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**RESEARCH ARTICLE**

# Towards an Ethical Electronics? Ecologies of Congolese Conflict Minerals

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This paper asks how coltan, cassiterite, wolframite and gold ores mined in the Democratic Republic of Congo relate networked microelectronics to brutal warlords, and what legal and industrial actions have been enacted by activists, NGOs, politicians and businesses aiming to address this situation. Exploring these questions requires the abandonment of immaterialist rhetorics of technology; tropes of cyberspace, virtuality, cloud computing and other discourses of digital disembodiment, instead inviting materialist analysis relating to the geological, geopolitical, industrial and informational flows surrounding globalised microelectronics industries.

The paper applies media ecologies and object-oriented ontology to explore ethics and electronics, in particular focussing upon the legislative action of Dodd-Frank Section 1502 and the release of the Fairphone as moves explicitly designed to address Congolese conflict minerals and networked microelectronics in which the networked technologies that are the 'causes' of social and ecological pathologies are simultaneously being used to mitigate their deleterious impacts.

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## Virtual Cloud Computing and the Material Turn

*The central event of the 20th century is the overthrow of matter. In technology, economics, and the politics of nations, wealth – in the form of physical resources – has been losing value and significance. The powers of mind are everywhere ascendant over the brute force of things.*

*(Dyson, 1994)*

Discourses of digital culture have largely been dominated by rhetoric which dematerialises the material architecture that enables the flow of binary code across the internet. Cyberspace, a ubiquitous trope within early 'new' media scholarship (e.g. Murray, 1997; Lessig, 1999; Lévy, 1999; Dodge and Kitchin, 2000), allegedly exists outside the borders and jurisdiction of national governments, forming a space where 'legal concepts of property, expression,

identity, movement, and context do not apply... They are all based on matter, and there is no matter here.' (Barlow, 1996) However, when considering the assemblages of minerals, metals, chemicals and code which compose the computers, modems, routers, exchange points, fibre-optic cables, monitors and myriad of other components that comprise the physical layers of the internet, we find that the weightless rhetoric of cyberspace is underpinned by vast amounts of matter. Additionally, the security service leaks initiated by Edward Snowden in 2013 denote that governmental agencies utilise the geographical distribution of the material infrastructure of the internet to enable programmes such as Tempora, XKeyscore and Boundless Informant to collect and data mine the vast majority of internet traffic, leveraging the material geographical affordances of the internet for the purpose of global surveillance. Revisiting the utopian and idealist claims pertaining to cyberspace, we find that both the independence and immateriality proposed as essential characteristics were erroneous propositions.

A similar argument can be made regarding virtuality, another key term within early internet scholarship (e.g. Rheingold, 1991; Hayles, 1993; Rheingold, 1993; Woolley, 1993; Holmes, 1997; Lister, 2002). Whilst virtualisation is a technical term within computing which refers to one computational platform emulating or simulating another, vernacular and scholarly appropriations of the virtual combine this with the definition of the virtual as that which is almost, but not quite real. This linguistic ambiguity is extended by the philosophical concept of the virtual originating within the work of Henri Bergson (1983), and popularised by Gilles Deleuze (1988; 1994). Here the virtual refers to latent potential outcomes, only a fraction of which can ever be actualised. Applying the latter definition of virtual, Brian Massumi (2002, 137) argues: 'Nothing is more destructive for the thinking and imaging of the virtual than equating it with the digital.' Whilst certain versions of virtuality such as Castells' (1996) culture of real virtuality, and Hayles' (1999) critique of the discourse of disembodied information address issues surrounding the virtual that gesture towards an informational space allegedly existing outside of material reality, there remains a strong tendency towards dematerialisation within the applications of the term within the context of digital culture.

The mode of labour frequently proclaimed to relate to information and communications technology is immaterial labour, a term which Maurizio Lazzarato (1996) introduced within an autonomist account of the reorganisation of labour within late-capitalist societies. Whilst Lazzarato examines material changes surrounding production within neoliberal contexts, the notion that this labour is somehow immaterial, and that immateriality is a key concept within the terrain of the digital is unfortunately one commonly attributed to this work. Indeed, rhetorics of immateriality frequently conceal pressing ethical and political issues whereby digital technologies have detrimental impacts upon social and environmental systems.

Discourses surrounding immateriality and digital technologies have recently resurfaced around cloud computing, whereby thin-client devices such as smartphones and tablets are used to remotely access storage and computational resources commonly located within corporate server farms. Whilst the analogy with floating gaseous vapour suggests that digital technology is lighter than air, a near massless and immaterial network, as Cubitt et al. (2011) demonstrate, the energy costs of distributed computational networks are a substantial and rapidly growing contributor to anthropogenic carbon dioxide emissions. The material technologies which afford cloud computing are thus an integral component within an unsustainable networked global economy.

