Living Books About Life

Medianatures

The Materiality of Information Technology and Electronic Waste

Edited by Jussi Parikka

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Introduction: The Materiality of Media and Waste

'And what if the ethical, or at least aesthetic, transformations of history were understood as waste's precipitates?' (Dominique Laporte, 2000: 16)

Medianatures picks up from Donna Haraway's idea of *naturecultures* – the topological continuum between nature and culture, the material entwining and enfolding of various agencies, meanings and interactions. Medianatures gives the concept of naturecultures a specific emphasis, and that emphasis is at the core of this living book. It is a useful concept and framework for investigating some of the ways in which our electronic and high-tech media culture is entwined with a variety of material agencies. The notion of 'materiality' is taken here in a literal sense to refer, for instance, to 'plasma reactions and ion implantation' (Yoshida, 1994: 105) – as in processes of semiconductor fabrication, or to an

alternative list of media studies objects and components which are studied from an e-waste management perspective: 'metal, motor/compressor, cooling, plastic, insulation, glass, LCD, rubber, wiring/electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, brominated flamed retardant (BFR)-containing plastic, batteries, CFC/HCFC/HFC/HC, external electric cables, refractory ceramic fibers, radioactive substances and electrolyte capacitors (over L/D 25 mm)', and which themselves are constituted from a range of materials – plastics, wood, plywood, copper, aluminum, silver, gold, palladium, lead, mercury, arsenic, cadmium, selenium, hexavalent chromium and flame retardants (Pinto, 2008).

In short, media are *of* nature, and return *to* nature – where the production process for our media devices, from screens to circuits, networks to interfaces, involves the standardization and mass-mobilization of minerals and other materialities. Discarded media technologies are themselves part of such a regime of natural 'things' – whether picked apart in an Asian recycling village, or then left to decay in urban or rural places. The natural affords our cultural agencies and assemblages – including media practices and concrete devices – and all of that comes back to nature. The articles selected express this materiality at the core of media technological culture, and the various ecological ties these themes share with the current political economy. They range from perspectives in environmental sciences concerning e-waste and the management of electronic media remains to computer science and ideas in green computing – as well as showcasing articles and reports about the production and dismantling of *things* such as Cathode Ray Tubes and

LCD-displays. Hence, this living book is not only about life, but also about death and dead media – but dead media in a very concrete sense of media as the death of nature, biological processes and organisms (including humans).

More generally, this collection is about the management of life and waste. Put crudely, it's about where you dump your shit you do not want on your doorstep – where 'shit' is one of the most important factors in the multiple, connected management of subjectivity, language , body and public space , as Dominique Laporte (2000) has well argued. In more elaborate terms, it relates to how we manage media-cultural devices as part of global info-tech capitalism and the relation of such capitalist push for new modes of production to limits of natural resources; of various materialities concerning human labour, materials science as well as politics of those various ecologies. It also reflects the boundaries of media studies perspectives – expanding from content analysis to the study of the material political economy of things and devices as well as from software to hardware perspectives again: something that Sean Cubitt (2009) has underlined as a crucial ecological step for media theory. In addition, it shows on a disciplinary level the various perspectives from which you can approach media technologies: from the point of view of materials that are necessary to build them (rare earth minerals), the global trade networks, the waste management, and so forth.

In terms of the multiplicity of ecologies, Félix Guattari's work on 'three ecologies' cannot be neglected here. An early forerunner learning from green politics and applying those ideas in relation to the critical analysis of

what he called 'integrated world capitalism', Guattari argued the need to understand contemporary culture in terms of not one but three ecologies. The environment, social relations and human subjectivity constitute cross-articulated regimes of the ethico-political (Guattari, 2000: 28). It is crucial to understand these as interlinked, and as formative in their transversal nature for processes of subjectification. In other words, subjectification happens not only in the social, or in the human psyche, but also across a range of boundaries where our natural ecology in its materiality is already thoroughly embedded in the regimes of signs – and the other way round. Guattari calls for the need to develop transversal modes of thought across Universes of reference if we are to understand the full power of such ecologies, and to grasp how each regime has its forms of pollution (Guattari mentions Donald Trump as a destructive form of parasitic algae).

