of the Earth's surface less liveable or even uninhabitable? Just as disaster studies scholars have shown how exposure to natural hazards follows contours hewn by socioeconomic inequality and dispossession, so too do climate justice studies reveal the deeply uneven causes and consequences of global warming. Faced with escalating climatic and geophysical instability, there is clearly much for critical social science to do.

Alongside considering the differential causalities and impacts of changing Earth processes, social scientists have also been troubling the very idea of 'the planetary'. Planet-scaled truth claims from the natural sciences, especially those linked to the Anthropocene hypothesis, have been taken to task by critical thinkers for assuming to speak on behalf of all humankind (see Lövbrand et al 2015). In this way, even as they are committed to minimizing geoclimatic threats to human populations, geoscientists find themselves implicated in the perpetuation of epistemic injustice or even violence against those whose alternative experiences and knowledge of the Earth are eclipsed by globally dominant perspectives. As sociologist Daniela Russ puts it, in a commentary that reaches back as far as Vernadsky and his circle: 'From early cosmical physics to today's Earth System Science, the planetary perspective does not 'decentre' all human beings equally but authorises the scientists who command the knowledge on the biosphere' (2022: 507) '(P)lanetary thought', she concludes, 'has never stopped but often furthered exploitation' (2022: 507).

The 'planetary', however, has also been invoked in social and philosophical thought to different ends: not to assert claims over the Earth in its completeness, but as a way to interrupt any sense of totality or closure. When literary theorist Gayatri Charkravorty Spivak (2003) introduced the notion of 'planetarity' in the 1990s, her intention was to unsettle what she viewed as omniscient and totalising notions of the global. What appealed to Spivak about the figure of the planet was its inhuman otherness: the deep, rumbling alterity that both underpinned human difference and defied full recuperation or comprehension. As 'planetary creatures' she intones '…alterity remains underived from us … it contains us as much as it flings us away' (2003: 73). In a different philosophical register but with similar intent, philosopher Elizabeth Grosz (2012) speaks of 'geopower': the powerful forces of the Earth and cosmos that are the condition of possibility – at once enabling and perturbing – of all human collective life. And in this way, Grosz complicates the question of how social or political power relations determine what is thought and made of the Earth by encouraging us to consider the primacy of planetary energies, processes and powers 'that are sometimes transformed into modes of ordering the human' (2012: 975)

In working up a notion of thermal planetarity that hinges around recent geoscience insights into the interface between the interior and exterior Earth, I build on Spivak and Grosz's respective provocations and consider how regions of the Earth that remain utterly unliveable serve as a kind of limit case for social inquiry. While attentive to the strained relationship between globalizing geosciences and other ways of knowing the Earth, I suggest that a thermoplanetary approach can help us think about how human actors are situated in ways that go beyond familiar social and historical framings of positionality. Planet-scaled thermal processes may exceed direct human reach, but certain social practices and agencies, I argue, encapsulate something of the inner/outer Earth juncture.

Whereas the current climate crisis and the Anthropocene hypothesis highlight relatively recent and overwhelmingly destructive anthropogenic activities, my longer range, broader spectrum approach, inspired in part by Bataille, suggests that humans have a deeper, richer engagement with the 'inhuman' energies of the Earth. Specifically, I look at a range of deployments of fire and consider how working with high heat effectively enfolds the stupendous energies of the Earth's interior and scales them down to a human level. Far from being a recent accomplishment, I suggest, humans have been dwelling amidst and engaging with the Earth's thermal processes from our very origins. Setting out from the emergence of ancestral humans or 'hominins' in the volcanically active East African Rift Valley, the chapter tracks our trajectory as 'creatures of fire and magma' through the intensifications of high heat technics in the ancient world and subsequent developments, before coming back to modern, and more familiar, climate-threatening thermo-industrial practices.

From there we arrive at the perhaps impossible task of imagining forms of thermopolitics that measure up to the current planetary predicament. Is it possible to think with and through scientific accounts of the Earth's thermal evolution, I ask, while staying attuned to the diversity of ways in which human actors navigate the thermal patterns and dynamics that contour their worlds? Can we engage more experimentally or even playfully with thermal processes while also confronting the way that planetary thermal gradients – in the form of racial ideologies – have been used to deny full humanity to entire human populations? Finally, I come back to the question of what it might mean for humans, as active thermal agents, to position ourselves within the ongoing and eventful thermal evolution of our planet: to ask at once what our own heat-intensifying interventions are making of the Earth and what a planet undergoing thermal transition may yet make of its first and only fire-manipulating creature.

Thermal Evolution of the Earth

Topical social science subfields such as planetary urbanization, planetary health and planetary justice address the cumulative effect of specific social activities on climate or other Earth processes and consider how such changes re-impact upon human life. Such work, however, rarely dwells on questions of what a planet is or what kind of planet we inhabit (see Clark and Szerszynski 2021: 1-4). These are issues that not only occupy astronomers and planetary scientists but draw them quickly into thermal considerations.

Thermal processes are part of the (still contentious) definition of planets: planets being roughly spherical bodies of condensed matter that, among other things, exist at a thermal mid-range between the cold of space and the intense heat of stars. Basic geophysics proposes that gravitational force acting on the chemical elements of a congealing planet determines how it organizes itself into compartments or spheres (Dick 2019: xxxiv-v). But flows of energy from a parent star (if it remains part of a solar system) and from its own interior tend to prevent a planet from descending into equilibrium – leaving its constitutive layers crosscut by gradients of temperature and pressure. In this way, most planets remain open to thermally driven evolution in which planetary subcomponents, over time, and from time to time alter their behaviour, reorganize into new configurations, and acquire new properties or capacities (Papuc and Davies, 2008).

