

“Zombie Media: Circuit Bending Media Archaeology into an Art Method “

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## Obsolescence Returns

In the United States, about 400 million units of consumer electronics are discarded every year. Electronic waste, like obsolete cellular telephones, computers, monitors, and televisions, compose the fastest growing and most toxic portion of waste in American society. As a result of rapid technological change, low initial cost and planned obsolescence, the federal Environmental Protection Agency (EPA) estimates that two-thirds of all discarded consumer electronics still work – approximately 250 million functioning computers, televisions, VCRs and cell phones are discarded each year in the United States.[1]

Digital culture is embedded in a large pile of network wires, lines, routers, switches, and other very material things that as Jonathan Sterne acutely and bluntly states, "will be trashed".[2] Far from being accidental, discarding and obsolescence are in fact internal to contemporary media technologies. As Sterne argues, the logic of new media does not only mean the replacement of old media by new media, but that digital culture is programmed with the assumption and expectation of a short-term forthcoming obsolescence. There is always a better laptop or mobile phone on the horizon: new media always becomes old.

This text is an investigation into planned obsolescence, media culture and temporalities of media objects; we approach this under the umbrella of media archaeology and aim to extend the media archaeological interest of knowledge into an art methodology, following the work of theorists such as Erkki Huhtamo [3] and others who have given the impetus to think about the complex materiality of media as technology – from Friedrich Kittler to Wolfgang Ernst and Sean Cubitt. Hence, media archaeology becomes not only a method for excavation of the repressed, the forgotten, or the past, but it extends itself into an artistic method close to Do-It-Yourself (DIY) culture, circuit bending, hardware hacking, and other exercises that are closely related to the political economy of information technology. Media in its various layers embodies memory: not only human memory, but the memory of things, of objects, of chemicals, and circuits.

## Planned Obsolescence

Planned obsolescence is a concept first put forward by Bernard London in 1932, as a proposed solution to the Great Depression. In London's mind, the economic downturn was prolonged by consumers that continued to use and reuse devices long after they were purchased. His proposal outlined that every product should be labelled with an expiration date, and that the government should charge tax on products that were used past their determined lifespan: "I propose that when a person continues to possess and use old clothing, automobiles and buildings, after they have passed their obsolescence date, as determined at the time they were created, he should be taxed for such continued use of what is legally 'dead'." [4]

Although London's proposal was never implemented as a government initiative, the planning of obsolescence was adopted by product designers and commercial industry: artificially decreasing the lifespan of consumer commodities – like new fashions that make old clothing appear outdated – increases the speed of obsolescence and stimulates the need to purchase. Industrial designers like Brooks Stevens popularized the dynamic of planned obsolescence in 1954 as instilling a “desire to own something a little newer, a little better, a little sooner than is necessary.”[5] Retailing experts like Victor Lebow further clarified this mandate in 1955: “These commodities and services must be offered to the consumer with a special urgency. We require not only ‘forced draft’ consumption, but ‘expensive’ consumption as well. We need things consumed, burned up, worn out, replaced, and discarded at an ever increasing pace.”[6]

In reference to contemporary consumer products, planned obsolescence takes many forms. It is not only an ideology, or a discourse, but more accurately takes place on a micropolitical level of design: difficult to replace batteries in personal MP3 audio players, proprietary cables and chargers that are only manufactured for a short period of time, discontinued customer support, or plastic enclosures that are glued shut and break if opened.[7] In other words, the technological objects are designed as a “black box” that is not engineered to be fixed and has no user serviceable parts inside.

