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Childhood and the geology of media

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Abstract

This paper concerns children's relations with the geological aspects of digital media technologies. Using ideas from media theory, I develop a conceptual framework for childhood studies research on digital media that goes beyond the dominant focus on children's use of technology. I argue that studies of use would benefit from being linked up with analyses of the technicality and physicality of technology. As an example of the analytical potential of this approach, I discuss the issue of child labour in cobalt mining in the Democratic Republic of Congo. The planetary nature of digital media require analyses that, in line with wider arguments in childhood studies, follow hidden relations across different scales, and address the politics of harmful materialities.

Keywords

media, technology, digital, physical, material, technics, cobalt, child labour

Word count: 6877 excluding references

Introduction

This paper is about children's relations with the earth energies and materials of digital media technologies. Childhood studies research on digital media has to date focussed primarily on how media technologies are being used by children. Such work, while valuable, occludes children's embodied relations with media materials in the phases that come before and after use, in the production of technologies and in their decomposition as waste. In the context of current debates about the Anthropocene, and the push towards more relational understandings of childhood across minority and majority world contexts, I argue that issues such as child labour in electronics supply chains (e.g. Dupere, 2016; Wakefield, 2016) and the toxic effects of e-waste recycling sites on children's bodies (e.g. Chen, Dietrich, Huo, & Ho, 2011; Huo et al., 2007; Zheng et al., 2008) deserve to be linked up with research on children's media use to extend analysis to the planetary scale. Working across the social, the technical and the physical can address two wider areas of childhood studies where calls have been made for more critical attention. The first is summarised by Ansell

(2009), who argues that to fully understand the conditions of children's lives, research needs to go beyond the confines of the local scale (as with research on minority world children's use of digital technologies in home and school), and trace wider flows and connections that are often hidden from view. The second area is highlighted by Horton and Kraftl (2017, p.4), who argue that many analyses of children's relations with non-human life have prioritised "materialities characterised by a singular, plainly-visible, divisible, neatly-bounded presence…material practices which are manifestly meaning-ful and readily-narratable", and promoted an "uncritically-normative view of encounters with nature as necessarily, axiomatically positive." They call for research on the materialities of childhood to recognise how children's lives are also shaped by more elusive, troubling, harmful or noxious materialities. In this regard, I argue that media theorist Jussi Parikka's twisted notion of the Anthrobscene is provocative, drawing attention to how media are constituted by processes of environmental exploitation and ruination – processes that, as I will show, involve children's bodies. In shifting attention towards the geo-politics of media, my aim is to displace, or at least significantly augment, the dominant focus in childhood studies on children's agency and voice.

The paper begins by conceptualising media and the Anthropocene. I then review literature on children's relations with media, examining its bias towards use and relative neglect of media technics, physics and materiality. As a way to redress this imbalance, I take up Simondon's critique of utilisation, and Parikka's ideas concerning medianatures and the geology of media. The final section of the paper explores how this conceptual apparatus could expand childhood studies accounts of children's relations with media, using the example of child labour in cobalt mining in the Democratic Republic of Congo. The socio-economic dimensions of this issue in turn add nuance to the concept of the Anthrobscene, demonstrating how analyses of these different aspects – social, technical and physical – can be mutually enriching.

Throughout the paper, I use the term media in two ways. A degree of fluidity between these definitions is necessary for the arguments I want to make. In a

broad sense, media refers to any assemblage that modulates forces to generate particular intensities. That definition applies to technologies conventionally thought of as media – photography, radio, film, telephony, television, networked computation – but as Parikka (2010) suggests, we can also think more broadly of media as any system that channels earth energies and materials in ways that produce aesthetic, sensory and affective intensities. Remixing Haraway's concept of culturenatures, Parikka (2013) uses the term medianatures to amplify how media "are not only a technology, a political agenda, or an exclusively human theme. Media are a contraction of forces of the world into specific resonating milieus" (Parikka, 2010, xiv). Starting out with such a broad definition may seem vague, but it has the advantage of making space to address issues that are salient to child-media relations but normally left out of childhood studies research on media, such as mineral mining, hardware manufacturing and electronics recycling.

More specifically, the media I have in mind throughout the paper are the networked, computational, consumer-orientated technologies that have become ubiquitous in recent decades, including hardware devices such as smartphones, tablet computers and games consoles, and related software systems such as social media platforms. These technologies have readily been adopted by minority world children and young people, and as such have been the focus of sustained attention in childhood studies, as I review below.