Far from demarcating a virtual cyber realm which escapes material reality, the networked microelectronic architectures of the internet impact upon a range of ethical and political issues which have frequently been marginalised by discourses of immateriality. Indeed, recent

years have seen nascent moves towards exploring such impacts, (e.g. Cubitt et al., 2011; Gabrys, 2011; Maxwell and Miller, 2012; Parikka, 2012; Taffel, 2012; Parikka, 2013; Goddard, 2014) and this paper seeks to locate itself within these academic constellations which could be understood as a material turn within digital studies. It is important, however, not to situate the material turn within a discourse/materiality dualism. Whereas Marx's materialism sought to turn Hegelian idealism on its head, the various approaches associated with 'new materialism' tend towards a monism whereby discourse and materiality inform and mutate one another rather than existing as incommensurable binary opposites. In what follows, this article uses a case study surrounding conflict minerals originating within the Democratic Republic of Congo (DRC) as a way of interrogating three sets of concerns. Firstly, the case study highlights a number of material impacts associated with the microelectronic-devices which form the architectures of the internet and networked cultures. Secondly, examining these practices affords a way of exploring various avenues by which more ethically responsible modes of microelectronics may emerge. Finally, the case study presents an example onto which to map divergent concepts which exist within contemporary materialist approaches and highlighting some of the key political and practical discrepancies between them.

### **Mobiles, Minerals and Materiality**

Within the veritable witches' brew of chemicals, metals, minerals, plastics and other substances required for the manufacture of contemporary networked microelectronics, a particular series of substances which have attracted significant attention over recent years are several minerals mined within the North and South Kivu provinces of DRC. Collectively known as 3TG, tungsten, tantalum, tin and gold are substances implicated in funding brutal warlords whose actions have prolonged the civil conflict which has lingered since the international phase of the Second Congo War ended in 2003.

3TG are important materials within contemporary microelectronic architectures for divergent reasons. Tantalum, which in DRC is derived from coltan ore, a portmanteau of tantalum and columbium (the element contemporaneously known as niobium), is used as a powder within electrolytic capacitors; components used to store electrical energy within microelectronic circuits. This is the primary global use of tantalum. Tantalum is used in this capacity because of its volumetric efficiency, entailing that capacitors can store relatively large electrical charges for their size; a hugely advantageous property when designing wafer-thin portable microelectronics.

In DRC, tin is derived from cassiterite ore, an oxidised form of tin. Around 55% of tin is used within solder, the fusible metal used for joining substances which have a higher melting point than the solder. Solder connects various microelectronic components to the printed circuit boards which connect them to one another. Historically, solder was composed of lead/tin alloys, however, in 2006 the European Union Restriction of Certain Hazardous Substances Directive prohibited the usage of lead within consumer electronics due to its toxicity. Consequently, contemporary solders tend to have higher tin contents than their historical antecedents. Additionally tin is used within indium tin oxide (ITO), a key substance used to produce transparent capacitive touchscreens, as found on smartphones and tablets. ITO is utilised in this capacity because it combines electrical conductivity with optical transparency. Although this represents a tiny amount of global tin usage, capacitive touchscreens are vital to contemporary computational ecologies.

Tungsten is a crucial component within integrated circuits, the silicon chips used ubiquitously within computing, where it is the material used for the contacts and plugs which connect the millions of transistors housed upon silicon wafers. Tungsten is utilised because

its thermal expansion coefficient is almost equal to that of silicon. Additionally, tungsten is utilised within copper/tungsten heat-sinks, which are used to draw heat away from CPUs and GPUs due to tungsten's high thermal conductivity coupled with its thermal expansion coefficient. Finally, whereas gold is primarily utilised in non-microelectronic ventures such as jewellery and bullion, it acts as an efficient and reliable conductor which is not susceptible to corrosion, and so is the preferred material used within the pins and connectors which mount microprocessors and RAM modules onto motherboards.

When considering precisely why these materials are important to the production of contemporary microelectronics, at first glance it appears that utility of 3TG derives from internal properties, such as the thermal expansion coefficient of tungsten or the melting point of tin. This idea of the isolated thing-in-itself approaches the perspective on material reality associated with Object Orientated Ontology (OOO). OOO argues that in contrast with the unproblematic realism attributed to positivist and Marxist approaches, whilst there is a reality out there, humans can only ever approach this reality in a partial way, thus adopting a speculative approach to realism. However, following Meillassoux (2008), OOO contends that the Kantian separation between the real and our encounter with it, which they term correlationism, creates an untenable situation whereby humans can only know the correlation between perception and the world, and never the world itself. Drawing heavily upon the methodological framework of Actor-Network Theory (Latour, 1993; 2005b), OOO extends the Latourian notion that objects have agency, but reconceptualises the world as 'composed of units or individual entities existing at a variety of different levels of scale, and that are themselves composed of other entities' (Bryant, 2014, 7).