### Repurposing Obsolescence in Contemporary Art

Despite a planned obsolescence, the probing, exploring and manipulating of consumer electronics outside of their standard lifespan is a key tactic in contemporary art practice. Reuse of consumer commodities emerges within various art methods of the early avant-garde in the early Twentieth Century, from Pablo Picasso and Georges Braque's work with found newspapers in 1912 to Marcel Duchamp's Bicycle Wheel of 1913 or his inverted Bedfordshire urinal “fountain” of 1917. Such practices have been widely addressed in media art historical writing, and hence we will focus on other aspects in our article.[8] The mass production of commodities has shifted significantly in the century since Braque, Picasso and Duchamp's readymade work in the 1910s: since a significant “readymade” portion of commodities in American society is electronic, artists have moved to working with and exploring electronics, computers, televisions, and household gadgets. Early artistic repurposers of consumer electronics include Nam June Paik, who worked with electrically rewiring televisions as early as 1963 to display abstract, minimalist shapes. Although many artists using electronics have focused on exploring the potential of new media forms, others have approached using electronic commodities in the spirit of assemblage, bricolage, readymade or collage: as an everyday and standing reserve, or Heideggerian *bestand*, of available raw materials.[9] Instead of using electronics to explore or develop cutting edge technologies, this approach uses “trailing edge” everyday and obsolete technologies as its key resource.

### Bending Circuits: The Incantor

Reed Ghazala, a Cincinnati-based American artist born in the 1950s, is a pivotal figure in the development of what is termed “circuit bending”: the creative short-circuiting of consumer electronics primarily for the purpose of generating novel sound or visual output.[10] The technique of circuit bending takes found objects like battery-powered children’s toys and inexpensive synthesizers and modifies them into DIY musical instruments and home-made audio generators.

Likely the most recognizable example of circuit bending is Ghazala’s Incantor series of devices, highly customized Speak & Spell, Speak & Read and Speak & Math children’s toys that he has built since 1978 (Figure 1). The methodology of bending the toy involves dismantling the electronic device and adding components like switches, knobs and sensors to allow the circuit to be altered and shifted by the user. Ghazala’s Incantor devices completely reconfigure the synthesized human voice circuitry within toy to spew out a noisy, glitchy tangle of sound that stutters, loops, screams and beats.



Figure 1. An Incantor, a modified, or “circuit-bent” Speak & Read, Reed Ghazala.

The process of circuit bending typically involves going to a second hand store or garage sale to obtain an inexpensive battery-powered device, taking the back cover of the device off, and probing the mechanism's circuit board. Any two points on the circuit board are connected by using a "jumper" wire that temporarily short-circuits and rewires the device. The battery-powered device is powered on during this process, and the speaker of the system is listened to for unusual sound effects that result from probing. If an interesting result is found, the connections are marked for modification, and switches, buttons or other devices can be inserted between these points to enable or disable the effect.

### Circuit Bending Formerly New Media

Circuit bending is an electronic DIY movement focused on manipulating circuits and changing the taken for granted function of the technology without formal training or approval. The manipulation of consumer electronics often traverses through the hidden content inside of a technological system for the joy of entering its concealed underlayer, often breaking apart and reverse engineering without formal expertise, manuals or defined endpoint. This approach is characteristic of the early 20<sup>th</sup> century wireless and radio culture, post- World War II electronic culture, especially post-1970s electronic amateurism, hobbyism, or DIY-tinkering that was typified in organizations like the Homebrew Computer Club.[11] Conceptually the history of such techniques can be related to nomadic, minor practices in the manner Deleuze and Guattari outline, but also through a connection to tinkering as methodology of media archaeological art of such artists as Paul Demarinis, as Huhtamo has noted.[12] In Certeau's terms, "these 'ways of operating' constitute the innumerable practices by means of which users reappropriate the space organized by techniques of sociocultural production." [13] Circuit bending is a way of operating that reminds us that users consistently reappropriate, customize and manipulate consumer products in unexpected ways, even when the inner workings of devices are intentionally engineered as an expert territory. Ghazala's Incantor is useful as a tool to remind us of sociotechnical issues in contemporary society, including planned obsolescence, the blackboxing of technology, and the interior accessibility of everyday consumer products.