More recently, scholars such as Matthew Fuller (2005) have elaborated such ideas towards media ecologies. This approach takes Guattarian influences, and mixes them with a specific mediatic approach, emphasizing media as another but intertwined regime of energies and materialities. Indeed, one can notice how crucial this extra layer is in terms of articulating the already mapped three ecologies. One could claim that mediatic ecology – which in this later development is by no means a continuation of, for instance, Neil Postman's conservative ecological thought – is in a privileged position to understand how post-Fordist 'Integrated World Capitalism' (Guattari's term) is participating in co-defining the regime of human subjectification, social environments and the exploitation of nature on a global level. Guattari was referring to the Integrated World

Capitalism as the tendency to move from 'producing goods and services towards structures producing signs, syntax and – in particular, through the control which it exercises over the media, advertising, opinion polls, etc. – subjectivity' (2000: 47). In his recent writings, Michel Serres has talked about the two regimes of pollution, where the hard pollution is the destruction of nature, while the soft pollution involves the destruction of the world of signs. Serres clarifies: 'By the first I mean on the one hand solid residues, liquids, and gases, emitted through the atmosphere by big industrial companies or gigantic garbage dumps, the shameful signature of big cities. By the second, tsunamis of writing, signs, images, and logos flooding rural civic, public and natural spaces as well as landscapes with their advertising' (2011: 41).

Yet what is missing is the link between the two – the 'hard' regime of entropic energy consumption and production of not just things, but also of material waste; and the immaterial regime of semiotics and signs – what we usually call 'media'. Indeed, scholars writing from the perspective of media ecology and others have pointed out that this dualism is unsupportable. Instead of strengthening the illusion of the media regime as supposedly immaterial and based on meaning, we need to take a look at it as completely embedded in material sciences. Think about the perverse complex ecology of it all: a specific design solution concerning a screen or computer component has an effect on it becoming-obsolescent sooner than 'necessary' – of course, not without the product itself being embedded in the capitalist discourse emphasizing newness as a fetishistic value that drives purchasing decisions, and after being abandoned for another device. The latter is often called

'recycling', but is actually a waste-trade, where old electronic media are shipped e.g. to India to be dismantled by means of some very rudimentary – and dangerous – processes that affect the lungs and nervous systems of the poor workers. Nor should we forget where the minerals for the components come from – such as coltan, which is mined in Congo and from which refined tantalum powder is obtained. Tantalum powder is extremely heat-resistant and hence ideal for manufacturing certain parts in mobile phones, Playstation game consoles and so forth. The mineral allows us to consume mediatic content but has at the same time its own genealogies of matter and politics, for instance in bloody wars in the Democratic Republic of Congo, where a range of European mining companies have had their own dubious part to play, including funding the war efforts in order to secure the extraction of the mineral (Cuvelier & Raeymaekers, 2002).

We are dealing with abstract relations, but concrete things – and all linked together as real parts of the global capitalist media industry. In other words, the materiality of media is to be taken literally. Our media devices are the products of various processes of mining, processing and standardizing minerals and other rare earth materials into finished mass-consumer products. After their use-value is exhausted, they become *things* of a different sort. Of course, abandoned and obsolete media technologies are not always just abandoned, but rather participate in another process – one that is often as complex and multiple as the one involving processing information, the way it happens with microchip based media. Often the products assembled in Asia are returned there, despite the increasing number of bans in those countries, for example China, to import electronic waste.

Jennifer Gabrys has pointed towards the complexitites of this new metamorphic economy, and its material, persisting nature: '[r]ecycling does not remove remainder or wastage; instead, it displaces and transforms waste' (2011: 138). This point about transformation – both in terms of materiality, of dismantling, reusing, or just being left to decay, and in terms of the status of some media devices as obsolete and out-of-use – is also spatially distributed across the globe. This affects mostly developing countries in Asia and Africa, as well as some Eastern European countries, which are in the process of adjusting to their new post-Soviet part in the global capitalist culture and the global political economy (Ciocoiu, Burcea & Tärtiu, 2010). For instance, Nigeria is one destination for electronic waste which is not able to process its toxic e-waste. Filled with lead, cadmium, and mercury, the abandoned components, when burnt, release dioxins and polyaromatic hydrocarbons. And yet, burning remains one way to 'resolve' the problem of piling up electronic junk, such as screens, in ports and landfills (Schmidt, 2006).