However, upon closer inspection, the desired characteristics of these materials are relational capacities rather than isolatable qualities, that is, they are qualities which are actuated by connecting these substances to other entities. What is important is not exclusively the thermal expansion coefficient of tungsten, but the fact that it closely correlates to that of silicon. Similarly, tin alloys' low melting point is low in relation to the various substances being fused by solder, as opposed to materials such as mercury or water. Exploring the relational capacities of dynamic systems draw parallels with the approach (or suite of approaches) derived from the process-based, monistic and pluralistic ontologies informed by theories of complexity and self-organisation found within the works of Gilles Deleuze and Felix Guattari (1977; 1987).

Whilst there are diverse appropriations of Deleuze and Guattari's works stretching across numerous disciplines including affect theory (Massumi, 2002; Thrift, 2004) and non-representational theory (Thrift, 2008; Dewsbury, 2010), one approach particularly pertinent to discussions here is media ecologies (Fuller, 2005; Goddard, 2010; Parikka, 2012; Taffel, 2013), which seeks to apply ecological (Herzogenrath, 2009) and geo-philosophical (Bonta and Protevi, 2004) readings of Deleuze and Guattari, whilst drawing heavily upon Guattari's solely authored works (1995; 2000), which explicitly focus upon an ecological ethics and praxis in order to explore media as complex and dynamic flows of matter, energy, symbols and affects. According to Fuller (2005, 2), ecology is a productive term to apply in relation to media systems, precisely because it 'is one of the most expressive [that] language currently has to indicate the massive and dynamic interrelation of processes and objects, beings and things, patterns and matter.' Ecology, as the study of interconnections between entities, departs from other fields of inquiry in that it is not the ecological 'things' themselves under scrutiny, but interactions and transformations of energy and matter between dynamic and evolutionary systems which are central.

The ecological focus upon connectivity points towards a pivotal divergence between OOO and Deleuzian approaches, which surrounds the respective importance bestowed upon processes and objects. Whereas Deleuze and Guattari (1987, 25) propose that it is necessary to

'overthrow ontology', to refocus from a static sense of being towards the process of becoming, for proponents of OOO such as Ian Bogost (2012) and Graham Harman (2010), this emphasis on transformation, flux and couplings presents a misplaced focus which systematically de-emphasises the importance of the thing-in-itself, the objects or units from which reality is composed and which are the central concern of OOO. This is not however to suggest a simple object/process binary opposition. OOO theorist Timothy Morton (2013, 72–73) asserts that 'A process is simply an object seen from a standpoint that is 1 + n dimensions lower than that object's dimensionality.' Correspondingly, objects are always processes when viewed from a different dimension. Homologous to the wave-particle duality within quantum physics, phenomena can be depicted as objects and processes, but whether we highlight dynamics which emphasise process, like flow, entanglement and relationality, or those which point towards objects, such as withdrawal, isolation and persistence, depends upon contextual specificity.

Throughout this article I argue that when examining issues surrounding materiality, micro-electronics and 3TG, mapping these systems as entangled processes has more political and ethical utility than approaching them as isolated objects. Indeed, as Alexander Galloway (2013) suggests, within a neoliberal social ecology which celebrates the atomised individual consumer and competitive individualism, OOO's emphasis on separation appears to correlate with forms of neo-conservative orthodoxy. Issues surrounding microelectronics, materiality, ethics and politics within a contemporary context are frequently associated with corporations and consumers adopting outlooks which view the world and their relation to it as inherently disconnected. Thinking about my smartphone, my tablet, my objects and how they meet my individual needs relegates the importance of the conditions under which the materials necessary for the production of the device were procured and refined, and similarly de-emphasises the fact that these objects contribute to globalised flows of toxic e-waste once my individual consumption of them ceases. On the contrary, emphasising these devices as existent within flows of energy and matter highlights these often ignored phenomena by decentering the focus upon the fetishized objects of consumption.

Returning to 3TG, the notion that an entity's capacities exist in latent form, but only becoming actualised through the interaction between material entities, resembles James J Gibson's (1986) theory of affordances. For Gibson, what humans perceive when they see a bed is not the material composition, size or weight of the bed, but that it affords lying down, rest and sleep for people. These properties are present within the bed, but they are only realised by the interaction between the bed and a human; if another entity such as an elephant were to encounter the bed, those connective, or virtual capacities would not be actualised. Correspondingly, for Deleuze and Guattari the investigation of phenomena requires the exploration of the ways that bodies behave in composition with one another:

We know nothing about a body until we know what it can do, in other words, what its affects are, how they can or cannot enter into composition with other affects, with the affects of another body, either to destroy that body or to be destroyed by it, either to exchange actions and passions with it or to join with it in composing a more powerful body.

