Fiery Arts: Pyrotechnology and the Political Aesthetics of the Anthropocene

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Abstract

The effects of combustion feature prominently in the planetary predicament signalled by the Anthropocene thesis. Historical studies of pyrotechnology – the application of heat to transform earth materials – suggest a wide-ranging inquiry into human fire use might bring new insights to the practical and political challenges of the Anthropocene. Drawing on Deleuze and Guattari, I use the term `pyrotechnic phylum' to refer to the multi-millennial developments of metallurgy, ceramics and related `fiery arts' centred on the enclosed fire of the oven, kiln and furnace. As an engagement with the forces and properties of the Earth, pyrotechnical innovation has a pronounced experimental and playful dimension – opening up possibilities that human geological agency might have aesthetic origins. Pyrotechnic histories also highlight the widely distributed character of innovation, raising questions about a singular `thermo-industrial revolution' centred on Europe. Bringing together a feeling for the creative, world-shaping aspects of the pyrotechnic arts and a sense of the decentred, collaborative nature of their development, it is suggested that the pyrotechnic phylum might be seen as a kind of a shared platform for political action. Though attentive to its current contraction and marginalization, I speculate about the possible role of pyrotechnology in a political aesthetics for the Anthropocene.

Key Words: pyrotechnology, Anthropocene, political aesthetics, art, fire,

Introduction: The Pyrotechnic Phylum

Metallurgist J E Rehder makes claim to `a practiced eye' that enables him, by reading subtle gradations in the color of flame, to estimate the temperature of materials undergoing transformation by heat to within a range of some 20 °C (2000, 11). Rehder's capacity for thermal discrimination may appear a little on the coarse side. After all, in a world of escalating anxiety over climate change, entire global futures seem to pivot on planetary temperature changes of just a degree or two. But Rehder is talking about a thermal spectrum that ranges from the modest 250 °C or so required to destructure most organic materials through to the 1400 – 1600 °C needed to smelt iron and fuse it with carbon (2000, 6-7). Moreover, the talents he is celebrating are not so much those of the contemporary metallurgist – aided by pyrometers and precision-engineered furnaces – but those of the artisans of antiquity, who worked with fuels and ores of variable quality and kilns of their own fabrication.

A few decades ago, historian Theodore Wertime urged his readers to take account of `the often forgotten but massive effects of man's re-shaping of earthy materials by fire' (1983, 446). For thousands of years, Wertime impresses upon us, pyrotechnical skills were a vital part of daily life. Just as the practiced application of fire to living or decaying biomass has been a key to the way of life of most hunter-gatherer and pastoral peoples, so too has skilled management of the contained fire of the kiln, crucible and furnace been central to settled life (Pyne 1995; Clark and Yusoff 2014). The towns and cities of antiquity were dotted with workshops specializing in the use of heat to shape and transform a huge range of materials. Indeed, as Rehder notes, the very composition of socio-material existence was in large part a pyrotechnic accomplishment:

> The material fabrics of nearly all settled civilizations have by and large consisted of things that exist only because of pyrotechnology – the generation, control, and application of heat, which at sufficient temperatures can alter the properties and compositions of all materials (2000, 3).

Such metamorphoses relied on skills accrued through many generations and in many places. However complex, the techniques themselves became commonplace, as evidenced by the familiarity across Europe of names like Smith, Schmidt, Lefebvre, Ferraro and Kovač: indicative of either occupation or residence close to a metalworking site. Metallurgy, however, is but one branch of the pyrotechnic crafts and the western end of the Eurasian landmass is only one region of a technical lineage that spanned much of the planet. As Wertime observes: `The great technologies that began 10,000 years ago can still be found in altered form in the bazaars and workshops of Afghanistan, Iran, Turkey, Ceylon, India, Thailand, and China' (1973, 682). But this was written over four decades ago. Artisanal workshops in many places have been shutting down – as they have been for several centuries – sometimes under pressure from other ways of producing and sometimes by imperial decree (Iles 2013, 71; Forbes 1950, 84). And as the fires of the small foundry or pottery works are quelled, so too are ancient skills quietly extinguished.

This may not be a good time to be diminishing the range of ways in which human collectivities work with fire. As atmospheric chemist Paul Crutzen - one of the first exponents of the Anthropocene thesis - announced two decades ago: `the preservation and study of fire will assist humanity in its larger stewardship of the Earth' (Goldammer and Crutzen 1993, 11). What Crutzen and Goldammer are talking about is the broadcast burning of forest and grassland: their recommendation representing a

shift away from the stance of zero tolerance of `wildfire' adopted by most western landscape managers in the 19th and early 20th centuries. As environmental historian Stephen Pyne counsels, fire `appears more profusely during times of rapid and extreme climatic change' (1994, 890; see also Bowman et al 2011, 2228). But what if, in this time of geo-climatic change, it is not only the open-field fires of the pastoralist or hunter-gatherer we ought to be preserving but also the enclosed flames of their artisanal counterparts? What if working or playing with fire as a means to transmute `earthy materials' were to be seen not merely as part of the problem of global environmental change but also as a mode of response?

Combustion is at the crux of Anthropocene thesis - the proposal that cumulative effects of human activities are tipping the Earth system into a new state or regime - thus qualifying as a novel geological epoch (Crutzen and Stoermer 2000; Crutzen 2002; Zalasiewicz et al 2010). While the details are hotly debated even amongst Anthropocene exponents, the impact of burning fossil hydrocarbons on the Earth's atmospheric composition figures prominently in most accounts. There are also claims for an early or multi-stage Anthropocene that point to the long impact of hominin fire use on terrestrial ecosystems (Glikson 2013), though current evidence suggests this does not add up to required planet-wide and simultaneous trace in the geological record (Bowman 2015; Steffen et al 2011a, 846-7). Another important early Anthropocene hypothesis hinges on the ecosystemic and geo-climatic effects of agriculture during the early to mid Holocene, which highlights - along with other activities - fire-induced deforestation (Ruddiman 2003). This argument too is contested on grounds that it falls short of the mandatory `geosynchronous' lithographic signal

However, those of us from other disciplines are not compelled to lend the significance to the precise moment of crossing an Earth system threshold that geological authorities insist upon. From a broader geohumanities perspective, there may be more to be gained from exploring the succession of developments, deviations and accidents that conspired to bring Earth systems to their current juncture. If it has recently become an issue that our species – or subsections of the human population – have acquired `geological' or `geophysical' agency, the question we might pose is what does it mean to be a geological agent, and how – or from where, have `we' acquired such powers? In this regard, the fact that combustion features prominently in three of the major Anthropocene theses seems important, as indeed is suggested in the `pyric phase model' (Bowman et al 2011). It would appear even more significant were consideration of the agricultural phase or stage to attend fully to artisanal pyrotechnology as a vital accompaniment to the rise and diffusion of farming as a way of life (though see Ruddiman 2003, 275, 279; Glikson 2013, 91). In this way, a still stronger claim might be made for a connection between the use of fire and human geological agency than has yet been the case. Such an argument, I suggest, could have profound implications for the way social science or humanities scholars think about the Anthropocene thesis, and how we might consider responding to its prompts and incitements.