Throughout the paper I have tried to avoid using the common term digital media because it is too specific to convey the first of these two definitions, and too broad to convey the second.

As for the Anthropocene, given the focus of this paper on the geology of media, it seems important to distinguish between geological and humanities definitions of the term. In the strictly geological sense, the Anthropocene has been proposed – and, at the time of writing, not yet adopted – as a new epoch in the geological time scale. This proposal is based on evidence of specific stratigraphic markers, including layers of microplastics, radioactive fallout from nuclear tests, fly ash,

human-produced debris, industrial slag, and pollutants such as polychlorinated biphenyls, along with a distinctive fossil record "reflecting such phenomena as the large predominance of domesticated species (especially livestock), elimination of large predators from most terrestrial and many marine environments, and widespread replacement of native floras with crop or garden species" (Zalasiewicz et al., 2017, p.214).

In this geological sense, the Anthropocene is a proposed scientific category without any explicit affiliation to ecological politics. Indeed, given how complicit the earth sciences have been in the extraction of fossil fuels and other minerals, these disciplines seem particularly ill-placed to help advance the debates about human-nature relations and environmental justice that in recent years have gathered around the notion of the Anthropocene in the humanities and social sciences [1]. In childhood studies, this more politicised conception of the Anthropocene has been used as a point of departure for rethinking children's relationships with nature (e.g. Malone, 2016), for developing ideas about interspecies learning and post-humanist environmental education (e.g. Nxumalo and Pacini-Ketchabaw, 2017; Taylor, 2017; Taylor and Pacini-Ketchabaw, 2015), and for speculatively imagining new future worlds (e.g. Rousell, Cutter-Mackenzie, & Foster, 2017), to take a small selection of recent work. In its orientation towards impending ecocatastrophe, this conception of the Anthropocene is arguably of special concern for anyone who works with the young, since the timescales involved look set to land the current generation of children in deep trouble. Those endless platitudes about how 'children are the future' are coming true, but with the future looking less like the sunlit uplands of possibility and more like a series of intractable difficulties with which humans will need to grapple. Children's growing involvement in climate action campaigning is testament to how these ideas are beginning to attain a degree of urgency for the young.

Debates about the Anthropocene are often couched in terms of rethinking relations between humans and nature, but they also point towards a technological paradox that is particularly relevant to the analysis of media. The

Anthropos of the Anthropocene is a human whose machines are so marvelous that their effects register on a geological scale, yet this planetary impact threatens the very existence of humans. Like a madcap inventor who finds himself trapped in a mechanism of his own making, the human species is confronting anthropogenic climate change which appears to be beyond its capabilities to stop. As sea ice melts, wildfires spread and floodwaters rise, while the elected president of the USA cuts climate change initiatives and trashes painstakingly constructed emissions agreements, the hope that modernist technical rationality might save us from the problems it has caused is beginning to melt into fantasy. In geology there is considerable investment in projects such as geoengineering and carbon capture (see Yusoff, 2013), but Haraway (2016, p.3) calls this approach out as "comic faith in technofixes", a retreat to the very modernist way of thinking that has led to the current mess. Mainstream geology seems too caught up with capitalist fantasies of environmental mastery to offer an alternative paradigm. Increasingly, it looks like our species will need to find other ways of relating to the geos, to come to terms with its self-inflicted ruination, to live and die with a greater sense of humility about the place of humans amongst other kinds of beings, and to face up to the prospect of a world after humans (Clark, 2014; Weinstein and Colebrook, 2017).

In this paper, I want to think about what childhood studies research on media might look like if it engaged more fully with these ideas, using the Anthropocene as a way to amplify the relations between children, technology and the earth. Rethinking networked computational media in relation to the Anthropocene is necessary because in the popular imagination these technologies are still seen in essentially modernist, human-centred terms: as progressing towards being ever faster, smaller and more marvelous, in ways that are usually portrayed either as utopian (e.g. connecting people, stimulating creativity, enabling new forms of learning) or dystopian (e.g. undermining social skills, causing psychological problems, enabling cyberbullying, online exploitation and so on). What such framings overlook is the fact that computational media are physical systems rooted in the earth, through which humans are entering into new relations with the planet.