(Deleuze and Guattari, 1987, 252)

Were integrated circuits composed of a material other than silicon, tungsten's thermal expansion coefficient would render it unsuitable for usage in heat sinks or plugs. Thinking in this relational manner suggests that when exploring the roles of materials within microelectronics, we must explore the ecologies in which specific materials are situated. Given the vast number of virtual properties, capacities and affordances relating to any entity, only through

exploring actualised relations within material assemblages can we obtain a productive comprehension of digital architectures. Having considered the utility of 3TG within microelectronics, I now turn towards a series of specific circumstances surrounding the Second Congo War as a way of contextualising how Congolese 3TG became implicated in the conflict and how this translated into issues surrounding microelectronics, ethics and activism.

### **3TG and the Second Congo War**

Whilst 3TG have been widely described as pivotal to the maintenance of the enduring Congolese conflict, the reasons behind the outbreak of hostilities are far removed from microelectronics. The Second Congo War began in August 1998, just over a year after the cessation of the First Congolese War, which ended with Mobutu Sese Seko being overthrown by rebel Congolese forces led by Laurent Desire Kabila and supported by Rwandan and Ugandan forces whose intervention related to the pursuit of Interhamwe militias associated with the 1994 Rwandan genocide, who were amongst the 1.2 million Hutu refugees who subsequently fled into the Eastern provinces of the nation then known as Zaire (Moyroud and Katunga, 2002, 160). Following a breakdown in relations between the Kabila government and its wartime allies, Rwandan and Ugandan troops were asked to leave DRC, sparking a second conflict where Rwandan and Ugandan forces allied with Congolese Tutsi groups and waged a campaign against the Kabila government, which was supported by Angolan, Namibian and Zimbabwean forces. The international phase of the conflict lasted until 2002, when the Sun City Agreement and Pretoria Accord formalised peace deals between DRC and Uganda and Rwanda respectively. However, whilst this saw the termination of official and direct involvement from foreign governments, civil conflict in DRC endures, with various militias, warlords and other armed groups continuing the violence which, by 2006, had claimed over 5.4 million lives (Coghlan et al., 2006), the vast majority of fatalities being attributed to malnutrition and epidemics of treatable diseases which flourished as social infrastructure collapsed.

The geopolitical background converges with 3TG, as once the conflict was underway, the various armed forces had to finance their campaigns, and 3TG became a crucial actor as a conflict-aggravating and sustaining factor. Ugandan coltan exports rose by 2800% between 1997 and 1999 (Essick, 2001), and Rwandan president Paul Kagame described Rwandan involvement in DRC as self-financing (UN Security Council, 2000; Montague, 2002), primarily due to the theft of Congolese mineral wealth, with Rwandan forces expropriating in excess of \$62 million worth of coltan in 1999 alone (Nest, 2011, p. 93). Since the cessation of the international phase of the conflict, various militias and warlords have fought for control of the 3TG mines which finance the continuation of armed struggle.

An additional factor which further complicated the situation with relation to coltan relates to the structure and fluctuations of tantalum markets, and specific events which occurred in 2000. Congolese coltan is just one source of tantalum within the globalised market, with Australia, Brazil and Thailand being other major global exporters. Most large-scale mining operations agree long term contracts with smelting and refining companies, which set fixed prices for tantalite and guaranteed quotas to be provided by the mining company. Such agreements benefit both parties; mining companies are guaranteed an income with which to recoup the costs of establishing and maintaining operations, whereas refineries are assured of receiving consistent quantities of tantalum. Due to the political instability within DRC, however, tantalum procurement arises from artisanal mining operations which is sold by miners to local Negotiants, who in turn sell material with Comptoirs (more organised collective entities, which act as minerals trading firms) based in the local capital (Goma for the Kivu regions). Comptoirs then sell ore on to export firms at spot market prices, providing the world's largest source of spot market tantalite (Nest, 2011, 60). In 2000, the global

tantalum market saw unprecedented demand, in part driven by the growing popularity of mobile microelectronics devices which utilised tantalum capacitors (Roskill, 2002). Whereas the long-term fixed-price contracts for tantalum were set at US\$40 per pound (Hayes and Burge, 2003, 22), the inability of these sources to meet the increased demand entailed that companies turned to spot markets to meet the shortfall. Consequently, spot-market prices of tantalum rose from US\$30 per pound in 1999 to a peak of US\$500 per pound (Hayes and Burge, 2003, p. 22) in 2000, at which point the US began releasing tantalum from its strategic reserves to alleviate the spike in the market (Cunningham, 2001, 9). The consequence of this massive increase in both the demand for and price of tantalum saw hundreds of thousands of Congolese citizens take up the newly lucrative business of artisanal coltan mining.

