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Dematerializing Digital Objects: Denial, Decay, Detritus and Other Matters of Fact

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DEMATERIALIZING DIGITAL OBJECTS:

DENIAL, DECAY, DETRITUS AND OTHER MATTERS OF FACT

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Abstract

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We know little about the materials that constitute the digital devices we use every day, from where those materials are derived, or where they will go when we discard them. Through a variety of means, digital devices are "dematerialized." That is, a digital object's material components are denied and concealed by complex cultural and economic practices that support a myth of immaterial and ubiquitous computing without material consequences. Since the early days of digital computing, designers have striven to design devices that are smaller, better, denser, and faster. These traits are framed as ideals against which new products are measured and they have encouraged a desire for ubiquitous, imperceptible integration of digital computing at all levels of modern life. This dissertation argues that the digital object is dematerialized and that this pervasive reduction of the physical object and our very awareness of the physicality of digital materials inhibits our ability to support awareness of the material limits and often detrimental impacts of digital devices. However, the material nature of the digital object may be more apparent after an object is rendered obsolete. Drawing from media archaeology, thing theory, and material culture studies, this dissertation examines a few "afterlives" of digital objects because it is only after its useful life that the object's materiality takes on transformative powers. For example, when discarded, its physical properties become problematic and may be framed as an environmental issue. Or, when treated as a material artifact in a museum the digital object resists historicity, and when saved as a memento it may take on unexpected nostalgic power. I argue that it is precisely the dematerialized aspects of the informatic media that have created the situation of 'e-waste' and it is through a new consciousness of their materiality that we might think about how these technologies evolve and occupy space in the future.

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Table of Contents

List of Figures

List of Appendices

INTRODUCTION

Sand is a thoroughly dull object of study, but before we dismiss sand and its banality completely, it is worth noting that sand is mostly composed of silica (Si), the fourteenth element of the periodic table and the second most abundant element on earth after oxygen. On earth, silica is always bound to oxygen (SiO_2) in the form of silicon dioxide and when crystallized into silicon wafers, it makes everyday computation possible. As the material basis of contemporary digital computation, silicon is present as a semiconductor in the solid state integrated circuits inside our digital devices. Silicon, like the sand from which it is made, is an abundant medium that we have come to think of as omnipresent (when visible or problematic) and inert (when concealed within a digital tool's outward form.) Digital devices then, despite their ubiquity and ordinariness in the early twenty-first century, are given a special, magical status. They promise to ease our work, speed our progress, and connect us in multiple ways. They are the tools of our age yet computers are rarely regarded as *material things*. Our discourse of computing is characterized by an enframing of immateriality that obscures the digital's very real material presence. Terms such as "wireless," "hypertext," "cyberspace," "cloud computing," and so forth belie computing's real material moorings and elevate digital things to mythic heights. And, more critically to this dissertation, this rhetoric problematizes the treatment and engagement with computers as material "things"[1] but as Jennifer Gabrys argues, "the material history of silicon and the microchip, the basic electronic component, exists not in an ideal or stable state but through multiple, migratory and transformative materializations." (2011: 28). That is, hardware moves through many states from raw material to finished product, and then inevitably meets an untimely, premature death after only a few short years until it is no longer useful or new.

Background

Harold Innis, Marshall McLuhan, and other media and material culture theorists have argued that the substance used as a medium is not just a passive carrier of information—materials are selected, developed, adopted, and discarded on the basis of their suitability as communication media. In *The Gutenberg Galaxy*, McLuhan approaches the rise of "typographic man" through a constellation of cultural, intellectual, religious, and social conditions that are materialized through Gutenberg's press; however, these conditions are pre-existing and are manifest through technological changes in media production (McLuhan 2000). Lisa Gitelman suggests that media and their materiality "are shaped by and help to shape the semiotic, perceptual and epistemic conditions that attend and prevail" (2006: 11). She argues that "… media are very influential, and their material properties do (literally and figuratively) *matter*, determining

[1] "Thing" is a term used frequently in this research. A thing is not simply a word for an unnamed object, but a status of an object created for a purpose. In material culture studies and philosophy of technology (e.g., Heidegger, Latour, Brown), things are not mundane; rather, they are powerful symbols of our values, language, and material conditions. This concept is elaborated in Chapter 2.

some of the local conditions of communication amid the broader circulations that at once express and constitute social relations." (10). Thus, media are materially constitutive of a civilization's bias towards space, time, knowledge, engagement, and power. That is to say that they are material embodiments of these overarching values and the constellations of the pre-existing conditions that lead to material and technological developments (see Kopytoff 1986).

The constitutive characteristics of a medium are intrinsic to its symbolic values. These symbolic values, such as mobility and timeliness, are transient and constructed socially but the formal quality of the medium is relatively stable and may offer a record of value systems as they may be expressed through media. These traces will surface or become evident when media are rendered obsolete. When a medium is no longer useful or useable, it becomes a vessel for only symbolic worth. As Friedrich Kittler writes, after the invention of the digital computer, "the world of the symbolic really turned into the world of the machine." (Kittler 1987: 18). This truism can be inverted, as the machine *is* the symbolic apparatus, embodying and employing meaning within a greater economy of symbolism. When examining older, simpler communication technologies, we see that they are "persuasive representations of text, space/time, and human presence…new media provide new sites for the ongoing and vernacular experience of representation as such." (Gitelman 2006: 4). That is to say that as we invent new media, so we reinvent ourselves representationally through those technologies. As symbols, all machines are essentially extensions of ourselves and therefore devices like the computer cannot be value-neutral. In *Understanding Media*, McLuhan compares our relationship with technology to the Greek myth of Narcissus (Shallis 1984; McLuhan 1964), the young man who gazes into his own reflection so much that he mistakes it for another person, a person so beautiful he becomes numb to reality and wastes away to his death. Narcissus' mirror represents media technologies as an extension of ourselves. So entranced by our mirror-image, we fail to see that our technologies are merely things which are means rather than ends in themselves (Shallis 1984). As Shallis writes, it is not technology which is problematic, but rather it is our attitude toward it that leads us to fail to recognize it for what it is. Like Narcissus' reflection, we often fall for the lure and glitter of digital content, failing to see the apparatus and its material presence. Digital technology then, "is seen not to be neutral or passive, but an active logos or utterance of the human mind or body that transforms the user and his ground." (McLuhan & Zingrone 1995: 379). The computer and its materials are rich with symbolic meaning as artifacts representative of ourselves, not merely as passive carriers of information. But the "logos" of the computer in the user's mind is not fixed. It is informed by convention, interpretation, and symbolic value. When alive and in use, the digital object is "dematerialized," it is rendered as ephemeral, ubiquitous, substanceless. The solid matters that comprise digital technologies are denied and erased through a rhetoric of immateriality that is the product of decades of noemic[2] discourse which conceals the material nature of digital objects. A dematerialization of the digital can be seen in common phrases such as "cloud

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[2] Edmund Husserl uses the term noema (from the Greek νόημα meaning that which is thought, perceived, or judged) to describe the way in which consciousness may represent an object with an ideal meaning (i.e., to believe that a waving hand signifies a greeting), but that meaning is not fixed and may be destabilized or reframed (i.e., the waving hand may mean that the waver was merely swatting away a fly). Noema is an object's perceived intentionality in a given moment. The noema of the digital object may be that it is immersive and ubiquitous and hence may be perceived as immaterial but a closer examination of the digital object as object may disrupt this immaterial ideal (Smith 2006).

computing," "ubiquity," "wireless," and "cyberspace" as these terms erase and deny and distort their material form from the macro level (for example, the internet) to the micro and atomic levels (for example, coding). Yet every aspect of digital technologies is material. The sealed shell of a digital device conceals tightly packed natural and synthetic components that have been mined, fused, doped, crystalized, soldered, and wired. The stuff of the digital is material indeed, but our language and understanding of the digital have been dematerialized.

