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# An Ontology Of Electronic Waste

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allowing us to repurpose abandoned electronic devices in our laboratory and give them a trajectory that is fundamentally different from their design requirements. We don't perform these activities with the illusion of marketing these devices within a so-called circular economy. We reverse engineer and hack electronic waste to discourage the production of devices, to limit the catastrophic events that start at mining sites and end up in open acid pools in Ghana.

If the public perceive a device as an event rather than an object, we hope to spread awareness of the full environmental context in which they are created and reduce the incentive to acquire new devices. If schematics and firmware are publicly available, planned obsolescence is thwarted. If reverse engineered and alternative software is publicly available, abandoned software support is no longer an issue and if devices can be repurposed to perform tasks beyond their design requirements, any claim to intellectual property becomes irrelevant. Our work is a form of sabotage, a wrench in the gears of electronics manufacturing.

Adopting this approach towards e-waste might seem like something that doesn't directly address the magnitude and scale of logistical problems we face, but we at Unbinare see this as a call to action; openly reverse engineering and hacking devices immediately removes the biggest cause of all of the problems we described; the concept of private property, and the governments and corporations that through it, maintain a stranglehold on the environment. To aid this process, we provide training in reverse engineering in the hope others will join us in the effort. So this is a call to the reader to go out and squat their empty buildings, go dumpster diving, hack their devices and create new possibilities. The road we are on leads to nowhere; let us, together, imagine new paths instead.

multitude of paths and possibilities. What was once considered abandoned is resurrected and given a new life, much of what the anarchists did in the Hague twenty years ago, by giving life and freedom to an otherwise restrictive and bureaucratic process.

The term *reverse engineering*, frequently evokes questionable connotations to those that put profit before well-being; to them, reverse engineering is employed within corporate espionage to uncover trade secrets and ‘intellectual property’ by competitors in order to produce and market counterfeit products. More correctly, reverse engineering can simply be explained as the reverse of engineering; where instead of starting at design requirements and ending up with a device, one starts with the device and you end up with information of the device. The main driver of this activity is curiosity and inquisitiveness, irrespective of the manufacturer’s claims of ‘intellectual property’ rights that precede or might follow the research and publication of this information. As anarchists, we believe there is no such thing as illegal knowledge; all of human knowledge should be free to the public without any corporate claim or governmental legislative body that inhibits its distribution.

Additionally, with all of the connotations that the term *hacking* evokes to us, it is important to primarily distinguish the term from its corporate and perverted counterpart *ethical hacking*, or hacking performed in the information security industry that favors the well-being of corporations and the state, through red teaming, bug bounty programs and vulnerability brokers that conspire with intelligence agencies to track down dissidents and human-rights activists. We should make one thing very clear; there is no such thing as ‘ethical hacking’ if it further solidifies the power of the state, its surveillance apparatus and the corporate control over our lives. Our use of the term *hacking* follows the creative research that is performed after the reverse engineering of devices,

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to be an object unto itself, it needs to be self-contained and isolated from its environment. Without having a clear distinction of what is owned and what is not, ownership cannot be enforced. To illustrate my argument, if private ownership of land requires borders and fences, it is in complete disregard of the ecological dynamics that connect it to the rest of the environment, such as forming a habitat for wildlife unique to the area.

Inversely, the squatted buildings in the The Hague, previously considered private property and subsequently isolated from the local community, were reintegrated within the dynamics of city life by providing social functions to the benefit of the local community. What was once considered a privately owned and isolated object, became an event that reintegrated itself within the dynamics of the environment.

Similarly, as we have disregarded private ownership and looked at the broader context in which devices are created, bought and disposed of, we have discovered that electronic devices become environmentally catastrophic events; they are tragic, temporal occurrences that unfold over time. With the aim to prevent these disastrous outcomes, we at Unbinare decided to focus on the intersection in time where a device, now an event, loses its perceived identity as an object unto itself and continues its journey in a waste stream. Here we arrive at an intersection where our actions reintegrate in the environmental dynamics of the event and potentially alter the trajectory along which it unfolds. We start to establish a unique form of exploration where we not only recognize the ontological uniqueness of each individual device and learn what actions it is capable of executing within its full environmental context, but also what actions a device may execute that it was not initially designed to perform.

This research is commonly described as *reverse engineering and hacking*; through these activities, the former linear and destructive trajectory of these devices suddenly branch into a

ment of matter and continued impediment to the environment. This aids us to come to the realization that once we have unleashed these catastrophic events into the world, the environment is *irreversibly* damaged.