This rush towards artisanal coltan mining in the Kivu provinces was accompanied by wide-scale deforestation in order for miners to access the ores, converting previously lush vegetation into landscapes of bare earth. The process of separating raw ores into saleable minerals is also ecologically damaging, causing soil erosion and degrading water catchments (Moyroud and Katunga, 2002, 173). The widespread flight from agriculture towards artisanal mining saw food prices rise due to shortages, and consequently people hunted endangered species such as Grauer's Mountain Gorilla and elephants as food. Whereas before the conflict in 1996 there were 8,000 gorillas and 3,600 elephants residing within the Kahuzi-Biega National Park, by 2001 there remained just 1,000 gorillas and 500 elephants. (Moyroud and Katunga, 2002, 173). Problems surrounding starvation and the hunting of endangered species for bushmeat are linked to the transformation of agricultural land to artisanal mining (Oxfam et al., 2001; Tegera, 2002, 20) and have been described by ecologists as 'ecocide' (Moyroud and Katunga, 2002, 174).

Analysing issues linked to 3TG and conflict within the Congo soon leads far away from the materials, with issues surrounding Congolese 3TG and networked microelectronics being interwoven with phenomena including the ore's geographical location, ethnic divisions and tensions which pre-dated the Congolese conflict (and can be traced back to decisions enacted by German and Belgian colonial administrations), the multiplicity of factors surrounding the actuation of military conflicts within Rwanda and DRC, and the globalised flows of metals, minerals, market valuations and mining contracts. In this case, numerous factors converged in such a way that during the conflict tantalum spot-market prices soared, and as the world's leading source of spot-market tantalum, artisanal Congolese coltan mining fleetingly became considerably more lucrative than subsistence agriculture causing huge numbers of Congolese citizens to take up this profession whilst foreign armies, and local militias, sought to continue funding participation in the conflict through strategically controlling mineral wealth. Consequently, microelectronics overwhelmingly consumed outside of Africa were responsible for sustaining a conflict which had devastating impacts for human and nonhuman life in DRC, presenting a form of material impact which reveals the fallacy of cyberutopian claims surrounding the immateriality of the internet.

This suggests that ethical issues surrounding the consumption of microelectronics containing Congolese 3TG map somewhat poorly onto the notion of the object-in-itself which is central to OOO. Whereas Bogost (2012, p. 40) situates this discourse in opposition to the Deleuzian notion of becoming, arguing 'the inherent partition between things is a premise of OOO,' an examination of the dense meshwork of relations surrounding microelectronics, 3TG and the Congolese conflict presents strong evidence against this notion of segregated and discrete entities. Engaging with complex issues requires mapping flows and connections in order to comprehend how the singularities they form continue to evolve, and what kinds of interventions are likely to have beneficial impacts. Rather than exploring phenomena as isolatable objects, this instead calls for an ecological praxis whereby material issues are

examined as entangled meshworks. As Karen Barad (2007) explains, entanglement does not merely suggest that independent, pre-existing entities are connected to one another, but that the entities are themselves constituted through their collaborative relations within ecological system across a variety of scales.

With the example of 3TG, only through exploring the convergence of flows surrounding pricing within global tantalum markets, the ethnic, regional, nationalist and international military violence in DRC, and the evolution of mobile microelectronics devices do we begin to gain a nuanced understanding of the issues involved, which is a prerequisite for undertaking ethical action designed to address the fact that consumer microelectronics continue to finance brutal violence in an impoverished and war-torn nation. The issue is not just the materials in themselves – as this would then entail that all tin, tungsten, tantalum and gold were equally implicated – but the specific economic, geopolitical and material conditions surrounding the procurement of these minerals from DRC, and particularly the Kivu provinces, from 1998 onwards.

The detrimental impacts of 3TG extend beyond human factors, including impacts such as soil erosion and deforestation, and this points towards an ethics which extends beyond the humanist focus of Marxist materialisms and the ethical frameworks of deontology and consequentialism. The posthuman (Rutsky, 1999; Wolfe, 2010; Braidotti, 2013), Deleuzian and OOO emphasis upon decentring Man and valuing nonhuman entities in more than a utilitarian manner becomes an important factor in contemplating what ethical action entails. If we are to collectively mobilise action which meaningfully addresses contemporary issues such as anthropogenic climate change, loss of biodiversity and deforestation, then adopting a posthuman or ecosophical perspective seems pivotal.

A criticism of posthuman approaches, particularly those associated with animal studies (Wolfe, 2009; Weil, 2012) is that the prominent focus within environmentalist narratives upon the destruction of charismatic megafauna such as gorillas and elephants represents only the slightest of gestures beyond humanist approaches, whereby those nonhumans deemed closest to, or most aesthetically appealing towards humanity are accorded disproportionate attention and status in comparison with microbial, insect, fungal and other modes of life which appear more alien to humans. OOO goes furthest here, contending that instead of animal liberation we should construct Latour's (2005a, 6) vision of an 'object-orientated democracy.' Whilst the notion that we should go beyond even biocentric and ecocentric positions is certainly intellectually radical, accepting that the ore being mined should receive equal status in terms of self-governance to the human miners or flora and fauna affected by the mining operation is both counterintuitive and suggests a political conservatism through the manner by which such moves conceal the tangible harms and suffering existing elsewhere in this assemblage.