To be dematerialized is to be reduced or stripped of material corporeality. Félix Guattari puts forth the notion of "deterritorialization," or the "smoothing out" of the collective dance of an ensemble of actors and technologies that conspire to create an end product (Guattari 2001: 41). Computers and digital devices are end products, and the vast constellation of actors and parts that conspire to make and then dismantle that object are smoothed out and erased by the totalizing completeness of the finished object. It has long been the goal of computer design protocols to reduce the bulk associated with computing materials for practical reasons. Solid state computing, like that which employs the integrated silicon chip, was intended to be miniaturized so that it could aid in military operations, such as computerized war heads and airborne applications, where weight and size are critical factors. During the Cold War, military engineers needed smaller, lighter computer chips which could be embedded into missiles and other weapons. Intelligent and light-weight guidance systems would be a key military advantage. Yet long after the Cold War, "smaller, lighter, faster, denser" continue to persist as the ideal characteristics of chip technology and each of these traits would be pushed to their material limits. To dematerialize was to miniaturize and increase the density of materials so that the least amount of materials and void space were used in a digital device. From a commercial point of view, smaller computers could be better integrated into efficient manufacturing systems, workspaces and, later, into the home. Less material allows for greater mobility and ubiquity. Practically speaking, dematerialization is a necessary process through which we can achieve total, invisible, ubiquitous, and ideal computing because materials and perceptible materiality impede this progressive project.

Dematerialization is a key factor in our perception of relative value and quality in digital technologies. To be advanced and progressive, new digital technologies must be smaller, lighter, more suited to mobility, and (more recently) concealed. Where once computers were sold to hobbyists who would tinker with its innards so that tactile and logical fancy might meet[3], the typical tablet PC today (for example, Altair's 1974 8800 vs. Apple's 2011 iPad 2) resists opening and hence, resists material disclosure (See

Figure 1: Altair 8800 from 1974 *(left)* and Apple's late CEO Steve Jobs holding the iPad in 2011 *(right)*. Images from the Computer History Museum and Apple, respectively.

Figure 1).

Multifunction interfaces like touch screens prohibit any mastery of the device's material components as the inner workings are concealed and mysterious beneath a sleek, sealed shell.

Dematerialization is not just a reduction of real materials but a reduction of the *association* between computing and materiality. As consumers we have been encouraged to value, esteem, and celebrate immateriality even where it is incompatible with practical truth but, as Jonathan Sterne writes, "If you call something a medium, then it has a physical infrastructure" (Sterne 2007: 16). Yet we forget this logical point. Through the rhetoric of immateriality reiterated in marketing, casual discourse, theoretical and practical research, our understanding of the link between the real presence of the digital tool and digital operations is not only erased but the traces of materiality are distorted. According to Jennifer Gabrys (2011), dematerialization refers to the conceptual processes which render invisible or ephemeral the infrastructures which support digital technologies. She argues that a "sense of immateriality is bound up with complex and specific ways of mobilizing and imagining material performativity as being free from resource requirements." (2011: 58). That is to say, we prefer to see our digital tools as uncomplicated by the material needs that have been obvious in other media: paper reminds us of the trees felled to make pulp, the railway left iron seams and quarried pits, even "electric" media like television indicate that they cannot be used without electricity. But digital technologies conceal their material origins, their material needs, and their material residues. Thus dematerialization is a systematic process of distortion which is called upon to support the effectiveness (and *affectiveness*) of the technology (Gabrys 2011). The ideal interface is one that demands the least physical engagement and tactile interference from its user. As such, technologies which support the illusion of a dematerialized medium are deemed most successful. In this way the digital engages in a kind of performativity:

> The sense of dematerialization… may emerge through the speed of exchange and space of the interface, which foreground the transfer of signals and light in place of the supports of chemical, meals, plastic, and labor. Here is a process of erasure—as well as a process of substitution that works toward a new performativity in the form of accelerated exchange and output… The ephemerality and accelerated rates of exchange that electronic networks facilitate influence, in turn, how we understand the materiality of immateriality of digital technologies. (Gabrys 2011: 58)

The speed of near-instant digital communications is partly to blame for the obscuring of the material underpinnings of the technology. Gabrys (2011) links these ephemeral and fleeting qualities of digital technologies to other fleeting and volatile entities, namely financial markets. Since financial institutions and market technologies (like the NASDAQ) were among the earliest to employ digital networks to support the speed and volume of volatile market information, digital markets pioneered the fleeting, immaterial, and illusory authority of digital volatility. In this sense, the dematerialization of digital technologies serves to support a greater sphere of volatile "provisionality," (Gabrys 2011) where on-demand tools serve just-in-time needs, creating the illusion that digital devices are called into being when needed and sublimated when not. In this light, digital dematerialization is a reflection and proponent of a rapidly changing world that favours instant but fleeting engagement. Technologies heavy with materials are perceived to slow or impede this volatility, hence "dematerialized" technologies prevail.

Digital objects, however, have a very short lifespan, they fall into an odd state of functional and material decay when their use value deteriorates. Death may come by way of obsolescence when it is supplanted by a newer technology, when it breaks, or simply because it isn't new anymore. Stripped of its functionality, the digital object undergoes a transformation—its materiality suddenly becomes visible and the processes of dematerialization fail. At its death, the veil of immateriality is lifted and the parts become visible and it becomes a tangible *thing*. There are many afterlives of the digital object. It may become garbage valued only for salvaged parts, a hazardous environmental pollutant, a nostalgic resurrection for collectors, or a museum's object of history. The digital object is tomorrow's fossil record of late capitalism and the Information Age.

Excavating the digital

Archaeologist Christine Finn spent the year 2000 in Silicon Valley treating the epicentre of computer hardware and software design as an archaeological site. Finn carefully excavates the layers of life, prosperity, and decay in the valley by identifying intersecting and diverging veins of material culture both on the surface and below in the form of local memory (Finn 2001). Finn, along with a handful of other scholars like Elizabeth Grossman (2006) and Jennifer Gabrys (2011) have recently taken on the task of examining the computer as a material artifact of our current age, rather than just a technological phenomenon or instrument that defies traditional frames of reference, as has been the case within content and user-oriented studies of "new" media. This new movement in media theory seeks to address the very real materialities of digital technologies to dispel the pervasive myth that the digital is immaterial, ethereal, and virtual. In order to address the materiality of digital tools, many of these researchers have sought to engage with their objects holistically, from their design and manufacture to their disposal as "garbage."

The physical properties of the digital object have been neglected broadly in media theory despite the fact that McLuhan and Innis' foundational work, which forms the basis of the discipline, brought media form to the foreground of communication theory. More recently however, researchers are re-examining the material nature of media, though much of this new insight comes from disciplines beyond communication and cultural studies. Grossman (2006) is among those who are exploring digital technologies from a materialist and environmentally-oriented perspective. In her expansive survey of the electronics industry, Grossman unravels a web of concealed material processes that are integral to computer manufacturing from coltan mining in Africa to toxic waste dumping in Silicon Valley. She traces the lifecycle of digital hardware from beginning to end, exposing the detriments of electronic waste (ewaste) as concrete reminders that the digital is not a move toward cleaner or leaner materials. Gabrys (2011), an environmental science and design researcher, explores the heaps of ewaste through a paleontological study. Garbage and other unwanted stuff (a problematic abstract category in itself) provide a rich terrain for forensic or archaeological study. Numerous studies on waste, or "garbology" (Rathje & Murphy 2001, 1992), confront us with the material fallout of our innovation and consumption practices. As Bruno Latour remarks, "technology is society made durable" (Latour cited in Law 2010) and as a material artifact, digital tools are both physically and symbolically embedded into the social, economic, and psychic fabric of our life-world and these durable things (i.e., non-biodegradable) offer a physical trace of our value systems as they may be manifest in material form.