From where we now stand, the best known emergent planetary property is life on Earth, or more specifically what Vernadsky – developing a concept introduced by geologist Eduard Suess – described as the biosphere: 'an indivisible and indissoluble whole, in which all parts are interconnected' (1998[1926]: 148). While recent astronomical scholarship draws attention to the possibility of life in subsurface oceans and other non-surface environments elsewhere in the cosmos (Summers and Trefil 2017: 101-3), thus far the only confirmed and studied biosphere is a surface or near-surface one, powered, as we've seen, by the heat and light of our sun. The relatively early evolution of photosynthesis on Earth – the utilization of sunlight by living organisms to drive chemical reactions – is generally viewed as the key to extending patchy, localized life to a more continuous, spherical, planet-transforming phenomenon (Judson 2017).

Vernadsky's solar-powered biosphere is credited with being the first modern scientific conceptualization of life as a geological or planetary force. By way of their incessant growth, reproduction and mobility, he argued, living organisms animate inert matter – redistributing oxygen, hydrogen, carbon, phosphorus, nitrogen and other elements horizontally across the Earth's crust. In this way, 'living matter' has interacted in sustaining and transformative ways with the Earth's atmosphere, hydrosphere, and lithosphere (Vernadsky 1998[1926]: 47-54; see also Margulis and Sagan 1995: 44-7).

While there are significant differences, there are also continuities between Vernadsky's biospheric thinking and the Gaia hypothesis, developed half a century later by chemist James Lovelock and biologist Lynn Margulis, which emphasizes the role of life in maintaining the fairly narrow range of physical and chemical planetary states conducive to its own flourishing.

Drawing on cybernetic theory, Lovelock's Gaian self-regulation is largely a matter of negative feedbacks: the dampening responses to changing stimuli that occur in tightly coupled systems. For example, he described how the thermochemical reaction of fire – because it converts oxygen and fuel into carbon dioxide – can play a vital role in regulating Earth's atmospheric composition (1987: 70-72). But Lovelock also acknowledged that positive or self-reinforcing feedback has had an active Gaian presence. As he noted: '(p)eriods of positive feedback, unstable, even chaotic, behavior are characteristic of working control systems and of living organisms' (1989: 220). Earth, Lovelock proposed, is an aging planet, struggling to self-regulate in the face of a gradually warming star, and this increases the likelihood of positive or runaway feedback. For this reason, he added, humankind may have chosen a particularly bad time to add large quantities of previously sequestered carbon compounds to the Earth's atmosphere (19889: 157).

Inherited from Gaia theory as well as from ecology and other fields, the idea of negative feedbacks flipping under sustained pressure into positive feedbacks became a staple of Earth system science: this being the main mechanism behind the periodic shifts in the operating state of the Earth that I referred to in the introduction. But as we have also touched upon, Earth systems science tends to be focused on the outer Earth system. Although this includes the upper reaches of the Earth's rocky crust, it important to keep in mind that the lithosphere (the crust plus the brittle uppermost mantle) comprises just 1% of our planet's mass. Rock that is cool enough to support life, in other words, is the exception when the Earth is viewed in its entirety (Clark 2018).

As we turn to the study of the inner Earth, the prescience of Vernadsky and his circle is again notable. Vernadsky thought in terms of a series of 'geospheres', each a 'concentric shell of the Earth' with distinct material properties and energetic states (1998[1926]: 91). Credited with being the first researcher to consider the role of heat released from radioactivity in the deep Earth as an agent of geological change, Vernadsky was also familiar with geophysicist Andrija Mohorovičić's use of seismographs to track the variable speed of seismic shock waves – which informed early hypotheses the Earth was composed of several layers around a core and included a significant discontinuity between the outer crust and mantle (1998[1926]: 96).

Applying the laws of thermodynamics, Vernadsky deduced that temperature and pressure acted upon the chemical composition of the various deep geospheres, leading to differentiation between layers and driving each layer or sphere towards equilibrium (1998[1926]: 97). Today, these basic principles remain sound, though subsequent discoveries have disclosed the processes that forestall equilibrium and allow for the ongoing thermal evolution of the inner Earth, as we saw above. In the bigger picture, despite our sun growing hotter as it ages, the main thermal trajectory of the Earth – as a four-dimensional body – is a gradual cooling or 'relaxation' (Murakami et al 2022; Ernst 2017). Convection, the extremely slow motion of the hot, viscous rock of the mantle layer, is now widely considered 'the primary mechanism by which the Earth transfers heat from its deep interior to its surface' (Schubert et al 2001: 586). First proposed by geologist Arthur Holmes in 1919 and bolstered by harder evidence in the post war period, mantle convection has been key to explaining the motion of the Earth's crust (Coltice et al 2017).

Current theories contend that early in the Earth's history slowly flowing rock self-organized into convection cycles driven from the bottom up – as hot, buoyant mantle material ascended, and from the top down – as dense tectonic plate slabs sank or 'subducted' beneath the crust (Ernst 2017: 337, 335). The main 'bottom up' driver of these vast, slow-moving gyres of viscous rock is thought to be the steep thermal gradient between the molten iron layer of the Earth's core and the solid-state mantle minerals – with recent approaches seeking to capture the force and complexity of this interaction through models of coupled core-mantle thermal evolution (Schubert et al 2001: 602-7, Murakami et al 2022). Unlike other rocky planets and moons in the solar system, Earth is large enough to have maintained enough deep-seated heat to drive mantle convection (Ernst 2017: 335). This in turn enables another coupled system at the 'top down' end: 'the unified lithic-convective mantle system' comprised of the evolving relationship between the mosaic of plates of which the planet's crust is composed and the overturning mantle beneath (Coltice et al 2017).