Media in childhood studies research

Social science studies of children's relations with media have to date been dominated by a focus on the practices through which media technologies are used. There is an established body of research on how children and young people are using networked computation for purposes such as forming identities and negotiating friendships (e.g. boyd, 2007; S. Livingstone and Brake, 2010; Merchant, 2005). Significant differences have been identified between children's patterns of technology use at home and at school (Lydia Plowman, McPake, & Stephen, 2008; Somekh et al., 2002). In education research, studies have examined how the use of computing technologies is influencing learning across a range of settings and age groups (Harrison et al., 2002; L. Plowman and Stephen, 2003). There is particular interest in consumer-orientated computational technologies such as iPads and iPods (Kagohara et al., 2013; Kucirkova, Sheehy, & Messer, 2015; Lynch and Redpath, 2014) and social media platforms (Carpenter and Krutka, 2014; Greenhow and Lewin, 2016). Often the focus on use is implicit, but in some cases a more explicit argument is made that what really matters is not the technology itself but how it is used (e.g. McKnight et al., 2016).

Not all studies focus so exclusively on use. Thompson and Cupples (2008), for example, draw on actor network theory to understand teenagers' SMS use of text messaging in a way that also attends to the technical dimension of this medium. Likewise, Pakkaari and Rautio (2018), while primarily focussed on media use, acknowledge the force of devices and the ideologies built into them. In addition, there is a growing body of research on how computational technologies are exercising power over children through systems such as data-based surveillance, data analytics, behaviour modification and computerised testing (Eynon, 2013; Finn, 2016; Sellar and Thompson, 2016; Selwyn, 2015; Williamson, 2015, 2016).

Nevertheless, a focus on media use predominates in the childhood studies literature. This orientation reflects a wider socio-cultural paradigm, underpinned both by post-Vygotsky developments in psychology that emphasise

the role of society and culture in learning, and by the new social studies of childhood, in which children are viewed as key players in constructing their own lives. Socio-culturally orientated studies of children's media use have undoubtedly made a valuable contribution to understanding children's relations with media technologies. They have questioned the rigid distinction often presumed to exist between online and offline 'worlds', the overly simplistic utopian-dystopian narratives about childhood and media that circulate in the popular sphere, and the misconceived myth of digital natives
. Studies of media use have also provided evidence that counters the tone of moral panic surrounding debates about screen time, internet addiction, sexting, online abuse and cyberbulling. Close sociological attention to what children and parents are doing with media has revealed a much more complex and nuanced picture, showing how the risks and opportunities of online communication are bound up with each other, and how media technologies are reconfiguring social interactions rather than destroying them (e.g.Helsper and Eynon, 2010).

This body of research has some blind spots, however, that are particularly problematic in relation to media. Socio-cultural perspectives have been critiqued for sidelining the role of the biological (Sonia Livingstone, 2008; Lydia Plowman, McPake, & Stephen, 2010), the geological (e.g. E. A. Wilson, 2015) and the technical (e.g. Clark, 2013). This paper draws attention to how all three of these realms are pertinent to the analysis of media: in children's relations with media materials, the bodily effects of these materials, and how these relations link children into a planetary network of technical objects. The definition of the technical I am using here is informed by Simondon, for whom technical objects constitute an ontologically distinct realm, not reducible to either culture and nature but mediating between them. Technical objects are artificial objects with their own distinctive historical genesis and evolution, driven by internal tendencies of technical refinement and the integration of functions, that are not related to external factors such as how the objects are used (e.g. Ernst, 2013).

The incuriosity about the technical that characterises much of the childhood studies research on children's relations with media is problematic given that – at

risk of stating the obvious – technical objects constitute one side of those relations. The assumption that technologies can be adequately explained by examining their utilisation reflects what Simondon refers to as the alienation of technics from culture. It also perpetuates that alienation, such that the technologies themselves tend to recede into the background of analysis, sometimes disappearing altogether (Simondon, 2017, p.25-29). This reduction of human-technology relations to human practices jars with wider shifts in social science towards addressing more-than-human beings, bodies and forces. In the context of debates about the Anthropocene, it no longer seems tenable to focus on the human practices of media to the exclusion of non-human actants.