Appeals to feeling and suffering exemplify the correlationist conceit: the assumption that the rights any thing should have are the same ones we believe we should have; that living things more like us are more important than those less like us; and that life itself is an existence of greater worth than inanimacy.

(Bogost, 2012, 73)

The ontological claim that all things exist equally does not necessarily equate to an ethical vantage point which erases difference. Whilst Bogost is right that we can never truly know what it is like to be cassiterite ore, tin solder or a molecule of water, this should not entail a nihilistic perspective, whereby palpable suffering is dismissed as correlationism. Here OOO supports an ethic in which inequalities of wealth, the proliferation of treatable diseases, and



anthropogenic climate change are all simply objects (or following Morton (2013), 'hyper-objects'), which should receive the same democratic and ethical consideration as other objects, including humans. The proliferation of diseases, of course, does mean the proliferation of life; but life forms which are predominantly valued negatively due to their harmful effects upon humans. Similarly, whilst anthropogenic climate change will likely generate a mass extinction event which entails a detrimental impact on global biodiversity, the earth has seen numerous mass extinction events during its history, but after each such event new life forms have adapted to fill ecological niches afforded by the transformed environment. Whilst thinking this way is politically unpalatable, effectively precluding any form of normative ethical critique geared towards positive ecological action and legitimising all manner of deeply inequitable and exploitative contemporaneous activities, examining such a philosophical position does raise pertinent questions regarding how we differentiate between positive and negative forms of life if we are not merely reiterating anthropocentrism.

In contrast to OOO, Deleuze and Guattari present an ethics whereby the universals of Kant's categorical imperative and the totality of the ethical cost/benefit analysis proposed by consequentialism are superseded by a system in which ethics are always contextual and contingent on their situation within concrete assemblages:

There is no Good or Evil in Nature, but there are good and bad things for each existing mode... The distinction between good things and bad provides the basis for a real ethical difference, which we must substitute for a false moral opposition.

(Deleuze, 1992, 253–254)

This ethic contends that good acts are those which augment the capabilities of assemblages – such as mutualistic and symbiotic relations – whereas bad acts diminish capacities by foreclosing possibilities, locking relations into stratified formations. Deleuze and Guattari (1987, 161) do, however, caution that 'Staying stratified – organized, signified, subjected – is not the worst that can happen; the worst that can happen is if you throw the strata into demented or suicidal collapse, which brings them back down on us heavier than ever.' Mobilisations of rapid intensities of change, such as outbreaks of malaria and other treatable diseases within DRC are understood as being even worse than remaining locked within stratified and exploitative relations, forming what Deleuze and Guattari describe as a cancerous Body without Organs, a mode of rapid but ultimately destructive growth. The challenge then, is to adopt vectors which provide resilient forms of growth in agential capacities, occupying the edge of chaos which treads the fine line between trapped within strata and pursuing modes of change which are likely to cause more harm than good, whilst acknowledging that absolute calculations within nonlinear self-organising systems are impossible, and that most forms of ethical deterritorialisation will be reterritorialised by what Guattari terms Integrated World Capitalism.

Whereas this section considered the connections between the Congolese conflict and 3TG, I shall next examine two recent attempts at ethically-motivated interventions into the relationships between 3TG and armed Congolese groups. By considering the differential consequences of these actions, we see that reductive solutions which seek to address phenomena in isolation are unlikely to provide the intended impacts.

### **Fairtrade Computing?**

Whilst UN reporting and criticism of the links between armed forces, 3TG and microelectronics manufacturing have been ongoing since 2001, since 2010 there has been significant NGO, activist and journalistic attention focussed towards these activities. Using the 3TG-laden

microelectronics devices whose production they seek to alter, these actors have created social media campaigns, online petitions and documentary films which outline issues surrounding the usage of Congolese 3TG, and have led to acknowledgement that this represents a serious issue. The fact that utilising the networked microelectronics – whose production is the issue at hand – has been essential in raising levels of awareness necessary for ethically motivated intervention, is itself a noteworthy phenomenon, suggesting that productive mobilisations have based upon pragmatic engagement rather than moral absolutism and abstention.