Purpose of this Study

Drawing from previous research which has approached computing and "the digital" from a material culture position, this project engages with digital objects as archaeological artifacts. My dissertation seeks to trace the processes of dematerialization of digital technologies so that their significance as durable "things" may be revealed. Digital objects are the synthetic material manifestations of a complex set of epistemological values that bind ideas, values, matter, and economies. By examining digital objects after they have reached the end of a productive (and very short) life, we can more critically and objectively engage with their materiality and strip away the many layers of rhetorical, mythic, and symbolic distortions that have made these objects appear immaterial. Accordingly, these dematerialized objects may be re-examined as material expressions of our age and we can move towards a more productive and forward-looking engagement with these "new" media.

This dissertation seeks to apply a comprehensive material culture analysis of computing hardware. Two questions are put forward:

- How may digital technologies be approached using analytical techniques, such as material culture studies and media archaeology, to engage critically with their material nature?
- Why is it that "dead" digital tools become problematic when historicized and what are the conceptual impediments to engaging with computing hardware as material culture artifacts?

It is the aim of this study to investigate the processes of dematerialization as they are made visible in the "afterlives" digital objects and in the rhetoric and language of the digital. This project also seeks to explore and identify some of the key ways in which each of these lives, as seen through a material culture lens and exposes the very real material nature of these tools and explodes the myth of the digital as an immaterial entity.

Definition of Key Terms

I use the following terms in this dissertation:

The terms “digital object,” “digital tool,” “digital hardware,” and “digital device” are used interchangeably to describe the myriad assortment of instruments we incorporate into our daily lives. These may include computers of all sorts, tablet PCs, cell phones, smart phones, music and entertainment players, calculators, GPSs, small electronics, embedded electronics, infrastructural electronics, and so forth. All digital tools are an assemblage of hardware, software, interfaces, and power sources. Thus, for the purposes of this current research the terms used to identify these materials are used metonymically and uniformly.

“The digital” denotes the general application of digital programming and hardware as well as the greater sphere of experiences and engagements via digital technology. The digital describes a ubiquitous and totalizing state of immersion in a highly digitized world.

“Material” is used throughout as a synonym for matter, things, the stuff of which an object is made. In this dissertation it is generally used in the literal sense of the word, though material, materiality, and materialism have taken on multiple meanings. Materiality is used at least six different ways across a variety of disciplines: archaeology, technology, Marxism, feminism, the philosophy of language, and critical geography (Sekimoto 2011). Materiality is a key term in archaeology and anthropology where it is a central concept in the investigation of the "materialization of [the] human mind and its engagement with the environment through concrete forms, such as cultural artifacts, rituals, monuments, and symbolic objects." (Sekimoto 2011: 54). Materiality is, however, never neutral in character. Marxian subfields, for instance dialectical materialism, cultural materialism, and historical materialism are generally concerned with distribution of power, political economy, and ownership of material modes of production. As Vivian Sobchack argues, technology (and its materiality) is "always historically informed not only by its materiality but also by its political, economic and social context, and thus always both co-constitutes and expresses cultural values." (1994: 84). I cannot explore all of the social and political contexts that are expressed through the materiality of digital technologies here; thus, following Latour and John Law, I use the term materiality narrowly in reference to an object's formal nature and "thingness" (Brown 2010; Latour 2005) of an object and its relationality to other actors and objects (Law 2010). In communications studies, materiality carries a particular import. As Sachi Sekimoto argues, materiality is key to communication studies because "materiality alters the way a) communication is conceptualized, b) meaning is conceptualized, and c) interpretation as a methodological approach is utilized." (2011: 54). In particular, materiality suggests concrete form and concrete *awareness* of the form. For example, Latour's (1993) study of Louis Pasteur, who identified and made microbes "real" by rendering visible the unseen (Rowlands 2005), the materiality of microorganisms is made visible, but so too are the nodes and networks of disease, hygiene, medicine, cures, agriculture, labs, and causal links. Materiality draws attention to the thingness of objects and grants those objects a modest amount of agency to exist outside of ourselves. Rather than collapsing the objects as reductive emblems of the broader systems which created them, a materialist view explodes those systems to render them visible. This conceptualization of materiality will be discussed in more depth in the Theoretical Context section.

"Immateriality," as it is used here, denotes a lack of thingness, matter, physical, or corporeal presence. It is sometimes used to describe assumptions about a lack of physical presence, particularly when such assumptions are false. It may also imply irrelevance in that the digital object's physical impacts are inconsequential and hence, immaterial.

"Dematerialized," as noted earlier, is a term used here to describe the process of material reduction in digital media. It denotes a reduction of size and bulk of digital devices, and it is used figuratively to describe the systematic process of denying the materiality of the digital media engagement at large. Dematerialization is the process by which the materiality and matter of "things" is denied, figuratively and literally through design practices, nomenclature, and other means. It has been suggested that dematerialization is the result of a change in economic conditions in the twentieth century in that modes of production, like goods manufacturing, were dematerialized when it became clear that newer, emerging technologies like radio and television were really as much technologies of distribution as they were of production (Pfeiffer 1994). With goods manufacturing shipped offshore, Western productivity has leaned toward the "immaterial" production of culture and information thus opening the door for a "raid on all matter" (Pfeiffer 1994: 2). More simply, in our current "Information Age" materiality is arcane and therefore the materiality of those distribution technologies must be denied because it ruptures the myth of the immaterial information-based economy. To talk of things, Pfeiffer suggests, is to risk being accused of "archaic fanaticism."[4] Thus we frame distribution technologies like the Internet and cell phones as immaterial because a dematerialized civilization is an advanced one.

Theoretical Context

Recent scholarship has begun to question the pervasive notion that digital technologies are immaterial and ephemeral, and material culture studies of computing are beginning to appear which seek to call renewed attention to the materiality of digital tools. Some of these projects apply an archaeological technique to contemporary digital devices (e.g., Gabrys 2011; Huhtamo & Parikka 2011; Bogost 2009; Grossman 2006; Finn 2001;) treating them as artifacts and exposing their very thingness. In doing so, these foundational works underscore the material nature of the digital and dismantle the veil of immateriality that has dominated our conceptualization of digital ubiquity. Regrounded and reframed as real material objects, their material impacts may be examined, particularly as they obsolesce and their materiality becomes problematic. Many of these investigations draw from diverse fields including applied science; science, technology, and society studies (STS); and the history of technology. These works are pertinent to the present study because they seek to link technologies and their design and use with broader ecologies of sign systems and social practices. For some material culture scholars, things have an agency all their own (Bennet 2010, 2002; Latour 2007). The

[4] Pfeiffer points to Baudrillard as an example of a theorist who has made his mark by talking about things and surfaces "to an almost obscene degree." (1994: 2, citing Baudrillard 1981) and that semioticians, like Baudrillard, have made a postmodern fetish of matter, the relic of the Industrial Age.

following section describes the three key theoretical perspectives and practices that inform this research: Material Culture Studies, Thing Theory, and Media Archaeology and also touches on some of the foundational literature that will be discussed in greater detail later.

Material culture and the digital object

In *Laws of Media,* McLuhan suggests that all things, whether they be bowls and spoons or telephones and computers, are artifacts that are verbal in structure (McLuhan & McLuhan 1988). That is, all things *speak*. Similarly, Jean Baudrillard claims that, "It is certain that objects are the carriers of indexed social significations, of a social and cultural hierarchy—and this in the very least of their details: form, material, colors, durability, arrangement in space—in short, it is certain that they constitute a code." (1981: 37). While true, we might qualify this statement by adding that objects carry the codes that we have embedded within them in their formal aesthetics, material composition, manufacturing processes and so on. These significations, however, are clouded and concealed by their wholeness as a complete object. The manner in which we treat a whole object, particularly the way we craft a discourse about that object, hides the layers of signification, nuance, and other connotative values that locate it within a broader web of meaning. He writes,

> The empirical 'object', given in its contingency of form, color, material, function, and discourse (or, if it is a cultural object, in its aesthetic finality) is a myth… But the object is *nothing*. It is nothing but the different types of relations and significations that converges, contradict themselves and twist around it, as such—the hidden logic that not only arranges this bundle of relations, but directs the manifest discourse that overlays and occludes it. (Baudrillard 1981: 63)

But there is more than code to be discovered in material analysis and perhaps the object is not "nothing" at all, as Baudrillard suggests. The relationship between things and meaning and between things and language cannot be delineated against the straightforward dimensions of signifier-signified. Rather,

> …the signifying force of material culture depends on the structure of its interrelations, and the signification of any particular artefact or item can be seen as being intersected by the meanings of other items… This follows from a view of material culture as being constituted in an open field rather than a closed system of signs. (Tilley & Shanks 2007: 88).

