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Big data ecologies

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abstract

Big Tech is increasingly 'partnering with/enslaving' nature in order to maintain and grow its operations while also demonstrating concern for the environment via large scale sustainable infrastructural developments. However, to green their cycles of production, Big Tech invests in infrastructure that not only sustains but also unwittingly serves to encourage consumption at a time of severe social and political unrest and environmental instability. In these material expansions, there is tremendous infrastructural, financial and political support for ongoing consumption and its embedded values: progress, innovation, and social transformation. In order to analyse this power dynamic, I argue that we must reconsider the scale, scope, and the various meanings and enactments of both indigenous and settler ecological thinking, and mediated ecologies, to better understand Big Tech in a rapidly changing environment. I propose the concept of 'Big Data Ecologies' to situate infrastructure at the centre of the discussion of neoliberalism within the rapid and global environmental transformations with which they are intertwined.

Introduction

> Snippet 1: The severe drought and forest fires of the last few years in California have now been widely headlined, visualized, and extrapolated by the news media as a case study of the early ravages of climate change on a global scale. As a result, water has been ushered back into conversation with local conservation practices, desalination proposals, and various other assessments, including the socio-political impacts of farm job losses. Meanwhile, California is also home to the largest cloud computing facilities in the US – with upward of 800 data centers – yet the drought is rarely discussed in relation to internet infrastructures, the electricity they consume, or the tremendous water required by data centers to cool their servers. (The California Energy Code, 2013)

> Snippet 2: As Hurricane Harvey devastated Houston with catastrophic flooding in October 2017, displacing its citizens and causing ongoing power outages for thousands of them, data centers in the area remained operational. Diesel generators allowed the lights to stay on and kept servers running. One data center in the area was stocked with food, water and cots, showers and washing machines. It provided a safe harbour for its workers, their family members, and even United States marshals (Dawn-Hiscox, 2017; Glantz, 2017). This data center was built to withstand a hurricane, tornado, or ice storm, to keep internet services going – and, because it is in Houston, to safeguard the data of 'practically every single large oil and gas company in the world.' (Glantz, 2017)

I begin with these two snippets from (US-based) news stories because they highlight the internet's reliance on nature (water, electricity, land, etc.), the industry's need to protect itself against it (natural disasters), as well as the requirement for storage of Big Data by various companies involved in ecosystems management (oil, gas, etc.). In other words, these snippets show how our recent turn to Big Data requires a material infrastructure to support it, as well as an industry discourse to rationalize its ongoing expansions. It is this complex relationship that I return to time and again as a way to understand how Big Tech is increasingly encroaching on ecosystems management to, ultimately, grow its own operations. As I explain below, Big Tech has made great strides in rendering various aspects of its industry more self-sustaining; but, and as a result, has carved out a more important (and direct) role for itself as custodian and manager of natural resources. This is a part of the neoliberalizing logics that dominate today's understanding of nature.

Big Tech is a main driver of sustainable development worldwide – especially when it comes to harnessing alternative sources of power – while also, and invariably, upholding the idea that perpetual growth is possible and economically desirable within these conditions. As such, the biggest internet companies – Apple, Amazon, Facebook, Microsoft and Google/Alphabet – are becoming environmentalists by their own definition, and grabbing at land, water, and power infrastructures to make their case as the industry best suited to manage natural resources, on which Big Tech is dependent (and on which the rest of the economy is also increasingly dependent). As a concept that accounts for all of this, I propose 'Big Data Ecologies' to expose that these sites are not only multiplying, but are increasingly at the behest of investors in Big Data infrastructure, and run by Big Data logics. Big Data thereby becomes the underlying currency that funds material developments, and thus formative in our new ecologies.

In the US in particular, data centers are the largest and fastest growing consumers of electricity, and in turn, of water (Sverdlik, 2016). Big Tech supports the stock market, Big Data for insurance companies, genome mapping,

financial transactions, mass surveillance and monitoring, the 'internet of things' and 'smart city' sensors and grids, and mobile communications for phone users writ large. By most industry accounts, data centers, and the cloud infrastructure that undergirds it, has become the most important sociotechnical system of our time. Because of this, the continuous expansion of server farms is encouraged, supported politically and financially, and celebrated as progress by the industry and most governments, which is most evident in urban and rural areas in search of economic revival. This is how the industry comes to be known as 'Big Tech', a conglomerate of internet companies that is increasingly outsizing all other forms of institutional power. Big Tech is considered to be an industry grouping with important economic, political and social influence and is adopting and adapting both public infrastructures and the environment for the internet. In turn, the accumulation of user data, as Big Data, is the main motivation of companies that offer online shopping, social networking, internet indexing, location services, and so on. In this sense, Big Tech are the new farmers – companies toiling matter as memory, companies using large swaths of land and water, working toward future storage and the storage of the future.