As new research explores the dynamic thermal relations between the Earth's interior and exterior, it is becoming apparent that not all changes occur at the same interminably slow rate. Increasingly complex models help explain the immensely drawn-out cycles of supercontinents formation and break-up but also point toward faster changes – 'sudden and perhaps catastrophic movements of material and heat' (Schubert et al 2001: 626). Possible chaotic behaviour of the deep Earth includes avalanches in the lower mantle; rapid collapses which might also be a trigger for the upwellings of superheated rock known as mantle plumes (Muller 2002). Such events are of more than hypothetical interest. While plate tectonics propelled by the coupled lithic-convective mantle system is credited with being the predominant force shaping the topography of the outer Earth, mantle flow exerts its own influence on the crust above it – resulting in deformations such as uplift, stretching, rifting and subsidence as well as occasional extrusions of molten mantle material (Davies et al 2019; Coltice et al 2017).

With growing confidence, researchers are now drawing out the connections between dynamic inner Earth processes and specific events in outer Earth history. A combination of techniques including seismic tomography (a form of remote sensing of subsurface 'inconsistencies' that develops Mohorovičić's tracking of earth tremors), geological reconstruction of past and present configurations of tectonic plates, and powerful computational modelling is being used to generate long term time-evolving simulations of the 4D Earth. Open access digital data covering the last billion years of 'the entire Earth system' now has enough resolution to link inner Earth dynamics not only to the evolution of continents or supercontinents but to the most tectonically complex areas such as the Caribbean and Southeast Asia (Muller et al 2019). By modelling feedbacks between tectonic plate motion and the evolving deep interior of the Earth, these data sets further cast light on outer Earth processes such as rising and falling sea levels, long term climate and ocean circulation change, and the evolutionary pathways and dispersals of biological life (Zahirovic et al 2019; Müller et al 2018). There is growing evidence that, just as upwelling melted mantle material contributes directly to the shaping of surface topography, so too do 'conveyor belts' pull both organic and inorganic matter deep into the subcrustal Earth (Müller et al 2022). In the words of geologists Terry Plank and Craig Manning (2019: 343): 'Subduction links surface biological processes with the deep Earth, creating a planet suffused with the signature of life'.

While we should be careful not to overextend the domain shaped by life, there seems little doubt that contemporary geoscience is in the process of conceptually meshing the planet's two immense energy domains into a single narrative. This has implications not only for telling the story of our planet, but for making sense of ourselves as surficial beings with a strange aptitude for probing beneath the sunlit, habitable outermost Earth. In the words of paleontologist Richard Fortey, 'We may all ultimately be the children of convection' (2005: 429). Or as science fiction-fantasy writer NK Jemisin puts it: 'We are all creatures born of heat and pressure and grinding, ceaseless movement' (2016: 361)

Creatures of Fire and Magma

While western social and philosophical thought engages with heat in numerous ways, explicit concern with the planetary dimensions of the thermal is rare, reflecting a more general unwillingness to think with or through planets as a category of being. The relative paucity of planet-focused or geologic thinking may in turn reflect a long-standing privileging of life, vitality and the organic – a priority that is hardly surprising given our own organismic being and the centrality of the governance of life in modern political thought and practice (see Clark and Yusoff 2017). So too has the growing insistence on the sociocultural or historical situatedness of all truth claims – and the corresponding acknowledgement of their partiality – been less than hospitable to planet-scaled inquiry. While it doesn't appear to have been the intention of science studies scholar Donna Haraway to impose scalar limits on critical inquiry, many of those who picked up on her denunciation of 'the god trick of seeing everything from nowhere' felt that it had a particular cogency for disciplines or knowledge formations that took the Earth in its entirety as their object (see Haraway 1988: 581).

But in recent years the provocations of climate change and the Anthropocene have prompted some social thinkers to expand their horizons. Across a range of disciplines, researchers have grown more willing, in the words of literary theorist Claire Colebrook, 'to situate human existence and thinking within broader and inhuman forces of the earth' (2022 unpag). While some of the more theoretically inclined inquiry draws upon

Bataille's energetic geophysics and his notion of the implication of social life in physical forces beyond our control, a more frequent reference point has been the collaborative work of Gilles Deleuze and Felix Guattari from the 1980s and early 1990s. Here, Deleuze and Guattari delve into the practical ways that variously skilled human agents have tapped into the self-organizing potentiality of the physical world (1987: 361-415). More than this, they sketch out a 'geophilosophy' in which thought (serving as a kind of synecdoche of human capabilities) is itself a manifestation of the Earth's immanent capacity for self-expression and generativity (1994: 85-113; Colebrook 2022).

Drawing on Deleuze and Guattari, philosopher Elizabeth Grosz (2008) has explored how creative activity can be viewed as a way of intervening in otherwise dauntingly powerful planetary processes. By carving out a small tract from the dynamic, unpredictable forces of the Earth and cosmos, Grosz proposes, artists and other agential humans are able to play variations on the metamorphic powers of the nature. Within the human-scaled enclosure established by a frame, wall or container, she ventures, they 'temporarily and provisionally slow down chaos enough to extract from it something not so much useful as intensifying, a performance, a refrain, an organization of color or movement …' (2008: 3).

In this section I take inspiration both from Grosz's depiction of a generative human enfolding of our planet's inhuman forcefulness and Bataille's desire for exuberant social communing with energetic excess to suggest how the human proclivity for working with high heat can be seen as an engagement with the 'monstrous' energy of the inner Earth. As environmental historian Stephen Pyne has noted, 'the capture of fire by *Homo*' is more than an event in human history: it also 'marks a divide in the natural history of the Earth' (1994: 889). If the emergence of a fire-handling creature establishes a temporal division in geohistory, so too might we see the use of high heat as a means by which humans traverse structural differentiations or boundaries established by the Earth itself. Specifically, I speculate that certain human uses of intense heat serve as ways to approach, reproduce, and manipulate the otherwise unliveable forces of the Earth's interior, and in this way effectively operate as hinges or mediations between the thermal domains of the inner and outer Earth. In the process, I want to stress, such interventions import forces into the human domain that defy full control or assimilation.