That is to say, material objects do not directly denote; they speak to a convergence at the intersection of materials, meaning, and significance. Daniel Miller suggests that to search for direct meaning in the materials produced by a culture might be less productive than it would be to search for *significance* instead. A study in materials should recognize that material production is intentional and is a subset of the wider culture and actively objectifies that culture's sense of order and being-in-the-world (Miller 2007 with reference to Bourdieu 1977). In Chapter 2 the rhetoric of the digital is examined using Baudrillard's concept of signifiers that are rearranged in discourse to produce new significations, particularly those which connote the digital as dematerialized. While this approach does not fall directly under the domain of material culture (rather, it is derived from semiotic theory), it shares a discursive focus on the ways in which meaning is socially constructed, reinforced, and reified through discourse.

More broadly however, material culture studies seeks to employ object-oriented investigations to understand the complex and often invisible dimensions of a culture which may be rendered visible through their material culture. Victor Buchli (2002) describes material culture studies has having always been closely tied to anthropology yet with an emphasis on the material practices of a given culture and the use of artifacts to build understanding of social groups, their practices, and their environment or economies at large. A typical material culture investigation might examine a material practice such as the creation and use of clay pots or the history of weaving and the concomitant practices surrounding weaving in a past society. Material culture studies often seeks to understand folklore and mythic narratives of a given culture through their material production, particularly when the culture in question no longer exists and all that remains are the material traces of a lost cultural logic. These studies tend to place a human made object at the centre of the investigation and the networks and dimensions associated with the material practices which produce that object are developed inductively. Museum exhibits which present the history of social groups (e.g., a holocaust museum) or of a specific practice (e.g., a maritime history museum or a museum of technology) typically showcase material culture as a key component in their visual displays because artifacts may be framed as representative of broader human practices and social or economic conditions. As Buchli reminds us, studies in material culture were borne out of an “Enlightenment era preoccupation with the materiality of social life” against which progress could be gauged materially and comparatively between cultures (or, more precisely, in comparison with an Anglo or Western sense of technical superiority) (Buchli 2002: 3).

The evolution of the use of material culture and museum displays is too long and complex to parse here; however, the current state of material culture exhibits is still framed by dominating ideological frameworks which serve to legitimize the practices of display and of material production at large. Today these practices reflect contemporary notions of community history, cultural diversity, objectivity, educational engagement, and multi-sensory immersion—notions that may be socially appealing but are no less problematic. Chapter 1, which explores the displays at the Computer History Museum, offers a short critique of the exhibit's overarching project and format as well as its problematic construction of computing history through computing objects.

Material culture studies may not always be tied to museums and the politics of display. Buchli credits archaeologist Gordon Childe whose early twentieth century works renewed the practice by infusing research with Marxian commentaries on the significant of material practices as a key signifier of social relations and power structures, particularly in consumer societies (Buchli 2002). Throughout the twentieth century, material culture research generally sought to tie material practices to hidden dimensions of social practices yet the field was somewhat limited to anthropological methodologies and typified by single object analyses, for example, the social history of ordinary things such as the paperclip or the pencil made newly visible through their analysis as cultural artifacts. More recently however, material culture research has incorporated trans-disciplinary research to enrich its positivist anthropological underpinnings, and constructivist theories and frameworks from semiotics, critical theory, political economy, philosophy, environmental science, and the arts have been woven into materialist views to create a rich and multifaceted view of material practices. Some key material culture studies that have informed this dissertation include Jessica Riskin's (2004) analysis of the "Defecating Duck" and the history of automata and weaving machines, Latour's study of laboratory instruments and household objects (See Latour 1987, 1991a, 1991b), among others. Material culture studies offer a useful approach to understanding digital technologies because the field reinforces the notion that technologies are key material artifacts of our age. The field underscores concrete material presence and allows for engagement with the material nature of a technology, whereas "new media studies," as a field of study, has generally denied digital technologies of their thingness. The materiality of digital technologies then, may be exposed as "stuff"—real and tangible. In the context of this current study, the thingness of a digital object becomes most evident when the object is obsolesced and it may be treated as a cultural artifact, much like a clay pot or stone tool of an ancient culture might be examined.

In Chapter 1, material culture studies provides an appropriate framework for the treatment of computers as museum artifacts. The problems inherent in displaying the "black boxes" of defunct computers of the past in a museum setting are apparent, not because computers make for poor material artifacts, but because our assumptions about computing as an abstract rather than material practice are at odds with the very material nature of museum displays. When obsolete computers are put on display in a museum, they rest in their display cases as mute, dead objects because they cannot be revived and rendered operational in a meaningful way. Hence their thingness overpowers their historical significance, making the display a difficult conceptual terrain to navigate. In Chapter 4, material culture studies inform this dissertation's discussion of the nostalgic value of dead, discarded and obsolete digital objects as they are reintegrated into personal collections as memorabilia. The practices of collecting, displaying, and engaging with old digital technologies represents an intersection between material form and idealized memory where sentimentality is expressed through the resurrection of obsolesced things.

Media archaeology of the digital artifact

This project draws significantly from "media archaeology," which is a developing interdisciplinary branch of media studies and bridges material culture studies and media studies within a historical framework. Media archaeology has emerged out of a reaction against the conceptual limitations of "new media studies." That many media studies scholars have recently engaged in historically-oriented object analysis indicates there is a need to reconsider the positioning of new media as eternally new and to recognize that forensic and materially oriented analysis in the discipline is necessary and productive (for example, Chun 2011a, 2011b; Huhtamo & Parikka 2011; Acland 2007; Sterne 2007; Siegert 2007; Gitelman 2006; Zielinski 2006; to name just a few).

Media archaeology, unlike new media studies, seeks to create a common framework within this interdisciplinary field (Huhtamo & Parikka 2011). In lieu of formal archaeological methods such as carbon dating specimens, the field is defined by its unorthodox and generalized, historically-oriented approach to discovering, uncovering, and articulating the cultural significance of media objects and the networks which support them. Unlike traditional archaeology, media archaeology mixes theory, philosophy, and interdisciplinarity with object-oriented analysis. This dissertation's application of media archaeology is shaped primarily by what Huhtamo and Parikka (2011) call the "German School" of media archaeology, so named not because it is populated by German theorists and practitioners, but because it shares an object-oriented approach that is derivative of Kittler, McLuhan, Heidegger, Mumford, Giedion and what they call a German reading of Foucault. Within this framework, media are truly "things" with formal significance, and not just as means or surfaces through which subjects interact. Rather, media archaeology seeks concrete examinations of media forms as real, corporeal things, providing a rich terrain for broader cultural analysis. Specifically, these methods seek to pose humanistic and philosophical questions about the relationship between objects and their users in what has been termed an ecology of media materialism (Huhtamo & Parikka 2011). As Foucault might argue, the method seeks a "systemic description of a discourse-object" (2002: 154) where distant correspondences and "silent births" are allowed into the analysis of objects. Media archaeology then abandons the traditional "History" of ideas and instead is concerned with these constellations of events which shape our objects (Zielinski 2006) within the context of techno-historical events (Kittler 1999, Parikka 2002). These twentieth century thinkers share a focus on technological objects as outward expressions of deeper Modernist values. The contemporary German media materialist school draws significantly from these pioneers and has taken up a productive stream of object-oriented media archaeology which is informed by Friedrich Kittler[5], Hans Gumbrecht, Karl Ludwig Pfeiffer, and others (Huhtamo & Parikka 2011). This school frames technology as determining and shaping the networks of which it is a part. Though this may sound deterministic in its approach, unlike McLuhan's determinism (whereby media may shape us), this newer, object-centered school seeks to give matter and materiality an elevated place in our understanding of the ways in which hard technologies affect soft practices (for example, see Kittler's 1999 *Gramophone, Film, Typewriter*). The soft determinism of the German school may be