Most Big Tech companies (Apple, Amazon, Facebook, Microsoft and Google/Alphabet) own and manage their data centers. They carefully curate their online representations of their data centers by blending marketing discourse to reinforce their various problem-solving impetuses while downplaying this hypervisibility in terms of the cloud's materiality and its potential impacts (Vonderau and Holt, 2015). In these representations, the glaring paradox of Big Tech is that it uses tremendous natural resources to develop technologies that fight environmental degradation. Part of that mandate has been to become more environmentally sustainable as a global industry. Big Tech accomplishes this by showing its mastery over the environment by, on one hand, creating data centers that can sustain hurricanes and other environmental disasters, and, on the other hand, by enabling Big Data science to flourish as seemingly 'clean' information production in service to industry and, presumably, humanity, even while consuming energy resources. These are the two interlocking components of Big Tech – they uphold the material infrastructure that upholds the logics, discourses, and new forms of socialities, that, in turn, uphold the material infrastructure – and so on, and so forth.

Given this relationship between ideas and instantiations, we may wonder how climate change can even coexist with Big Tech. If, as all indices seem to point to, Big Tech already epitomize the technological fix, how can we be living in times of such environmental unrest and, simultaneously, of such incredible computational power? There are a few options that help explore this connection: the *first* is that the ultimate technological fix in fact requires a global

environmental catastrophe; the *second* is that there has long been a false symbiosis in the relationship between nature (the untouched) and computing (as human progress) – and it has reached a tipping point; and the *third* is that we are in a moment of convergence, handing over not only nature to Big Tech (from the commons), but also the very concept of 'the natural' and what it might encompass.

(As a queer Canadian settler) I explore these three options by drawing mainly from the work of indigenous and queer/feminist thinkers, and others influenced by them (directly, or indirectly drawing on similar concepts). Stacy Alaimo, Wendy Brown, Keller Easterling, Donna Haraway, Sara Hunt, Ruth Irwin, Lisa Parks, Juanita Sundberg, Kim TallBear, Zoe Todd, Vanessa Watts, and Sheena Wilson, among others, have each greatly shaped the possibilities for reconsidering the entanglements of nature, science, technology, and culture. With them, I propose a conceptual repositioning of Big Tech that complicates the existing environmental framing and ecosystem logics that supports the industry and largely function to justify the perpetual growth of digital communications. Big Tech upholds the idea of shifting its mode of energy production to alternative, sustainable, and renewable sources without implementing radical changes at the level of labour, resource ownership or conceptions of the environment, which have become more pressing matters at this time of global climatic transformations but remain at odds with capitalist endeavours. It is this particular material entanglement – of public and private infrastructure – that is explored in this paper and which serves as my contribution to the growing literature about internet materialities and their various political, social and environmental impacts (Burrington, 2014; Cubitt, 2013; Fish, 2014; Gabrys, 2011; LeBel, 2012; Maxwell, 2014; Miller, 2015; Taffel, 2012; Vonderau and Holt, 2015).

Increasingly, Big Tech has mandated itself to be responsible and to manage natural resources sustainably, premised on the logic of natural balance – i.e. that as long as nature returns to a state of homeostasis, and as long as companies work to replenish what they use, it follows that the development of communications infrastructure is a (two-fold) sign of progress. Despite the US's withdrawal from the Paris Agreement on climate change, Big Tech remains committed to a shift to renewable energy to power the internet economy. As Facebook founder and CEO Mark Zuckerberg put it:

> Withdrawing from the Paris climate agreement is bad for the environment, bad for the economy, ... we've committed that every new data center we build will be powered by 100 percent renewable energy. Stopping climate change is something we can only do as a global community, and we have to act together before it's too late. (Miller, 2017)

Similarly, Joe Kava, Google Vice President of Data Centers, claims that

> huge cloud operators have a responsibility to use their buying power to drive changes in the US. utility industry, which should boost its mix of renewables and make clean energy available to more customers. (Miller 2017)

Apple, Amazon, and Microsoft have made similar promises and have indicated that this helps them meet their corporate social responsibility goals. On the surface, it looks like Big Tech is taking on the task of making global energy more sustainable for the environment's sake, to fight climate change. Outside of Big Tech's main corporations it becomes much more difficult to generate one's own power or to find alternative (green) providers but the motivation is there. Fighting climate change is said to be the driver of Big Tech's sustainable turn, yet, as I point out in this article, this is premised on faulty logics that frames nature more as software than as an agentic organism (Alaimo, 2011; Todd, 2016). This is important because it speaks to long held colonial ideas about controlling nature, managing it as interconnected nodes in a system, and foremost, as requiring human intervention to stay alive for the benefit of humans.

The impetus for Big Tech's Big Data collection is underscored also by the idea that the more data we collect, the more we can know about the world we live in. This pursuant positivist logic is that we will act according to objective and scientific knowledge that can be transferred to myriad social, commercial, and political ends. To do this, Big Tech unwittingly follows its own uneasy logic – one that situates the environment, technology, and humans within an a priori systems-based framework that is self-regulating and self-organizing. This is an idea that is perfect for our neoliberal times, that sees market rationality pervading all aspects of life, until nature and humans alike become merely instrumental (Brown, 2015; Moore, 2015; Watts, 2013; Curtis, 2011; Odum, 1994). Neoliberalism is the dominant ecological ideal of our era, too: when left alone, nature will maintain an equilibrium that can be restored if disrupted through both calculable and mappable market-driven assessments and interventions. This kind of ecological thinking, then, also means a highly controlled society where surveillance and monitoring are integral to communications infrastructure and where infrastructure is increasingly embedded in (if not disguised as) nature (Parks, 2010).