Paleontological evidence suggests that fire handling was a hominin acquisition that preceded the emergence of *Homo sapiens* by hundreds of thousands of years. Ancestral human fire use figures prominently in accounts of pivotal dietary transformations, occupation of a wide range of niches and climatic zones, and increasing ability to transform both discrete materials and entire ecosystems (Pyne, 1995; Wrangham 2009). We should also keep in mind that human origin stories, at least in western knowledge formations, locate key evolutionary developments in the geologically active terrain of East Africa. While the drift of continents and smaller landmasses represented in recent 4D 'entire Earth system' models occur on time scales too great to be meaningful to narratives of human evolution, mapping of interior Earth dynamics still has much to offer when it comes to making sense of the forces that sculpted formative hominin and pre-hominin landscapes.

The East African Rift is described by geoscientists as the largest and most enduring example of the fracturing that occurs when rising plumes of extra-hot magma push the Earth's crust upwards (King and Bailey, 2006). As cracks opened in the continental crust of eastern Africa, the land subsided, creating steep-sided walls and a deep valley floor that collected water and accumulated sediment. The resulting complex topography supported exceptionally diverse mosaic ecosystems – a rich source of nutrients and an attraction to game animals. Rocky outcrops, evolutionary theorists have proposed, would have provided platforms for early hunters to observe prey, while solidified lava pumped out of numerous active volcanoes in the Rift Valley may have provided natural stockades and safe nesting sites for hominins: ground-dwelling primates who were relatively defenseless but agile enough clamber over rugged terrain (King and Bailey, 2006). A longer standing theory addresses the possible contribution of microclimates of the Great Rift in helping early hominins deal with the extreme climatic fluctuations of the Plio-Pleistocene (Coppens 1999).

It is likely that the Rift Valley was the setting where the genus *Homo* first captured fire and set it to work to cook food and to encourage the new plant growth that attracted browsing animals. Moreover, there has long been speculation as to whether lava flows – a source of wildfire ignition – may have been implicated in ancestral human familiarization with the force of fire (Bailey et al 2000). What has been inferred from fossil records with more confidence is that hominin toolmakers came to an early appreciation of the affordances of volcanic rock. There is also intriguing evidence that hominin groups who migrated away from the Rift Valley learnt to use their own hearth fires as a way to transform the properties of rock. Excavations at coastal sites in South Africa indicate that by around 70,000 years ago, high heat was being slowly applied to selected stones – most likely to improve their flaking and sharpening qualities (Brown et at 2009). As we might choose to read this, ancestral humans had discovered how to use controlled thermal force to make rock formed by the sedimentary processes of the outer Earth behave more like the volcanic or igneous rock that welled up from the planet's interior. In short, this is the first evidence we have of humans using high heat to coax inorganic matter across a threshold into a new state (see Simondon 1992: 300-301; Deleuze and Guattari 1987: 410-411).

A similar logic can be discerned in the ancient Fertile Crescent. In the 1990s archaeologists excavating the 4000-year-old Mashkan-shapir site unearthed grindstones seemingly fashioned from dense, fine-grained volcanically extruded rock that had been used for grinding grain elsewhere in the Middle East since the early days of agriculture. Later tests indicated this was in fact alluvial silt transformed into an approximation of igneous rock by kiln temperatures of around 1200 °C. As researchers explain, this use of high heat to transform inorganic matter was part of a much broader set of practices: 'Material compositionally identical to synthetic basalt was a by-product of the ceramic and metallurgical industries before the second millennium B.C.' (Stone et al 1998: 2093).

Indeed, much of the fabric of urban-agrarian existence, by this time, was a product of high heat technology. While domestic ovens rendered grains digestible, from out of the artisanal kiln came the building materials of brick, plaster and mortar, the ceramics used for preparing, serving and storing foodstuffs, the metals forged into tools, weapons, and tokens of value (Wertime 1973). It is revealing that by 4000 years ago, metalworkers were stoking their 'fiery furnaces' to temperatures of 1200-1300 ° C – which geologists have subsequently identified as the higher end of the heat of lava (Rehder 2000: 54). In this regard, we might see the work of metallurgists, as they push ores through sold-liquid-solid phase transitions, as a kind of reproduction of the pathway of the viscous rock of the mantle as it rises, melts and decrystallizes and then subsequently re-solidifies as it stalls in subsurface chambers or gets extruded onto the planetary surface. Just as differential temperature and rates of crystallization in a magma chamber or other intrusion separates ore from non-ore minerals, so does the metallurgist concentrate and purify metallic ores by coaxing them across thermal thresholds in a chambered space (Clark 2022).

Effectively, then, the intense heat-chambered operations of metallurgist provide a microcosm of the inner-outer Earth articulation: a workable, human-scaled enfolding of otherwise unapproachable forces. While high-heat artisans had no way of comprehending the thermochemical reactions involved, the fact that so many deities across the ancient world presided at once over volcanoes, subterranean fire, metallurgy and other pyrotechnologies, suggests a certain intuition or tacit understanding that the threshold between inner and outer Earth was open to negotiation (Clark et al 2018). As historian of science Cyril Stanley Smith notes, by the 18th Century some European metallurgists were explicit that that 'the furnaces of the ironmaster … imitate the products of volcanoes', while insights from the arts of metalworking, ceramics and glassmaking played a galvanising role in the nascent scientific study of volcanic processes (1982: 177).