## Reverse Engineering as Direct Action

This realization resemble insights that come from ontological nominalism, a doctrine in metaphysics that denies the real being of abstract objects and considers them to only be concepts that originate in the mind; constructions of language with no physical reality. If we consider a device through the universal abstraction that is applied to it, for instance ‘a mobile phone’, we restrict this device to exclude the particular environmental dynamics it is part of; the reality of the mined minerals that reside inside the device (with the ecological and social destruction that enabled it) and the reality of the slow, irreversible damage it will cause to the environment after its use.

Although we only informally use nominalism as a means to address the contrast between universals and particulars, it provides us with an interesting point of departure to reason about electronic devices in novel ways and brings the broader environmental context back into the acknowledgment of the problem. If we are accustomed to address an electronic device through its universal abstraction, such as ‘a mobile phone’, then any other line of reasoning that follows will concern itself with this abstraction. If we in turn move from a single discarded device into a multiplicity of mobile phones and still use the same line of reasoning, we will arrive at a *pile* of mobile phones.

This allows for the current environmental problems with electronic waste to persist. As the concept of private property requires anything which is subject to the claim of ownership

## Abstract

*We all know about the false promises of the tech industry, and yet we adopt their myths. A report on the points of contact between squatting and e-waste, on greenwashing at e-waste conferences and on the tools of an anarchist reverse engineering laboratory.*

## Introduction

About twenty years before I founded Unbinare, an anarchist e-waste reverse engineering laboratory, I was an interdisciplinary art student and a young hacker in the city of the Hague, the Netherlands, with a extremely slim budget. To make ends meet in the first year of my studies, my neighbor in my student residence and I, both fascinated with hacking hardware for experimental electronic music, would go out late in the evening on Thursday nights with a supermarket shopping cart in search of discarded electronics on the sidewalks in the Hague’s city center. This might sound foreign to the current residents of the city, but around the turn of the century, e-waste recycling was not actively regulated and residents at that time threw their old and worn beige personal computers out on the street to be picked up by garbage trucks on Friday mornings. Next to computers, we would find a range of consumer electronic items such as home stereo amplifiers and old, dusty cathode-ray tube television sets. To our luck we lived in the vicinity of an electronics store specialized in selling electronic components and renowned locally for the amount and diversity of parts they had readily available. About one hundred meters away and around the corner from our components supplier was a long street, at the time populated with a row of second-hand electronics stores.

We would collect as many devices our shopping cart could hold and bring them back to our student residence. Once we unloaded them on the oil-stained floors of our bedrooms (which looked more like hackerspaces than sleeping quarters, riddled with parts and dissembled devices), we accessed their enclosures to examine their circuitry, removing any component we could salvage for our electronic music projects and repair the rest. Once devices were repaired and tested, we would sell them to the second hand electronics shop owners. From the salvaged parts we collected I would create do-it-yourself electronic music instruments that allowed me to perform live noise music in squatted buildings all over the city. It was a time when electronic waste was readily available to anyone, enabling us to make discarded devices available for reuse through repair. In a similar vein, so were abandoned buildings in the city available to anyone who wanted to liberate them to the local community.

Through squatting these abandoned buildings and converting them into autonomous zones with residences, concert halls, theaters and restaurants, anarchists around the turn of the century brought life and freedom to an otherwise restrictive and bureaucratic city. They occupied an old squatted tax office in the middle of the Hague, called *De Blauwe Aanslag* or *The Blue Attack* (An informal translation I playfully adhered to was *The Blue Fungus*) in english. Dozens of anarchists resided in the self-managed social center, which hosted a radio station, published magazines, curated concerts and organized protests. Elsewhere in the city, near the Plein square, comrades managed a theater space called *The White Space*, where I would perform my first pieces of improvised noise music, a vegan soup kitchen aptly named *Het Vermoorde Slagertje* or *The Murdered Butcher* and a large squatted industrial autonomous zone called De Vloek or The Curse in the harbour of Scheveningen. These spaces would entirely be run by anarchists and was the only community that was genuinely welcoming and unprejudiced towards a young

