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Unearthing Techno-Ecology

On the Possibility of a Technical Media Philosophy of Ecology

Tim Barker and Conor McKeown

Abstract

Studies of media and ecology are often reduced to questions of representation: understanding the cultural mediation of nature means looking to screen based content. However, given recent work in materialist media studies from Doug Kahn, Lisa Parks and Eugene Thacker in particular, a new possibility comes into view. We now know that before nature is mediated through culture, it is often passed through layers of technology. With that in mind, this paper offers a radical rethinking of the technological mediation of the ecological. Through a study of the technical apparatus as an active system of knowledge, two different sections of the paper will illustrate the 'tool-kit' that makes possible a technical study of ecology. The first looks to historical developments of hardware such as the telegraph, radio, and satellites to pinpoint examples where media technology has been used to pick up signals from the natural world. Framed by the philosophy of Peter Sloterdijk, it explores the way nature has been given form through its transduction into communication systems. The second section of this paper, addressing ecology on a different register, looks past the surface of digital media to the manner in which ecologies are mediated via computer code. In this section, by conducting a reverse-engineering of the software based eco-media videogame Mountain *(O'Reilly, 2014), we encounter the ecological structure of code systems which could be applied to other data visualisation systems. These two methods of analysis suggest the possibilities of a technologically focused study of eco-media: in coming to grips with both global and internal ecologies through what Sloterdijk terms 'air conditioning' systems – the material processes that provide the atmosphere of everyday life – we investigate the possibilities for innovative, post-human, approaches to a natural world entwined with media and technology.*

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Introduction

> To oppose the cosmic frost infiltrating the human sphere through the open windows of the enlightenment, modern humanity makes use of a deliberate greenhouse effect:
> it attempts to balance out its shellessness in space, following the shattering of the celestial domes, through an artificial civilizatory world.
>
> (Sloterdijk and Heinrichs 2011 [2004]: 24)

Globality, the oscillating condition of immunity and community constitutive of contemporary life, has been produced by the relationships formed between social, political, economic, geographic and technological spheres. The term "immunity", after its treatment by Peter Sloterdijk, now designates systems of protection and healing, while the term "community" refers to reciprocal systems of openness and sensitivity that operate within these spaces of immunity. According to Sloterdijk, humans, at least since they began living in a world without God, have become radically open to the world and, to protect themselves, spheres of immunity have had to be created that both exclude and include varying levels of community. These conditions oscillate in contemporary culture as the human both exposes him or herself to the outside world, but then, in an attempt at defence, closes off to create spheres in which they live with others. This action establishes ecological relationships between beings and produces the terms of the global, as a set of protocols that one must be able to operate within in order to be included within this space. These are very particular forms of relations that offer the condition of togetherness and also aloneness that Sloterdijk explores with the image of bubbles, globes and foam. As well as being culturally produced, in the foaming socialisation of connectivity and individualisation afforded by urban life, both immunity and community are to varying degrees produced, supported or afforded by the technical regimes of the hardware and software of human communication systems. Where Sloterdijk focuses on the social and human relationships within the context of spherical relations, in this essay we turn our attention to the relationship between humans and so-called nature; we ask: how have ecological systems manifested themselves via media technology, which may occur as software represent the natural world in computer code or as sensitive media pick up and transform signals from the outside world, 'unearthing' them from associations with an imagined natural environment? In order to answer this vital question – which takes on a particular significance as humans attempt to grapple with, prepare for and mitigate the catastrophic global changes that are beginning to come into view – we look to the conditioning systems of spheres, with a particular focus on the role of technology in supporting the development of ecological spaces.

When Sloterdijk draws our attention to the "cosmic frost infiltrating the human sphere" (Sloterdijk and Heinrichs 2011 [2004]: 24) he alerts us to the project of house building that characterises modernity and its attempt to

alleviate the terror faced by humans standing before an open sky, cold, dark and devoid of God. After the Copernican Revolution the sky as an immune system was essentially useless. It, according to Sloterdijk, no longer offered the protection of an enclosed "terrorless shell". What was needed was a way of enclosing relationships and producing ways of being with the global Earth.