While some groups or cultures have explored tightly-focused high-heat transmutations of inorganic matter, others have specialised in the application of fire to open spaces – learning to shape entire ecosystems, landscapes or even continents through skilled and timely burning. But no matter how skilled human fire-users are or where they are situated, Pyne insists, they share risk of fire escaping control or having unintended consequences (2001: 15, 83). Just as our distant forebears could not have foreseen the ultimate effects of capturing fire, so too were the full reverberations of stoking kilns to volcanic temperatures beyond the compass of ancient artisans. The same can be said of the concoction of gunpower or what its 9th century Chinese inventors referred to as *huo yao* or fire drug. The ignition of the charcoal-sulfur-nitrate compound generates a runaway heat-releasing or exothermic process that converts fuel into hot gas into a few thousandths of a second: a combustive reaction so rapid that it has no natural equivalent. So when considering both the subsequent development of explosive weapons and the use of explosives to accelerate mineral extraction, we should keep in mind that near-instantaneous combustion is the first entirely new kind of fire the Earth has seen since the first terrestrial plants caught alight roughly 400 million years ago (Clark 2019; 2023a).

Finally, as we know only too well, the setting to work of fossil hydrocarbons to power various kinds of heat engine continues to have unintended, and potentially runaway, consequences for the outer Earth system. Moreover, the setting to work of 'fossilized sun rays' has dramatically increased the transformative power of furnaces as well as the ability to extract, refine and transport still more of the subterranean resources of the Earth's crust

If thermal evolution is a key to what our planet has become, I have been suggesting, so too has intervention in thermal processes been integral to human evolution and development. Fire-handling has not only been crucial to the way humans have engaged with the planet's solar-infused surface, it has allowed a diurnal, surface-dwelling creature to venture into the Earth's lightless but resource-rich subsurface (Clark 2021). More than this, the use of high heat – if in opaque and surrogate ways – has enabled human agents to manipulate the kind of thermal forces that are definitive of the Earth's interior. Or to put it in Vernadsky's terms, just as biological life in general has greatly accelerated the movement and transformation of minerals, humans have developed a special proclivity for intensifying the mobility and metamorphic power of matter as it circulates between the Earth's interior and exterior.

Rather than simply being a late achievement of our species, then, the inhabitation, traversal and probing of the inner/outer Earth juncture begins to look more like a deep-seated and recurrent tendency – an originary complication of being human. In this regard, if we heed the counsel of critical social thinkers to consider our positioning when speaking or acting, we need to do more than just reckon with our social or historical location. For we are also, in various ways, creatures with a peculiar capacity for interpolating ourselves between our planet's two great thermal systems: beings who apprehend the world from and through the contact zone between interior and exterior Earth. In the following section, I begin to consider the political implications of occupying this conjunctional zone – in all its excess and unfathomability – while keeping in mind how thermal gradients have been used to inflict their own unthinkable strictures on the matter of being human.

The Impossible Politics of Thermoplanetarity

When Bataille spoke of 'the passage of warmth and light from one being to another' this was an ideal not an injunction or decree. Warm and generous social encounters are a hopeful possibility, but the global trend Bataille discerns is toward more of the capitalist and militarist expansion that has already 'turned the whole world into a colossal powder keg' (1993 [1976]: 428). Russ's earlier point is cogent here: planetary thought has no necessarily progressive political valence. It can offer pointers about what the Earth is and what it might yet become, but what we do about this is a wide-open question.

For many contemporary western critical social thinkers, the priority is not to set out from a firm base of ontological and epistemological claims, but to take incitement from specific calls for justice, recognition or other forms of redress. While such approaches have a long lineage, intensifying concern about the connection between epistemic injustice or violence and other kinds of domination is adding to their currency. In the context of planetary environmental issues, anthropologist Elizabeth Povinelli is explicit: 'all ontological claims are and must be dependent on one's historical and social analysis of power'. As she elaborates, with a stress on the compounding impacts of capitalism and colonialism on Black and Indigenous lives: 'beginning with an ontological claim and then moving to the social, political, and historical implications of that claim recapitulates a form of colonial reason even as it seeks to confront and unravel it (2021: 23).

There is, as Povinelli is only too well aware, a troubling history of Earth science implication in colonial and capitalist projects: a history of understanding Earth processes in order to identify mineral and other resources, then taking this mapping as grounds for appropriation. It is worth recalling that in the era of European imperialism, or what is increasingly referred to as racial capitalism, the matter of whose lands, resources and bodies were open to appropriation also rested upon a planet-scaled thermal gradient. While whiteness and temperate origins were equated in western discourses with being fully human, black and brown skin and inhabitation of tropical latitudes were taken as grounds for denial of this status – the resultant 'moral climatologies' offering sweeping justification for the combined force of physical, sociopolitical and epistemic violence (Livingstone 2002; Gunaratnam and Clark 2012). It is the intersection of this dehumanizing logic with the experience of a seismically and energetically volatile planet Earth that animates Jemisin's *Broken Earth* trilogy: a fictional bringing together of exposure to inner Earth forces with the violence of enslavement. As geographer Kathryn

Yusoff elaborates on this theme, there is a long, brutal history of 'traffic between the inhuman as matter and the inhuman as race' (2018: 5).

But as Yusoff makes clear, this traffic is two-way. The social, political and epistemic power that identifies some bodies as less human – more mired or enmeshed in nature – than other bodies, should itself be seen as a particular kind of channelling and imposition of forces that ultimately derive from the Earth itself. Or as Grosz puts it:

> What we understand as the history of politics—the regulations, actions and movements of individuals and collectives relative to other individuals and collectives—is possible only because geopower has already elaborated an encounter between forms of life and forms of the earth (2012: 975).