As a way of operating, circuit bending is an aspect of digital culture that does not easily fit under the term "new media" – the customized, trashy and folksy methodologies of circuit bending recall historical practices of reuse and serve as a useful counterpoint to envisioning digital culture only in terms of a glossy, high-tech "Californian Ideology". [14] We find Ghazala's explorations similar in spirit to media archaeology, and propose a stronger articulation of media archaeology as an art methodology – and furthermore not only an art methodology that addresses the past, but expands into a wider set of questions concerning dead media, or what we shall call zombie media – the living dead of media history, [15] and the living dead of discarded waste that is not only of inspirational value to artists but signals death in the concrete sense of the real death of nature through its toxic chemicals and heavy metals. In short, what gets bent is not only

the false image of linear history but the circuits and archive that form the contemporary media landscape. For us, “media” is approached through the concrete artefacts, design solutions and various technological layers that range from hardware to software processes, each of which in their own way participate in the circulation of time and memory. The media is an archive in the Foucauldian sense as a condition of knowledge, but also as a condition of perceptions, sensations, memory and time. In this text, a special emphasis is placed on hardware even if we do not wish to claim that it is the only aspect about media we should consider.

### Media Archaeology as Bending Circuitry

The political economy of consumer capitalism is a media archaeological problem as well. Media archaeology has been successful in setting itself as a methodology of lost ideas, unusual machines and re-emerging desires and discourses searching for elements of difference in relation to mainstream technological excitement and hype, but not always connecting such ideas to political economy or ecology.

With wide implications for the media archaeological methodology, the archive is increasingly being rethought not as a spatial place of history, but as a contemporary technological circuit that redistributes temporality. This is how Wolfgang Ernst suggests theorists and artists to rethink media archaeology; not only as an excavation of the past, but as an intensive gaze on the microtemporal modulations that take place in computerized circuits of technology.[16] This alternative sense of technological temporality is closer to engineering diagrams and circuits than the historian's hermeneutic interpretation of documents. Drawing directly from Foucault, media archaeology is for Ernst monumental not narrative: it focuses more on the real technological conditions of expressions, than content of media. Hence, Ernst is not interested in alternative media histories in a similar way as for example Huhtamo or Siegfried Zielinski, or even in imaginary media that challenges mainstream discourses of media technology[17] but in concrete devices through which we can understand the nature of temporality in contemporary electronic and digital culture. For Ernst, just like for so many media archaeological artists such as DeMarinis, Gebhard Sengmüller or more recent wave of young artists such as Institute for Algorithmics interested in concrete sonic archaeologies of contemporary media, media archaeology starts from the media assemblage – a device that is operational.

Circuits are what define modernity and our IT-oriented condition. Circuits inside radios, computers, televisions are only one face of circuitry. The circuits that can be opened up from their plastic enclosures are only relays to wider, more abstract circuits in terms of cables and lines, of electromagnetic radiation and wireless transmission. The air is filled with waves of “disembodied” information technology and culture is permeated with circuits of political economy. Hence, it would be an important project to write a media archaeology of circuits. The circuit, not the past, is where media archaeology starts if we

want to develop a more concrete design-oriented version of how we can think about recycling and remediating[18] as art methods.

Yet, there is a special challenge for work that takes as its object a concrete opening up of technologies. The inner workings of consumer electronics and information technologies are increasingly concealed as a result of the development of newer generations of technologies, a feature that is characteristic of recent decades of technological culture. So what does a media archaeology of consumer objects look like when we do not go back in time to media history, but inside a device?

Once developed and deployed widely, technical components are understood by users as objects that serve a particular function: an electronic toy makes a sound when a button is pressed, a telephone makes a telephone call, and a computer printer outputs a document when requested. The inner workings of the device are unknown to the user, with the circuitry of the device like a mysterious “black box” that is largely irrelevant to using it (Figure 2). It is only an object with a particular input that results in a specific output; its mechanism is invisible. From a design perspective, the technology is intentionally created to render the mechanism invisible and usable as a single punctualized object.

Punctualization refers to a concept in Actor-Network Theory to describe when components are brought together into a single complex system that can be used as a single object. We refer to the disassembly of these single objects as "depunctualization" – which shows a circuit of dependencies that ties the owner to the corporation that manufactured the device.[19]



Figure 2. A blackboxed system processes input into output without the user's knowledge of the interior functionality of the system.