Hence, focusing on the materiality of components and waste of electronic media suggests extremely long and uneven networks of the spatial distribution – and also labour distribution – of media cultures, as well as a completely different temporality to that which is usually marketed as an aspect of digital technologies. As Gabrys argues, instead of speed, efficiency and progress, we are confronted with the time of dust and soil. These are long-term temporal perspectives that more often are measurable in terms of scientific timescales that involve geological and environmental science perspectives. If humanities and social sciences have mostly been occupied

with the human scale of time – of years, decades, or, at best, civilizations of hundreds or thousands of years – perhaps we need to look at timescales of thousands and even millions of years to reveal how materials live?

Cubitt has been one of the most perceptive critics of the material and environmental contexts of electronic, and especially screen, media. His *Ecomedia* (2005) already mapped the discussions concerning ecologies in media. More recently, he has continued to look inside the screen as well in order to understand the materials science behind it – and the environmental chain that is initiated after a medium has been used. The fabrication of screens such as LCD's involves the use of many rare minerals – for instance, selenium and germanium. Cathode Ray Tubes are also a difficulty for any waste management due to their toxic content. Plasma screens will potentially present an even bigger problem due to the unique electro-chemical reactions of plasma cells coated in phosphor (Cubitt, 2009).1 Electronic media and screens are perfect – albeit grim – examples of the process of topological entanglement which involves various layers of globalization: rare earth materials, spectacle-based industries of marketing and digital media, desires of networked connectivity, the soft tissue of underpaid workers of colour risking their health, outsourcing of manufacturing to developing countries, and waste management (or more frankly, waste problems) as a (forced) part of the developing countries business models. An increasing amount of production is moved to developing countries – for instance, semiconductor industries emerging in Singapore and Malaysia – and the same goes for dumping materials, from China to India, Pakistan and the African countries.

Cubitt connects this entanglement with a new approach to screen media avant-garde: 'The digital realm is an avant-garde to the extent that it is driven by perpetual innovation and perpetual destruction. The built-in obsolescence of digital culture, the endless trashing of last year's model, the spendthrift throwing away of batteries and mobile phones and monitors and mice . . . and all the heavy metals, all the toxins, sent off to some god-forsaken Chinese recycling village . . . that is the digital avant-garde' (Cubitt, non-dated).2 A look at the range of reports concerning the materials as well as networks of screen components gives a further insight into this perspective. Think of the range of elements the CRT in your living room or on your desktop is made of. 'A typical computer color monitor/TV is composed of a plastic housing (casing), CRT, a deflection yoke, printed wiring board (PWB) with integrated circuit (IC), connecting wires, metals (precious and non-precious), and rubber' (Nnorom, Osibanjo & Ogwuegbu, 2011). The actual listing of materials is only the beginning; as important is the process of what happens when the electron gun part of the CRT fires on the phosphor part of the screen to create what we usually focus on as a media studies object – images. This process itself produces chemical reactions, releases x-rays, which means the need to protect us from our media with further layers of lead, and so forth (Nnorom, Osibanjo & Ogwuegbu, 2011). Indeed, if you list the materials contained in a typical desktop computer (plastics, lead, aluminum, gallium, nickel, vanadium, beryllium, chromium, cadmium, mercury, arsenic, and silica), you will be able to come up with a corresponding list of health risks – which range from allergic reactions to various cancers, skeletal problems, asthma, bronchitis, ulcers,

liver and kidney damage and for instance damage to brain functions (Schmidt, 2002: 190). However, the devices are fabricated so that the consumer interpellated in marketing discourses, and attached to the machine at home or at work, is in a 'protected mode' (see Kittler, 1997), whereas the people compiling the machines – and dismantling them – are the ones who encounter the raw, dangerous materiality of our media technologies (see e.g. Clapp, 2006).