> "We are never absolutely 'in the world' to use the problematic formula of *Being and Time* with some reserve; we are normally in a bubble of tinted space, in a determined and allocated point [...]. It is only in times of catastrophe, when all the dwellings implode and the naked exterior appears in broad daylight, that mortals are perhaps effectively held in the void, as Heidegger put it; but as a general rule, what applies to them is the law of dwelling in a shared, auto-poeticising space." (ibid.: 144)

A major part of this house building project was the development of technology that articulates events into global systems and in this sense encloses the world in a new, artificial shell: "industrial-scale civilization, the welfare state, the world market and the media sphere: all these large-scale projects aim, in a shelless time, for an imitation of the now impossible, imaginary spheric security" (Sloterdijk 2011 [1998]: 25).

Sloterdijk's "spherology" is an approach that is convergent in many ways with media theory, most apparently in its emphasis on relationality, visitation and technically enclosed spaces (ibid.: 25). Inspired by Sloterdijk's work, this essay outlines a radical rethinking of the role of technical media in the development of the ecological. In a number of examples that illustrate the 'tool kit' that makes possible a technologically focused media philosophy of ecology we explore two different, but related, registers of the technical-ecological relationship. These different registers are discussed in two sections (one which focuses on hardware, the other on software) that describe media technology as, following the work of Wolfgang Ernst (2013: 48), epistemological instruments. Global media technology, including 'info sphere' building instruments such as the hardware of communications networks and the simulated environments offered by software code, are presented as *analytical* devices that provide points of contact with so-called nature. These devices pick up, transduce and measure signals from the world and to understand the way these devices 'tune' human users into the ecological requires not textual analysis, but, as Ernst puts it "a close reading of the literal 'wiring' of the recording machine, of its voice coil and the other techno-logical ingredients of this wondrous mechanism" (ibid.: 61). Ernst separates the term technological into its constitutive parts to emphasise the role of both hardware (techno) and software (logic) in coding the materiality of the world. In what follows we similarly present an argument that looks to techno-logically produced ecologies. The first section focuses on the mediation of concepts of nature, communication and ecology via the historical development of information spheres. Looking to hardware developments such as the telegraph, radio, and satellites this section pinpoints examples where communications media has been used – accidentally or otherwise – to pick up signal from the natural world. This section then explores the cultural mediation of ecologies

and argues that, throughout media history, as what might be termed 'the outside world' has entered into the symbolic and technical regime of communication in order to be imagined, it has simultaneously been constructed via technical apparatuses. As Sloterdijk states,

> "The electronic and telematic globalisation of today already represents the third wave of actual globalisation. It's the final stage of a process that began in the epoch of Greek philosophical cosmology, and whose present vectors are rapid transportation as well as ultra high-speed telecommunication. At the same time, it's the product of a radical disappointment, whereby human beings had to abandon the privilege of inhabiting a real cosmos – which is to say a closed and comforting world." (2011 [2004]: 223)

Vast networks of communication have been established, with telegraph wires and fibre optic cables covering the surface of the Earth and wireless radio signal moving through the atmosphere. This system of media has been designed to insulate human communication from outside interference: Networked human communication over vast distances is possible because the line that connects the sender and receiver excludes entropic noise. However, this communication network, both over the Earth, in the air and beyond, is also *sensitive*. For a message to move down a line, the line itself has to be sensitive enough to conduct the flow of signal (Connor 2002). Although attempts are always made to balance sensitivity and noise, this sensitivity, or openness, occasionally allows communication to be open to interruptions in the form of noise, errors and hacking. Human communication systems are based on this trade-off between open and closed systems and, as will be discussed in the first section of this paper, relationships are sustained through this double movement. The first section of this paper hence focuses on ecology and its mediation via the hardware of electronic communication.

The second section of this paper, addressing ecology on a different register, focuses on the manner in which ecologies are mediated via computer code. This section argues that by conducting a reverse engineering of eco-media that uses software to 'write' ecologies, such as ecologically oriented computer games, we can see much more about the eco-critical nature of media – as a technology that provides the infrastructure for representation and the supports for discourse – than that which is offered through an exploration of 'imaginary' content. By looking at the relationships inherent in the software, such as between the development environments ("engine"), the high-level codes used to program within them, the code libraries that allow languages to function and the compilers that translate high-level code to machine readable codes, we begin to see the way that ecologies are represented in digital culture before they become content for the imagination.