[5] Kittler would not have self-identified as a media archaeologist, his work emerged *avant la lettre*.

counterbalanced by what Huhtamo and Parikka (2011) call the Anglo-American[6] school which is informed by post-Foucauldian thought in which technological systems like media are derived from and are shaped by their broader social and ideological contexts. This school applies critical theory and new historicist critique to assess media objects as material embodiments of broader, pre-existing and often latent values. This school's genealogy of influential works may be traced through French critical theory employing the foundational works of Foucault, Lacan, Derrida, Baudrillard, Bataille and English language theorists including Raymond Williams, and the Frankfurt School (Huhtamo & Parikka 2011). Huhtamo and Parikka assert that the divergence is a result of different readings and applications of Foucault's works. To parse a very complex set of theoretical influences, the Foucauldian influenced Anglo-American school emphasizes the immaterial (particularly discourse) effects of systems and technologies with an eye toward language as a terrain where power structures may surface whereas the German school is "thing-oriented" and views systems and technologies as techno-historical events and where language is not given as much significance within broader networks of actors and actants (Huhtamo & Parikka 2011 citing Kittler 1999). As German scholar Eva Horn summarizes, "… Foucault observed the rules and truth effects that governed a given network of historical discourse, post-Foucauldian media theory broadens the scope of an archaeology of knowledge by including the material objects that enable its constitution." (Horn 2007: 10). The German school offers a counterpoint to what they perceive to be a lack of materialist

[6] So named by Huhtamo and Parikka because it is dominated by scholars whose works are primarily written in English, though many of the scholars are not Anglo or American.

sensibilities in the wake of the very immaterially focussed Anglo-American theories. Gumbrecht and Pfeiffer (1994), for example, have accused the Foucauldian tradition of *logocentrism* and an overemphasis on words and texts over material things and even Latour, who leans toward the German school, has made calls for the return of a material view within studies of technological objects and their networks (Latour 2007).[7] It is reflected in the works of many media archaeologists, as Horn writes, that "The history and theory of cultural techniques goes beyond any media theory; it encompasses media but also includes, as [Bernhard] Siegert points out… symbolic operations (such as writing, counting, or measuring)." (2007: 12). In other words, current media theories often lack analysis linking the concrete aspects of media with their symbolic power, perhaps as a defence against accusations of being deterministic or reductive; however, the field also draws from new historicism and many of theories and connections already put forth by critical theory, cultural materialism, feminism, post-colonial studies, and other postmodern disciplines (Huhtamo & Parikka 2011), though unlike new-historicist studies, identifying the locus of power is not the primary goal of

[7] While Huhtamo and Parikka (2011) present these two schools as parallel and distinct, their separate paths may be drawn along linguistic rather than fundamentally divergent or irreconcilable views. Also, scholars emerging from English language institutions are more likely to have been exposed to the canon of Foucauldian and left-leaning critical theory texts so it is not surprising that Anglo-American scholars draw predominately from these sources, i.e., they carry greater currency within Anglo scholarship than the less familiar German canon. It is these somewhat universal canons that afford this new field some cross-disciplinary appeal among English-speaking scholars. The conference, Media Histories: Epistemology, Materiality, Temporality in March, 2011 at Columbia University in New York represented an effort to bridge and connect the German and Anglo-American schools. The conference brought together scholars from the Weimar-based Internationales Kolleg für Kulturtechnikforschung und Medienphilosophie (IKKM) and Columbia and Princeton Universities.

analysis. Instead, the goal of media archaeology is to map the networks which shape media technology in order to identify broader systems of cultural values that may be expressed materially through media technologies. These media apparatuses can be viewed as material traces of a cultural logic.

Huhtamo and Parikka (2011) suggest that the German school and its brand of media archaeology arises from a general dissatisfaction with "'canonized' narratives of media culture" and that contemporary media studies are limited in their analysis and by their own definitions of a medium and by a lack of historical exploration and are often neglectful of material analysis particularly in new media studies which generally deny form and privilege content.[8] As Lovink suggests, "media archaeology is … a methodology, a hermeneutic reading of the 'new' against the grain of the past, rather than a telling of this histories of technologies from past to present." (Lovink 2003: 11). Another significant feature of media archaeology is that it is squarely grounded in the humanities. Unlike new media studies which has drawn largely from social sciences methods and empirical research, media archaeology pulls together various humanistic and pedagogical techniques to produce a tapestry of analyses and insights. At its heart, the media archaeology project's "objective is to find a middle way between the realistic ontology of the sciences and the social constructionist ontology of the humanities." (Parikka 2002: 74). As a multi-modal methodology, media archaeology "rummages textual, visual, and auditory archives as well as collections of artifacts, emphasizing both the discursive

[8] New media theory has been called "vapour theory" for its lack of real substance and its "gaseous flapping of the gums about technologies, their effects and aesthetics." (Lunenfeld as cited by Lovink 2004: 235).

and the material manifestations of culture." (2011: 3). Huhtamo and Parikka (2011) describe the unorthodox and trans-disciplinary method as "nomadic," or as a "travelling" (Bal 2002) across interconnected worlds (Haraway 2004). Specifically, the method derives its multi-modal techniques from McLuhan's (1964) *Understanding Media: The Extensions of Man*. In this work McLuhan weaves an assortment of approaches to examine the nature of media and their impacts. In addition to McLuhan's unconventional methods, his focus on "temporal connections, translations, and mergers between media" greatly inspired the German school (Huhtamo & Parikka 2011: 5).

Gitelman suggests that media archaeologists seek "a built-in refusal of teleology, of narrative explanations that smack structurally of the impositions of metahistory." (Lovink 2003 in Gitelman 2006). Further, media archaeology resists any teleological assumptions about the perfection of the current media-cultural conditions (Huhtamo & Parikka 2011). This particular view of media archaeology methods is relevant to the first chapter of this dissertation which attempts to see through the standardized history of technology which is teleological in tone; instead, I seek to dismantle specific tropes in this history to get at the processes that have dematerialized digital objects and their history.

Media archaeology is particularly relevant to this study and its engagement with digital hardware as a material artifact. Donna Haraway draws a vision of a multitude of socially constructed objects like the chip (and fetuses, bombs, and cyborgs) that are like balls of yarn which can be exploded and unravelled to connect to a multitude of interconnected worlds and actors. She explains, "Out of the chip you can in fact untangle the entire planet, on which the subjects and objects are sedimented" (2004: 338). The chip, a small and ubiquitous object, is the *material* trace of a complex network of actors, actants, causes and effects, dreams and nightmares, myths and truths. For N. Katherine Hayles materiality brings together physical properties, dynamic capabilities, and the users' creative use of these. She writes:

> The physical attributes constituting any artifact are potentially infinite; in a digital computer, for example, they include the polymers used to fabricate the case, the rare earth elements used to make the phosphors in the CRT screen, the palladium used for the power cord prongs, and so forth… An emergent property, materiality depends on how the work mobilizes its resources as a physical artifact as well as the user's interaction with the work and the interpretive strategies she develops…(32).