A focus on utilisation also makes it difficult to differentiate between forms of use that are more technically conditioned and those that are more inventive. For example, some studies have reported that young children are capable of becoming proficient and enthusiastic users of iPads (M. W. Wilson, 2014). Within the new social studies of childhood paradigm, such findings are interpreted as evidence of children's agencies and capacities, but a more technically-orientated analysis would frame this differently, as confirmation of the effectiveness of designs that have been deliberately engineered to capture human attention and thereby generate surplus value. To borrow terms used by Flusser (Flewitt, Messer, & Kucirkova, 2015; Lynch and Redpath, 2014), the children have become functionaries of the programme of the iPad, which shows itself to be capable of using children rather than the other way around.

This is not to suggest that media systems operate in a purely deterministic way, overriding any possibility for human creativity or agency. Rather, networked computation functions an apparatus of governmental biopower in the Foucaultian sense – reading Foucault here as a socio-material rather than socio-cultural theorist, following his materially grounded conceptions of discourse, institutional space, the dispositif and technologies of the self (2013). From this point of view, networked computation is a technology that *produces* particular kinds of human subjectivity, by eliciting and shaping human action, in ways that then feed forward and are recouped into the system, through algorithmic data

processing for example. Whilst it is possible for human subjects to repurpose these technologies for genuinely novel and unexpected uses, such inventions are unlikely to be found in the routine operation of the user interface within its designed parameters.

Defining networked computational media

Stepping away from utilisation to look more closely at the technical level of networked computational media, there are at least three significant features that distinguish these systems from other kinds of media. Getting a handle on these features of networked computation is helpful for properly defining the technical objects with which most of the recent research on children and digital technologies is concerned.

First, in computation all signals are subsumed into universal calculation and thus become interchangeable as binary data. Images, text, audio, video are all registered as binary numbers in the on or off positions of microscopic switches. In other words, there is a distinctive episto-ontology based on principles such as signal processing, transduction, and the automated mass switching made possible by the invention of transistors. Such matters might seem, to social researchers, like obscure details, but they are in fact of foundational importance to how computational technology functions, and as such need to be taken into account in the analysis of computational media.

Second, the networking of modern computation makes devices interoperable across planetary scales. Bratton (Foucault, 1977, 1981, 1988) writes of media as an accidental multi-layered megastructure, rooted in the earth and extending upwards to the cloud, with profound implications for geopolitics and new models of sovereignty. To take one example of how this planetary scale matters for children's relations with media, a focus on practices of use might lead us to conclude that, with the advent of internet video telephony services such as Skype and Facetime, space has been collapsed and distance conquered, enabling children to communicate in real time with distant others. Yet this 'everything everywhere' perception of distance shrinking is a hallucination produced at the

phenomenological level of the interface, in a way that is sufficiently alluring to capture attention and thereby generate profit. These perceptual effects are generated by a physical infrastructure that is in fact not collapsing space but extending across it, in ways that constitute new forms of colonisation and empire building (2014). The illusion of co-presence produced by networked computation depends on large scale engineering achievements such as the replacement of copper submarine cables with optical fibres.

Likewise the perception of 'real time' communication is also an illusion. As Ernst (Graham, Andersen, & Mann, 2015; Herregraven, 2015) points out, streaming devices have their own microtemporalities based around buffering processes, in which delays are used precisely to compensate for the inherent discontinuity of digital processing. The packet switched architecture of the internet means that data is sent as a series of discrete chunks rather than in a continuous stream. The trick of so called 'real time' processes is to transduce these data chunks into light and sound just fast enough to fool the human senses into perceiving continuity from data that is discontinuous at the technical level (2013).

Third, the current configuration of networked computation depends on an ongoing process of miniaturisation-mobilisation, in which technical evolution is working not to increase the processing power of computational machines per se, but rather to optimise the ratio between performance, size and weight. Rolled up in this movement is a whole complex of factors, including the aspirations of ubiquitous computing, the reduced instruction set paradigm driving the processing chips used in many smart phones and tablets, the development of broadband wireless cellular infrastructure, and – of particular relevance to my discussion of cobalt later in the paper – the engineering of compact high power batteries through lithium ion technologies.

The combination of universal binary computation, planetary networking and miniaturisation-mobilisation is what has produced the current configuration of the security-entertainment complex (Soon, 2017; Sprenger, 2015), or what Colman et al. (Thrift, 2011) call the algorithmic condition. Given the significance

of these technical developments, what seems problematic is how childhood studies research on children's relations with media not only tend to focus on utilisation at the expense of technics, but often do so as a default starting position, with little consideration of the alternative perspectives that have been developed in media theory. Utilisation is merely the most visible tip of the media iceberg. Whilst it may constitute an important part of the media assemblage, childhood studies too often mistakes it for the entirety of what is significant. Some of the most analytically generative work in media theory has arisen out of a refusal to equate media technics and materialities with their utilisation. It is to this work that I will now turn.