A technical media philosophy of ecology intervenes in a field of debate that has been shaped by two domains: one of these is eco-criticism and the other is media ecology. The field of eco-criticism has emerged as a mode of study that crosses the disciplines of literary theory (Heise 2008; Morton 2009), film theory (Ingram 2000; Ivakhiv 2013), media studies (Kahn 2013), art theory

(Miles 2014) and philosophy (Serres 1995 [1990]; Latour 2005). Its main aim is to study the way that ecosystems and the natural world have been positioned in cultural texts including film, television, art, literature and video games. Media ecology has likewise emerged as an important field of study. Pioneered by people such as Marshall McLuhan and Neil Postman, this field conceptualises media themselves as an eco-system, with little to no account for the natural world. This approach has more recently been reformulated in quite radical ways by both Matthew Fuller (2005) and Erich Hörl (2013), who move far beyond McLuhan and Postman's anthropocentric understanding of communication and instead think ecologically about the 'powers of action' dispersed via organic, cultural, technical and political systems. This approach is continued in Jussi Parikka's work, which similarly situates media as a milieu that is irreducible to the usual terms of human communication. Parikka writes that just as "an animal has to find a specific tune with its environment, a technology has to work through rhythmic relations with other force fields such as politics and economics" (Parikka 2010: xiv). Media do not simply form an environment in which people live as subjects. Instead, after Fuller, Hörl and Parikka, they can be understood to operate in a way that establishes non-centralised ecological relationships between organic, technical and political registers that build fragile and artificial spaces. A technical media philosophy of ecology takes an approach that is inspired by, but yet different to, both eco-criticism and media ecology. It does this by focusing on the way the technology of media not only picture ecology as images on screens, but actually intervene in the interpretation of ecology that transforms their political, social and economic effects. In this sense it builds on the more innovative approaches to media ecology outlined by Fuller, Parikka and Hörl and focuses on uncovering the cultural role built into these active systems of knowledge through a study of their interpretative frameworks, codes and protocols.

The relationships between the natural and the symbolic environment, between subject and predicate, what Alfred North Whitehead once referred to as the "buzzing world", is one of the elements of contemporary life that might come to light in a study of ecology framed by technical media. Whitehead states:

> "All modern philosophy hinges round the difficulty of describing the world in terms of subject and predicate, substance and quality, particular and universal. The result always does violence to the immediate experience which we express in our actions, our hopes, our sympathies, our purposes, and which we enjoy in spite of our lack of phrases for its verbal analysis. We find ourselves in a buzzing world, amid a democracy of fellow creatures." (1978 [1929]: 50)

This buzzing world includes both the objects described by science and the experience of these objects described in the humanities. In proposing a technologically inspired philosophy of ecology, we hope to outline potential pictures of this 'buzzingness' by focussing on the mediated representation of ecology. As already mentioned, this does not involve looking at images on screens but involves looking at how these representations are *performed* by media-as-tech-

nology. A number of ecologically-oriented media theorists have likewise begun to grapple with the relationship between the 'hard' natural world and the 'soft' environment produced by media. With the exception of recent and ongoing work such as Doug Kahn's (2012; 2013) exploration of electromagnetism in the arts and Bruce Clarke's (2009) cybernetic inspired approach to environmentalism, most of the literature in the field has focused on the way that the cinematic or the television apparatus translates the 'natural' into symbolic content (see for instance Ingram 2004; Murray and Heumann 2014; Rust et al 2013). Similar work has been conducted within digital games studies where the focus remains on the ethical impact of environmental representation (see for example Goggin 2014; Chang 2012). While this is undeniably valuable work, there is room to move past the current focus on mediated images and conduct a deeper form of discourse analysis that focuses on the material processes that give form to the so-called objects of nature and the buzzingness to which Whitehead draws our attention.

Info-spheres and sensitive hardware

Since the discovery of electro-magnetic waves in the 19th century, the human being has existed as a social entity in info-spheres consisting of technical media such as telefax, telegraph, telephone, television and the Internet. What is more, global relationships, as understood via Sloterdijk, have been defined by the limits of the territories covered by these info-spheres and the sensitivity of technological 'sensing' systems. Theorists such as James Carey, David Harvey and Marshall McLuhan have told us for some time about the dramatic reconfigurations of space as people now communicate electronically over vast distances. There has also been a similarly radical reconfiguration of space and the notion of information emanating from the Earth itself, which was originally established by discoveries in the field of cybernetics. Not involving human-to-human communication and hence so far being set beyond the pale of most contemporary anthropocentric media theory, it instead involves rethinking communications technology as a system for sensing signal originating from non-human sources beyond what had previously been possible. As media begun to be used to pick up signal from nature it also begun to produce technical images of nature, mediated and measured based on the materiality of hardware. An example of this occurred in 1886, when electromagnetic radiation emitted by atmospheric disturbances was picked up and made audible on long telephone lines in Austria (Croom 2012: 259). As is widely known, telegraph operators send signals by starting and stopping electric signals that run through networks of copper wire. The specific sequence and timings of these starts and stops make up a telegraph code. However, during atmospheric events, such as storms and aural light shows, stronger electrical currents interfere with and overrun the coded messages (Carlowicz and Lopez 2004: 55). In this sense, media quite literally give form to the 'buzzing' world once described by Whitehead. Both the ontological 'real' bolts of lightning and the subjectively 'real' aural qualities picked up as