The mediated attention surrounding mineral extraction from DRC translated into lobbying pressure designed to enact legislation that mandates industrial action, rather than allowing voluntary industrial self-regulation. In the USA, the outcome was section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act (commonly referred to as the Dodd-Frank Act), a wide-ranging post-recession US law modifying financial regulation. Section 1502 dealt with issues surrounding the procurement of Congolese conflict minerals, explicitly requiring companies to determine whether their products contain 3TG from DRC. President Obama signed the law into effect in July 2010, and in August 2012 the Securities and Exchange Commission (SEC) published the rules and regulations which companies had to adhere to with regards to their efforts to trace minerals. Consequently, in an attempt to avoid regulation, the National Association of Manufacturers, Chamber of Commerce of the USA and Business Roundtable filed a lawsuit against the SEC contending that section 1502 was a transgression of the First Amendment of the US Constitution, however this case was dismissed in July 2013 (US District Court, 2013).

Despite the intention for Section 1502 to improve the situation in DRC by reducing the availability of funds to militias, the impacts of the bill were heavily criticised. Requiring Congolese 3TG to be certified as conflict-free saw major electronics corporations simply avoid purchasing them, with reports that even before SEC reporting was introduced, legal exports of tantalum from DRC fell by over 90% (Kavanagh, 2011; Seay, 2012). Whilst this was accompanied by an increase in illegally smuggled tantalum, the net result was that thousands of artisanal miners who had previously survived on a meagre income from legitimate mining operations were unable to obtain revenue from their labour, entailing that this legislation had effectively inflicted further suffering on Congolese citizens whilst boosting the black market trade smuggling minerals out of DRC (Aronsen, 2011; Dizolele, 2011). Western lawmakers and campaigners were accused of over-simplifying the complex process of mineral procurement, and by doing so detrimentally impacted upon the livelihoods of the people they sought to assist. Because of the nature of a globalised production process, it was simply easier for corporations to purchase 3TG from other nations, thereby avoiding the criticisms associated with using conflict minerals and the additional cost of certification. A pertinent critique of the approach undertaken here, is that by focussing solely upon the perceived problem – Congolese 3TG – without taking the multiplicity of processes which connect this issue to global markets into consideration, a highly reductive, molar approach was adopted, and whilst this solved the problem of funding militias, it detrimentally impacted upon millions of Congolese citizens who depend upon mining to make a living. Here we see why OOO's approach of focussing upon isolatable phenomena whilst underplaying the entangled web of relations that comprise these phenomena is problematic when applied to ethical or political action; artificially separating individual entities precludes the kind of systemic awareness necessary for effective political intervention.

An alternative approach to mineral procurement has been undertaken by Fairphone, a company which grew out of a Netherlands-based NGO, the Fairphone Foundation, which was established to research and campaign around ethical microelectronics production. The Fairphone project evolved because the foundation decided that making a commercial product

embodying their values demonstrated the viability of ethically-inflected methods of microelectronics production. The device itself is a smartphone featuring a capacitive touchscreen running a modified version of Google's Android OS. Fairphone sources materials from partner institutions based in DRC, such as tantalum from the Katanga-based Solutions for Hope initiative (Ballester, 2013) and tin from the Kivu-based conflict-free tin initiative (van Able, 2013). These local initiatives certify particular mines as being conflict-free, and tag all minerals leaving these mines, meaning that they remain traceable and thus can bring economic benefits to Congolese miners and associated workers without funding warlords and militias.

The company crowd-funded the production costs of the phone, using an online advertising campaign to inform potential customers that production would be economically viable once 5,000 orders had been placed, illustrating that in the twenty-first century, the production of ethical hardware requires an assemblage involving software and content. Rather than situating materiality and discourse as oppositional terms separated by a great divide, this presents an example of how they feedback into one another. Consequently, Fairphone presents a venture which leveraged ecologies of content and software to impact upon the production of microelectronics in ways designed to improve the lives of those involved in procuring the materials necessary to construct the devices. By early 2014 an initial production run of 25,000 Fairphones was underway.

Whilst the project highlights that a more ethical microelectronics production model is possible, the 25,000 Fairphones contrast with a broader industry which saw over 1.8 billion mobile phones sold in 2013 (Gartner, 2014), denoting that 0.0014% of mobiles were produced in a more ethically responsible fashion. Sean Cubitt (2013) has recently argued that ethical consumerism cannot provide answers to issues around the ecological impacts of microelectronics manufacture; that it merely represents the abdication of regulatory governmental practices by devolving ethical responsibility onto the individual, and Fairphone could be seen as indicative of this. Ethical microelectronics could simply become a lifestyle choice practiced by a tiny minority of consumers well-connected to informational flows surrounding the ethics and ecologies of the global microelectronics industry, thus creating minimal disturbance to mainstream corporate practices whilst affording the extension of the central mantra of neoliberal consumer culture: the right of the atomised individual to choose. Fairphone, then, is no panacea for the range of issues surrounding Congolese 3TG or the broader ethics of microelectronics production. However, by highlighting the potential for product design and mineral procurement to productively engage with mining communities, it delineates a less reductive and damaging direction than Dodd-Frank Section 1502.