electronic devices and dispose of them. A few common causes that encourage the abandonment of electronic devices are blatant overconsumption, the short life span of cheap electronic devices, planned obsolescence, the inability to repair devices, abandoned software support, the end-of-life status of devices and the deliberate destruction of unsold products. To shortly give an overview of what happens after devices are discarded, The Global E-waste Statistics Partnership (GESp), recently released a document called the Global Transboundary E-waste Flows Monitor 2022, which aims to shed some light on the global flow and processing of e-waste. In that document, we find that in 2019, we produced about 7.3 kilograms of electronic waste per capita. This sums up to 53.6 million tonnes (Mt) of e-waste. This is expected to rise to a staggering 74.7 Mt of e-waste in 2030 and 110 Mt by 2050. As shocking as this projection might be, the most surprising figure I found is that in 2019 only 17 percent, or 9.3 Mt of it was managed in a way that was environmentally sound. This means that 83 percent, or 44.3 Mt of global e-waste literally fell off our radar. The majority is mixed up with other waste streams, ending up in countries the global south where they are traded, burned, dumped in landfills and dissolved in open acid pools, endangering the health of people that process this waste in the informal sector and ultimately the environment at large.

After this trajectory from the very beginning (the mining of ore) to the end of an electronic device (ending up in waste streams), we can argue that from the creation and the supposed death of a device, it is only a thing that exists as an *object unto itself* for a very short time; the device, to us at least, only retains its identity as object when we purchase and use it. This is in disregard of the entire process that precedes its purchase (the establishment of a mining site) and the fate of the device once it is abandoned (wandering in waste streams towards the global south). A more fitting ontology of a device is that each device is a unique, catastrophic event, an irreversible displace-

need no further introduction. Although the process of creating a device also causes harm to the environment further down the line than just the tailings that are released in the environment, such as the tremendous amount of water that is used in the semiconductor industry for instance, we can already notice that irreparable harm is immediately done at the start of production, before a device is even brought into existence. That something or someone had to permanently cease to exist, in order for the device to come into being.

## An Ontology Of E-Waste

With this insight we arrive at what I would loosely characterize as an 'ontological axiom' that can help us understand what e-waste is. Let us begin with the proposition that everything that exists is in existence *by virtue* of its existence. That the entire reason for being, is existence itself. If we accept this proposition, what automatically follows is when everything is in existence by virtue of itself, any other thing that is not an intrinsic property of that thing cannot own or lay claim to it. Therefore nobody can own anything; no object, no land, no human or any other animal. From this point we can argue that private property is not only theft, but that private property effectively *does not exist*. We may observe that things may relate to one another, even demonstrate an interdependence, but they cannot belong to each other. The objects we produce with our hands are no different. I believe our uncanny ability to invent and bring objects into the world has not yet taught us what it truly means for something to exist. This callousness results in the situation that the devices we create, by the very ways in which we produce them, permanently and destructively infringe on the *existence* of other things.

This permanent and destructive behavior continues after people have rescinded the fictitious private ownership of their

black kid such as myself with a natural propensity to hack devices.

While these experiences have firmly embedded themselves within my memory and have sculpted many confidantes of my generation into the people we are today, many things have drastically changed in the past twenty years. Around the turn of the century I used to be besieged and harassed by skinhead nazis in the street. Twenty years later, these characters have made their fascist rhetoric palpable to the general population by making memes, wearing suits and running right-wing populist parties in the government. Before the dutch squatting ban on the 1<sup>st</sup> of October 2010, we used to be able to discover and create free public spaces and autonomous zones rich with potential, life and colour. Now, former social housing projects are commercialized and deserted properties are bought up in droves by the rich for real estate speculation and remain vacant and uninhabited. Lastly, where we used to be able to physically see electronic waste in the street, allowing us take the initiative to repair or repurpose devices ourselves, now cities across the country have installed recycling facilities where only a fraction of the growing volume of electronic trash ends up and where the remainder finds itself in other waste streams, concealed from the public.

## Techno-Fetishism

In describing what the scene was like twenty years ago, we have covered considerable ground; there is a reason why I mention these seemingly unrelated things, from personal anecdotes to changes in political circumstances. I am trying to highlight, from personal experience, subtle changes that occur in the social climate where we live and work and play; highlighting an uncompromising defense of freedom, an unyielding independence from state and corporate control that we took for

granted and is gradually fizzling out in our cities. Due to the disparity with the current social climate it can be difficult to recollect a time where our mental health was not continuously at risk, where our every thought and action was not accumulated, quantified and exploited by corporations and the state and where their attempts to influence our behavior was still unbearably obvious, unabashedly manipulative and ludicrously ineffective. In spite of everything, the emergent aspects of this approach are as alive and relevant today as they were then; the ability to resourcefully and autonomously define the rules by which we live, to fervently oppose the state, subvert corporate control and act according to our own particular needs and desires without surveillance and manipulation.