Blackboxing, or the development of technological objects to a point where they are simply used and not understood as technical objects, is a requirement of infrastructure and technological development. A computer system, for example, is almost incomprehensible if thought of in terms of its millions of transistors, circuits, mathematical calculations, and technical components. Black boxes are the punctualized building blocks from which new technologies and infrastructures are built.[20]



Figure 3. When a blackboxed system is broken, output stops. At this point, the blackbox becomes depunctualized.

A black box, however, is a system that is not technically understood or accessed, and as a result these technologies are often completely unusable when they become obsolete or broken. Once the input/output or desired functionality of the device stops working it is often unfixable and inaccessible for modification for most individuals. Unlike a household lamp which can be fitted with replacement light bulbs, many consumer electronic devices have no user-serviceable parts, and the technology is discarded after it breaks (Figure 3). The depunctualization, or breaking apart the device into its components, is difficult due to the highly specialized engineering and manufacturing processes used in the design of the artifact: contemporary electronic devices are intentionally built to be discarded, and their obsolescence is clearly planned (Figure 4).



Figure 4. The interior of a blackboxed system is expert territory and tends not to be user serviceable.

Within the framework of media archaeology, it is important to note that there is not only one box. Instead, one box hides a multitude of other black boxes that have been working in interaction, in various roles, in differing durations. As Bruno Latour notes, its often when things break down a seemingly inert system opens up to reveal that objects contain more objects, and actually those numerous objects are composed of relations, histories and contingencies.

Consider Latour's methodological exercise as an art methodology for media archaeology: "Look around the room [...] Consider how many black boxes there are in the room. Open the black boxes; examine the assemblies inside. Each of the parts inside the black box is itself a black box full of parts. If any part were to break, how many humans would immediately materialize around each. How far back in time, away in space, should we retrace our steps to follow all those silent entities that contribute peacefully to your reading this chapter at your desk? Return each of these entities to step 1; imagine the time when each was disinterested and going its own way, without being bent, enrolled, enlisted, mobilized, folded in any of the others' plots. From which forest should we take our wood. In which quarry should we let the stones quietly rest." [21]

For the arts, objects are never inert but consist of various temporalities, relations and potentials that can be brought together and broken apart. Things break apart everyday anyhow – especially high technology – and end up as inert objects, dead media, discarded technology. Yet, dead media creeps back as dangerous toxins into the soil, or then as zombie media recycled into new assemblies. According to Ernst, media archaeology is less "about dead media, but on media undead. There is an untimeliness of media which is incorporated here." [22] Hence, there is a distinct difference to the dead media project of

Bruce Sterling which in a different kind of way addressed media forgotten and obsolescent. Zombie media is interested in media not only out of use, but resurrected to new uses, contexts and adaptations.

### Archivist/Circuit Bender

For the figure of the artist, technical media has meant nods both towards engineering as well as the archive, as Huhtamo has noted: “the role of the artist-engineer, which rose into prominence in the 1960s (although its two sides rarely met in one person), has at least partly been supplanted by that of the artist-archaeologist.”[23] Yet, methodologies of reuse, hardware hacking and circuit bending are becoming increasingly central in this context as well. Bending or repurposing the archive of media history strongly relates to the pioneering works of artists such as Paul DeMarinis, Zoe Beloff or Gebhard Sengmüller – where a variety of old media technologies have been modified and repurposed to create pseudo-historical objects from a speculative future.

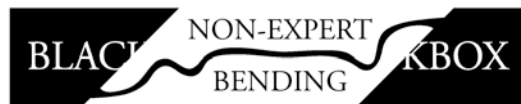


Figure 5. Despite being expert territory, portions of the non-user-serviceable interior of the blackbox system can be manipulated and bent by non-experts. We propose that both computer hardware and historical archives can be bent.

Referring to Demarinis's various sound based projects such as *The Edison Effect* (1989-1993) and *Gray Matter* (1995), Huhtamo has suggested that the notion of the artist-archaeologist can be approached as a t(h)inkerer.[24] In the age of consumer electronics, the artist can also be seen as an archaeological circuit bender and hacker, which links media archaeology with the political agenda of contemporary media production. The black boxes of the historical archive and consumer electronics are cracked open, bent, and modified (Figure 5).