CRT's are huge energy consumers as well. Even if we could argue that the digital has a special theoretical relation to zero-entropy (Pasquinelli, 2011), the digital softness and swiftness of content delivered on our screens is reliant on yet another relation of transmission – namely energy. The fact that every search engine search consumes energy (estimates vary) is indicative of the fact that even the smallest gesture at the interface (press 'OK') is connected to these huge consumptive practices and installations that require energy. Server farms, for example, demand gigantic amounts of energy,3 and are now replaced as the key sites of the industrial era. In Finland, they are being installed in abandoned factories:

> Since 2005, Google has been installing 1160 servers into a single shipping container, complete with batteries, power, cabling, water-cooling and fans, drawing as much as 250 kilowatts of power. The containers are stacked and networked in buildings holding 45 containers, each drawing down 10 megawatts apiece (including additional cooling and water pumps) in one facility dating back to 2005, which now has three such buildings. The design was subject of a patent applied for early in 2008. Since then, Google has been building server farms across the US and globally: in Oregon, Virginia, Iowa, South

> Carolina and Oklahoma, in Dublin, Lithuania, the Netherlands and Austria, and in India and Malaysia among other sites. Google has made technical decisions on such questions as voltage to achieve maximum efficiency: about 20 percent of power goes to non-computing uses (mainly cooling). (Cubitt, Hassan & Volkmer, 2011: 151-152).

In any case, such points are reminders of how 'voltage' and energy consumption are related to the processing power and size of our media technologies. The shift from vacuum tubes to transistors was a big step in terms of lowering energy consumption in devices, and more recent developments in computing involving massively multicore chips are furthers steps towards the efficient use of voltage and, hence, energy (Yu, 2010). The audiovisual content of contemporary media cultures has an archaic relation to energy consumption, which means that when an increasing amount of our devices are channeling more heavy content – for instance, mobile phones as one central distributor of high technical quality visual and audio entertainment – it forces an energy consumption focus on the processor and software design (Silven & Jyrkkä, 2007).

In short, one needs to be more aware of the fact that any computational operation is an energy operation and that software is linked not only to hardware but to a wider material grid. From basic operations such as a search engine query, to, for instance, such a crucial part of our visual culture as encoding a piece of video, we are dealing with *computational costs* (see Silven & Jyrkkä, 2007). Hence it is no wonder that tackling such (monetary and environmental) costs – for instance, through *automated*

internal transitions and energy efficiency in the actual use-time of processors and distributed environments such as data centres (Lang & Patel, 2009) – is becoming one of the most important issues for design today.

But the material and energetic perspective does not just apply to recent information technology. Media history is one long story of materials and experiments with materials – of what conducts, what does not, what reflects, what insulates and so forth. We could map a whole media history of experimentation with materials – only with the modern media industries, a mass-production and standardization of materials for production has become such wide scale. As such, it is interesting to adopt a longer historical perspective to this issue of materials and energy. The nineteenth century was addressing these questions already, as we can see from many examples. There exists not only a media history of the telegraph, the telephone, television, and the computer, but also a media history of selenium, copper, zinc, dilute sulphuric acid, shellac, silk, wool, gutta percha and various animal tissue used in technical devices.

Interestingly, already the energetics of mediatic apparatuses – and of society in general – was discussed by experimenters such as Nikola Tesla (1856-1943), who never grew tired to emphasise the importance of energy and electricity – in terms of how they participate in understanding the modern physical world of waves (as such, also the basis for the mediatic phenomenon of light and hence seeing, as he underlines). More importantly, electricity and the transmission of energy were becoming crucial issues for Tesla at the end of the nineteenth

century, one hundred years before the contemporary culture of server farms:

> Therefore the phenomena of light and heat and others besides these, may be called electrical phenomena. Thus electrical science has become the mother science of all and its study has become all important. The day when we shall know exactly what 'electricity' is, will chronicle an event probably greater, more important than any other recorded in the history of the human race. The time will come when the comfort, the very existence, perhaps, of man will depend upon that wonderful agent. For our existence and comfort we require heat, light and mechanical power. How do we now get all these? We get them from fuel, we get them by consuming material. What will man do when the forests disappear, when the coal fields are exhausted? Only one thing, according to our present knowledge will remain; that is, to transmit power at great distances. Men will go to the waterfalls, to the tides, which are the stores of an infinitesimal part of Nature's immeasurable energy. There will they harness the energy and transmit the same to their settlements, to warm their homes by, to give them light, and to keep their obedient slaves, the machines, toiling. But how will they transmit this energy if not by electricity? Judge then, if the comfort, nay, the very existence, of man will not depend on electricity. I am aware that this view is not that of a practical engineer, but neither is it that of an illusionist, for it is certain, that power transmission, which at present is merely a stimulus to enterprise, will some day be a dire necessity. (Martin, 1894: 301)