This echoes Heidegger's (1971) assertion that objects are full of people, and Latour's (1993) recognition of quasi-subjects and quasi-objects (Brown 2004; see also Serres 2007). And while this project cannot address or identify all of the ties between digital hardware their immense networks, media archaeology allows for a cross-disciplinary view of the digital object as an artifact and historical *thing* as opposed to the more typical view of digital engagement, *in vivo*. Chapter 1 explores the ways in which media archaeology might be more productive in terms of treating computing technologies historically, as computers appear to resist typical frameworks for engagement with artifacts. Chapter 2 employs media archaeology techniques to access the rhetorical and conceptual networks which frame digital technologies, and Chapter 3 presents the findings of informative media archaeologies which excavate the digital object in order to map the complex ways in which the dematerialization of digital tools is rendered most apparent at the ewaste dump site.

Thing theory

"Thing theory," a term coined by Bill Brown (2004), asks us to recall that familiar experience of suddenly realizing the presence of something that was previously invisible; for example, a window. One generally looks *through* a window, but a dirty window obscures this normal act. Suddenly, one is looking *at* the window, the dirty window, and the window then becomes an object by the process of being looked at. He suggests that "We begin to confront the thingness of objects when they stop working for us…" (4). That is, the window's materiality, now opaque with dirt, is revived and brings the network of the window—its relative dirtiness, its placement on the wall, the person whose responsibility it is to clean it—are rendered visible. The same is true for digital technologies, it is at the end of their useful life that their status as objects and not ideas is exposed. Thing theory approaches "the thing badly encountered" and the "thing not quite apprehended" (5)—in other words, the broken and the not quite fully realized. Brown's thing theory operationalizes Arjun Appardurai's notion that, despite our theoretical understanding that human subjects anoint things with meaning, methodologically speaking, it is things circulating through their networks that reveal their human-object contexts (Appadurai 1986 in Brown 2004: 6). Brown suggests it is through this process that objects assert themselves as *things* and their relationship to their human subjects changes.

Ultimately, thing theory seeks to erode the dichotomy between subject and object. For example, Webb Keane (2005) calls for a renewed attention to the object rather than the subject. This pervasive split is a result of the post-structuralist project in which subjectivity is elevated above objecthood, and a fixed or limited view that the object is merely acted upon (Keane

2005). In much post-structuralist and postmodern theorizing, ideas become things and material things are "transparent expressions of meaning." (Keane 2005: 183). Thing theory then, is an emerging template for engaging with materiality and matter which refuses to subordinate things to ideas. Unlike dominating theories concerned with words, ideas, and ideologies, thing theory "…asks less about the material effects of ideas and ideology than about the ideological and ideational effects of the material world and transformations of it." (Brown 2004: 7).

Thing theory similarly seeks to reduce the status of ideas from material to immaterial, thus reversing the Foucauldian project (Keane 2005). Keane also suggests that there is a residual Modernist view, imparted by way of a Protestant disavowal of aesthetics, which rejects the acknowledgement of the formal qualities of objects and reduces them to merely functional concepts. This long-running tradition supports a "celebration of function over appearance, its rejection of surfaces not just as superfluous but as immoral." (Keane 2005: 184). An examination of the form is immoral in some camps likely because it is seen as foregrounding objects before human subjects (Lukács 2009). Perhaps this discomfort with formal analysis eschews an intense exploration of subjectivity as Foucault might have preferred, and instead thing theory seeks to revisit the Heideggerian notion that the shoemaker knows himself when he looks upon his shoes—his creations—which render real and visible the complex set of networks and things through which agency is manifest. As Michel Serres declares, "*le sujet naît de l'object*" (Serres 1989 in Brown 2004: 1[9]). In another light, things have a power that

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[9] The full quote is: "Nous existons comme hommes depuis l'aube par autre chose que la parole, par la chose justement irréductible au verbe. Le sujet naît de l'objet. L'hominien paraît devant ce qui gît là." From Michel Serres' *Statues* (1989).

persists regardless of subjective intervention, that they are still essentially derivative of cosmic elementary particles and hence, regardless of technological manipulations, they retain some of their own elemental, atomic "vibrancy." (Bennett 2002, 2010). This vibrancy, as Jane Bennett suggests, might be most visible in an object's afterlife; for example, the digital object's inability to decay naturally and hence it persists indefinitely in a multitude of ways where they become hazardous and problematic, or perhaps in another afterlife, nostalgic and emotionally evocative.

It is also worth noting that there has been substantial research and theorizing on the interplay between technology and the body and the intersection between the two as a locus of material presence (Hayles 2002, 1999; Sobchack 1994; Ihde 1990). My dissertation cannot explore this dimension of materiality but many of these key texts are part of the corpus that informs thing theory and material engagements with technology, particularly their use of phenomenological approaches to interpreting the interplay between human subjectivity and material objectivity (Sobchack 1994; Ihde 1990).

Chapters 3 and 4 use thing theory in the context of discarded digital objects and their thingness, which becomes most visible at the garbage dump and in the nostalgic redemption of obsolesced machines.

Other influential disciplines

This project is enriched through transdisciplinary methods and findings. Chapters 1 and 3 engage with emerging theories from museum studies (e.g., Macdonald 1998; Knell 2007; D. Miller 2007) which provides a rich critique of science and technology exhibits and the ways in which computational history and its artifacts pose a challenge within the framework of traditional object-oriented exhibits. The Toronto and Frankfurt schools of communication and media theory provide foundational theories on the relationship between culture, power, and the material dimensions of media (e.g., Innis 2007, 1991; McLuhan 2000; Adorno 1973); and the works of Walter Ong (1958, 1971, 1982, 2004), John Durham Peters (1999), Bruno Latour (1987, 1991a, 1991b, 1993, 2007), Wendy Chun (2011a, 2011b), and others whose works resist categorization but nonetheless they provide some of the clearest and most progressive critiques of the materiality of communication and media. For example, this project has been informed by a number of feminist scholars including Haraway (2001, 2003, 2004) and Hayles (2002) who critique notions of gender within the matrices of science and technologies and their concomitant theories and less classifiable scholars including Sarah Kember (Kember & Zylinska 2012) and Jane Bennett (2002, 2010) who investigate notions of vitality and its relationship to materiality. Similarly, Canadian scholars Jonathan Sterne and Charles Acland's historically oriented work on media apparatuses has provided chapters 1, 3, and 4 with a methodological entry point for viewing new media as old artifact and cultural "residue" (Sterne 2007, Acland 2007).

Methods

This project bridges historical, cultural, and material culture analyses to examine digital technologies as a medium that is symbolic of contemporary values when digital objects are obsolesced or are at their "death." And are ready for disposal, decay, salvage, and recovery. Digital devices are resurrected as objects full of symbolic meaning as they are transformed into objects relegated to collections, nostalgic reframing, museums and archiving, art, etc. Like fossils, disintegrating digital objects speak to the archaeologist of their symbolic worth long after their living applications have ceased. It is within this process of decay that the material's symbolic meaning is revealed.

The materiality and thingness of a digital object is perhaps most noticeable at the end of that object's life. In other words, it is in the "afterlife" that the materiality of the digital becomes perceptible and even problematic because the veil of immateriality has been lifted and the digital object may be exposed as a "thing." This dissertation explores both a few possible states of digital objects and it is in these states that the object's material form resists the pervasive myth of dematerialization. Dematerialization may be most visible when a digital object becomes

1) an artifact of material culture on display in a museum setting;
2) a rhetorical object;
3) detritus and debris; or
4) a nostalgic memento.

The Computer History Museum in Mountain View, California presents a good starting point for examining the problematic narratives of the history of computing and the resulting distortions and assumptions that these frames represent. There are surprisingly few museums dedicated to the history of computing and digital technologies, despite their importance in contemporary society. Chapter 1 begins at the Computer History Museum with an assessment of the presentation of the Difference Engine N$^{o.}$2 and its evocative power within the greater scope of computer history. The analyses presented combine archival research from the Computer History Museum and the Smithsonian Lemelson Center's Computer Oral History archives as well as alternative histories that treat digital objects not as a tale of computing history so much as a history of communication and media.