In this paper, I draw on historical studies of pyrotechnology, environmental history, geophilosophy and more-than-human geography to make a case for the pivotal importance of working with fire in the emergence of human capacities to shape their material worlds. For Wertime, ceramics, metallurgy, glass-making and related fire-centred crafts form `a single, complex pyrotechnic tradition' (1973, 67). In what is a rare philosophical engagement with artisanal traditions, Gilles Deleuze and Félix Guattari make a related point. There are, they propose, certain enduring `phylogenetic

lines' that are characterised not so much by a particular intention or series of products, but by a shared way of tapping and organizing flows of matter-energy (1987, 406-7). While metallurgy for Deleuze and Guattari is paradigmatic of such `machinic processes', they tentatively – and rather enigmatically - propose a more encompassing `phylum' extending all the way from `the pot to the motor' (1987, 407).

Building on these insights, the notion of a `pyrotechnic phylum' is used here to bring together a range of practices involving the manipulation of heat and chemicals in an enclosed space to transform `earthy materials' into novel states. With no insinuation of a teleological trajectory, I follow Pyne's promptings that the kilns and furnaces central to the pyrotechnic enterprise provide vital preconditions for the robust chambered `heat engines' required to combust fossil fuels (see Pyne 2001: 126, 135-6). In a more general sense, I propose that accomplishments of the pyrotechnic phylum have played a significant role in social acquisitions of geologic agency. While sharing with many social thinkers a certain unease with the way that much Anthropocene discourse seems to posit a unified and singular *anthropos*, I resist counterclaims that too straightforwardly prioritize social structural dynamics and power differentials. Instead, I attempt to decenter the human in ways that do not foreclose on the possibility of geological forces helping shape human subjects and collectivities. If pyrotechnical ventures have played a part in what geographer Kathryn Yusoff refers to as our `geologic subjectification' (2013, 780), I hope to show that fiery engagement with the stuff of the Earth has been at once a differentiating process and a contributor to the shared skill and experience Michael Hardt and Antonio Negri (2009) and others refer to as `the common'.

There are three main strands to my argument. First, we will see how the material metamorphoses at the heart of the pyrotechnic phylum draw us into domains where

chance and unpredictability are implicated with orderly operations. Probing the potentialities that inhere in various compositions of matter-energy calls for sensibilities that are every bit as artistic as they are technical, I argue, raising the possibility that human geological agency might be considered to have aesthetic origins. Second, I survey the distributed and decentred spatio-temporal relations of the pyrotechnic lineage – in ways that challenge assumptions that an `industrial revolution' can have a single centre or simple origin. Finally, drawing these two themes together, I suggest that delving into the *longue durée* of pyrotechnical experimentation and practice offers provocation for exploring the political aesthetics of the Anthropocene. If politics is itself an imaginative and generative enterprise, then the predicament shorthanded by the Anthropocene might be taken as an impetus to consider what kinds of creative, participatory and collective material-energetic experimentation are best suited to our epoch.

At a time when deliberate large-scale interventions into the operation of Earth systems are on the political agenda, reviewing the fiery arts of the pyrotechnic phylum may be instructive - both with regard to *how* we might experimentally engage with complex physical systems and *who* gets to participate in these experiments. Considering the possibility of our becoming more adept geological agents, I propose, raises questions about the types of fire that ought to be preserved or enhanced. Might we not come to see pyrotechnology, figuratively and literally, as a *crucible* of the kind of collective sensibilities and practices which meet the challenge of a rapidly heating world?

Crafting the Anthropocene

When geoscience Anthropocene proponents submit that our species may be on `a one-way trip to an uncertain future in a new, but very different, state of the Earth System' (Steffen et al 2011b, 757), their aim is at once empirical and political (Clark, 2014: 26-7). A lesson on hubris, the Anthropocene concept also serves to raise awareness about possible ways to avert human catastrophes attending rapid geophysical change. This means that Anthropocene diagnoses are generally configured around need and intention. Whatever earth-historical moment is selected for the onset of human geological agency, change to the Earth system tends to be viewed as an unintended consequence of deliberate actions: the general implication being that attempts by human actors to assert their will over nature to date have been thwarted by the complexity and interconnectedness of the physical world. This prompts ambitions for some kind of political shift in which social exchanges with the Earth system would be subjected to an unprecedented degree of regulation and redirection.

Though perhaps not as politically naïve as some social critics might suppose, the politics harboured in the Anthropocene thesis does have a pronounced technical-managerial tenor. If this is something critical social thinkers wish to query and supplement, we might consider setting out not only from within the confidences of our own disciplines, but also by looking for ambivalence and instability within the geosciences themselves. Which is to say, it might be a more generous and generative gesture to start with some of the multiplicity *within* the lineages of Earth science.

In Anthropocene discourse, as intimated earlier, a strong contender for the onset of planet-wide anthropic impact is the period of take-off and rapid expansion of fossil-fuelled industrialization – or the `thermo-industrial revolution' – usually taken to be centered on Great Britain (Steffen et al 2011a: 847). As Earth systems scientist Will Steffen and his colleagues sum up: `We thus suggest that the year AD 1800 could

reasonably be chosen as the beginning of the Anthropocene' (Steffen et al 2011a: 849). Great Britain at the turn of the 19th century, however, is also an interesting juncture in terms of early scientific engagement with the Earth as a system.

In the year 1800, Scottish scientist James Hall -working in the relatively new field of geology - reported the results of an experiment with the heating and cooling of local basaltic rocks. `On the 17th of January 1798' writes Hall, `I introduced a black lead crucible, filled with fragments of this stone, into the great reverberating furnace at Mr Barker's iron foundry' (1880, 85). Partly prompted by an accident in a glass manufacturing works in which slow cooling bottle-glass had been observed to resume a `stony structure', his experiments demonstrated that rock could be transformed back and forth – with heating and gradual cooling - from a smooth, glassy or lava-like texture to a granular or crystalline stoniness.