At first, it may seem that Tesla was thinking in a way that was later seen in the 1990s hype about the post-

material world – from Nicholas Negroponte ('from atoms to bits') to reports on how information society might lead into e-materialisation as a phase of new energy economies and green futures:

> E-materialization is likely to be the source of some of the biggest impacts the Internet has on energy intensity and pollution. That is because the most energy intensive industries on the planet are the industries that extract raw materials and convert them into useful commodities, such as plastic and other chemicals, paper, and construction materials such as the famous 'bricks and mortar.' In addition, the transportation of these heavy materials engenders a great deal of energy consumption. If atoms can genuinely be replaced by bits, and distributed by the Internet, rather than trucks, trains and planes, the energy savings will be significant. Since the energy-intensive industries are also those responsible for the vast majority of hazardous waste and toxic chemical pollutants, e-materialization holds the potential to prevent the creation of that pollution in the first place. This is much better than disposing of or treating that pollution later. (Romm, 1999: 38)

And yet, unlike the 1990s enthusiasm for the post-energy economy of information, Tesla's vision relates to energy in its materiality. The CO2 industries that rely on coal and wood are not replaced by immateriality, but by the specific electrical forces – which he, in his own quirky way, goes on to describe and demonstrate. The point is not the accuracy – or inaccuracy – of some of Tesla's ideas, but rather how the way he envisions new media and society as revolving around energy anyway. He thus offers us a richer way to think about informatics – as a field

which is impossible to understand without considering its entropic effects.

Media archaeological perspectives can offer alternative views to media, science and energy, as well as other, more political ideas. This relates to the need to think about the ecological materiality of media devices already in design practice. One of the problems of current regime of 'planned obsolescence' – a term that actually stems from the 1930s – is the short use-span of electronic media, whether mobile phones, televisions, or laptop computers. As such, this is emphasized through design solutions that strengthen the black box nature of media technologies which are not to be opened up, fixed or reused. Focusing on design from the point of view of sustainability and *Extended Producer Responsibility* means having to focus on materials used as much as the processes in which materials are processed. This includes considering issues such as those identified by Pinto (2008):

- Inventory management
- Production process modification
- Volume reduction
- Recovery and reuse
- Sustainable product design, which involves:
- Rethinking procedures involved in designing the product (flat computers)
- Use of renewable material and energy
- Creating electronic components and peripherals of biodegradable material
- Looking at a green packaging option

- Utilizing a minimum packaging material

In a more artistic vein (see the section, 'Ecosophy'), similar themes have been addressed by circuit bending and hardware hacking methodologies – for instance, by Garnet Hertz's Dead Media Lab (http://www.conceptlab.com/deadmedia/), which extends the media archaeological idea of dead, abandoned media to environmental concerns. This is the context in which Hertz & Parikka (2012) have talked about zombie media, rather than dead media. According to the zombie media concept, technological devices never die, but decay and leave environmental residues, and are then repurposed and reused in a more environmental friendly way. This again points towards the need to consider design practices. It flags the importance of such basic design solutions as casing, reusability and replaceability of parts, accessibility for fixing and manipulation, etc.

It is essential, however, to remain critical of the 'sustainability' discourse in design and in information technology in general, and to unpick some of its core assumptions. The (false) idea of digitality as automatically reducing CO2 and other environmental waste is one such claim that needs to be urgently challenged (Fuchs, 2008). Sustainability is a good example of what Slavoj Žižek has referred in various of his talks and writings as the refashioning of capitalism into something 'with a friendly face'. Sustainability thus become one possible investment focus, even if, at its core, nothing per se changes about capitalism as a mode of production which is keen to expand and intensify its accumulative nature. Ecology is therefore in danger of becoming a personal ethical project (Žižek, 2009: 53-54,