Big greening efforts

Data centers are being constructed around the world at a rate of a 15 percent increase every year, which will see an additional 33 million servers by 2020, all of which are supplied and powered by regional water and power sources (Marr,

2016). These data centers become fodder for how Big Tech manages to simultaneously acknowledge their role in depleting natural resources while also situating themselves as *the* safeguard and solution to society's ills. To be clear, the point here is not to critique greening efforts in and of themselves, but rather to situate those discourses and their applications within a wider neoliberal context, and the market-driven decision-making that inspires Big Tech expansions. Big Tech is a neoliberal project and as such is also a colonial one – enslaving nature under the guise of emancipation (Tobias-Coleman, 2015).

To show this, I present two examples of Big Tech enslaving nature, focusing firstly on Google's conversion of a wastewater facility to cool its servers (Google Green Blog, 2012), and secondly, on Apple's purchase of a forest to manage its own product packaging needs (Cushing, 2015). By presenting these examples (among so many others), I show how Big Tech sees itself as 'partnering' with nature in order to maintain and grow its operations at a time of severe social and political unrest and environmental instability. Ironically, in order to green their cycles of production, Big Tech is 'investing' in nature and in public infrastructure in ways that not only sustain but also unwittingly serve to encourage consumption. In these material expansions, there is tremendous infrastructural, financial, and political support for continued consumption, and its embedded values: progress, innovation, and social transformation. For these sites (which are only two examples among a growing number), I hone in on an instance of infrastructural transformation – such as water and forest – in order to make a point about the very inseparability of any one natural element from its system, while also demonstrating their specificity, as entangled and ecosystemic. This is the benefit and challenge of the ecosystemic approach: to break down the components in order to make an argument about the interconnectedness of all elements, both always already material-discursive (Haraway, 2003). Or, put in other words, the material-discursive conceptualization of nature by Big Tech is one that keeps in place a) the nature/culture binary, b) the idea of ecosystemic homeostasis or balance, and c) the idea of nature as inert and at the service of human 'progress' demonstrated foremost through technological deployments.

Google water

The portion of Google's website dedicated to the environment states that:

> We're a data-driven company. The science of climate change tells us that building a carbon-free electrical grid is an urgent global priority[1].

[1] https://environment.google/projects/ppa/

Google looked to power purchase agreements (PPAs), which are large-scale, long-term contracts (between one party that generates electricity and one that is looking to purchase it) to buy renewable energy at volumes required by the company. Of note, Google first entered into a 20-year agreement with a wind farm in Iowa in 2010 and has since signed 19 more agreements. Google is now the largest corporate renewable energy buyer on the planet, directly purchasing 2.6 gigawatts of renewable energy. In the company's view, 'additionality' is the idea that through its actions the world has more clean energy (not less, even given how much Google itself consumes).

In 2016, Google had plans to operate 14 data centers globally, with 7 in North America. These numbers, however, remain estimates given the relative secrecy of Big Tech with regards to its infrastructure's locations (Hardy, 2015). Like many data center developers, Google has looked to adapt existing buildings into server farms. It recently converted a defunct power plant in Alabama, which had been running since 1952, into a data center. Google also converted an old paper mill in Finland. Both of these conversions have been praised in the media for the ways the company is repurposing existing infrastructure, adapting old power grids and rekindling the community's economy (Hardy, 2015). This is also part of Google's strategic posturing, as an ecologically aware company, which like many others, does not see its profits as inherently antithetical to the ravages of capitalism in which it participates. But Google is also based there, at the old mill and power plant, because those sites provide steady power, are located near rail lines for easy fibre optic cable installation, and close to a water reservoir to use for cooling its servers.

The notion of an energy efficient and environmentally conscious company – what Google calls 'The Big Picture' on its website – somewhat ironically deflects attention from the incredible size and scale of their operations. Instead, the site focuses on Google's aim to have 'zero impact' on climate by having all its products and services be 'carbon neutral.' 'Renewable' energy has been the byword of Google for the past three years. They pay for reductions in emissions from landfills and claim that their data centers actually save energy. While the Google search engine – what the company is best known for – consistently uses the same amount of electricity as a city of approximately 200,000 people (in the US), it justifies itself in doing so by suggesting that this reduces the overall energy consumption. However, this has only been proven through an awkward comparison between Google searches with real-world searches (Glanz, 2011). Companies like Google use branding and PR jargon to downplay depletion; they draw attention to how much energy they are creating rather than the consumption encouraged at various levels by the industry. At its main campus, Google has its own bike-to-work program, and in certain locations, community

gardens supply its cafeterias (Noble and Roberts, 2016). There are swimming pools, climbing walls, bowling alleys, and golf courses to keep employees happy at work (Wainwright, 2013). To further reinforce the intersecting ideals of well-being and efficiency, Google has built its own power networks and infrastructures, and has shifted from coal to wind and solar (Lawson, 2015). And, in one of its grandest gestures yet, Google has partnered with public water infrastructure to lock-in a permanent and reliable source to cool its servers.