they travel down long telegraph wires bring the 'soft' coded world of electronic communication into a relation with the 'hard' world of nature and climate, all be it one that has been coded by media. Doug Kahn tells us that Alexander Graham Bell's assistant Thomas Watson used to spend hours listening to these signals, transduced into new forms by the telephone, which reportedly sounded like music (2013: 27-28). "Once Watson's workday came to a close and no one was on the other end of the line, he listened to sounds other than voices. Environmental energies had long been ever-present in the telegraph system, but the *transductive* capability of the telephone made them audible as never before." (Kahn 2013: 27)

In addition to wired communication made possible by telegraph lines, noise from the atmosphere entered into the technological sphere of human communication via radio. Steven Connor points out that in 1919 the German physicist Heinrich Barkhausen described 'whistling tones', very low frequency radio waves heard as sounds descending from the highest audible tone to the lowest audible tone on amplifiers originally used to intercept transmissions during World War I. In deep underground bunkers Barkhausen set up equipment designed to detect very weak electrical signals that leaked into the ground from Allied radio transmissions. Doing so, he accidently recorded strange whistling sounds that overtook the military chatter. Originally Barkhausen erroneously suggested that these tones were emitted from the Earth's surface (Connor 2010: 207). But it was not until 1930 that he identified these 'whistling tones' as "launched at the Earth's surface by lightning bolts" (Post, 1995: 1622). Not only were these natural events turned into electronic events, as they were picked up by technical media, they were also formalised in language: They became objects in both technical and symbolic spheres. As Connor writes,

> "The noises that interrupted and sometimes swamped communications were not merely random, but had their own acoustic profiles. A phonology and then a phonetics of the atmosphere began to be devised, as the mouth and tongue assisted the ear in picking out, naming and echoing back in language the different kinds of interference. Observing that the electro-magnetic atmosphere 'had a language of its own', J.J. Fahie wrote that the sound of lightning discharges registering on telephone lines was 'very characteristic – something like the quenching of a drop of molten metal in water, or the sound of a distant rocket'. As early as 1913 Eccles proposed a distribution of radio atmospherics into 'clicks,' 'grinders' and 'hisses'." (2010: 206)

Noise, picked up by technical media and transmitted to earpieces, was then given cultural form via language. This technical and then symbolic measurement of nature fulfilled the role of what Sloterdijk calls air-conditioning systems. It turned the noise of the atmosphere into information that users were able to live within. A shell was created by the electronic and symbolic environments of communication and language that coded the otherwise incomprehensible atmosphere. Events, as Connor points out, via their mediation, were made graspable.

It was also discovered in more everyday contexts that when in-doors, listening to the radio during a thunderstorm, static takes over the broadcaster's voice: at this point the general public was introduced to interference from

atmospherics. In the early twentieth century acute listeners were able to use the noise on the channel to determine the direction and magnitude of a storm by tinkering with the position of the radio antennae. As Don Ihde states in his work on the phenomenology of listening, the act of sound and listening has been subtly yet profoundly transformed by electronic communication:

> "Above all, the electronic communications revolution has made us aware that once silent realms are in fact realms of sound and noise. The ocean now resounds with whale songs and shrimp percussions made possible by the extension of listening through electronic amplification. The distant stars, which perhaps are not so thoroughly in a 'harmony of the spheres' of the Pythagoreans, nevertheless sputter in the static of radio-astronomy [...]. It is not merely that the world has suddenly become noisier, or that we can hear further, or even that sound is somehow demandingly pervasive in a technological culture. It is rather that by living with electronic instruments our experience of listening itself is being transformed, and included in this transformation are the ideas we have about the world and ourselves." (2009: 4-5)

Eventually, as the antenna was turned skyward, the practice of technological listening led to radio astronomy and the identification of sound waves beyond the Earth itself, as a background noise of the radiation of the universe. One no longer needs to be out in the storm to experience its clamour and sense its disturbance. Now all that is needed are 'sensitive' technical media.