For instance, when we put things in perspective using this attitude and examine the situation it should be evident that obscuring the electronic waste we produce behind recycling and environmental waste management strategies facilitates the tech industry to greenwash their products and sell more of them. It permits them to continue to project a mythical future scenario where these products will be environmentally ethical, make our lives easier, more comfortable and more connected.

I will go out on a limb and assume that the reader is mindful of the fact that the greenwashing we are subjected to is a marketing ploy conjured up by tech companies and that we don't genuinely believe in the science fiction sold to us by advertising companies, somehow I still suspect that the underlying message is implicitly accepted by most of us. The subtle ideological allusion that the electronic devices we use, sanitized by the visual absence of waste, are somehow inherently rational, virtuous and immaculate. That they are manufactured in some kind of sterile vacuum unaffected by the capriciousness and brutality of life. That due to their portrayal as the praxis of the scientific research that preceded them (technology as a manifestation of the virtues associated with the scientific method and empirical research), we are prompted to trust them implic-

Lets start at the production of devices. If we start at the absolute beginning of the production process, we could consider all of the materials that go into the formation of the circuit boards and components of an electronic device. For example, in order to fabricate circuit boards, one requires industrial metals. These are obtained from mined ore, an aggregation of one or more minerals. Obtaining these materials requires the destructive activity of establishing a mining site, once a habitat to local wildlife that is tragically reduced and displaced, part of a rich and abundant ecosystem that maintains a delicate equilibrium that is irrevocably disturbed. It is from these lifeless graveyards that we obtain the materials we require. For example, from the mined ore Chalcopyrite we obtain Copper, which is used as a conductor to provide electrical connections to components. From Quartz we obtain Silicon, which forms the basis of integrated circuits. From Spodumene we obtain Lithium, which is used in the cathodes of lithium-ion batteries and so on.

Next to these destructive extraction practices, almost all of our electronic devices also contain materials that, due to the economic inequality capitalism engenders, require industrial powers to establish violent conflict in developing countries to obtain cheaply. These minerals are commonly referred to as 3TG minerals; Tin, Tantalum (which stems from Tantalite and is used in capacitors to regulate voltage) and Tungsten. They are sourced from the Democratic Republic of Congo or adjoining countries and their trade funds violent, repressive militias that specialize in sexual and gender-based violence; immediately dispelling the myth of technology's rational and detached neutrality.

The mining of ore also unleashes tailings (by-products) that may contain Arsenic (a potent poison), Barite, Cadmium, Calcite, Lead, which causes widespread neurological damage and dramatically impedes on the cognitive development of children, Fluorite (more poisonous than lead), Manganese, Sulfur, Zinc and I believe the harm of radioactive materials



talistic economy is the primary cause of the problem, not the solution. A short analogy; expecting capitalism to solve our environmental problems is like lying in a hospital bed, suffering from a life-threatening illness and expecting the disease to cure you.

One of the more recent e-waste conferences I visited had a trade floor on the ground floor of the event. The trade floor was packed with companies that owned smelting facilities or developed state-of-the-art circuit board shredding machines. There was a lot of talk about artificial intelligence and cloud-based inventory solutions for processing waste, but very little talk about the causes and nature of electronic waste and the different conceptual ways in which we can address this massive problem to begin with.

Again, our current capitalistic economy is not a sensible and impartial exchange of goods and services. It is an ideological framework; a value system governed by belief, rituals and superstition. It is like a consecrated statue of a deity to which we direct our hopes, fears and desires. We think we are dealing with a problem that requires a capitalistic solution, a shift in how we extract and exchange monetary value in relation to waste, but nothing could be farther from the truth; it is time we should come to understand what the nature of electronic waste *is*.

## Dealing With E-Waste Conceptually

Conceptually talking about the nature of electronic waste is an ontological question. Ontology is a branch of metaphysics that concerns itself primarily with claims about the nature of being and existence. By loosely borrowing concepts from this field we can find ways to look at the problem in a different way and perhaps approximate what electronic waste actually *is*.

itly. This implies that we automatically gloss over many of the heinous intentions that drive the introduction of these products to the market and adopt an inclination to think about electronics within a narrow frame of reference—without full awareness of the very real, broad environmental and social context in which they operate.