Water is cheaper than electricity. This is why water is used to cool servers in most data centers today. Servers, which are essentially computer hard drives stacked in rows, generate a lot of heat. These servers are then stored in large windowless units, generally in a building the size of several football fields. A midsize center uses between 80 million and 130 million gallons of water a year for cooling, according to various industry estimates (FitzGerald, 2015). This is roughly as much water in a year as 158,000 Olympic sized swimming pools, which is equivalent also to the water used in three hospitals, or for planting 100 acres of almond trees, or to maintain two 18-hole golf courses – and this for computer chips alone (The Wall Street Journal, 2015). Google, however, has been exemplary in its attempt to green its cooling processes, by harvesting rainwater and other non-drinkable sources to reduce its footprint. In fact, it can now boast of using only recycled waters to cool its servers. But, data centers require highly treated water, unlike agriculture or electric utilities.

In 2012, Google headlined on its company blog that it was helping 'the Hooch' (Chattahoochee River) with water conservation at their Douglas County (Georgia) data center. Boasting their efficient energy consumption by using evaporative free cooling, as well as their recent shift from potable water to recycled/grey waters, Google is accounting for the environment and local communities that surround its data centers (Google Green Blog, 2012). Having partnered with the Douglasville-Douglas County Water and Sewer Authority (WSA) in 2007, Google was able to rely on recycled water from the The Hooch to cool its servers. The water is treated – filtered, sterilized and chlorinated – once more at a Google-built sidestream (effluent) treatment plant before it circulates through its evaporative cooling towers, and before 70 percent of it is returned to the river, with 30 percent diverted back to the data center (Myslewski, 2012). For the WSA, this has meant an increased capacity to save water in their reservoir for times of drought, as explained in detail also in a promotional Google Green's YouTube video on 'smart water' (Google Green, 2012b). This was Google's first water treatment plant in the United States and was constructed based on similar plans in Belgium, where it treats water from an industrial canal. In Belgium, Google built a 20,000 square foot water treatment plant, which removes solid materials and sludge, which is in turn repurposed for cement manufacturing and landfill.

In terms of Big Data Ecologies, Google puts to work each displaced and repurposed material byproduct.

Overall, Google data center engineers working toward greening their 'smart water' technology assert that there is 'no impact on the availability of water in a given region' if every drop is 'returned to its origin' (Coors, 2015). Again, in a promotional context, no further insights emerge about what delimits 'impact' nor how such a thing might be measured. Since 2010, the nonprofit organization Carbon Disclosure Project has been pressuring companies to issue reports on their water consumption, but this request has been largely denied despite water's non-fungibility (Woody, 2010). The comments on Google's promotional 'smart water' video are divided and reflect some the general public's views, concerns and questions: some praise Google's efforts toward sustainability and others question its propagandistic tone. While the praise echoes the words of Google itself – to frame the environment as something to manage responsibly by working to always restore a sense of equilibrium – the skepticism points to more common and larger questions about multinational corporations becoming increasingly entangled with public infrastructure. As Big Tech is successfully making itself self-sustaining through renewable energies, these companies increasingly exist as islands and fortresses of data, where communities are effectively pushed out, and can only exist outside of this media ecosystem. In times of severe droughts (or floods), it is unclear who will be given priority – communities or Big Tech – and we don't know how this priority will be measured. Or we do – in Houston, the data centers stayed on while tens of thousands of individuals went without power.

Despite innovations, and perhaps in light of them, many questions remain about water treatment and about what 'clean' water means in these various contexts. With such an intensive treatment by Google, including chlorination – which is said to be more 'effective' than the Water and Sewer processes – could the water be too clean? The question came up for me in part because a newspaper clip suggested as much ten years ago: the August 9, 2007, *The Quincy Valley Post-Register* reported that the water generated from data centers came out 'too clean to run through the city's industrial wastewater treatment plant.' According to this brief report, the water killed off the bacteria needed to break down solids. In that sense, the water is 'dead' because it is absent of minerals and bacteria. However, while the question of natural resource management accountability about water in this case remains difficult to answer it's nevertheless pertinent as a rhetorical provocation.

From indigenous and queer-feminist perspectives, natural resources are always already agentic and political (Alaimo and Hekman, 2007; Todd, 2016). To

engage the 'coloniality of power' as Juanita Sundberg (2014) proposes, for example, in the case of Big Tech, would mean to put into question patterns and dynamics emerging from longstanding and ongoing colonial pursuits that continue to normalize and naturalize labour, technology and the knowledge produced as a result. In a sense, this means that both Big Tech and its watchers (like Greenpeace) has only recognized its greening efforts within the current neoliberal framework. Similarly, Leanne Betasamosake Simpson (2014) argues that protecting the source of knowledge is in the protection of land, which, applied to Big Tech might mean considering that growing real estate deals, and the immense size of data centers (eg. a data center in Norway is planned to be the size of 84 football fields),[2] means an expansion and anchoring of Eurocentric, colonial, positivist thinking (and usually at the expense of other modalities). And, as Eve Tuck and K. Wayne Yang (2012) remind us, 'decolonization is not a metaphor' (3), and as such, data centers play a hand at furthering settler futurity in at least two ways: they stake a claim to land and its proximity to water, and they further locate humanity outside of human bodies, and into machines. How different would our sense of progress be if we accounted for the material and architectural creep of settler technological imaginaries?