In 1931 Karl Jansky discovered that even when all the background noise supplied by atmospheric disturbances, such as thunderstorms were eliminated there persisted a residual background noise in his equipment (Connor 2010: 205). Jansky was working at Bell Labs between 1930 and 1931 on investigating possible sources of interference on long distance radio communication (Lovell 1967: 10). Following his observation that the noise changed throughout the period of the day, on a 23 hour and 56 minute loop, corresponding with time it took for the Earth to achieve one complete rotation he was able to conclude that the noise originated from a point beyond the Earth's shell. Humans once again looked to the sky and attempted to come to grips with the messages entering into the global atmosphere.

Based on the discoveries made by Jansky, in 1937 Grote Reber pointed a purpose designed aerial toward the sky and, as the world's first radio astronomer, made the discovery that this 'cosmic static' picked up by Jansky emanated from clusters of stars in the milky way (Connor 2010: 205), which eventually led to the massive radar arrays that we see today. Reber's radio telescope consisted of a nine meter diameter bowl-shaped antenna, mounted on a platform that allowed it to swivel and be pointed at different segments of the sky. Using this he was able to detect the radio waves emitted by the ionized gas between stars and subsequently set out creating an astronomical map that represented the noise of the universe. Because of this development in technology humans were able to be secure of their place in a world that could make sense (quite literally) of the noise of the universe. Technical apparatuses here, as things that act in our experience of the world, simultaneously engage and disengage us with so-called

nature – both allowing greater access to, and in fact producing our visions of, ontology and the spheres we live within, but then drawing us into their own technicity. Buzzing wires and white noise gave form to the atmospheric events and reminded us of our place within a sphere, connected to one another by information in an otherwise noisy cosmos. As Kahn points out, the electronic environments of the world have become media environments (2010: 25). What the inventions and accidents, from radio astronomy to the detection of whistling tones, showed us was that the air is not neutral but incredibly noisy. In order to live with these atmospheres of noise we condition the air with our media and turn it into information. Noise has been reconfigured by the air-conditioning systems of our media: they have become, as Sloterdijk would put it, our life support systems. They are a way of coping, of existing, inside an atmosphere otherwise filled with noise. In the words of Sjoerd van Tuinen "'we', as information-processing animals and thus as medial protagonists of natura naturans, are engaged in a process not only of self-formation (humanism), but also of world formation (ecology)" (2009: 110).

Contemporary media systems continue in the upgrading of the massive sensing grid that spreads across the Earth, forming information into spheres. Like the telegraph and the radio these info-spheres mediated signal originating either from the Earth itself or from beyond its atmosphere. When listeners turned their radio aerials towards the sky or when Watson listened through the telephone to the natural radio produced over very long telegraph wires, they were not listening to the atmosphere itself, but rather the atmosphere in concert with technology, as it was put in contact with a system that conditioned and made atmospherics audible: they were listening to a polyphony of Earth and media components. This tendency continues. When studying data using visualisation techniques, or organising it based on database management software, humans are not confronted with ecology itself but with a polyphony of software and Earth signal. These phenomena bring to mind McLuhan's arguments regarding media as an extension of man. However, after Sloterdijk, it might be that media technology, rather than fulfilling the potential for extension, creates enclosed spaces of relationships, limiting or insulating, rather than extending, the senses. As Sloterdijk has shown us, this is the only way to live within the cacophony of the world, by using technical media that select and produce spheres of immunity. The background is made foreground, the vague is made exact: "we live in a culture that is practically unable to speak about the most manifest, about the fundamental clearing, about the atmosphere in which we live" (Sloterdijk and Heinrichs 2011 [2001]: 143). The invention of technical media that accidentally picked up this signal and offered new opportunities to speak of it, transduced it into both the technical spheres of media and the symbolic spheres of language. The media used to condition the relationships within spheres of immunity, whether at the level of hardware or software, must not be underestimated as an active component in the way ecologies are represented and the manner in which relationships are established between humans and nature on cultural, social, political and economic registers.