Rethinking media: from utilisation to the geology of media

At the beginning of *On The Mode Of Existence of Technical Objects*, Gilbert Simondon sets out a bold ambition to overcome the alienation of technology from humans, which he describes as a form of xenophobia: "The most powerful case of alienation in the contemporary world resides in this misunderstanding of the machine, which is not an alienation caused by the machine, but by the non-knowledge of its nature and essence" (2018). This alienation of the technical arises through machines being treated in strictly utilitarian terms, as things that have no intrinsic significance but are wholly defined by their service of human needs.

Simondon argues that this focus on utilization is misleading, since dissimilar technologies can be used for similar purposes, and so focus on use-value fails to discern the distinctive qualities of a technical object. Utilisation also creates barriers to the analysis of technical objects: "the use relation is not conducive to the raising of awareness, because its habitual repetition erases the awareness of structures and operations within the stereotypy of adapted gestures." (ibid., p.18) With networked computation, this situation is exacerbated by the tendency of consumer-orientated devices to screen their workings from users: "on an intentionally superficial level, perfect graphic user interfaces…hide a whole machine from its users." (Simondon, 2017, p.16) Consequently, studies that focus on gathering observations or accounts of how these technologies are used

cannot adequately address the technical. As such they perpetuate the problem of alienation, obstructing the sort of technical awareness that Simondon thinks is needed for humans to develop a proper understanding of machines, and hence a more fulfilling relationship with them.

One way to develop this awareness is to push beyond utilization to address the processes that come before and after the use phase, in the production of technologies, and in their afterlives as waste. A growing body of work in media studies is investigating these issues, developing materially-orientated analyses of the environmental and ecological effects of media technologies (Kittler, 1995, unpaginated). Such analyses can be traced back to materialist media theorists such as Kittler, for whom media are physical apparatuses of power-knowledge that set the conditions of possibility for the human subject. From this perspective, media analysis should excavate "the material structures of technologies and the changes these introduce into culture, not the ways in which these are used or the content of the messages that pass through them." (Gabrys, 2011; Maxwell and Miller, 2012; Taffel, 2012). Along similar lines, Wolfgang Ernst (Gane, 2005, p.29) distinguishes between cultural histories of media, which examine the human practices and meanings that develop around the use of media machines, and the media archaeological approach, which unearths the histories of these machines using non-interpretive, non-narrative methods, digging into the physics of their engineering.

Jussi Parikka has been building a body of media theory that takes up these more-than-human dimensions of media in relation to the Anthropocene. Parikka twists the stratigraphic term into the more politically weaponised concept of the Anthrobscene. With its two halves grinding against each other in uncomfortable torsion, the word evokes "the unsustainable, politically dubious, and ethically suspicious practices that maintain technological culture and its corporate networks…[such as] the environmentally disastrous consequences of planned obsolescence of electronic media, the energy costs of digital culture, and, for instance, the neocolonial arrangements of material and energy extraction across the globe." (2013). The Anthropos imagined here cuts a dishevelled figure, a man

whose crowning achievements turn out to be propped up by grotesque acts of despoilment, like a planetary scale Harvey Weinstein or Jimmy Saville. If Haraway's (Parikka, 2015a, introduction 6/10) concept of the Chthulucene points towards a new post-human epoch, then the Anthrobscene sums up the last gasps of macho modernism. It is the perfect name for the era of Donald Trump, Vladimir Putin and Xi Jinping.

As a way to analyse the Anthrobscene, Parikka sets out what he calls a geology of media, approaching media technologies not as tools for transmitting meaning but as assemblages of earth materials. The notion of geology deployed here bypasses the discipline's complicity in the extractive industries, winding further back to the seminal ideas of geologists such as James Hutton. Appropriated into media theory, geological thought becomes a provocation to face up to the inhuman dimension of media – expanding the bandwidth of analysis to consider the deep time of media technologies, in their prehistories as earth minerals and their afterlives as toxic waste:

> a deep time of the planet is inside our machines, crystallized as part of the contemporary political economy: material histories of labor and the planet are entangled in devices…Data mining might be a leading hype term for our digital age…but it is enabled only by the sort of mining that we associate with the ground and its ungrounding. Digital culture starts in the depths and deep times of the planet. Sadly, this story is most often more obscene than something to be celebrated with awe. (2016)

Parikka writes of these materialities as 'harder than hardware' – a statement which can be taken in a physical sense, as the hard stuff of metals and rare earth minerals, but also in the sense of something that presents difficulty, the sort of trouble that Haraway wants us to stay with, and which the notion of the Anthrobscene forces us to confront. Unlike the Anthropocene, the Anthrobscene does not hide this trouble behind a veneer of scientific respectability. It is not a neutral category to help future scientists classify strata, but a call to action.