There seems to be no way to salvage what has been lost and no means by which to control the environment within our current global socio-political conditions. Given the vastly variant temporalities of capitalism and nature, the move to 'green' our communications infrastructure starts to more closely resemble a means of feeding and watering the machine, by privileging clean water and electricity for communication ends than for human ends, as we have already done with e-waste and toxic rare earth mining practices. Jason Moore's (2015) idea that humans have come to serve as 'cheap nature' for capitalism's expansion may hint at the future of ecology, where many bodies are further lodged into the media ecosystems, while fewer and fewer benefit from its product. Of course, this has huge political implications and becomes yet another way to demonstrate which bodies are valued and which are put to service of capitalism itself.

Apple trees

Corporate declarations about their 'eco-standings' are often in direct contrast to independent assessments. In 2011, Apple was rated with the worst score by Greenpeace for its fossil fuels emissions, relying heavily on coal and nuclear energy. Despite this, Apple's self-assessment that same year declared that it was

2 http://www.poandpo.com/companies/norway-to-build-worlds-biggest-data-center-1782017403/.

dedicated to the careful lifecycle management of products, including 'controlling the quantity and type of materials used in their manufacture, improving their energy efficiency, and designing them for better recyclability' (Apple, 2011; Gross, 2011). In 2012, Greenpeace reported once again that Apple, along with Amazon and Microsoft, was rapidly expanding 'without adequate regard to source of electricity' and relied 'heavily on dirty energy to power their clouds' (Greenpeace, 2012). But in 2014, Greenpeace saw a change. In their report, they discussed Apple's commitment to power its data centers with 100% renewable energy. The report also presented the company as the 'most improved' and 'most innovative' and 'most aggressive' in its greening endeavours (Greenpeace, 2014). Over the course of a few years Apple went from loser to leader in Greenpeace's assessments of their environmental impacts and innovations, and this despite ongoing challenges to these claims made by journalists (Cole, 2015). Already by 2015, Apple was touted as a prime example of Big Tech purportedly powering itself exclusively from solar, wind, hydro, and geothermal power (Green Energy Investing, 2015). By 2016, Apple is selling power into wholesale markets because of the investments it made in solar power for its data centers, as another foray by Big Tech into the energy business (Crawford, 2016). And, in 2017, as the latest Greenpeace reports suggest, Apple holds its title as leader in its global greening efforts for its data centers but gets a lesser grade on its ability to manage a 'closed-loop supply chain' (Greenpeace, 2017).

According to the Greenpeace Guide to Greener Electronics 2017 Company Report Card, Apple

> has established an extensive take-back system through its stores and local partners across countries where it sells its products, though it does not make public which recycling partners it relies upon, or where that waste is sent. (Greenpeace, 2017: 17)

Apple currently maintains strict 'must shred' agreements with its recyclers thus forcing devices to be shredded instead of repaired or refurbished (Koebler, 2017), while also working with disassembly robots to eventually reuse all the materials in phones, such as tin and aluminum, to create new devices. This example serves to show how Big Tech can still, for now, easily silo off its data centers from the devices that power internet culture and generate the data that becomes the currency with which companies can expand. By not acknowledging that the mobile phone, and all data generated by internet traffic, is the true fuel of the data center, the company fails in making a truly believable argument for sustainability.

Despite advancements in greening their data centers, Apple remains a company dedicated foremost to profit – i.e., making a phone that costs $5 to assemble (in

the Global South) and transforming it through marketing into a revered device costing upward of $600 (in the Global North). For operations to continue to function at this scale, Apple must rely on a precarious workforce whose collective agency has been eviscerated by market globalization and is therefore willing to put in long hours in almost always terrible working and living conditions (Cole, 2015). The technological glow of the West relies on the bleak working conditions of the East, where people have been more easily enslaved and disposed of by Big Tech and their promises of global prosperity (Moore, 2015). Furthermore, many of the educated and market-savvy customers that Apple relies on are aware of the appalling working conditions for assembly workers (The Passionate Eye, 2015). Apple's efforts to achieve a kind of Western sustainability, or sustaining the West itself, invite its customer to support its operations, to strive for a greener future, but without having to account for the nuances of 'cheap' versus 'costly' human bodies (or their labour) on a global scale.

In Apple's Environmental Responsibility 2015 Progress Report, they discuss recent accomplishments, of which one is to partner with The Conservation Fund to 'permanently protect more than 36,000 acres of working forest' located in Maine and North Carolina. This partnership was intended to ensure their packaging had a 'net-zero impact on the world's supply of sustainable virgin fiber.' (Apple Environmental Responsibility Report, 2015) This is a measure that remains in place into 2017, where the company boasts that its yearly production from its forest conservation projects is now 'greater than the amount of virgin fiber used in Apple's product packaging during fiscal year 2016.' (Apple Environmental Responsibility Report, 2017: 24) This signals that as sustainability endeavours increase, so too does Big Tech's control over 'its' environment.