### Media Archaeological Time: Time of the Living Dead

We want to bring these various components now together: planned obsolescence, the material nature of information and electronic waste. Planned obsolescence was introduced as the logic of consumer technology cycles, which is embedded in a culture of material information technologies that in themselves should be increasingly understood through the chemicals, toxic components and the residue they leave behind after their media function has been “consumed”. The realization that information technology is never ephemeral and therefore can never completely die has of both ecological as well as media archaeological importance. As a material assemblage IT also has its duration that

is not restricted to its human-centered use value: media cultural objects and information technology have an intimate connection with the soil, the air, and nature as a concrete, temporal reality. Just like nature affords the building of information technology – how for example gutta percha was an essential substance for insulating 19th century telegraphic lines or how columbite tantalite is an essential mineral for a range of contemporary high-tech devices – those devices return to nature.[25]

In short, information technology involves multiple ecologies that travel across political economy and natural ecology.[26] This Guattarian take on media ecology is connected to an ecosophical stance: an awareness of overlapping ecologies feeding into interrelations between the social, mental, somatic, non-organic, and animal. Indeed, following Sean Cubitt's lead, we argue that archaeologies of screen and information technology media should increasingly not look only at the past, but inside the screen to reveal a whole different take on future-oriented 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.”[27] Hence, this archaeology of tinkering, remixing and collage would not start from Duchamp and the historical avant-garde, but from opening up the screen, the technology.

Media archaeological methods have carved out complex, overlapping, multiscalar temporalities of the human world in terms of media cultural histories, but in the midst of an ecological crisis a more thorough non-human view is needed. In this context, bending media archaeology into an artistic methodology can be seen as a way to tap into the ecosophic potential of such practices as circuit bending, hardware hacking, and other ways of reusing and reintroducing dead media into a new cycle of life for such objects. Assembled into new constructions, such materials and ideas become zombies that carry with them histories but are also reminders of the non-human temporalities involved in technical media. Technical media processes and works at sub-phenomenological speeds and frequencies[28], but it also taps in to the temporalities of nature– thousands of years of non-linear and non-human history.[29]