It is worth noting that there are considerable differences between Simondon and Parikka. Simondon is concerned with technical objects in general, whereas Parikka's interest is in media systems. Simondon also insists that "the technical object is not a natural, physical system, it is the physical translation of an intellectual system…it cannot be examined inductively like a natural object, precisely because it is artificial." (Parikka, 2015b, p.57-58) This position differs markedly from that of Parikka, whose work experiments with approaching media technologies as hybrid natural-cultural assemblages. At risk of intellectual incoherence, however, what I am attempting here is to take something from both these approaches. I want to argue for approaching media as socio-culturally embedded *and* having specific technicities independent of use *and* as physical assemblages of earth energies and materials. Media are simultaneously operating on all of these registers; as such they require analysis that pries open the inter-relations between them, rather than becoming fixated on one or the other.

In the following final section of the paper, I set out an example of how technically and physically orientated analyses can be put to into dialogue with perspectives from the new social studies of childhood, by examining how children are caught up in Anthrobscene cobalt mining. What I think both Simondon and Parikka share is a desire to develop analyses of technologies that are adequate to the technical and material dimensions of these systems. Simondon takes us beyond utilisation, while Parikka links media to the Anthropocene and its geologic politics. As I will show, sociological analysis can also provide empirical insights that 'speak back' to materialist media theory, producing a kind of reciprocal refinement of these ideas.

Artisanal cobalt mining: bodies, minerals, labour
Cobalt is a crucial ingredient in mobile media. Used to make lithium ion rechargeable batteries, it enables smartphones, tablets, laptops, cameras and other portable devices to hold charge reliably, in a lightweight and small package, thus facilitating the miniaturisation-mobilisation of computational

media. Lithium ion cells are also used to power electric vehicles – another example of the Anthrobscene's comic faith in technical fixes for climate change. The cobalt market is variable, with a history of price spikes and troughs. Due to the expanding market in electric vehicles, global demand for cobalt has been rising faster than supply in recent years, and between 2016 and 2018 cobalt prices quadrupled (Simondon, 2017, p.49). This minor metal has become an object of technical and economic desire, in which marvelous electrical affordances are tied to Anthrobscene production processes.

The Democratic Republic of Congo (DRC) is by far the world's largest producer of cobalt. The country currently generates around 58% of global cobalt supplies (InfoMine, 2018). A proportion of the country's cobalt production comes from artisanal and small-scale mining: non-mechanised, low-tech manual labour, carried out in an ad-hoc way with little regulation, often unlicensed and illegal. Artisanal cobalt mining is concentrated in the south of the DRC, in the former province of Katanga around the city of Lubumbashi. The sector expanded after the collapse in the 1990s of the state owned mining company, Gécamines, which left miners out of work and mines unworked. As a result of this deindustrialisation, informal and unregulated mining developed as miners sought a means of subsistence. Some work extracting heterogenite (cobalt ore) underground in tunnels using hand tools. Others dig for pieces of ore in the tailings leftover from industrial mines, or work sorting, washing and crushing ore by hand prior to sale. Since the early 2000s industrial mining has been rebuilt, following the introduction of a new mining code providing favourable conditions for foreign investment, and conflicts have arisen between incoming foreign mining companies and artisanal miners. Nevertheless, artisanal mining continues to provide a livelihood for tens of thousands of people in the Katanga region (Kay, 2018).

Many children are involved in artisanal cobalt mining in the DRC, but precise numbers are difficult to ascertain. (Hönke, 2010; Tsurukawa, Prakash, & Manhart, 2011) report that in DRC artisanal cobalt mining "28% of the workforce or between 19,000 to 30,000 miners are children under the age of 15,

some of them being as young as 6 years old. Another 14%, or between 9,000 and 15,000 workers are 15 to 17 years old." In 2012, UNICEF estimated that there were 40,000 children working in artisanal mines in southern Katanga, representing around a third of the total number of workers Tsurukawa, et al. (2011, p.32).