When the view of the Earth as a blue marble was produced, humans did not simply see the Earth itself, but the planet in concert with satellite systems. Somewhere in the region of 3000 satellites now encircle and insulate the Earth, enabling both communication within information spheres and the recording, measurement and imaging of global systems. Since their earliest deployment, by undertaking both these roles, satellites have created an artificial atmosphere around the Earth based on the transmission of signals and the monitoring of global flows. An example of this, given by Lisa Parks, is the development of satellite television systems. As Parks points out, aspects of satellite television such as live international transmission, direct satellite broadcasting, astronomical observation and the images of weather patterns given to us in the nightly weather report, "have helped to determine (that is, have helped to shape and set the limits of) the spheres of cultural and economic activity that constitute what we know as 'the global'" (Parks 2005: 2). Parks gives a number of examples including *Our World*, a 1967 broadcast designed to link regions in a new global transmission, and the Aboriginal satellite network *Imparja TV*, which demarcate geopolitical spaces based on the geographies covered by transmitted signal. In the case of *Our World*, the programme attempted to connect geographically dispersed viewers in a 'global now' (Parks 2005: 22). Profiling news, current affairs and variety show-style performances from participant nations, the show attempted to offer a televised 'tour' of the global. However, the cameras for *Our World* did not venture into the third world, but merely represented these 'corners' of the globe as statistics in news reports (Parks 2005: 28). The world building project of *Our World*, and the global system that it represented was based on the protocols and preferences of television regulations and broadcasters and, according to Parks, simply rehearsed Western hegemony, now coming from the skies. The terms of the global are now defined not only by access to media but by the areas covered by satellite transmission.

The 'atmosphere', both in the sense of an enclosed sphere but also in the more poetic sense of a surrounding mood, feeling of predisposition, has now come into view. Satellites not only represent images of the planet but produce relationships between regions, while excluding others. The movement and range of satellites links nations together in shared info-spheres, while excluding others. Developments in satellite technology offer scientists significantly new images of the globe. But simultaneously, satellites reformulate relationships between geographic locations based on the way they demarcate the world into signal territories. As Parks (2005) points out, satellite 'footprints' act as geopolitical communicative spheres, which, like political alliances or international trade relations, generate an ecology of global relationships between geographic spaces. As mentioned previously, where a view to media content might serve the humanist agenda of self-reflection, looking to the function of media-as-technology – hardware which, after Sloterdijk, we can understand as actively engaged in the act of air-conditioning – might offer possibilities of a media philosophy of ecology (or world building).

Coding Ecology

The process of world building operates not just in terms of hardware, but also via software processes where computer code is used to represent worlds. Like the previous section, a view to the software used to simulate spherical relations offers a way of bringing into focus the function of media technology as what Ernst refers to as epistemological instruments. Both the hardware and software that are engaged in a process of building artificial globes act as experimental apparatuses for creating phenomena that previously did not exist. In terms of hardware this happens via transduction. In terms of software this takes the form of what Ernst calls 'numerical experiments' (2013: 191), which act as operative diagrams performed by the computer. "In between the physical laboratory experiment on the one hand and theoretical physics on the other, such simulations realize a true media theory, that is, theoretical reasoning is being algorithmically implemented in the real world" (ibid.: 191).

In a sense computer games have become one of the pre-dominant forms of sphere building as coders construct new info-spheres separate from but open to the exterior, non-digital world. Most commonly this phenomena of writing nature as code is explored with a focus on the shortcomings of these games that point to their inability to express the complexity of ecologies. Alenda Chang writes, "Game environments tend to lean heavily on clichéd landscapes, abandoning any attempts at regional specificity for pre-patterned and ultimately generic scenes" (2011: 59). Chang's study (2012) of farm simulation games such as *Farmville* (Zynga 2009) foregrounds the potential pitfalls of representations of ecosystems that ignore such realities as soil quality deterioration and monoculture crop dependencies and implicitly encourage ideas of agriculture consistent with an unrealistic pastoral idyll.

Chang's approach, taking games at face-value, highlights ingrained cultural mediations of ecology. However, another perspective might be gained by analyzing games at the level of code which focuses more on the construction of Sloterdijk's spherical relations through the operability of media apparatuses. Working from the 'ground up' it is possible to view digital architecture as a coded representation of the systemic, indeed *ecological*, structure of the natural world, independent of a game's visuals.