In 2015, Apple partnered with the World Wildlife Fund on a new multi-year project focused on responsible forest management in China (Apple Environmental Responsibility, 2015). This turn to forest management and protection by Apple (and Big Tech more generally) is important in identifying neoliberal resources management. The very concept of 'working forests' speaks to Apple's market-based conservation approaches (The Conservation Fund, 2015). As per the report, this partnership was intended to 'transition up to one million acres of forest, across southern provinces of China, into responsible management by 2020' by, among other things, 'establishing long-term market incentives in China for responsibly sourced paper' (Apple Environmental Responsibility Report, 2017: 25). This serves as a good example of how ecosystems management fits nicely into the neoclassical liberal framework, if you can value the component parts and show people how they will benefit from their use (Thompson, 2011).

Launched in 1985, the Conservation Fund is an American environmental non-profit with a dual mandate of environmental preservation and economic development. Since 1998, the Working Forest Fund (WFF) of the Conservation Fund has aimed to address and mitigate the loss of the US's privately-held forests, which account for more than half of all forest in the US, with 30 million acres of its forestland sold every year (The Conservation Fund, 2015b). They acquire endangered private forestland with the goal of ecological management and restoration, while also finding ways to be economically profitable. 'Working forests' are owned by large investors, like Apple, which means that they are intended to manage their products sustainably through fiber for pulp, paper, and wood products (Apple Environment Renewable Resources, 2015). Generally, this means allowing for 30% of the forest to be used, a threshold of tree density set to ensure biodiversity, and a fine-tuned balance maintained between naturally occurring forest floods and fires.

On their Environmental Sustainability website, Apple defines innovation as 'working with what's here to make something new' – a bizarre turn of phrase that reveals nothing about the link between managing finite resources, but rather equates the eternal promise of incremental innovation with the marketing stance that this makes it something 'new'. With its perfect Greenpeace scorecard, Apple epitomizes the ideal of renewability of Big Tech, while disconnected from issues of consumption and the Big Data Ecologies it inhabits.

Apple is a key player in shaping public perceptions of Big Tech. With Google, Facebook, Microsoft, and Amazon, it leads the way for product design, production, communication, distribution, consumption, engineering and architecture. While it remains the case that these companies constitute only a fraction of the 5% of total ownership of operational data centers in the world – as few companies own or run their own data centers – their cultural influence is vastly disproportionate.

The idea of maintaining 'appropriate thresholds' for ongoing exploitation or of 'calculated risk' in ecological management reinforces the cybernetic-ecosystemic dream. Ecosystems management is a field called to task for having been based on leaps from available evidence, where data was forced to fit the theory born of the logics of the time (from 1850 to 1950 in Europe and America). Hugely informed by the emergence of the supercomputer in the US in the 1960s, which was able to correlate data at a scale larger than ever before in the social sciences, the desire to frame and fit nature into a similar cybernetic model proved impossible to resist. As for the emergence of social sciences, where surveys and questionnaires were thought to reveal a deeper truth about human nature based on the conclusions that could be reached by sampling such large groups, more data

meant more objectivity, and more objectivity meant more power to assert a particular order of things, including over nature (Ashby, 1956; Odum, 1994; Curtis, 2011).

When it emerged as a discipline, the dominant logic of Ecology was largely informed by Darwin's evolutionary theories, as well as the advent of Cybernetics as 'the scientific study of how people, animals, and machines control and communicate information.' (Merriam-Webster, 2006) In Ecology, nodes (plant, animal, water, etc.) in an ecosystem were increasingly understood to be disturbed by environmental factors, especially in relation to the extinction of certain species. This, in turn, reinforced the idea that these nodes needed to adapt to environmental factors for survival, otherwise they were succeeded by a more stable version of themselves. As a scientific logic, Ecology proved that stability – imposed or 'natural' – was not only the goal, but that with proper calculation and manipulation, a kind of beneficent order was possible because of this continuous adaptation.

However, recent research emerging from climate change studies forces us to confront the limits of Ecology as a discipline, concept, and theory of ongoing adaptability. Instead we are now forced to reconsider the many 'eco-logics' that have allowed neoliberal policies to dominate. We are now confronted with capitalism's antithetic relationship to the environment and recognize it for what it is: a means to maintain economically viable commodity production in our current era of mass communication, for the personal/private profit of relatively few under the guise of improving the lives of the masses. The only hope for the critical scholar at this juncture – or 'impasse' as Sheena Wilson (2014) frames it – is for a 'revolution of mentalities' (Guattari, 1995: 119) that relocates critical and heartfelt thought as central to the existential shift now needed, rather than looking to technology, media, policy, or Big Data as remedies (Taffel, 2012; Hunt, 2014; Easterling, 2014).

Thinking big

Ecology is the broadest but youngest of sciences. It was first conceived during the 18C as an 'economy of nature' by Swedish botanist Carolus Linnaeus who observed and documented the interactions of plants and animals. In 1866, 'Ecology' got its official name from German biologist, Ernst Haeckel, as the concept shifted from the lab to the field. Early ecology produced food chain diagrams and animal pyramids as means to interpret and explain the various support systems at play in specific contexts. In the 1920 and 1930s, ecological work became quantified and partitioned in order to be explored scientifically,

where principles of physical chemistry could be applied to nature. However, the ideas that ended up most transforming the field were the recognition of organisms as part of a physical environment, and the observation of competition among species. Modern ecology emerged in the 1970s, developed as a utilitarian and serviced-based approach to generate public interest in environmental conservation. Through these reconfigurations, the field shifted again, from 'ecology' to 'ecosystems,' or 'systems ecology.' By the 1990s, ecosystems management became more overtly a method to estimate the economic value of natural resources: nature as commodity. As we see with Big Tech, land and water in particular have become incorporated into trade mechanisms.