The Computer History Museum also provides a useful backdrop or template for assessing the treatment of digital and computing objects as material culture artifacts on display. Chapter 1 focuses on the museum's The Visible Storage Room to interrogate the one-dimensional treatment of these material artifacts and to examine the ways in which the politics of display interferes with a more productive assessment of dead digital objects as things.

Despite the vast and varied archival materials available at the Computer History Museum and the Lemelson Center, I was not able to glean sufficient evidence in the oral histories to build a discourse analysis for this project, as I had originally intended. There simply was insufficient explanatory dialogue on the topic of materials in the oral histories. This deficiency was compounded by the difficulties presented when navigating the oral history collection. For example, the research is limited in terms of the rules and restrictions of the archive area (only a pencil and a few sheets of foolscap was allowed), transcriptions could not be photocopied or scanned, and much of the material is not catalogued or accessible through digital means. Since budgetary restrictions limited my trip to three days, I could not extract sufficient materials to develop a thorough discourse analysis. It was for these reasons that I repositioned my analysis in Chapter 1 to examine the artifacts on display and to critique the idiosyncrasies of the material collection, rather than a deeper investigation of the archives.

Departing from the museum setting, Chapter 2 explores the ways in which the progressive dematerialization of digital objects may be exposed in the distortions of the rhetoric of the digital. When an object is obsolesced, its materiality exposes and challenges the concealing nature of digital rhetoric. In other words, the death of the digital object reveals the emptiness and subterfuge of the systematic dematerialization of digital technologies. Using the works of Heidegger, Latour, and Peters, this chapter applies thing theories to examine the relationship between digital things and the ways we speak of thingness or their perceived lack of thingness. This chapter instrumentalizes thing theory and critiques of science and technology and bridges these to notions of the digital as a medium for language, logic, and rhetoric.

Chapter 3 explores the crisis-point at which *matters* of fact can no longer be denied, that is, when computers become waste, or garbage. Computers are trapped in a rhetoric of novelty, utility, and immateriality which are all conditions that make computers very problematic when they become waste by way of obsolescence—a state which occurs rapidly and predictably. Computers as waste is not just an environmental or economic issue, but conceptually computers are incompatible with notions of being old or useless. Drawing from media archaeologies, this chapter engages with digital objects as detritus and explores the ways in which the categorical transition from useful object to trash exposes the processes by which dematerialized digital objects become garbage, and hence become problematically rematerialized.

The fourth and final chapter returns to the Computer History Museum's Visible Storage Room display. At the end of the exhibit is a collection of digital objects whose value is nostalgic. Long obsolesced as useful things, these objects evoke an emotional response rooted in memory and personal connections with the objects. In this afterlife, the dead digital object is recaptured by nostalgia and symbolic, personal value for the trace. The digital object as nostalgic memento represents an unforeseen outcome of the digital age, one that seems incompatible with a revolution that was driven by novelty and innovation but left little room for sentimentality for the old and forgotten. It is in the context of nostalgia that digital devices are embraced as material objects, no longer valued for their function but for a personal connection which they represent materially.

Relevance

The research questions are valid and imperative because we are at a crisis point in the development and diffusion of digital technologies. Decades of rapid innovation and consumption of digital technologies driven by awe and appreciation for the ease, speed, and accessibility of digital technologies crisis has left us with a digital hangover which reminds us, as Sterne writes, that "the entire edifice of new communication technology is a giant trash heap waiting to happen, a monument to the hubris of computing and the peculiar shape of digital capitalism." (Sterne 2007: 17).

As an object of capital within an "information economy," we acknowledge that information and data are central commodities of exchange and that the digital tools which create, distribute, and give worth to these commodities are key to the growth and maintenance of this new economic terrain. Yet we are reaching a crisis point in terms of the material fallout of these supposedly dematerialized capital flows—tons of discarded, dead digital objects are piling up in landfills, basements, warehouses, and informal dumps. High tech garbage is both the result and driver of the new, information-based economy which on the one hand conceals the material productivity required to support a digital economy and, on the other hand, supplies a rapid material turnover of digital tools to meet the seemingly endless demands of "immaterial" digital economic engagement. As Charles Acland suggests, "This ideology of transformation and immateriality—that is, a language of capital's easy (re)production process—offers one explanation for the central place of 'new media' in our social and critical context." (2007: xviii).

The first years of the Digital Age led us to engage with digital technologies with little concern for their material presence, choosing instead to treat them as if they were immaterial, but the time has come to expose and tackle the material nature of these technologies so that we may better examine the forces that compel us to consume, dispose, and to reinforce the problematic enframing of immateriality. To do this, a critical examination of the materiality of digital technologies is in order because it is not just that an accumulation of "dead" digital tools presents a growing area of concern, it is that the root cause of our denial of the materiality of the digital lies in our very perception of electronic media and matter. Dead and discarded media have numerous afterlives and it is in these post-consumer states that the distorting processes of dematerialization may be exposed and reframed.

To the researcher's knowledge, there has been no study of digital technologies across a number of possible "afterlives" for the purposes of exposing their materiality. While there have been several case studies and object-oriented explorations of obsolesced new media, none has combined media archaeology, material culture studies, or philosophies of technologies to explore the peculiar processes of dematerialization as they may apply to digital technologies. This project seeks to contribute a critical analysis of the dematerialization of the digital object and the ways that problematic may be exposed. Researchers of contemporary material culture, media studies, and cultural studies may find this work offers a unique counter-point in that it is object-oriented rather than the more common subject-oriented research in digital media theory which tends to favour a focus on users and content, and rarely on form and matter but as Haraway argues, thinking technologies like digital computers, have effectivity *and* materiality. By categorizing these two dimensions of technology, she argues, we can more productively question one category (i.e., materiality) to interrogate the other (in this case, effect and affect) (Haraway 2003: 335). This is a unique and radical approach to studying digital technologies as it is more commonly content, affect, and subjectivity in relationship to technology that are subjected to research. This is also in sharp contrast to some of the emerging subsets of new media studies. For example, Kember and Zylinska (2012) prefer to do away with such "false divisons" in favour of looking at digital mediation as a whole, and doing away with analysis of discrete digital objects. However, I would argue that digital objects and their objecthood has not been sufficiently examined at all, whereas mediation is a well-trod terrain among new media scholars. This project attempts to reframe and revisit such discrete objects, particularly in the context of objects and their problematic materiality.

CHAPTER ONE
HISTORICAL OBJECTS

RESURRECTING THE UNDEAD
AND OTHER PROBLEMS IN COMPUTING HISTORY

Temples in the Valley

What does one look for when the object in question has been dematerialized and stripped bare of its material traces? How can a researcher approach an archaeology of dematerialized media when the very thingness of the things under study are elusive? Where does one start? At a museum, of course. Museums are keepers and constructors of the past, they bring the living to the dead (de Certeau 1988) so that the present may seem less ordinary. My journey begins at the Computer History Museum in Mountain View, California, or "Silicon Valley," the epicenter of modern computing. I went to the museum with a purpose, namely: to discover why digital technologies have such a strange relationship with matter and materiality. I wondered how a museum would present material artifacts whose very materiality has been otherwise dematerialized. Would the museum setting force materiality upon these artifacts? As an inert, silent object in a display case, would a dead computer reveal its material form in new ways? What I discovered from this visit and my trip in 2007 to the Smithsonian Institute's Lemelson Center for computing history, was that computing history is a difficult terrain. Far from the neat, linear history of technological progress that I expected, these museums present a number of problems, many of which appear to result from a tension between the treatment of digital objects as historical artifacts on the one hand, and the mythic narrative of computing on the other.