Inspired by the formative geological writings of his elder compatriot James Hutton, Hall was seeking evidence that rocks with crystalline structures were formed primarily by `plutonic' heat and pressure within the Earth, rather than through the hydrological and sedimentary processes that competing `neptunist' theories proposed (Smith 1981,174). As Hall was well aware, Hutton himself was skeptical that the forces of the Earth could be experimentally replicated, being rather derisive of those who `judge of the great operations the mineral kingdom, from having kindled a fire, and looked into the bottom of a little crucible' (Hutton cited in Hall 1880, 84). But in a series of experiments that played an important role in garnering support for Hutton's `plutonic' thesis, the younger geologist was able to show that temperatures attainable in a foundry furnace sufficed to make the necessary metamorphosis of crystalline basalt to a vitreous or lava-like consistency.

Historian Martin Rudwick proposes that Hutton's vision of the Earth as a `beautiful machine' which operated as a vast heat-driven system of molten and circulating materials drew very much upon the experience of the steam engines that were impacting so momentously on late 18th century life (2005, 162). But metallurgist and materials scientist Cyril Stanley Smith opens up another line of inquiry. Both Hutton and Hall's thermo-centric theories of Earth processes, he suggests, were influenced by research associated with the practical arts of glass-making and ceramics – although in both cases the geologists dropped earlier references to artisanal technologies in later publications aimed at more exclusively scientific audience (1981, 182-3, 185). As Smith would have it, early geological experiments were seeking to demonstrate:

> what many potters and metallurgists knew from experience, namely that many rocks could be melted and that quartz or flint would flux calcareous rocks, clays, earths, and many metallic minerals to give a melted mass with a vitreous look' (1981, 176).

Through rising trade with China from the late 15th century, discerning Europeans had developed a taste for porcelain, prompting concerted efforts to replicate its intriguingly translucent yet tough quality. In the early 18th century René de Réaumur conducted numerous experiments with clay and glass in the attempt to discover the composition of `fine china', while J H Pott reputedly carried out a further 30,000 experiments to ascertain the essential ingredients of Chinese porcelain (Smith, 1981, 175-6). Such research, Smith insists, was an inspiration for plutonic theories of rock formation. As he concludes, a vital counterpart to the more deductive scientific reasoning about Earth processes was `…the study of the chemical and thermal behaviour of earths and rocks that was to a large degree incited by the desire to duplicate Oriental ceramics' (1981,175).

Smith's appreciation of the role of Chinese ceramics – which leads on to consideration of China's early lead in high heat pyrotechnology – can serve to decenter conventional industrial genealogies, pointing to more distributed models of innovation and diffusion, as we will see. Moreover, Smith's focus on the complicity of the `decorative arts' with scientific development – and the sheer exorbitance of the pyrotechnical experimentalism that he describes– suggests a more encompassing vision of human agency than the instrumental thrust typical of Anthropocene narratives. While there is no shortage of intentionality in European efforts to decipher the secrets of porcelain, there is clearly something going on that exceeds the remit of purpose or necessity. As Smith extends his argument:

> Nearly all the industrially useful properties of matter and ways of shaping materials had their origins in the decorative arts. Indeed prior to the twentieth century, few people except those engaged in aesthetically motivated play were likely to make discoveries (1981, 242).

Alongside their grumblings about the less-than-progressive politics inhering in mainstream Anthropocene discourse, social scientists and humanities scholars have also begun to develop alternative approaches to the politics of the current planetary predicament. Resonating with Smith's notion of `aesthetically motivated play', a significant number of these political explorations express strong aesthetic concerns. Commentators have noted how artists, writers and performers are already exploring the challenges posed to the human sensorium by the new cultural prominence of geophysical and deep temporal change (Ellsworth and Kruse 2013). Visual culture theorist Nicholas Mirzoeff is quite explicit. `(T)o visualize the Anthropocene', he

insists, ` is to invoke the aesthetic' (2014, 213). Drawing on Jacques Rancière's claim that there is an aesthetic at the core of any genuinely political mobilization that conditions what counts or matters as sense experience, Mirzoeff holds out hope for a positive contribution of the arts in working towards new collective forms of political subjectivity appropriate to the Anthropocene.

Beyond the task of visualizing emergent geophysical conditions, other theorists are advancing versions of a political aesthetic that acknowledge the role of the arts in the active material constitution of alternative worlds. In the words of Heather Davis and Etienne Turpin: `art provides a polyarchic site of experimentation for "living in a damaged world," as Anna Tsing has called it'[1] (2015, 4). One such experimental site has been explored by Deborah Dixon (2009), who has looked at the way that artists are probing the possibilities of `life as expressive medium' using genetic technologies - as a means to engendering new and more responsible collective practices and sensibilities. While a provocation for these projects may be less-than-desirable bio-political developments, Dixon affirms the capacity of creative art to advance a `"visceral aesthetics" … of sight, sound, touch, smell and even taste (to) provoke curiosity and wonder' (2009, 421).

Others are ratcheting up the category of the aesthetic to encompass practical intervention at the planetary scale. Maialen Galarraga and Bronislaw Szerszynski (2012) propose that we critically engage with intentional intervention in global climate according to the conceptual categories through which artistic creativity has been conceptualized: challenging us to think of the world that geoengineering might bring into being as a form of climate artisanship, architecture or artistry. Angling more abstractly at the climate change situation McKenzie Wark incants: `Is not the totality of all our endeavors, all our social relations, tending towards the making over

of the planet as a total work of art? (2012, 39). Michael Marder raises similar questions with explicit reference to the role of combustion is delivering us into the predicament of planetary over-heating. `Ultimately' Marder ventures, `we burn ourselves and our world for the sake of burning, and the spectacular blaze is the ontological *l'art pour l'art* for which the entire planet supplies the materials (2015, 95).