Before ecosystems management became a utilitarian deployment of science, the environment was largely considered to be in 'natural production' offering 'non-appropriable gifts of nature' (Gómez-Baggethun et al., 2010). Nature was not something owned, and as such, had no inherent monetary value, nor was it perceived as serving humans in any useful way. But the mainstreaming through science and policy making of ecosystems management by the late 1990s saw the value of global natural capital and ecosystem services become interlinked. This approach: 'stressed human dependency not only on ecosystem services, but also on the underlying ecosystem functioning, contributing to make visible the role of biodiversity and ecological processes in human well-being.' (Gómez-Baggethun et al., 2010: 1214) Incentives for conservation became baked into the economy – monetized, appropriated and exchanged – coinciding with the expansion of neoliberalism. Now, the connection between neoliberalism and dataism becomes crucial to understanding this potentially new wave of ecosystems management.

This new wave will reinforce the idea of control – of a control society – or a society controlled by scientific logics, which is increasingly determined by Big Data and its push to quantify every aspect of existence as a way to be better managed. This is key. If we have Big Data determining our needs, we also need to create the Big Data Ecologies to maintain them. It becomes not only more difficult to opt out of this system, but also more difficult to see outside of this frame. However, the idea of an ecosystem was shaped early on according to a budding machine logic, where elements of the ecosystem were understood and manipulated as nodes in a complex system of interrelationships that can be 'datafied' – mapped, observed, intercepted and interpolated. Now the machine (and its logics) has changed – it is algorithmically larger and more powerful, and it is learning from 'itself' in a manner we term 'artificial' intelligence.

While Ecology as a discipline has long been focused on the interrelationships between living organisms and the environments in which they live, the concept of 'media ecology' has denoted different theoretical intentions, though arguably

circling back to this always vexing concept of nature. Marshall McLuhan (1962, 1964) developed the concept of 'media ecology' in the late 1960s to explain the various eras of humanity according to the role of technology in social transformations. Neil Postman (1970) carried on this intellectual legacy and used the concept of media ecology to draw attention to processes and structures of media rather than to its content or to textual analysis. Matthew Fuller (2007) pluralised the concept, as 'media ecologies,' and invited readers to a kind of multiplicitous materiality, complicating perceptions about the physicality of information. Since then, numerous important interrelated concepts have emerged to reinstate more overtly the ideas of nature and materiality within a mediated ecological frame: Stacy Alaimo's desire to 'track' 'environmental traces' in texts (2011), Jussi Parikka's (2012) 'medianature' – borrowed from Donna Haraway's (2003) earlier idea of 'naturecultures,' – both pointing to the complex weaving of meaning and materiality. Serenella Iovino and Serpil Oppermann's (2014) 'material ecocriticism,' further suggests that stories (are) matter, those generated by material agencies and phenomena and, most importantly to the argument, scholars who put into question the universality of the Anthropocene, such as Ruth Irwin (2013), Sheena Wilson (2014), Jason W. Moore (2015) or Zoe Todd (2016), who position the geological era in question as a neoliberal undoing, rather than generalisable human impact. These scholarly interventions come to represent a reformulation of media theory by complicating matter at the heart of both technology and the environment, as neither distinct nor separable. In particular, by suggesting that media objects (and their affects/effects) have agency this (new) materialist turn in media and communication studies allows for a rethinking of the traditional ecological framework in favour of 'Big Data Ecologies' that bear a particular pointedness – a responsibility and an accountability.

Who has power, who benefits, who suffers, and how those choices are justified by the meanings attributed to 'nature' and innovation vary according to conditions at different technological junctures. This task of deciphering those power dynamics is, in part, the work reserved for critical scholars. Communication infrastructures elicit something important about our shared cultural values, structures, and histories that cannot be measured by Big Data or science alone. Big Data becomes the site of justification for, rather than a byproduct of, the natural disasters and effects of global warming that we must now all endure despite our positionality, philosophical ideals, material access, or place of power in the world. As such, an expanded and more readily interdisciplinary adaptation of the concept of Big Data Ecologies can be employed to advance our understanding of Big Tech as a Western convenience, where waste and polluting processes are most often done in an unacknowledged 'elsewhere,' as a system that relies heavily on disjunctures and contradictions (for

discursive/greenwashing purposes in particular), and on the public perception of communications infrastructure as cloud-like, as immaterial and ephemeral. Conversely, Big Tech's hypervisibility around their data centers and their greening efforts fail to consider the implications outside of the economic perspective that sets value, inclusive of human worth and/in relation to primary resources (Kaika and Swyngedouw, 2014). As Wilson explains, by imagining ways to salvage capitalism and the environment as though the survival of one is not reliant on the destruction of the other, we fail to see beyond the superficial offerings of greening initiatives by Big Tech. In line with Wilson my overall argument is about how the so-called 'greening' of Big Data Ecologies are thin narratives that deploy textual and visual rhetorical strategies intended to obfuscate and overwrite resource exploitation.