We see this constricted frame of reference within greenwashing render a characteristic that can only be described as a dominant and perverse form of techno-fetishism; a preoccupation with the benefits of technological novelty, the obsession with technological aesthetics and the ideal of technology as a catalyst for human prosperity. An ideal that bleeds into popular discourse and is frequently regurgitated in the media. For example, some narratives that frequently pass by the average person's news feed are elaborate transhumanist fantasies exploring the future convergence of humanity and artificial intelligence, the clearing of micro-plastics in the ocean using advanced robotics, the promise of sustainable biomimetic architecture and urbanism and even billionaires selling the marvel of private spaceflight and the future colonization of mars. On the other hand there are also voices of apprehension and skepticism; people who, rightfully so, address problematic developments in technology, be it about the dystopian amount of state and corporate surveillance we are increasingly subjected to and the rapid disappearance of civil liberties that follow, not to mention news about arms manufacturers in the west's military-industrial complex that directly or indirectly incite long wars in order to sustain a lucrative market for high-tech weaponry.

Although it is in our collective benefit to hear voices contradict the marketing spin manufacturers employ to sell their devices, the veiled and inexplicit trust in technology, that it is supposed to operate in an neutral and impartial manner is peculiarly still intact. What I feel remains in both perspectives is that the progression of technological innovation is somehow inevitable (you could almost say that it is like a force of na-

ture) and that progress in the human condition is inextricably linked to the rapid forward march of technological innovation. The aforementioned biomimeticism in architecture and design is a prime example of that phenomenon. In my assessment, we assume that by creating biomorphic architectural edifices that resemble geometric structures we find in nature, we create morphologies that are harmonious with it; allowing us to avert the growing problems of global warming. In doing so, we appear to suggest that we can somehow reintegrate ourselves within our ecosystem in dialogue with the natural equilibrium that sustains the health of the environment while continuing to build high-tech architecture. What this attitude reveals is that all we can do is *amend* technological developments we find problematic; apathetically changing the bits we dislike to keep the remainder of the ideology intact. Duct-taping the environmental challenges we encounter by iteratively designing new products that claim to solve problems the previous versions created, while the pathological problems endemic to a capitalist economy endure at the root of our ecological crisis.

It feels as if certain fundamental questions regarding technology and our relationship to it are not being asked in earnest, and I wonder why. Is it because we, the public, don't fully understand the intricacies that go into how electronic devices are made? Are we subject to confirmation bias because it fits our economics and the means by which we sustain ourselves and our families financially? Or does the problem go farther; is the real problem inherently ideological, that the ways in which we think about ourselves and the environment is stranded and stuck, persistently compounded with technology? Perhaps in this sense the progressive and secular segment of the western world, where we arrogantly characterize ourselves as a post-ideological society, liberated from the backward and restrictive confines of dogmatic religion, is still deeply ideological. Perhaps we have simply replaced religious ideology with an ideology that privileges scientism

and techno- fetishism. That the disastrous environmental chain reactions that originate from technological development are not unpremeditated and accidental, but the undisguised outward expression of its inner characteristics.

## False Solutions

Electronic waste is an interesting subject because its very existence immediately provides a counterweight to the dominant ideological narrative and defies oversimplification. The problem is bewilderingly complex. If technology advances, if it is, as they say, progress, why does so many of it *regress*, ending up broken and dead in landfills? Why do these devices which only a few years ago were heralded as the harbingers of the future now lay idle in a pile, leaking battery fluid into the soil? As part of my work running a reverse engineering laboratory I visit conferences on electronic waste and the most bizarre aspect of visiting these events is that next to endless, ineffective discussions about environmental policy, our techno-fetishism and capitalistic obsession with the commodification of our problems rapidly takes over and yet again produces a whole range of unnecessary products and solutions.

At these events one hears buzzwords like 'circular economy' thrown around abundantly. In short, it is the concept that you can use waste as a resource for other products, and so close the loop from production to disposal. I find using this term to again be a misleading, biomimetic pipe dream. As I mentioned earlier, the context in which the problem situates itself is broad and complex. The objective should not be to extract economic value from objects and materials we consider to be waste, but to reimagine *what* we consider waste *to be*. There is not a single, competitive business strategy that is going to be effective in time and at scale that will outperform solving this ecological crisis in an open, unilateral, uncompetitive way. Our capi-