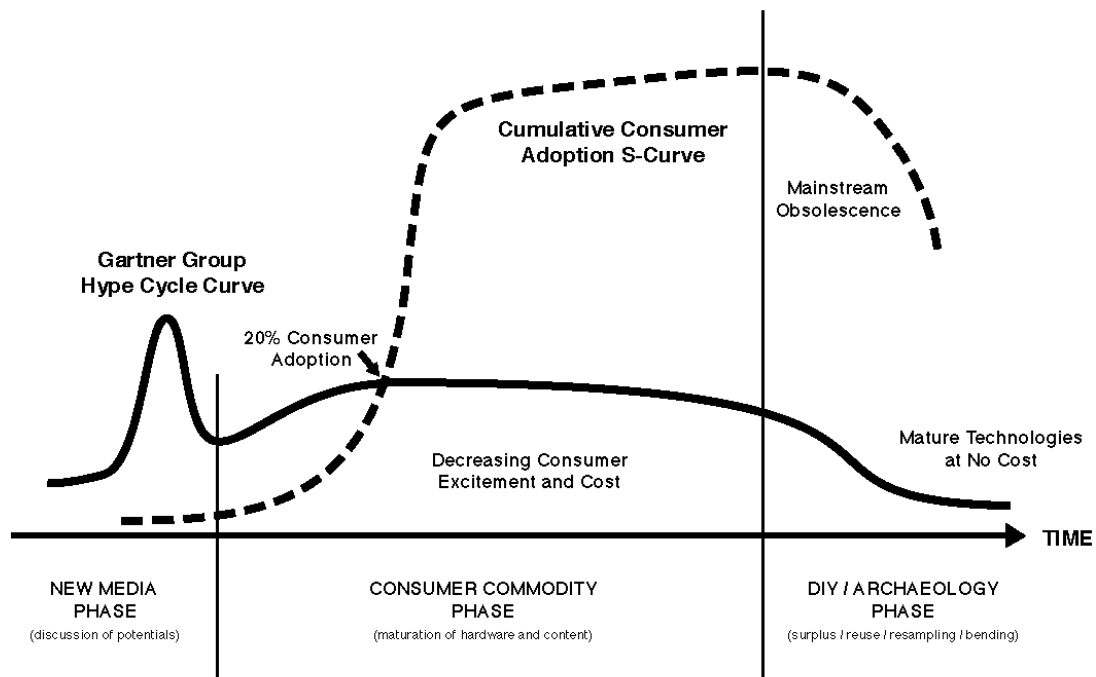


Figure 8. Phases of media positioned in reference to political economy: New Media and Media Archaeology are overlaid on Gartner Group's Hype Cycle and Adoption Curve diagrams, graphic representations of the economic maturity, adoption and business application of specific technologies.[30]

As a conclusion, communications technology have moved beyond the new media phase, through the consumer commodity phase and much of it is already obsolete and in an "archaeology phase." The practice of amateurism and hobbyist DIY characterize not only early adoption of technologies, but also the obsolescence phase. Chronologically, digital media has moved from a speculative opportunity in the 1990s, became widely adopted as a consumer commodity in the 2000s, and has now become archaeological. As a result, studying topics like reuse, remixing, and sampling has become more important than discussions of technical potentials (Figure 8). Furthermore, if temporality is increasingly circulated, modulated and stored in technical media devices – the diagrammatics and concrete circuits that tap into the microtemporality that is below the threshold of conscious human perception – we need to develop similar circuit bending, art and activist practices as an analytical and creative methodology: hence, the turn to archives in a wider sense that also encompasses circuits, switches, chips and other high-tech processes. Such epistemo-archaeological tasks are not only of artistic interest but tap into the ecosophical sphere in understanding and reinventing relations between the various ecologies across subjectivity, nature and technology.

Although death of media may be useful as a tactic to oppose dialog that only focuses on the newness of media, we believe that media never dies: it decays, rots, reforms, remixes, and gets historicized, reinterpreted and collected (Figure 8). It either stays as a residue in

the soil and in the air as concrete dead media, or is reappropriated through artistic, tinkering methodologies.

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## Notes

- [1] Environmental Protection Agency. Fact Sheet: Management of Electronic Waste in the United States, July 2008, EPA 530-F-08-014.
- [2] Jonathan Sterne, "Out with the Trash: On the Future of New Media." In: *Residual Media*, edited by Charles R. Acland. (Minneapolis: University of Minnesota Press, 2007), 17.
- [3] Erkki Huhtamo: "Thinkering with Media: On the Art of Paul DeMarinis," in Paul DeMarinis / *Buried in Noise*, ed. Beirer, Himmelsbach and Seiffarth (Berlin: Kehrer, 2010), 33-46.
- [4] Bernard London, "Ending the Depression Through Planned Obsolescence" (pamphlet), 1932. Reproduced by Adbusters Magazine, "How Consumer Society is Made to Break," available online at <http://www.adbusters.org/category/tags/obsolescence> (Last modified October 20th 2008).
- [5] Brooks Stevens, Talk at Midland (Minneapolis) in 1954, audio recording available at <http://www.mam.org/collection/archives/brooks/biography.asp>
- [6] Victor Lebow, Price Competition in 1955, *The New York University Journal of Retailing*, Volume XXXI, Number 1, Spring 1955, page 7.
- [7] For example, Apple's iPod personal audio players and similar devices are manufactured with no user serviceable parts inside, including its battery. After approximately three years of use, the lithium-polymer battery will no longer work and the device will either need to be professionally serviced or discarded.
- [8] Diane Waldman, *Collage, Assemblage, and the Found Object*. (New York: Harry N. Abrams, Inc. 1992) 17. Calvin Tomkins, *Duchamp: A Biography*, (New York: Holt, 1998), 181. On media art historical writing concerning the early avantgarde, see for example Erkki Huhtamo, "Twin-Touch-Test-Redux: Media Archaeological Approach to Art, Interactivity, and Tactility" in *Mediaarthistories*, edited by Oliver Grau (Cambridge, MA: The MIT Press 2007), 71-101 and Dieter Daniels, "Duchamp: Interface: Turing: A Hypothetical Encounter between the Bachelor Machine and the Universal Machine" in *Mediaarthistories*, pp. 103-136.
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[11] John Markoff, *What the Dormouse Said: How the Sixties Counterculture Shaped the Personal Computer Industry* (New York: Penguin, 2005). Susan Douglas, *Inventing American Broadcasting, 1899-1922* (Baltimore: Johns Hopkins University Press, 1989).