Such an implication of artistic impulses and sensibilities in the shaping of earth processes has also been worked in the other direction. For Elizabeth Grosz (2008, 2011, 2012), art – in the broadest sense - is an extension of or extrapolation upon the properties and forces of the Earth itself. As Grosz would have it, drawing on both Deleuze and Irigarary, art picks up on the generativity of life itself to extend the play of the Earth: it `bring(s) out the latent possibilities or potentialities that the earth and its forces already contain (2012, 974). Through our various forms of creative and practical activity, she proposes, human beings tap into these earthly and cosmic powers and the materials they generate. In conversation with Grosz and others, Kathryn Yusoff (2015) poses the question of how primordial human aesthetic experiences might be implicated in the eventual unfolding of the conditions assigned `the Anthropocene'. Yusoff speculates how paleolithic cave art – in and through the way that its practitioners channelled the `inhuman' forces of the biological and the mineralogical domains – might have opened up new possibilities of human subjectivity. `How this excessive quality of identity is negotiated potentially has profound consequences for how human 'life' is understood in the context of a broader field of the Anthropocene' she maintains. `Considering the human within geologic time poses the problem of thinking an inhuman milieu, both before, after and internal to 'us'' (2015, 388).

Like Yusoff, I am interested in how immersing ourselves in the *longue durée* of human creativity - with its deep experiences of grappling with geologic processes - might offer incitement to a political aesthetics responsive to the summons of the Anthropocene. Between the intimate geo-aesthetics of Pleistocene cave art and the planet-scaled practical and sensorial challenges of Earth system change, I propose, lie the vital mediations of the pyrotechnic phylum. In the following section I look more closely at the role of thermal experimentation with `earthy materials' as an expressive and world-shaping practice, beginning with the question of what it means to live and work in the presence of fire.

Fire Play, Fire Power

Whatever decision Anthropocene researchers make about the threshold of human impact on Earth systems, paleoarcheologists and environmental historians recognise that the emergence of a living being with the ability to manipulate fire is a momentous event in the natural history of the Earth (see Pyne 1994, 889). Over hundreds of thousands of years, hominins learned how to use broadcast burning to manage and transform the biotic landscapes in which they lived (Bowman et al 2011, Glikson, 2013). Along the way, they also discovered what fire could do to other materials: `What began with meat and tubers eventually fed bone, stone, sand, metal, liquids, wood, whatever might be found, into the transmuting flames' (Pyne and Pyne 2012, 99). While every fire, to some degree, manifests a unique combination of the properties of its fuel and ambient conditions, the key to greater control over fire's transformative powers has been its enclosure in purpose-built containers. By way of the encasing of combustion, not only could heat be increased, but both the temperature and the atmospheric conditions of each blaze were opened to modulation (Pyne, 2001: 126).

There are important premonitions of the coming of the pyrotechnic phylum in the form of pottery kilns - dated at around 25,000 BP - uncovered at the Dolní Věstonice site in today's Czech Republic (see Hitchcock, 2012). But archeological evidence suggests that chambered flame comes of age with the emergence of agriculture and the advance of human sedentarization in the early Holocene. In the Neolithic world, the oven that renders grain palatable to the human digestive system also fires the earthenware used for storing and serving foodstuffs, while multiplying heat sources are used to make plasters, bricks and tiles – Rehder's `material fabrics of settled civilizations' (2000, 3). Assembled into hard, impervious structures, pyrotechnical products play a key part in organizing the distribution of bodies – both human and animal - in burgeoning urban spaces. Effecting a kind `mineralization' of daily life, durable urban infrastructure serves to channel the flow of bodies and the play of their senses, conditioning who encounters whom, what is seen and unseen, what mixes and what is kept apart (De Landa 1997, 27–8; Clark and Yusoff 2014, 217).

This does not mean, however, that `civilized' flame fully submits to the dictates of utility. As anthropologist Gordon Childe reminds us, with every firing of raw earth into baked clay, a product comes into being that is radically different in colour, texture and durability from its constituent materials (2003 [1936], 90). Yet even these changes pale next to the metamorphoses wrought by the metallurgical arts:

> The chemical change effected by smelting is much more unexpected than that which transforms clay into pottery. The conversion of crystalline or powdery green or blue ores into tough red copper is a veritable transubstantiation. The change from solid to the liquid state

> and back again, controlled in casting, is hardly less startling (Childe 1942, 85)

So dramatic is the transmutation from ore to smelted metal that in accounting for the invention of metallurgy, contemplation of the role of chance, accident or playfulness seems almost inevitable. The prevailing explanation for the discovery of copper – the first ore to be smelted – locates it as an offshoot of ceramics. Copper ores such as azurite and malachite are known to have been used to glaze pottery – itself a largely decorative practice – which archeometallurgists suggest may have inadvertently left driblets of metallic copper on the kiln floor (Aitchison 1960: 40). Beyond such first flourishes, the smelting of metallic ores remained, as Deleuze and Guattari put it – with the help of a neologism inspired by Husserl - an `*anexact yet rigorous'* process (1987: 367 authors italics). Not only were kilns themselves essentially homemade and the quality of both fuels and ores inconsistent, but the very process of smelting is based on a series of thermochemical reactions – dependent on specific catalytic agents in the right quantities - that were in no way accessible to the ancient artisan. As R J Forbes, one of Deleuze and Guattari's key sources, sums up:

> in the early days of metallurgy, processes were found and developed by trial and error, methods and apparatus borrowed by one branch from another….Only gradually have countless generations of miners and metallurgists learned to understand the reactions occurring during the treatment of their ores and metal (1950, 201).

The acquisition of these skills and their transmission clearly required sharp observation, discipline and rigour (see Wertime 1973, 630). But as Cyril Smith

reminds us, both the variety of procedures they discovered and the sheer beauty of the objects ancient artisans fashioned are indicative of the pleasures of artisanal work. In his words, `one (can) feel the joy that early man took in the discovery of the properties of materials' (1981, 194).

In the thought of Deleuze and Guattari, the metallurgist is paradigmatic of a mode of engagement attuned to a compositionally rich, variable and dynamic physical world. Metalworkers and other artisans follow pathways of physico-chemical transformations that are intrinsic to the material complexes or systems in question, while at the same time having to deal with the variation that occurs because the composition of any `actual' system differs with every iteration (1987, 409-412). In brief, the defining attribute of the artisan is a propensity for coaxing materials over determinate thresholds under inconstant conditions - in which he or she cannot know for sure when and how the vital moments of transition will unfold. Similarly, for Smith, artisanship is characterized by its dealings with `aggregates and assemblies' of matter: that is, with a real world inconsistency and irregularity that until very recently was too complex even for the physical sciences to adequately analyze (1981, 49, 54, 191-4).