98; see also Yeomans and Günalay, 2009). Indeed, as Gartner Research (Plummer et al., 2008) projected in their 2008 consumer trend prediction, Green IT and tracking carbon dioxide footprints for information technology is something that producers and sellers have to start taking into account. This involves moving forward from mere 'sustainability' – which assumes that we can continue as things are, in terms of our political economy, our subjectivity, and the accepted miseries of the world, as long as we make it sustainable for us and for the ecology. As such, the discourse of sustainability on its own is unsustainable, and needs to be reinforced with a stronger, ecosophical project that maps environmental concerns as part of aesthetics, economy and the politics of subjectification.

This is a paradoxical situation: increasingly, digital economy has to take theses aspects concerning the massive environmental catastrophe into account and focus on the management of not just production and desired use, but also on the management of desired non-use. Waste management (see the section on 'Waste') is a growing theme in literature concerned with this side of the eco-technological connection. It touches on this bit of the production chain that is throwing grave concerns on capitalist accumulation; yet it also presents a possibility for intensifying the processes of capitalism to the area of seeming uselessness – garbage and waste. Whereas management of hazardous materials from e-waste has been a topic discussed since the 1980s (and already 1990s saw the key international policies suggested (the Basel Convention in 1994)), the United States has still not ratified the call.

This issue has many implications. On the specific level concerning waste and garbage, it relates to legislation, policies, the fair and transparent waste management of electronic media, production and dismantling processes and the understanding of the energy-intensive nature of high-tech media in a manner that needs to be followed through and addressed from the point of view of its environmental effects. Already in the 1980s (see Yoshida, 1994) there were reports on the wide use of dangerous chemicals in semiconductor industries. Mapping such links is the work of true media ecology – of media existing *in* and as *part of* ecology.

For humanities and media studies scholars, e-waste can be connected to the material accounts of media and contemporary culture. On the one hand, we need to be looking more closely at the intensity of the waste as living dead material – whereby 'waste' is not just waste but also a form of life, and thus is in need of its own biopolitics. As beautifully put by Gabrys, 'The architecture of the landfill accretes through the sedimentation of trash, layers covered with earth and compacted into airless cells. The landfill settles, shifts, and subsides, generating methane gases and carbon dioxide. […] But this shifting architecture decomposes into the soil to expel greenhouse gases and heavy metal runoff, as well as intractable and scattered objects that refuse to decay' (2011: 140-141).

This also has implications for the way in which we approach our media technology. It is about time we developed vocabularies for those media devices of ours in their materiality – not as reduced from their politics and social connections, but as messy, topological and processually entangled in worlds of so many layers from

nature to society and to psyche. This relates to the recent project of new materialism, a theoretical wave of coming up with ontological and epistemological ways to understand the agency and micropolitics of matter. Here, I want to use as a springboard a perspective on apparatuses that comes from the feminist philosopher of science Karen Barad. In her passage, she talks about scientific apparatuses and their materiality as intensive, formative and always participating in the reconfiguring of the world. As an experiment, think of this passage quoted below as applying to our electronic media technologies too – and start noticing the implications for a materially informed idea about the devices themselves which are not just produced *from* but which are also *contributing to* the material, natural world. So, following Barad, what are apparatuses and, more specifically, *media apparatuses* (but not in the manner of the film theory apparatus-theory)?

> 1) apparatuses are specific material-discursive practices (they are not merely laboratory setups that embody human concepts and take measurements); 2) apparatuses produce differences that matter—they are boundary-making practices that are formative of matter and meaning, productive of, and part of, the phenomena produced; 3) apparatuses are material configurations/dynamic reconfigurings of the world; 4) apparatuses are themselves phenomena (constituted and dynamically reconstituted as part of the ongoing intra-activity of the world); 5) apparatuses have no intrinsic boundaries but are open-ended practices; and 6) apparatuses are not located in the world but are material configurations and reconfigurings of the world that re(con)figure spatiality and temporality as well as (the traditional notion of) dynamics (i.e. they do not exist

> as static structures, nor do they merely unfold or evolve in space and time). (Barad, 2007: 146)

Technology and apparatuses are far from static, and so is 'matter' or 'nature', both filled as they are with catalyzing forces and becomings in a manner that testifies to their vibrancy (Bennett, 2010). Technologies are intensively involved in the world and hence share an eco-technological link, or in other words, a material-mediatic continuum. For media studies, this continuum is important to elaborate in order to really tap into the ecological contexts of medianatures as a theme that needs urgent attention. For the wider field of environmental sciences and product design, both for end-consumers and industries (for instance, greener data grids and servers or components), the challenge is as urgent.