David O'Reilly's iOS (Apple mobile devices) game *Mountain* (2014) offers an example that, on the surface, appears to present a simple and closed ecology. But if we look deeper, at the level of code, this game in fact is based on a number of complex eco-systems that it invites human users to inhabit. On the surface we can see that the game begins with a blank screen. After a short time, the player is non-verbally prompted to use the touchscreen to draw in response to phrases: 'anxiety', 'pain', 'mother' or a variety of others. After three prompts, the game constructs a mountain allegedly unique to those answers. It hovers, slowly rotating through space, in the centre of the device screen, rendered in impressive graphical detail. From that point the game has begun and is in play. However, unlike the majority of games, there are no objectives, no enemies, no lives and no 'hi-score'. Although the bottom of the screen can be tapped to

produce an array of musical notes, gameplay remains limited to witnessing and contemplating. Time passes signified by the background changing from day to night. Weather systems develop including rain, snow, light and fog. Flora and fauna grow and die on the mountain's sides and, on rare occasions, unusual objects fall from the sky. The game toys with standard notions of interaction by providing the players with input capabilities but leaving them to wonder what effect their actions, if any, may have.

Considering *Mountain* from an ecological perspective using the existing techniques of ecomedia criticism reveals a limited text. To its credit, the mountain can be argued to be the heart of this text, not serving as the backdrop for an anthropocentric narrative resonating with the desired qualities of literature suggested by first generation eco-criticism. However, this does not excuse its representation of a "generic ecology" suggested by Chang. Indeed, the arbitrary nature of the construction of the mountain at the beginning of the game encourages the idea that this is an algorithmically generated and entirely synthetic object, void of regional specifics and complex ecological relationships.

Looking past the level of image based representation and viewing the game as source code, a different story is told. The titular mountain rotates slowly about its axis. The player can influence this action using the now ubiquitous swipe controls of their touch screen device. This rotation function is handled by a C# script similar to the following simplified version:

```
using UnityEngine;
using System.Collections;
public class Spin : MonoBehaviour
{
    public float speed = 10f;
        void Update ()
    {
        transform.Rotate(Vector3.up, speed * Time.deltaTime);
    }
}
```

Focusing on the rotate function, the most important line here is the third: "public class Spin : MonoBehaviour". This contains the "spin" class and so is ultimately responsible for the rotation of the mountain. However, the phrase "spin" in isolation means nothing to a computer system. The other lines of code presented here are all required so that "spin" can be recognised and enacted by the computer in the desired way. Digging into the game code, an ecology of systematic interdependencies comes to light. Not only do pieces of code only 'make sense' based on the ecologies of the software system, a game's software also creates ecological systems that human users, as input, become operable within. This is a process of world building that constructs new ecological spheres within which human users now can come to terms with their being in the world as a being-in-(info)spheres. *Mountain* was constructed, as most contemporary videogames are, within a variety of different software environments in order to

speed up the creation process and ensure stability. Predominantly, games like *Mountain* are made using game creation 'engines' such as *Unity*. This engine is itself not that different from a game in that it presents the user with a real-time, interactive, three-dimensional space. Engines can be populated with software 'objects': code associated with certain variables or data to produce inter-active entities in gameplay. Although one intention of an engine is to keep coding to a minimum, code for *Unity* is written in the high-level C# language. Furthermore, *Unity* utilises a special software "library" that makes coding easier. The first and second lines quoted above "using UnityEngine" and "using System. Collections" are prompts to a "compiler" program: software that transposes the source code of *Mountain* written by human programmers into machine or binary code so it can be enacted by a computer. It is these libraries, written in the low-level "assembly" language, that allow prompts such as "spin" to be interpreted usefully by a computer. While this communication between software entities is, in reality, a further form of transduction, changing the stored electrical pulses of computer memory into pulses that create sounds or images, this transduction nevertheless relies on a carefully constructed system of ecological interdependencies to function. While the images presented on-screen provide a way of 'hallucinating' an environment, as Ernst would put it, analysing source code provides an insight into a representation of ecology closer to the practice of what Sloterdijk encapsulates in the phrase 'world building', that is not reducible to the term 'environment'.

Human interaction, conceived through this eco-coding framework, has a visibly minute impact on software processes. Staying with the rotation of the mountain, as mentioned earlier, it is possible for users to change the speed or direction. The speed of rotation is handled by the phrase: "transform.Rotate (Vector3.up, speed * Time.deltaTime);". This complex line has several dependencies on *Unity* that make it difficult to explain entirely: "Vector3" for instance, is a *Unity* method for handling the location of 3-dimensional graphics by charting the x, y and z co-ordinate of a single polygon and extending this information to all graphical data associated with it. However, broadly speaking, this line means that the location/shape ("transform") of the mountain changes ("Rotate") as the co-ordinate information of the associated polygons is increased ("Vector3. up") by a fixed value ("speed") at a fixed rate ("Time.deltaTime"). The amount of rotation, we are told, is "10f", which is to say an exact 10 pixels. The rate of this increase is set by the algorithm "Time.deltaTime", a pre-programmed entity that ensures the changing co-ordinates of the pixels is enacted at a rate that makes it comfortable for human vision. Rather than changing the pixel location as quickly as possible, instead, "delta.Time" makes this change only a handful of frames per-second. This ensures a smooth but not too rapid appearance of movement. It is important to understand here that the computer, in this instance an iPhone 4 or newer, not only performs the necessary calculations required to process the next image, it also calculates the rate at which it should display these images to remain user-friendly. In other words, the computer does more work in order to slow down. However, the player can still increase the rate of this rotation, giving them a feeling of control over the mountain they