It is this intimacy with the negotiation of `unanalyzable complexities' (Smith 1981, 325) – both in the realm of production and in the milieu into which new products are introduced - that leads Smith to a vision of innovation every bit as eloquent as that of his philosophical counterparts. `Discovery requires aesthetically motivated curiosity, not logic', he vouches, `for new things can acquire validity only by interaction in an environment that has yet to be' (1981, 325). Such an environment, Smith continues, can be less than welcoming, for `a new thing of any kind' opens up `a region of misfit within the pre-existing structure' (1981, 325). What Deleuze and Guattari bring to the

generous-spirited genealogies typical of pyrotechnical history is a more incisive account of the way such `misfit' tends to be dealt with. They offer an analysis of the political machinations through which the novel products and the sensorial breakthroughs proffered by the artisan come to be captured by the powerful vested interests they shorthand as `the State'; a process of appropriation that tends to recur at different historical and geographical junctures (Deleuze and Guattari 1987, 415, 424-431; Protevi 2013, 49).

According to Forbes, anticipating Smith's more general point: `Metal made its first impression as a fascinating luxury from which evolved a need' (1950, 11). As objects of splendour and beauty, metallic artifacts came to be signifiers of status – their shimmering visual cues complimenting the more stolid impositions of mineral infrastructure in the partitioning of bodies and the ordering of encounters. Metals were set to work as tools, implements, and measures or tokens of value. If metallurgy created objects worth hoarding, sociologist Johann Goudsblom notes, `it also supplied the weapons with which these objects might be appropriated' (1992, 633) thus reinforcing trends towards uneven distributions of wealth and property – in ways too profound and complex to do justice to here. Eventually, anthropologist Jack Goody adds, whole empires in the ancient world came to configure their boundaries around the distribution of metallic ores and other mineral resources (2012: 80 -1).

Deleuze and Guattari try to avoid simply idealizing the `itinerating' metallurgist or demonizing the State for its capture of artisanal innovation, though it is clear where their sympathies lie. What they do insist upon is that there are always openings to resist the State's `restratification' of the material pathways opened up and traversed by the experimental practices of the artisan. It is from DeleuzoGuattarian geophilosophy that Grosz develops the idea that the potentialities of a dynamic and complex Earth are

always in excess of the actual ways in which they are framed and channelled by skilled operators. This superfluity of possibility is what enables art or craft to `take( ) what it needs – the excess of colors, forms, materials – from the earth to produce its own excess' (2008, 9). So too, for Cyril Smith, it is the very exorbitance of the physico-material world - its play of regularity and irregularity, its stunningly varied hues, textures and patterns, its compositional richness – that lure human actors into acts of creation (1981, 191-203). Or as Wertime chimes in: `The assortment of ores confronting early man was staggering' (1964: 1257).

Pyrotechnical scholarship – including its DeleuzoGuattarian inflections – drives home the real depth of the human experience in negotiating pathways in dynamic physical systems. It also gestures at the way that aesthetic sensibilities – joy in discovery and creative expression – may have been a precondition of the eventual crystalization of scientific and technical disciplines. Although insisting that - by virtue of its embedding in ritual and its lack of formalized transmission - the metalworking arts remain essentially craft lore, Childe nonetheless vouches for their formative contribution to later knowledge complexes. `Metallurgical lore' he observes `is the first approximation to international science' (1942: 86). As Smith would have it, much of today's industrial knowledge and practice has ultimately arisen out of `a rich and varied sensual experience of the kind that comes directly from play with minerals, fire, and colors' (1981, 203). And by extension we might imagine that the very sciences of the Anthropocene have transmuting flames and `little crucibles' bubbling in their distant and not so distant past.

To get a sense of the breadth – as well as the depth – of the pyrotechnic phylum, we now turn to the relays and networks in which it has been implicated. These spatio-temporal distributions are important, I argue, not only for what they tell us about the

diffusion, range and evolving diversity of the pyrotechnic arts, but for what they indicate about the collaborative nature of working with fire.

Distributions of the Crucible

There is a certain convenience for critical social thinkers – if we are attracted to the concept - to conceive of an Anthropocene that takes off around the time and place of the industrial revolution. Or as we prefer to see it, the moment at which industrial capitalism rises to global dominance. This foregrounds a juncture when social-structural divisions are deep and profoundly consequential, authorizing us - in the interests of our quest for global socio-economic and environmental justice - to put the stress on the fundamental dividedness of the *anthropos* in the Anthropocene (see Malm and Hornberg 2014; Bonneuil 2015). But localizing the decisive planet-altering thermodynamic achievements to a specific social stratum, at a well-defined historical moment, in a particular region, can come with its own occlusions. While `(c)apitalists in a small corner of the Western world' (Malm and Hornberg 2014, 64) are indeed deserving of sustained critical scrutiny, care must be taken so that such insistence does not devalue the technological and aesthetic accomplishments of other times and places.

Fire use, as I touched upon early in the last section, not only draws together our species, but implicates much of the genus *Homo* - which in itself might be taken as way to trouble the unity or coherence of `the human'. While not all peoples made the shift to chambered fire, the pyrotechnologies centred on the oven, kiln, crucible and furnace have a much more distributed genesis than is often assumed (see Goody 2012, 307). In keeping with his concern with what it means to work with systems characterised by `unanalyzable complexities', Cyril Smith offers the tellingly

deconstructive insight that `full-panoplied origin is a material impossibility' (2008, 377). Indeed, classic metallurgical texts are decidedly light on master-narratives and logocentrism, tending to eschew linear and unicentric logics in favour of tracing extended fields of innovation and dispersal. In his canonical *Metallurgy in Antiquity*, Forbes insists: `the early metal worker was not pushed along the path of progress because he had no idea it was a path at all' (1950: 12), before proceeding on a survey whose geographical compass stretches from smithies of Papua New Guinea, to the bronze-workers of Zimbabwe, and on to the Inca and Aztec metallurgists of the Americas.

As Deleuze and Guattari famously note, artisans have an inherently `nomadic' streak. As prospectors track seams of ore through the Earth's crust, and as smiths follow the topology of physicochemical reactions, so too do artisans journey from one collectivity to another (1987, 409-415). `Propagation and diffusion', Deleuze and Guattari insist, `are fully a part of the line of innovation' (1987, 405). There are still intense debates about the relative importance of independent invention and diffusion, especially with regard to metallurgy. For example, whether iron smelting was introduced to Sub-Saharan Africa or developed indigenously – perhaps on multiple occasions – is as yet unresolved, though the extraordinary diversity of iron-producing techniques has been taken of evidence of `spontaneous generation' (Alpern, 2005; Killick, 2009). Either way, as anthropologist Peter Schmidt observes, by the late 19th century 'there were hundreds if not thousands of different iron-production systems active on the continent' (cited in Alpern 2005, 85; Schmidt, 1996, 9).