### **Conclusion: Ecological Ethics and Electronics**

A central contention of this paper has been that the claim of dematerialisation inherent in numerous discourses surrounding digital culture is fundamentally misplaced; far from being a system of free-floating information in a virtual cyber-reality, the internet is a material technological system like any other, albeit one whose specific contemporary forms, especially those surrounding wireless information transmission, thin-client access to networks and the miniaturisation of electronics, present a seductive appearance that materiality is somehow marginalised. However, when interrogating the ethics and politics of media systems, it is crucial to include analyses of the flows of matter and energy, the assemblages of minerals, metals, human labour, and toxic by-products, without which there would be no internet. Whilst this suggests a decentring of the social constructivist focus upon content and information, it by no means requires replacing this with a formalism which relegates the importance of discursive content. Indeed, when approaching assemblages such as the Fairphone, we see that content, software, and hardware are not discrete domains which can be understood

in isolation, but form entangled ecologies which always coexist and co-evolve as dynamic meshworks.

That we are discussing dynamic and entangled phenomena entails that materialist approaches that are associated with process philosophy, such as Deleuze and Guattari-based approaches and media ecology, are well placed to map the flows of energy and matter which take place across diverse spatio-temporal and organisational scales. In contrast to OOO's emphasis upon the separation of objects, process philosophy contends that what humans experience as apparently discrete objects are always implicated in a multiplicity of self-organisational processes, transforming the ontological conception of being into multiple states of becoming. Cassiterite, coltan and wolframite ores are not inherently problematic, but the convergence of specific affordances of the elements derived from these ores within a particular geographical location, alongside other specificities relating to networked micro-electronics, global markets, mining contracts, colonial histories and geopolitical factors, saw them become conflict-aggravating factors in DRC.

Whilst elements of this situation reached a peak around 2000 because of the spike in global tantalite prices, the legislative, and micro-industrial actions outlined here occurred over a decade later, denoting that even within the timeless time of the network society (Castells, 1996) there exists a significant time lag between events occurring outside of well-connected regions of network society and subsequent action designed to address these issues. One notable feature of both the NGO/activist campaigns which created the pressure for the introduction of Dodd-Frank Section 1502 and the Fairphone, is the centrality of 3TG-containing microelectronic devices to the interventions designed to affect the production of future microelectronic devices. This echoes Bernard Stiegler's (1998; 2010; 2013) position regarding the pharmacological nature of technics, which is simultaneously presented as poison and cure, which presents an argument for a pragmatically orientated ethics which eschews a moral absolutism predicated upon avoiding harms. In a complex and turbulent world of entangled flows, the notion of separation collapses, and indeed, as the impacts of Dodd-Frank Section 1502 illustrate, the disconnection of elements from global networks is likely to enact new forms of suffering upon those disconnected. This consequently suggests a strategy of pragmatic interventions designed to make positive micro and macro-political impacts.

In this sense, Fairphone could suggest a useful way forward; although the first iteration of the phone is manufactured in a non-unionised Chinese factory whose labour practices have been questioned, and the company itself readily admits that its initial offering does not entirely meet criteria that would be analogous to fair trade and living wage certification in other fields, their work with grassroots Congolese schemes ensures that miners are able to make a living from their labour, whilst preventing militias and warlords profiting from this. However, ethical consumerism can be understood as a market-based, individual-led approach which correlates with neoliberal orthodoxy surrounding consumer choice, effectively acting as a replacement for collectivised ethico-political action. As Dodd-Frank 1502 demonstrates, though, collectivised action is no guarantee of success, especially when molar political action largely ignores the complexities of the globalised issues, and implements reductive 'solutions' which create negative consequences for the parties that the legislation was designed to protect.

Where this leaves us, then, is seeing the value in approaches which encourage a broad spectrum of interventions which combine micropolitical activist, NGO, and ethical consumer-led interventions with legislative and international actions. Rather than identifying a single area in which interventions are most likely to produce positive outcomes – an either/or strategy – this instead suggests a strategy influenced by the pluralistic logic of the AND (Deleuze and Guattari, 1987, 28). In a turbulent and dynamic world there are unlikely to

be straightforward and singular solutions to complex issues; instead, an ethic that encourages iterative pragmatic experimentations and broad spectrum approaches is most likely to produce beneficial outcomes. When examining the increased flows of attention and action from activists, artists, scholars, journalists and legislators aimed towards the enduring issues of Congolese conflict minerals, one might ask whether we are potentially seeing the first steps along a pathway to an ethical electronics, an internet which reflexively engages with the social and ecological conditions of its material construction. Undoubtedly there are enormous challenges in realising such a vision within the confines of neoliberalism, where economic growth is understood as the primary unit of wealth and a destructive form of competitive individualism is lionised over collectivised and mutualistic relations, and this further highlights the need for geopolitical mobilisations across a range of scales if an ethical microelectronics is to materialise.

### Competing Interests

The author declares that they have no competing interests.

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