observe. Of course, from a code perspective, player input really only changes the variable "10f" to a higher or lower value, affecting the animation speed. To change the direction of rotation, the co-ordinate values will descend rather than ascend – rather than increasing the pixel co-ordinate values by 10f, they will decrease. From this perspective, human input is not a matter of "controlling" or "using" the game. Rather, human input is a small contribution to the vast code ecosystem. This is similar to the way communication hardware, as set out in the previous section, transduces human and non-human voices into the same electronically coded media environments. The code remains open to infiltration and change within this environment, through the provision of alterable variables, while simultaneously immune and fixed in its structure and execution.

Mountain is a game that forefronts the need for a reading beyond the surface level as its design resists interpretive penetration at the level of textuality, remaining unresponsive to player input. Returning to Chang's criticism of digital games' portrayal of the natural world (their lack of detail) an insight into the software system behind the visual element of games provides an interesting alternative understanding. While games may never represent the natural world to a comparable level of visual fidelity, they are – however – structured in a way that is entirely natural. *Mountain*, although seemingly a singular piece of software, relies on input from a variety of other software entities for its encoding and still more for its execution. Just as entities within eco-systems rely on their neighbouring entities for existence, so too does software require this ecological practice. At the same time, software code creates a variously open and closed, what after Sloterdijk we decscribe as 'immune' and 'communal' system, to allow the sharing of values across itself and the feeling of interaction while remaining a stable system.

Michel Serres wrote about the disjunction of the human perception of time and planetary weather: "Above all, we surely don't know how to think about the relations between time and weather, temps and temps: a single French word for two seemingly disparate realities." (1997: 27) This temporal disjunction between humankind and nature is visually symbolised within *Mountain* as the players ponder the lack of immediate response to their input. Adding to this, looking into the realm of the technical, a similar temporal disjunction takes place: human input is reduced to a minute influence on an ecologically structured confluence of software processes; the rapid and elegantly entwined "microtemporal" world (Ernst 2013: 62) amounts to a composed sphere where the human 'user' is tranduced into a symbolic, and largely impenetrable software environment. This new perspective, an unearthing of natural systems from the biological and resultant exposure of techno-ecology, exposes the limitations of existing analytical frameworks. Beyond seeking to question the level of visual fidelity with which software represents the perceived natural world we can instead question the various shell-like layers of immunity and community that are established by technological systems.

Conclusion

In this paper we have set out to describe the possibility of a technical media philosophy of ecology – to *unearth* the idea of ecology from its associations with 'the natural' and instead focus on the interpellation of this idea into contemporary technical language. This approach focuses on the processes of transduction and measurement, concepts that are important to both media philosophers and electrical engineers. Via the process of transduction, inputs are transmitted to voltages that are able to be quantified and which can then be turned into language and explained. The first section of this paper explored the process of transduction that operated as noise from the Earth was picked up and coded by the hardware of communications systems. In the second section of this paper, this process was further illustrated by turning to the game *Mountain*, which offered a way to think about computer code as a further mediation of the concept of the ecological. In both these sections an emphasis on world building emerged. Inspired by Sloterdijk, we attempted throughout the paper to thread a technical media philosophy of the production of spheres, which include both humans and non-humans in a communicative relational space. These two sections are connected by the identification of media technology functioning as epistemological devices put to work when transducing, measuring and simulating ecological relationships. Telegraph wires, radios and computer code, amongst many other world building technical media, have the potential to act as a grid which covers the Earth, encircling the globe, and in fact setting the conditions on the relationships within this constructed sphere. The two sections, which offer two different methods of analysis, one focused on hardware, the other on software, suggest the possibilities of a technologically focused study of eco-media, which highlights the production of what Sloterdijk terms 'air conditioning' systems and explores the material processes that provide the atmosphere of everyday life.

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