This resonates with Povinelli's own concept of geontopower (2016: 1-20), which likewise asks us to attend to the way that power in modern capitalist and colonial orders is energised, enabled and sometimes unsettled by geologic or planetary forces – and in this sense calls for something more or other than we get from analyses of a 'biopower' that is viewed as operating through and over human lives. With this in mind, I want to provisionally note some ways that viewing humans as exceptionally active hinges between inner and outer Earth thermal domains – as agents of what we might call 'thermopower' – can supplement existing social, historical and biopolitical analyses of power. The challenge here is to focus not on specific technologies but on the more elusive matter of how certain kinds of social practices, assemblages and organizational forms negotiate our planet's structural divisions and gradients – and in the process 'capture', temporarily and incompletely, a fraction of the Earth's thermal power.

Setting out from human evolution in volcanic landscapes and early hominin fire use, we are clearly deep in the realm of speculation. Here, we might consider how using high heat to alter properties of lithic materials used in hunting may have shifted power relations between humans and other animals: a question raising issues of entangled animality, religion and violence that intrigued Bataille (2009) among others. When we come to early agrarian-urban social formations and the emergence of the more recognizable 'state form' (Scott 2017: 13), the stress has most often been on administration of grain surpluses and the labour that generated them – though Deleuze and Guattari have also foregrounded the relationship between the more settled agrarian peoples and nomadic miner-metallurgist bands (1987: 404-431). Other thinkers have focused on the materials that issued from the furnace, particularly metals and their importance for military and security purposes, as mediums of increasingly extensive trade, and as 'aesthetic visual displays of identity' that helped position people in ever more complex, gender-divided and hierarchical social worlds (Roberts et al 2009: 1019; Wertime 1973; Clark 2021). In the case of the weapons designed to contain and direct the exothermic force of gunpowder, we are fully drawn into the threat and infliction of physical violence that underpins the globally contoured inequality of the modern world. Coupled with fossil-fueled heat engines that facilitate its mass production and long-range deployment, explosive weaponry in its many forms has become axial both to the exertion of power and most forms of resistance to it (Dalby, 2017; Clark 2019; 2021).

What I am suggesting here is that if we follow sociologist Elena Beregow (2019) in acknowledging an inherently 'thermopolitical' dimension to human power relations, then we should also look for the traces of an encompassing planetary dimension to thermopower. But the 'anatomy' of such thermoplanetary power will likely resist a full diagramming, not simply because we have as yet inadequately traced its composition and effects, but because it is entails encounters with regions of existence that defy assimilation or full comprehension – or what Foucault referred to as 'the pure naked experience of the outside' (1989: 27). Hearth fires, furnaces, firearms, and heat engines are more than mediums for setting heat to work, I have sought to show, they are articulation between two sets of unliveable, incalculable forces. Each enfolds, localises, and down-sizes these inhuman powers, only to produce effects or repercussions that once more exceed their social containment and bleed out into the wider world (Clark 2022).

This excess is not an excuse for avoiding the question of how 'thermal violence' or injustice channels planetary forces (see Starosielski 2019). It is cogent but insufficient to note that, as heat-seeking, fire-wielding beings, all humans share an exposure to the risks or fallout of thermal misadventure. As we have seen, both critical disaster studies and discourses of climate justice make it very clear that vulnerability to thermoplanetary threats, whatever their trigger, is grossly uneven in distribution as is access to the affordances of heat or coolness. Whether we are talking about enjoying thermal benefits or exposure to thermal hazards, then, what we need are accounts of the way structured inequality is itself, to some degree, conditioned by the way social groups are differentially positioned in relation to thermoplanetary structures, gradients, and dynamics.

In this regard, when it comes to working with high heat, historical and cross-cultural research attests to the way metallurgists and other pyrotechnologists have frequently been socially marginalised, on the very grounds of their disquieting ability to transmute the properties of matter (Forbes 1950: 62; Eliade 1978: 79). Those who sought out ores in the subsurface have been similarly characterised, with the additional stigma that such work – on account of its particularly onerous and hazardous nature – was frequently assigned to bonded labour. As extraction intensified under the demands of modernisation, miners and their communities often came to be viewed as a kind of degenerate subspecies: 'a separate race of humans' (Freese 2016: 45). But as we saw above, an even more extensive and brutalising 'verticalisation' was instituted by European colonial power over the entire surface of the Earth, through its mapping of degrees of humanness onto planetary thermal gradients (see Mbembe 2017: 16). As Yusoff's 'traffic between the inhuman as matter and the inhuman as race' suggests, racialization on a planetary scale sets chromatism or 'epidermalization' to work in specific and recurrent ways. Racialized bodies have been and continue to be coerced into the life-sapping work of extracting the bounty of a thermally differentiated planet, while being exposed to the full force of thermoplanetary extremity. Whether the tasks in question involve mining, plantation work, forest-clearing or other land-breaking, or the building and maintenance of infrastructure, what we confront is global division of labour where disempowered and dispossessed people are positioned in such a way as to absorb the pressures and shocks of a thermodynamically variable Earth on behalf of the powerful and privileged (Clark and Szerszynski 2021: 114-121). Or at least this is how brutally uneven exposure to planetary volatility appears when read through the lens of Jemisin's *Broken Earth* trilogy (2016).

Epistemic injustice or violence, in the centuries of western domination, has also been inflicted in and through thermoplanetary processes. Pyne draws attention to the anomalously fire-free condition of north-western Europe, and its people's fundamental misunderstanding of the seasonal rhythms of fire in other parts of the world.