Qualitative research on children's involvement in cobalt production is sparse, and presents a complex picture. (Walther, 2012) interviewed 17 children in the DRC who reported having either mined, collected or handled cobalt. The resulting report emphasises hardships and dangers, portraying child artisanal mining as highly exploitative, with children carrying heavy loads of 20-40kg, working for up to 12 hours per day, and causing difficulties such as pain in their bodies, frequent illnesses, going without food, being physically assaulted by security guards patrolling the mines, being paid unfairly for ore by traders, and being subject to extortion through illegal 'taxes' demanded by corrupt police and government officials. The report also highlights safety issues, noting that artisanal cobalt miners work without even rudimentary protective equipment such as dust masks, gloves or overalls, that they complained of lung and other health problems due to inhaling dust, and that they were also subject to hazards of fatality and injury due to mineshafts collapsing or equipment failing. Media portrayals of Congolese cobalt mining tend to amplify these hardships, reproducing established narratives of 'developing world' victimhood and poverty.

Such bleak descriptions of bodily degradation contrast with the findings of Afrewatch and Amnesty International (2016). Through 44 interviews with members of 21 households, these authors found that children's mining in the DRC is often a way in which working class children contribute to their families, comparable in socio-economic terms to agricultural and domestic labour. In many cases, children reported working alongside other family or community members, such that their mining labour socialises them into these collectives, enabling them to fulfill family duties and obligations, and giving them a greater stake in family life as a result. André and Godin's research also revealed that

some middle class children opt to work in the mines not out of economic necessity but as a way of generating an independent income and forging their own identities, in defiance of their parents' wishes that they focus on schooling.

These differing representations can be linked to broader debates about child labour, particularly the question of whether it ought to be framed as an abuse of children's rights or conversely as a form of participation in the life of the community. The concept of the Anthrobscene steers us towards seeing child mining as a mutually exploitative, damaging relationship between child bodies and the earth, which is no doubt part of the picture. Yet the sociological research I have reported on can help to give nuance to the concept of the Anthrobscene. For example, child labour is often criticised as taking children away from educational opportunities, and parents in André and Godin's study articulated that anxiety, but at the same time some children in Amnesty's research spoke of doing mining work outside of school hours precisely as a way to raise money to pay for school fees. The wider context of this issue is one in which western post-industrial norms about childhood have been exported to the majority world, through the work of NGOs and development agencies promoting a universal ideal of childhood, which Boyden André and Godin (2014) characterises as "essentially sentimental": that children should be carefree, innocent and happy, protected from harm, economically provided for by their parents, and engaged in school-based learning rather than productive work.

Thus Wyness (1997, p.188) has argued that moral outrage over child labour is exclusionary, because it portrays children's involvement in material production as a deviant and deficit form of participation. Rather than viewing child labour as a problem to be eradicated and replaced with western liberal democratic voice-based forms of participation, he suggests we might instead recognise child labour as a way in which many children in the majority world contribute to their families and communities. From this point of view, the ethical imperative is not to ban child labour but to make it less exploitative. While NGOs and governments are pressing for manufacturers to do due diligence, ensuring that none of their minerals are sourced through child labour (2013), an alternative response would

be to examine the specific forms of exploitation faced by child miners and campaign for action on these, e.g. for improvements to safety and working conditions, fair regulation and remuneration, and ensuring that work is balanced with the provision of education. As Boyden (e.g. Partzsch and Vlaskamp, 2016) puts it: "In many societies, in rural areas particularly, work is and has always been a traditional activity of childhood and it may be fundamental to the transmission of skills and knowledge between generations... What is harmful is child involvement in work processes that impede normal development and health, and child labour that is exploitative." Given the messy history of mining in the DRC, however, including its role in military conflict and the failure of previous attempts at regulation, implementing non-harmful, non-exploitative forms of child mining is likely to be challenging. There is potential, however, for using networked computation itself to improve conditions for cobalt miners. For example, (1997, p.207) suggest that mobile phones could be used to send real-time updates on commodity prices to artisanal miners, who often work in remote locations with limited access to information, enabling them to get a fairer price for their minerals at the point of sale.