While the pyrotechnic phylum flows, ebbs and irrupts across a vast historical-geographical field, there is broad agreement that the ancient Middle East has an axial importance - hinging on the relative proximity of its metalliferous highlands and

fertile alluvial plains. Archaeologist Aslihan Yener speaks of a mid-to-late 3rd millennium BCE `technical and industrial explosion' in metal production that occurs when advances made by metal-working nomads of the plateaus find novel outlets in the burgeoning lowland agricultural centers (2000, 67, 126). As metallurgical historian Leslie Aitchison relates in an earlier account: `by the middle of the third millennium B.C., metal-working had been established through a band of territory that stretched from north-west India, through Baluchistan, Elam, Turkistan, Mesopotamia, Anatolia, Syria, Palestine, and up the Valley of the Nile …' (1960, 43). From here metallurgy and related developments diffused east to China and west to Greece and Rome - eventually reaching Western Europe (Goody 2012, 32).

Nearly all pyrotechnology theorists stress the significance of trade networks as conduits of raw materials, products, people and innovations. For many millennia, what has been termed the Eurasian corridor – the Fertile Crescent and its surrounding highlands – functioned as an active hub and transit zone in an intensely generative relay of pyrotechnic know-how that spans the Euroasian landmass (Goody 2012, 161, 154). Smith's account of European efforts to replicate Chinese porcelain during the 18th Century speaks of just one, comparatively belated, episode in a transcontinental traffic that Goody insists is `of fundamental importance in the story of Eurasian cultures' (2012, 154). By 1500 BCE Chinese artisans had taken the lead in `high heat' pyrotechnology, attaining kiln temperatures well over 1200 °C – that enabled the manufacture of glazed stoneware or `primitive porcelain' (Goody, 2012, 165). Such heat levels were also sufficient to melt copper and to cast iron, which became the crux of a pyrotechnical complex characterized by `a large scale, labour-intensive chain of production, with ore-miners, fuel gatherers, ceramacists and foundry workers' (Goody 2012: 166). Only much later, Goody adds, did the high heat methods pioneered in China move westwards (2012, 65).

Though it is a relatively brief interlude by geological or archeological standards, the decline of the Western Roman Empire from the 4th century saw a corresponding fall in the production of metals in Europe and the abandonment of numerous mines – though some of the more accessible mineral resources had already been exhausted (Nef 1967, 7-8; Goody 2012, 81-2). With the 10th century discovery of new metalliferous lodes in the mountainous regions in Central Europe came a gradual revitalization of European mining and metallurgy, reaching a takeoff point somewhere in the mid 12th century (Nef 1967, 9-10). By the late 15th century, as historian Fernand Braudel recounts, increasingly ambitious mining operations had spawned a new kind of wealthy absentee investor – which also served to place formerly independent mine workers in a more dependent position. `Capitalism', declares Braudel, `entered a new and decisive stage' (1982: 321).

These emergent social relations, together with a complex configuration of other changes – including new technological capacities to exploit subsurface resources and the expansion of extractive industry to overseas colonies – set European extractive and industrial development on a self-amplifying pathway. This, of course, brings us to familiar terrain for social scientists and historians. Less conventional, perhaps, are the reminders by pyrotechnology researchers of the relative tardiness of Europe's industrial ascendance and of the depth of its inheritance from the much broader Euroasian pyrotechnic lineage. Until well into the 18th century, Goody notes, England - and Europe more generally - lagged behind China in high heat technology and industrial organisation (2012, 305). By the 16th century, the Chinese were mass producing ceramics for the international market using what have been described as assembly-line techniques: with over 1000 kilns and some 70,000 workers, the Jingdezhen porcelain works in Jiangxi province was reportedly the largest industrial

operation in the world (Goody, 2012, 157). Five centuries earlier, faced with advancing deforestation, the Chinese were already using coal for iron and ceramics on an industrial scale (Goody, 2012, 175, 218). `Eleventh century China's blast furnaces were run by private industrialists and manned by hundreds of wage labourers' reports Barbara Freese, `they were fuelled by coke and they churned out thousands of tons of iron yearly' (2006, 205).

Reviewing the intensive movement of pyrotechnic products and skills along the Eurasian corridor - dominated for long periods by *east to west* traffic - Goody cautions against generalizing from Europe's `temporary superiority' (2012, 290) `European advantage in the nineteenth century' he concludes, `has distorted our understanding of history and the coming of the modern world (2012, 280). In this way, what thinking through the multi-millennial and transcontinental nexus of the pyrotechnic phylum can do for us is to unsettle notions of a single, decisive thermo-industrial revolution. Without making a claim for their epochal imprint on the Earth's geological record, so-called `premodern' pyrotechnical developments comprise a multitude of interwoven and nodal breakthroughs in the heat-driven transformation of earthy matter. And indeed, such a distributed sense of ascendant thermodynamic agency would seem to resonate much more strongly than the prevailing Eurocentric model with the complexity theory at the core of Earth systems science - as well as the relational materialisms now popular in social thought.

But there is a perhaps more important point, one that takes us back to the very core of the pyrotechnic adventure. The mechanical, metal-encased engines of the last three centuries have to be robust enough to handle the highly concentrated energy of fossilized hydrocarbons (Pyne 2001, 126, 135-6). These heat-engines are precision-engineered and standardized, just as fossil fuels have now been chemically distilled

and processed into high consistenty. The precise, continuous and repeatable operations this enables are a world away from the vagaries and inconsistencies that rendered most ancient pyrotechnical procedures a unique event – though it is certainly anticipated by some of the earlier Chinese uses of high heat in industrial production. From the perspective of the pyrotechnical *longue durée*, however, what most characterises the thermo-industrial regime that eventually conduced to transform Earth systems was not so much their amplification of metamorphic or geomorphic potentiality, as their *contraction* (Clark and Yusoff 2014, 222).