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This living book consists of three sections. The first, titled 'Material', engages with some of the processes and materials from which technical media is produced. This offers a new look at media materialism in a way that is slightly less McLuhanian ('the medium is the message') but that insists that the material is the message – or, as Fumikazu Yoshida has it: 'the relationship between high-technology and environmental problems focuses on high-technology like microelectronics and new material, while biotechnology develops on the basis of new sorts of substances: this is contrary to the saying, 'the message is more important than the material.' These substances , even if they have little value in themselves, have long-term and combined effects on human health which are not yet sufficiently clear' (1994: 105).

The second section, 'Energetics', focuses on energy consumption and includes various perspectives on hand-held mobile devices, data-grids and server economies. The key question is how such new forms of digital economy and energy use (on an abstract informatic level, computers are zero-entropy machines) relate to the old regimes of energy production, and, for instance, CO2 emissions.

Third, we focus on 'Waste' management – a growing part of literature on the materiality of electronic media and information technology cultures. It relates to the global distribution of electronic waste devices as well as the capitalist tendency to be able to recycle such uselessness (shit') into economic value (Laporte, 2000). In spite of the increasing amount of international regulation since the 1990s, e-waste is still being exported to developing countries (to India and Pakistan, but still also to China). The process follows international labour trends: work in those countries is cheap. Or, as Pinto bluntly states, 'The dumping of e-waste, particularly computer waste, into India from developed countries ('green passport' according to Gutierrez), because the latter find it convenient and economical to export waste, has further complicated the problems with waste management' (2008). As work is becoming more expensive in China due to rising labour costs and wages, new countries will become the final address for the things which developed countries do not want any more.

The last section of the book is titled 'Ecosophy', following Félix Guattari's (2000) concept. Ecosophy refers to the creative moment across the three ecological layers he identified as nature, the social and the human subjective

ecology. As such, it refers to the creation of new practices and relations within and across ecologies, recognizing that the standard 'environmental ecology' perspective is in itself insufficient to tackle the links between capitalist modes of production and specific forms of living attached to that economy. This is why this particular section addresses some ethico-aesthetic perspectives that tap into 'ecology' and media in a different vein: it includes texts and links to projects talk about artistic, social science and media theoretical ways to rethink relations between materials, the environment and technologies.

The texts selected for this collection are principally of three kinds: academic peer-reviewed scientific articles; NGO produced reports concerning e-waste and its global contexts; and social science and media theory interventions into the energetics and nature of contemporary media ecology – including ethical and artistic perspectives. In addition, Appendix 1 includes Jennifer Gabrys' (2011) book, *Digital Rubbish: A Natural History of Electronics*, which offers an excellent reading of the complex links between media, waste, labour and temporality – something this living book attempts to convey as well. One option is to start reading it from the Appendix. Whether from the beginning, from the end or from the middle, I hope you enjoy digging into trash and waste. All things new have to have a bit of dirt in them anyway.

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Notes

1 See also the video of Cubitt's talk at Anglia Ruskin University 'Trust, Identity, Privacy and Security in Digital Culture, September 10, 2009, http://barney.inspire.anglia.ac.uk/inspire_j/ds1.html.

2 Sean Cubitt interviewed by Simon Mills, Framed, online at http://www.framejournal.net/interview/10/sean-cubitt.

3 However, a recent report by Koomey (2011) has shown that the growth in the energy consumption of data centres is actually smaller than predicted.

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Jason Holden and Christopher Kelty
The Environmental Impact of the Manufacturing of Semiconductors

Fumikazu Yoshida
High-Tech Pollution

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Appendix 1

Jennifer Gabrys
Digital Rubbish: A Natural History of Electronics
Phone Story: an educational game about the dark side of your favorite smart phone

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