Not only did European colonisers ruinously seek to prohibit burning in fire-prone landscapes, they failed to recognize that much of the land they were wresting from Indigenous peoples had been judiciously shaped by fire over many generations (Pyne 2001: 81-82; 152-4). Today, as climate change is intensifying wildfire risks in many places, Europe's globalized attempts at fire suppression are finally giving way to appreciation of traditional burning as a means of managing the thermal cycles and pulses of the outer Earth.

However, even research sympathetic to wider traditions of fire-use still tends to see fire as primarily ecological: an intervention into living worlds rather than an engagement with geologic or planetary processes. As yet there is far too little reappraisal of the richness and diversity of high heat artisanship across the globe – and place-based pyrotechnical practices continue to be decimated by thermo-industrial mass production. And only very recently have western researchers begun to acknowledge the contributions that a world of other ways of understanding Earth processes have made to the canons of geoscience (see Bobbette 2023).

Conclusion: 'What in fire-under-Earth are you?'

The mechanisms that do the work of negotiating between the inner and outer Earth in western geoscience – conveyor belts, mantle upwellings, volcanism, subduction and such – may not offer much help when it comes to the matter of how humans might learn to live with such vast, unassimilable forces. But we shouldn't underestimate the significance to western thought of the growing integration the Earth's two great thermal domains. The hinging together of the solar-powered outer Earth and the radiogenically-heated inner Earth, I am arguing, is rich in provocations that stir up and overflow conventional social science critiques of the natural sciences. Rather than dismiss perspectives on the Earth from within as a view from nowhere, we might otherwise see them as unsettling the assumption that all thought resides in places, nodes or networks on the sunlit surface of our planet – a reminder that there is no localised experience that does not open out into the nonlocalizable and the unliveable.

Just as the encounter with the unfinished thermal evolution of the Earth offers incitements that are not easy for the social sciences to assimilate, so too does it jar and strain the self-understanding of the geosciences, although we might see this restive condition as being ongoing at least since the 'tectonic' upheavals of the 1960s. Even if it has yet to fully transform the onto-epistemological foundations of Earth science, the sense of our planet's inherent capacity to self-differentiate or become otherwise is an uncomfortable fit with the natural sciences classical quest for clear and enduring truths. Compounding earlier evidence of a ground which ungrounds itself, geoscience finds itself confronting – in the words of literary theorist Timothy Morton – 'an abyss whose reality becomes increasingly uncanny, not less, the more scientific instruments are able to probe it' (2012: 233). This is especially pertinent when it comes to exploring the composition of the inner Earth using seismic tomography: the method pioneered by Mohorovičić that entails tracking the shockwaves from natural earthquakes. For here geophysicists find themselves reliant upon a source of knowledge that can literally tear the ground out from beneath terrestrial communities, including their own data-gathering stations (Clark 2018).

The idea of confronting an otherness or eventfulness so unassimilable that it rattles the very platforms from which we apprehend and seek to understand the world is a staple of post-structural philosophy and social theory. We find this in Foucault's 'naked experience of the outside', in Derrida's logic of the 'irreducible exteriority of the other' (1978: 93), and writ large in Spivak's notion of an irrecuperable planetary alterity. Though it may be fair to say that the geosciences still hold onto the idea of a subject of knowledge who stands above or beyond such subversions, it is worth remembering that the philosophical idea of radical exteriority – of our own susceptibility as living, thinking beings to forces we can never fully recuperate or comprehend – owes a great deal to the work of Bataille (Kendall 2013: 31). But so too should we recall that a pivotal influence on Bataille's notion of an energetic economy 'equal to the universe' was Vernadsky's theorization of an Earth-transforming solar-powered biosphere.

Just as I have been making a case that agential relations with deep thermo-planetary dynamics are as much a part of the primordial condition of being human as they are a recent acquisition, by this reading we might also view some of the most influential social and philosophical inquiry of recent times as always already informed – if in indirect and rarely acknowledged ways – by early scientific theories of the thermal forcing of an evolving Earth (see Sagan 2013: 40; Clark 2011: 21-22). But whether we engage with these 'monstrous' energies in a scientific or more philosophical register, I have been arguing, they present challenges to the way critical social thought tends to approach political action and commitment. Most of the trials and experiments through which human agents have learned to channel the geo- or thermopower of our planet are unlikely to have been directly politically motivated, although they may eventually have had profound consequences for power relations or 'modes of ordering the human'. Even if they are not ostensibly political, however, more explorative or aesthetic interventions in the stuff of a turbulent Earth and cosmos help open up novel futures: they expand our sense of what is possible, desirable, worth doing or trying. As Grosz vouches, interventions in Earth processes that exceed the needs of survival – whether performed by humans or other living things – 'produce intensities and sensations that themselves summon up a new kind of life' (2008: 79).

To what extent these new kinds of life are worth living may well become a matter of debate and contestation: struggles in which thermopower, as we've seen, can be at once an object and a medium, fought over and fought with. But the condition of exposure to uncontrollable physical forces that humans share with other living beings, and the fact that all thermoplanetary interventions – both playful and purposive – come with palpable risks, brings another dimension to the social negotiation of the inner/outer Earth interface. It is instructive that so many cultures seem to have approached heat-induced metamorphosis with extreme care and a sense of awe, often encapsulated in lore and ritual. As historian Mircea Eliade observes of the use of fire in the ancient or traditional societies to transform matter: 'It was … the manifestation of a magico-religious power which could modify the world and which, consequently, did not belong to this world' (1978: 79). In this regard, what I have been referring to as a juncture or articulation between planetary thermal systems seems to have been treated in many cultures or epistemic communities as a threshold: an intensely meaningful portal between the known and the unknown that called for careful preparation, deft mediation and wise guidance (Clark and Szerszynski 2023).