This is less a matter of what fuels thermo-chemical transformation - or the rate and scale at which this takes place - as it is about the motivation for using heat to transform matter. Reflecting on the essence of terrestrial combustion, Pyne reminds us that 'Fire remains, above all, the great transmuter' (2001: 120). By enclosing and intensifying the force of fire, as we have seen, skilled pyrotechnic agents precipitated a momentous expansion in this metamorphic `fire power': contriving, over the course of some 10,000 years, a spectrum of thermal operations that augmented and elaborated upon the transformational possibilities inherent in the physical world. What characterizes the combustive operations of the emergent 18-19th century thermo-industrial regime, on the other hand, is that heat is predominantly used to do mechanical or kinetic work (Clark and Yusoff 2014: 222). In brief, chambered fire has morphed from a transmuter into a prime mover.

From the point of view of `prime moving', fossil-fuelled heat engines have replaced wind, water and animal power – which gives the impression of massive expansion in capacity (see Mumford 2010[1934], 112). But if we take a fire-centered perspective, what has occurred is a channeling and compression of the work of heat - more in the nature of a contraction of the multi-directional and polymorphic potential of

combustion. As prime mover, fire has progressively migrated deeper into or further from the production process. New regimes of heat engines, manufacturing machines and, eventually, electronic apparatuses have `separated combustion from flame and segregated the chambers where burning occurs from the places where its energy is felt' (Pyne 2001, 128). All across the great transcontinental spaces of the pyrotechnic phylum, the work done by the new regime of combustive machinery will eventually, often forcibly, displace or engulf the functions of a great many other enclosed fires. This is more than a matter of new fossil-fuelled productive technologies out-performing less powerful machines and it is more than a matter of the imposition of new set of social relations - though this is undoubtedly important. It is also, perhaps primarily, a shift away from the metamorphic preoccupations of the pyrotechnic phylum. And in this sense, it stands as a fundamental reorganization of the way fire occurs on Earth.

As a novel partitioning of thermal potentiality - a redistribution of the force and the play of fire - the new industrial regime changes the very material fabric of sociable life at a multiple scales. This has profound implications for the tasks, conditions and possibilities of collective action. In the final section, I return to the political challenges posed by the Anthropocene thesis, and ask what else might be done with the geomorphic power of fire at the current juncture in Earth and social history.

Pyropolitical Aesthetics for the Anthropocene

We have seen how the diverse ways in which fire has been used to shape and transmute earthy materials have played a crucial role in composing the fabric of socio-material existence and in propagating communities of sense and praxis. Far from setting `us' on a determinative trail (cf Bonneuil, 2015), being a uniquely fire

species on a fire planet has provided opportunities for a broad spectrum of `becomings' with different geological elements and processes. In fact, the deeper into the folds, layerings and temporalities of the geologic we delve, the further that we implicate human existence in the potentialities of the Earth, and the richer the possibilities for our differentiated self-making.

As philosopher Alva Noë observes `Experience isn't something that happens in us. It is something we do; it is a temporally extended process of skillful probing' (cited in Protevi 2013, 148; Noë 2004, 261). The pyrotechnic phylum is the term I have been using for the application of fire in such a `skilful probing' of the potentialities of heterogeneous materials. But I would add to Noë's observation that experience is also bound up with exposure to events and process that are outside or beyond us - with our confrontations with the powers of the inhuman (Clark 2011). In this regard, the pyrotechnic phylum is, crucially, an engagement with the dynamism of the Earth and cosmos; with forces that also threaten to overpower us (see Grosz 2011,190). In portioning off a small section of this volatility - enclosing it within the hardy casement of the kiln, crucible or furnace - it becomes possible to work or play with what might otherwise feel overwhelming.

Pyrotechnic experimentalism, then both responds to the allure, the wonder, the diversity of earthy matter and to the threatening forcefulness of the inhuman Earth. In this way, though most of us lack the experience or cultural memory of enduring major shifts in Earth systems, what human populations do indeed have - if we take in the *longue durée* of the pyrotechnic phylum - is a treasury of knowhow about scaling down, framing and containing the forces of a volatile planet. In various forms and manifestations, distributed throughout our many collectives, we have a great deal of practical experience in intervening in complex physical systems and in coaxing

heterogeneous materials along pathways and over thresholds. The work of potters, smiths and other artisans is prosaic and mundane - that is, `activity exercised within spaces of ordinariness' (Berlant 2007, 758) – though it has often also taken place in a context of environmental change and volatility. And yet, from these spaces have come some of the most beautiful and enchanting objects ever to grace the planet.

The extinction of varieties or `species' of fire has not been high on the agenda of western environmentalism. Despite recent reappraisals of both natural and `prescribed' burning, there are still many environmentalists for whom fire is equated with the destruction of ecosystems and with escalating carbon emissions (see Clark and Yusoff 2014, 207-8). Such distrust of fire, Pyne argues, has a lot to do with cultural experience that reflects the exceptional infrequency of wildfire in North West Europe and the worldwide export of a deep-seated `pyrophobia' during the colonial period (1997, 10-15, 494-5). In the context of ascending environmental concerns, hostility towards fire has often joined forces with a generalised aversion towards industrial production. In contemporary environmental politics this is frequently manifest as a preference for both pastoral forms of production and low-impact electronic technologies: a dyad that tends to spirit away the gritty realities of extracting, processing and shaping the mineral resources of the Earth (though exceptions may be made for the `gentler' pyrotechnic morphings of the ceramic kiln). We should not forget, however, that the hardware of low carbon living – wind turbines, solar panels, advanced insulation – remains dependent upon such key pyro-industrial products as metals, glass and ceramics. As, of course, does most manufacturing and more conventional infrastructure. It might also be timely to consider how such needs would be met should destabilising planetary conditions be accompanied by serious disruptions of global supply chains.

Pressing though they may be, such concerns still tether us to an imaginary of need and utility. It should also be noted that the way most environmental concerns are articulated – both at the planetary scale of Anthropocene problematics and at more localized levels – tends to make appeals to subjects as if they were pre-formed and lying in wait. The politics of the environment and Earth, that is, characteristically assumes the existence of practical-political agents who already know who and what they are - and thus ought to be capable of judging what is in their best interests. But our excursion into the deep, originary aesthetics of pyrotechnic innovation suggests a more complicated – or implicated – sense of subject formation and collective action.