With the Google Water and Apple Forest examples, I have carefully accounted for the ways in which Big Tech, and their data centers in particular, have come to monumentalize consumption, and have set in motion a means by which expansion – especially of green energy alternatives – are a symbol of technological success and survival. And yet no matter how green data centers become, and no matter how innovative renewable energy is, there is a larger media ecosystem undergirding it – a world of limited natural resources, techno-trash, toxic bodies, and e-waste – driven by ideals of innovation based on the perpetual marketing of the new. Public relations and marketing need to go beyond common branding tactics, where greening mechanisms are themselves used to perpetuate a sustainable future. What is revealed in both examples is that the goals of Big Tech are fundamentally at odds with the business of these companies, whether it is device manufacture in East Asia, delivery of goods from warehouses across North America, or the cooling operations required of massive always-on server farms.

While more environmentally sound in the immediate sense, green alternatives situated in proximity to sites of consumption, but not of production, ultimately cannot inherently resolve questions of social accountability or enlightened governance that are crucial in terms of current policy debates. Indeed, it is extremely problematic to ask these companies to take on a central role in the debate of what constitutes the public good when they have other very real objectives, such as providing returns to stockholders. So part of the problem here – a big part – is the erosion of regional, national and international public policy that could set and attain 'good' energy goals through policy and legislation, rather than leave it to the good graces of a company, which is subject to the fickle winds of public perception. As the now widely used concept of the Anthropocene has suggested, human impact has become central to our notion and assessment of progress in relation to nature (Brown and Timmerman, 2015). We must,

however, further consider how economic incentives have changed since the world was still largely unmapped (in the settler sense), imagined by many of its explorers as undepletable, offering abundant resources to all, for all times. At our current juncture, however, green alternatives further evade cause in that they allow us to stall and deflect on the question of both consumption and production, even at our breaking point (Zehner, 2012).

Instead of dealing with consumption at the site of production, Big Tech is investing in large swaths of land, public infrastructure and in the management and containment of natural resources primarily in its marketplaces, as discursively enclosed ecosystems. Just as Houston's sprawling housing and industrial developments on vulnerable waterways could not stand in the way of a so-called 100-year storm, Hurricane Harvey, Big Tech is building containment systems that will not achieve the same goals in data management. It does this in order to counter competition for the growing rarity of natural resources, to control its sources of energy, and to keep up with ever-growing consumption demands. It is grabbing at natural resources, water and land, and also the wind and sun, to seem self-sufficient and also, by way of a complex definition, self-contained. This pairing is not necessarily new nor specific to new media economies. However, these examples do demonstrate the ways in which Big Tech becomes a spawning species of its own doing: at once predatory, fungal, feral and invasive.

While Big Tech has always relied upon nature in the production of technologies and is increasingly attempting to manage itself as an ecosystem, that is, as a self-sustaining complex network of interdependent and interconnected nodes in a system, it nevertheless fails to reconsider the impact of the very demand on which its supply depends. While implementing material physical infrastructures toward ecosystemic ends, it deploys a capitalist modality of nature to assert itself as green and environmentally-friendly. Natural resources are necessary to the operations of Big Tech, even if, by any calculation, online consumption (McKeown, 2013) – as social media, surveillance, communication, and entertainment – simply cannot be materially supported at today's data-driven expansion rates (Nye, 1996). The problem, however, is that while the concept of a global ecosystem is necessary to make a case against greed and overconsumption, it is also a re-invocation of the same scientific regimes that have long rationalized the domination of machine logics over nature.

We entrust technology with the task to solve the problems it creates, even if water, forests, and rare earth minerals are inherently – and ultimately – counter-commercially sustainable. In other words, the planet can never replenish the raw materials that have been extruded, and once disused, returned as waste to the

ecosystem. Forest, and ecosystems more generally, are said to have a tipping point after which they will not replenish on their own. The time lag of the effects and repercussions of hasty and greedy human interventions – causing animal extinction or forest depletion – take significantly longer to manifest than capitalism invests in managing those same resources. Natural resources are transformed for quick and immediate economic profit. As such, they require rationing policies and practices or they otherwise risk becoming (too quickly) overused and too carelessly dumped elsewhere, determined also by oversimplified economic calculations. In economic terms, value is independent of the resource itself. Nature comes to belong to the highest bidder. This, in turn, means the ecosystemic logic is one based on present and potential utility, with little to no concern for the long term, or for future generations. Big Tech must be repositioned within a Big Data ecosystemic framework to acknowledge technological progress and innovation as a complex player in the transformation of nature and its management, rather than simply either its abuser or its custodian.

What this paper has demonstrated is that the concept of the ecosystem created long ago, through dubious methods, has been updated and rearticulated, but not fundamentally rethought. It has managed to remain in the public imaginary as the most important way to conceive of the relationship between humans and nature. While the idea of human impact on nature propelled by neoliberal policies is now indisputable, the concept of the ecology and of managing ecosystems risks providing false hope. What we need to come to terms with as a culture is that there is no equilibrium to return to. That is a worldview rendered obsolete.

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