Whatever its strengths in identifying gradients, boundaries, couplings and other properties of the 'entire Earth system', modern western geoscientists have little to offer in the way of figures to guide us across perilous points of transition or belief systems and rituals that would help themselves and others deal with the anxiety, grief and trauma that often attends the loss of familiar worlds (Clark and Szerszynski 2021: 160-168). And in much the same way that the overwriting and undermining of culturally diverse thermal knowledge and skill narrows the options of responding practically to accelerating Earth system change, it also diminishes a great wealth of ways of imagining, explaining and dwelling amidst those things that can't be changed – the inhuman forces and processes Grosz refers to as 'cosmological imponderables' (2008: 23).

While they may have largely forgotten the residue of Vernadsky's cosmical physics in their take on the reality, 20th century philosophies of radical exteriority have devoted a lot of attention to world-shattering events – rifts, disasters, cataclysms, catastrophes – and the deep wounding and irrecuperable loss they inflict (Clark 2023b). If such invocations of extremity might be taken as a largely western, more-or-less secular pathway into the realms of the unthinkable and the unassimilable, so too can they encourage a receptiveness to other cultural-historical experiences of catastrophic loss. Critical thinkers are increasingly drawing on the thematization of irreducible alterity both to grapple with the thermal crisis of climate change and as a way to converse with accounts of the ending of worlds given by peoples subjected to slavery, conquest and colonialism (and the intersection of these two monstrous sets of afflictions).

There is further potential, I want to suggest, for philosophies of exteriority or extremity to open up conversations with geoscientists in the context of heightening climatic perturbation, around the themes of contact with 'the churning planetary interior', inner/outer Earth coupling, and our planet's unfinished thermal evolution. This way of thinking can help us not only to see how collective life responds to the rifts – both literal and metaphoric – that periodically tears apart the fabric of our worlds, but to view such rending as the very incitement for becoming human: in the words of Derrida, 'the wound or inspiration which opens speech and then makes possible every logos or every rationalism' (1978: 98). But as we have seen, there is a distinct though sometimes convergent philosophical tradition which sets out less from loss or rupture than from the generative powers that humans share with the Earth and cosmos. In this approach, exemplified by Deleuze and Guattari's geophilosophy, such definitive human attributes as thought or imagination are re-envisioned as particularly intensive offshoots of the Earth's own powers of expression and self-transformation. Along these lines, as Colebrook explains, geophilosophy seeks to explain 'the genesis of art and philosophy from the earth', while eventually arriving at the question of how '(t)he Earth—by means of philosophy and art—creates forces that go beyond the earth' (2022: unpag).

For our purposes, a geophilosophical focus prompts us the think about how an astronomical body with exceptionally dynamic plate tectonics and surface/interior relations has given rise to a being with peculiar capacities for coaxing matter across thermal thresholds. In other words, how has a planet with an inherent propensity both to generate thermal boundaries and move across them incited or induced one of its constitutive life forms into heat-driven threshold-traversing behaviour? To return to the issue of human evolution, conventional studies point to the importance of fire-cooked food in fuelling the energy-demanding hominin brain (Wrangham 2009) – which already complicates earlier assumptions that fire-mastery was an achievement of a big-brained primate. But theories attending to the role of the East African Rift's active volcanism and distinctive microclimates in early human evolution might also encourage us see the organismic uptake of fire-handling as an expression of planetary potentiality at a site of exceptionally vigorous interchange between the Earth's inner and outer thermal domains – and in this sense to view the planet's first fire creature as itself as a kind of 'monster of energy'.

More than a matter of reimagining the deep past, putting human evolution and planetary thermal evolution together in the ways I have suggesting is about opening out the practical and conceptual resources that we bring to bear on climate change and related problems. It spurs us to revisit ways of engaging with thermal processes that may have been extinguished or eclipsed, to seek out Earth-oriented practices with the potential for rekindling, repurposing or further elaboration, to be on the lookout for novel experiments and improvisations that might emerge from unprecedented thermophysical experience. And in this regard its worth recalling the words of Cyril Stanley Smith, whose work as a historian of science built on his own experience as a metallurgist. 'All big things grow from little things, he mused, 'but new little things are destroyed by their environment unless they are cherished for reasons more like love than purpose' (1982: 331)

So too must we be on the alert for new manifestations of thermal violence – whether physical, social or epistemic. Grosz's insistence that forms of political power are ultimately derived from geopower should serve as a warning that any shift in the Earth's thermal dynamics, whatever its trigger, constitutes a reorganization of forces with the potential to be 'transformed into modes of ordering the human' – for better or worse (see Grosz 2012: 975). There remain grounds for concern around the ways that planet-scaled thermal inquiry might be politically or ethically mobilised, especially in the context of mounting pressure to decolonise global thought and the urgent, unfinished work of overcoming the Euro-modern classification of humanity according to surficial thermal gradients.

While novel geoscientific efforts to hinge together the thermal domains of the Earth help us to understand physical threats to or opportunities for human life and direct our attention to portals between liveable and unliveable worlds, I have been suggesting that there is no necessary political imperative or valence to such moves. As it stands, we are a long way from knowing how to respond effectively to the thermal misadventures of members of our own species, let alone knowing how to merge this problem with the matter of how best to live with the ongoing thermal adventures of the Earth itself. But like the paroxysms of heat and pressure at the core of NK Jemisin's *Broken Earth* trilogy, so far-reaching are the processes and dynamics that inner/outer Earth geoscience presents to us, that we would do well to find a place for them in our political thinking and in our more general pondering of what it means to be human. As Jemisin's protagonist asks of another central character: 'What in fire-under-Earth are you?' (2016: 112). It is a question we should all be asking of ourselves, though some of us more pointedly and pressingly than others.

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