In generating new materials and processes, pyrotechnic artisans changed the composition of everyday existence. They produced new things to see or feel or to value, and they helped transform the make-up of built space in ways that precipitated new patterns of movement, encounter and gathering. In ways that could never have been anticipated, such changes impacted on the individual and collective sensorium (see Grosz 2008, 77). In this sense, by channeling and elaborating on the forces of the Earth, pyrotechnicians also helped shape the `selves' or `subjects' who shared the worlds they were helping fabricate. And in this way, reflection on the pyrotechnic phylum reminds us that subjects are constantly in the making. And that they are in the making with and through the Earth (see Yusoff 2013, 2015).

Such a view of the subject has implications for how we conceive of and engage in politics. Politics, some critical thinkers have lately been insisting, is much more than a matter of discourse, of conflicting interests and vociferous debates. It is also, to some degree, `aesthetic' - a process of imagining how the ordering of people, signs and things might be otherwise and of actually trying to construct alternative arrangements (Rancière 2004; Dikeç 2015). Our historical probing of the pyrotechnic

phylum - though it inevitably shades into the speculative – adds substance to this sense of the political as a work of fabulation and crafting – in a way that also stresses the open-ended, experimental and pragmatic nature of these processes. This is not to say that the aesthetic is always already political, though it may well imply that `the political is inherently aesthetic at the conceptual and substantive level' (Dixon 2009, 412). In other words, experimentation and creativity that is broadly `artistic' plays a crucial role in generating the sensibilities, base materials and platforms that are the conditions of political action (see Yusoff 2010, 79). By the same token, it must be acknowledged that aesthetic dispositions are also implicated in the diagramming of things and the distributions of the sensible *against* which collective actors mobilize – however much we foist responsibility for the darker side of these orderings onto the `State' or other powerful interests.

Much collective action in the manner I am suggesting might be described as `pyropolitical' (Clark 2011, 164-5; Marder 2015). This is not just, in Marder's sense, that it concerns struggles over situations and threats involving `the dyad of fire and atmosphere' or that fire is frequently unleashed during political uprisings. I mean pyropolitical in the more `archeological' sense; that fire is implicated – all the way down into the depths of our human being – in processes of collective self-making and re-shaping. While it may be true that fire as an physico-material force and as an element of political mobilization never fully escapes its `explosive ambiguity' (Marder 2015, xiii), a focus on artisanal fire-use draws attention to the degree to which flame can be corralled, modulated, ushered into world-making work.

Collaboration and diffusion, as we have seen, have been essential elements in this marshaling of fire. In their affirmation of the potential of `the common', Michael Hardt and Antonio Negri look to contemporary forms of creative production –

especially those deploying digital media - as the site for the `metamorphosis' of new subjectivities and collaborative dispositions (2009, 115-8, 311). They note that the fashioning of images, codes and information is not bound by scarcity: `when I share an idea or image with you, my capacity to think with it is not lessened' (2009, 283). The pyrotechnic arts have rarely been `open source' in this sense – their transmission has most often been guarded and selective (here we need to bear in mind not only the `magical' element of fire-induced transmutation but the more prosaic fact that escaping flame could envelop villages, pasture or forests). Even so, fire might be regarded as the primordial form of an element undiminished by its reproduction - and this extends into technical uses. It is not simply that pyrotechnical ideas and materials have travelled along networks, but that they have often been catalysts or vital components of the assemblages that made networking possible. Just as metallurgy combined with the domestication of the horse to enable new kinds of nomadism, so too did metals and literacy emerge together and forge a mutually supportive – and momentous - association (Goody 2012, 28 108; cf Deleuze and Guattari 1987, 399). Pyrotechnology, in short has helped compose the very networks it has traversed. And without its material and ideational traceries, Hardt and Negri's nascent informatic commonwealth would be only so much whispering in the wind.

Merged into a vast, decentered and `polyarchic' platform of knowhow and componentry, the pyrotechnic phylum as been so fundamental to the shaping of socio-material life that it has tended to recede into murmuring anonymity. So much so that its attenuation and contraction – its progressive partitioning out of the collective sensory field – seems to have attracted little sustained attention. Just as it is next to impossible to gauge the impact of introducing a new object or technique into an existing milieu, so too is it devilishly difficult to assess the ultimate consequences of the disappearance of skills or material practices. Pyne has documented some of the

damage – social and ecological – arising from attempts to extirpate broadcast fire from landscapes adapted to its rhythmical presence (1997, 170-2). But the waning or extinction of so many varieties of chambered artisanal fire, to my knowledge, has attracted no comparative attention. And this not a good time to be losing, or to have lost, varieties of fire. As Pyne counsels, this is a planet that 'will burn regardless of what humans do' (1994: 907). Combustion got us into the Anthropocene, and we would do well to consider that in fire's capacity to shape both built and biotic landscapes lies an immense potentiality to respond to the current situation. One way or another, it looks likely we will find ourselves fighting fire with fire (Clark 2012, 259).

This is not about trying to rewind our way back to the `technical and industrial explosions' of the mid Holocene. But it is about seeking to preserve or enhance the diversity of fire on Earth. Pyrotechnology has been a vital element in the construction of a common global existence as well as in the diversification and partitioning of human collectivities. When pyrotechnic skills are extinguished or appropriated what is lost is not only part of the scaffolding of communal life, but a form of expression of the Earth itself – an actualization of the planet's geological potentiality. If, in its capacity to bring something new into the world, politics - as Mustafa Dikeç suggests – has a sublime aspect (2015, 106-117), then much of that sublimity ultimately derives from channeling and expressing the forces of the Earth. In quelling fire, we diminish not only the technical resources but also the political prospects for crafting prodigiously livable worlds. By keeping our variegated fires stoked, we hold open our transmutational possibilities – because in doing so we are holding ourselves open to the exuberance of the Earth itself.

In times of accelerating geophysical change, preserving and proliferating the

pyropolitical arts might be a matter of some urgency. It may be almost impossible to predict or even imagine what `species' of fire will flourish under geo-climatic conditions the likes of which our species and genus has never yet encountered, though experience suggests that we should look for signs of experimentation along a broad and mobile front. While the pressing sense of necessity conveyed by most Anthropocene theorists seems fully justified, so too might we hold out the hope that a novel fusion of well-modulated fire, earthy materials and collective imagination would also be an occasion, in the words of Cyril Smith, for `creative participatory joy' (1981, 355).

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[1] *Anthropocene: Arts of Living on a Damaged Planet*, as Davis and Turpin note, was the title of a conference organized by Anna Tsing at the University of California, Santa Cruz, CA: 8–10 May 2014.