Taken together, this evidence demonstrates the potential of analyses that join up different aspects of technology – social, technical, (geo)physical. This sort of multi-layered analysis takes seriously the task of thinking more relationally about childhood and its materialities. It seems a missed opportunity, for instance, that while Andre and Godin Geenen and Radley (2014) provide fascinating insights into the socio-economic aspects of child mining in the DRC, they make only brief reference to the ore being mined, relegating its constituent minerals relegated to a footnote, and neglect the crucial detail of cobalt's importance within the technical evolution of mobile technologies. Consequently the analysis remains localised to the DRC, rather than articulating how the micro-politics of child mining is just one part of a massive planetary assemblage that also involves Chinese ore buyers, refining processes, shipping, tech manufacturing factories, plastics, handheld devices, consumers, wireless radio signals, and so on. The analytic separation of social and cultural practices from the technics and materialities with which they are bound up contributes to the

alienation of the technical, and the widespread collective ignorance of what is going on behind the screens.

To put this another way: it is possible, perhaps likely, that many of the smartphones and tablets on which minority world children are tapping and swiping contain minerals that have been through the hands of Congolese child miners. The image of the child as an agential user of technology begins to look like a privileged minority world position, propped up by Anthrobscene processes with which other children, elsewhere, are caught up. These other child bodies, usually pushed out of sight and out of mind in discussions of technology, constitute a material underside to narratives of children's technology use. Recognising the physical connections between these different child bodies unearths how geographically distant milieus come into relation through media. The fetishism through which networked computing devices are seen purely as consumer commodities begins to dissolve, giving way to a deeper understanding of how these devices link us, geo-physically, into dizzyingly complex planetary scale assemblages. I have tried to develop an analytical framework capable of addressing these different aspects of child-media relations together, in a way that is more attuned to the planetary entanglements of life in the Anthrobscene.

Conclusion

This paper has set out an analytical approach that expands on the scope of childhood studies research on media technologies. To date this work has primarily addressed how children and their significant others are using technologies. I have argued that this focus alone is not sufficient to address children's relations with media in the Anthropocene. Drawing on Simondon, I have defined the technical as a distinct realm of objects that cannot be understood by focussing only on their utilization. Going beyond use directs analysis towards the materialities of media machines, raising questions about minerals, e-waste and labour – issues that have been addressed by materialist media studies. I have drawn on Parikka in particular because his concepts of medianatures, the Anthrobscene and the geology of media all resonate with humanities and social sciences thinking about the Anthropocene – as a profound

and urgent challenge, to which all disciplines are accountable, owing to its significance for life on earth, both human and more-than-human.

The contribution of the paper cuts two ways. First, for research on childhood and media, the paper develops an expanded analytical framework that addresses the relations between children and media materials, and between minority and majority world childhoods. My discussion of child labour in cobalt mining in the Democratic Republic of Congo shows how analysis can work across the social, the technical and the physical to provide an expanded perspective on children's relations with media. The planetary networks of computational media require forms of analysis that are multi-layered, encompassing disparate elements. This kind of analysis answers Ansell's (2014) call for a way of working with scale that both acknowledges the importance to children of highly localised spaces, and also traces outwards to other spaces, tracing the larger networks through which childhoods are constituted.

Second, for research on childhood in the Anthropocene, the paper shows how networked computational media mediate between children and the earth. Much of the research to date in this area has examined children's relations with animals (2009). This paper shows how Anthrobscene childhoods are also constituted by children's relations with other kinds of bodies, specifically media devices and minerals. Aligning with Horton and Kraftl's (e.g. Malone, 2016; Nxumalo and Pacini-Ketchabaw, 2017; Taylor and Pacini-Ketchabaw, 2017) interest in the troubling side of childhood materialities, I have drawn attention to material entanglements that are exploitative and potentially harmful, whilst trying to avoid reproducing the simplistic narratives of vulnerability and victimhood that characterise many accounts of child mining.

Against the popular view that media are destroying children's relations with the natural world, this paper suggests that media are systems through which children are in fact entangled with the earth. In the case of cobalt and other media minerals, problematic but potentially provocative relations that are hidden by the superficiality of utilization. If we want our media to help us

formulate ecological politics for the Anthropocene, it might be worth finding ways to push beyond a focus on utilisation, get behind the screens, and dig into the social-technical-physical relations that constitute these technologies.

Notes

[1] I am indebted to Douglas Kahn for this critique of geology, based on his presentation in June 2018 at Tuned City festival, Ancient Messini, Greece.

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