[12] Erkki Huhtamo, "Thinkering with Media: The Art of Paul DeMarinis" In: Paul DeMarinis, *Buried in Noise*, Kehrer Verlag, 2011. The notion of the tinkerer is here apt in terms of its roots in a longer cultural history of nomadism. See Mary Burke, 'Tinkers'. *Synge and the Cultural History of the Irish Traveler* (Oxford: Oxford University Press, 2009).

[13] Michel de Certeau, *The Practice of Everyday Life*, translated by Steven Rendall (Berkeley, CA: University of California Press, 2002) xiv.

[14] In 1995 Richard Barbrook and Andy Cameron coined the phrase "The Californian Ideology" in an essay by the same title which provided a genealogy of the concept of the internet as a placeless and universalizing utopia, with information technologies as emancipatory, limitless and beyond geography. See <<http://www.hrc.wmin.ac.uk/theory-californianideology-main.html>>

[15] Cf. Charles R. Acland, "Introduction. Residual Media." In: *Residual Media*, edited by Charles R. Acland (Minneapolis: University of Minnesota Press, 2007), xx.

[16] Wolfgang Ernst, "Let There Be Irony: Cultural History and Media Archaeology in Parallel Lines." *Art History*, Vol. 28, No 5, November 2005, 582-603.

[17] See Eric Kluitenberg, ed. *The Book of Imaginary Media* (Rotterdam: Nai Publishers, 2006).

[18] Cf. Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge, MA: The MIT Press, 1999).

[19] For more information, see Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999.) See also Eugene Thacker, "Introduction" to Alex Galloway, *Protocol: How Control Exists after Decentralization* (Cambridge, MA: MIT Press, 2004), xiii.

[20] Albert Borgmann, *Holding On to Reality: The Nature of Information at the Turn of the Millennium* (Chicago: University of Chicago Press, 1999), 176. For a relevant discussion of infrastructure, see "Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces," by Susan Leigh Star and Karen Ruhleder, 1996, *Information Systems Research*, Vol. 7, No 1, 63-92.

[21] Latour, *Pandora's Hope*, 185.

[22] Personal correspondence with Garnet Hetz, October 20th 2009.

[23] Erkki Huhtamo, "Time-Traveling in the Gallery: An Archaeological Approach in Media Art." In *Immersed in Technology: Art and Virtual Environments*, edited by Mary Ann Moser with Douglas McLeod (Cambridge, MA: The MIT Press, 1996), 243.

[24] Erkki Huhtamo, "Thinkering with Media: The Art of Paul DeMarinis" In: Paul DeMarinis, *Buried in Noise*, Kehrer Verlag, 2011.

[25] Gutta percha is a natural latex rubber made from tropical trees native to Southeast Asia and northern Australasia. Columbite tantalite or "coltan" is a dull black metallic ore, primarily from the eastern Democratic Republic of the Congo whose export has been cited as helping to finance the present-day conflict in the Congo.

[26] Félix Guattari, *The Three Ecologies*. Trans. Ian Pindar and Paul Sutton. (London and New Brunswick, NJ: Athlone Press, 2000).

[27] Sean Cubitt interviewed by Simon Mills, *Framed*, online at <http://www.framejournal.net/interview/10/sean-cubitt>.

[28] Such hidden, partly abstract but completely real and material "epistemologies of everyday life" are investigated in a media archaeological vein by the Institute for Algorhythmics, <http://www.algorhythmics.com/>.

[29] Cf. Manuel DeLanda, *A Thousand Years of Non-Linear History*. (New York: Zone Books, 1997).

[30] For more information on Gartner Group's Hype Cycle theory, see Jackie Fenn & Mark Raskino, *Understanding Gartner's Hype Cycles*, 2009. Gartner Group.