Setting out to research computers as material artifacts proved to be more challenging than I had anticipated. I knew that within the fields of computer history and material culture studies that the computer-as-artifact was a difficult object of study—not because the computer in anyway defies the boundaries of these disciplines but because the ubiquity of computers makes them difficult to classify and they are dematerialized, meaning that to put a computer on display already poses a conceptual incongruity in that if digital technologies cannot be seen as material things, then how may they be displayed as things in a meaningful way? The display case creates an ironic frame, not only because computers seem out of place in a museum (museums are for old, forgotten things, special things, not ordinary devices) but because we are reluctant to embrace contemporary objects as future remains. A computer museum, then, is at odds with itself at many levels.

To historicize new technology is to disrupt its novelty. Computing technology, driven by novelty and innovation, makes for a particularly unique and difficult historical object. To present technological objects as non-functioning historical objects on display rather than in an operational state underscores their "thingness" which punctures the object's aura as a technological feat in the present. Academic researchers may now readily *declare* that all history is subjective (McHoul & Grace 1997), but many archives and museums are less inclined to present history as interpretive because it is the narrative of progress, triumph, and change that gives the objects on display their interest value. It would seem that tying the computer's development to identifiable anchors such as WWII, the Cold War, and key figures as is the case in the Computer History Museum contextualizes this history of objects within a larger matrix of American history. This may aid our understanding of the cultural values of the objects within the history of technology, but this framing fails to answer many questions or to paint a rich and complex history of computing materials as embodiments of cultural values, rather than as objects that merely serve those values. The following chapter seeks to identify and discuss some of the problems that are evident in the treatment of computers as artifacts. This chapter cannot cover all of the dimensions of the history of modern digital technologies, nor can a parsed history be presented here because this history is varied and complex (Mahoney & Haight 2011). Rather, this chapter addresses some of the problems that develop within the treatment of digital technologies as historical objects and museum artifacts. If digital technologies are broadly denied their materiality, then it is in the context of the museum that systematic dematerialization of the digital is confronted with the matter-bound nature of material culture artifacts. The museum allows for not only a media archaeology of digital technology, but it also reveals that those institutions seeking to present computing history do so within a narrow narrative of familiar tropes such as nationalistic and local pride, lone geniuses, and entrepreneurial radicalism. As it were, the digital object appears to resist historicity because its value rests primarily in its novelty and contribution toward a linear progress leading toward the present and beyond to a perfect, dematerialized digital future. Framed as embodiments of "the future," digital technologies make for difficult historical objects in a museum setting because their obsolescence resists their framing as significant or successful specimens.

A Day at the Museum

Visiting the Computer History Museum had been high on my research wish-list while preparing this dissertation and a family event landed me in Silicon Valley in the spring of 2009. I drove to Mountain View in a rented SUV and pulled into the sunny parking lot, ready to take advantage of this opportunity to immerse myself into the computer history archives. What struck me initially was the optimistic banality of the town. I found myself checking and rechecking my downloaded maps to make sure that I was indeed in Mountain View, otherwise known as Silicon Valley, the home of newly minted billionaires, and ill-fated IPOs, and the birthplace of the "officeplex" where play and work become indistinguishable. It was difficult to get a sense that, for the past fifty years, this has been the epicentre of the information economy. Like many of the towns that dot the corridor of the valley, Mountain View is sprawling and industrial yet pastoral and quaint in a way that only exists in California. Inspired by Finn's (2001) archaeological and ethnographic approach to studying the unique development of the valley and the high tech industry, I similarly sought to excavate and examine digital technology from material culture perspective. In particular, I wished to see how dead computers, as material artifacts would be treated historically given that these objects are generally denied their materiality when in use. The museum provides visitors with copies of its biannual publication, *Core*, so that they may understand the museum's mission. The Spring/Summer 2007 issue was available at the time and in its opening pages, curator Dag Spicer provides the following impetus for the museum's collection activities:

> This incredible fragility of our world's material traces—hardware, software, the ideas behind them, the marketing materials, the people involved who can (for a while) be interviewed for an oral history—makes the window for preserving computing history especially narrow. While the delicate nature of artifact discover and preservation is well known to archaeologists (from whom all museum curators draw some of their DNA), computers present unique challenges—first of which is a form of consciousness raising, so that old computers are not automatically considered to have no value.
>
> Every day, year after year, the Computer History Museum works against time. Every year many thousands of tons of computer equipment are disposed of in the world's landfills—

> a problem unforeseen in the utopian days of early computing. Many of these items are rather uninteresting, mass-produced IBM-compatible machines of which the Museum has sufficient exemplars.
>
> But others are truly worthy of being saved. Although we cannot know absolutely, it seems certain that extremely rare (in some cases, unique) items from computing's early days are in this same waste stream. (Spicer 2007: 9).

Fragility, urgency, disposal, and impermanence frame the museum's imperative. In addition to the more typical imperatives for preservation like rarity, uniqueness, and ingenuity, at this museum there is a distinct sense of immanent loss of history if it is not created quickly. In other words, creation and preservation of history are the guiding principles behind the collection, and while noble, these two driving forces—*making* and *telling* history—both support and skew the digital object as a historical artifact. In the following sections, I reflect on the difficulties inherent in creating and preserving material artifacts when the object to be preserved, the computer, is culturally constructed as immaterial.

But where to begin?

Historical narratives always offer a clear starting point, it is in the nature of "history" to seek such delineating moments in our past. Perhaps this is a product of linear thinking, and the project to develop a history of computing and digital computing is no different, it desires a first, a beginning, a dawn. Yet the origins of computing are neither clear nor abrupt because distinctions between "computing," "computers," or hardware and software are similarly unclear. For example, Kittler (1995) famously argues "there is no software" and Horn (2007) suggests "there are no media." But stockpiles of computers in our offices, homes, and dumpsters suggest that these things have a cumulative history as evidenced in their growing numbers. And while countless books have been written on the history of computing, there is no clear or irrefutable consensus on its origins. Some point to the history of weaving as the origin of computing; for example, a popular encyclopedia on the history of technology states:

> The historical roots of the modern electronic computer go back to the automated Jacquard loom (1801), which used punch cards to control weaving patterns. Another stream in this river of technological change flowed from the calculating needs of industrializing society and notably the mechanical 'calculating engines' of Charles Babbage who conceived of a universal calculating machine or computer. (McClellan & Dorn 2006: 406).

This kind of statement implies that two streams of practice—programming and calculating—converged at some point to create the thing we now call a computer. Yet how many laypeople use their computer to compute regularly? And is the history of the Jacquard loom, which employed a script rather a history of a communicative practice (i.e., inscription or encoding and decoding) that we call programming as Dunne (2005) might argue? These are a few of the many problems that become apparent when engaging with a historical tale of digital technologies and much of this history is coloured by a sense of what a computer's highest or truest purpose is, which is usually deemed to be computation and supra-human information processing, despite the fact that quotidian computing by the masses is far more communicative and creative than it is computational and arithmetic. Digital objects today are more likely to be used by laypeople as a medium for communication, that is to write, read, talk, design, engage, create, and connect. And it is this fixation and narrow view of digital tools and their location within a history of computational instruments that presents the first of many problems in the museum.

The behemoth at the gates

The visitor at the Computer History Museum is first confronted with the fully functional and precisely reconstructed Babbage Difference Engine N$^{o.}$2—one of only two machines of its kind in the world, which at the time of my visit was on loan from Nathan Myhrvold, former CTO of Microsoft (CHM 2009). The size of a mini-van and weighing five tons, Charles Babbage's difference engine, conceived in 1821, is a formidable piece to behold. Standing as an assemblage of metal cogs, drums, and other industrial parts one cannot help but be impressed by its seriousness. Babbage apparently conceived calculation as a kind of mechanical grunt-work. He is reported to have exclaimed: "I wish to God these calculations had been executed by steam!" (Huhtamo & Parikka 2011: 278). An array of levers, rotating parts, and pistons had to be programmed patiently and precisely to produce the end product—a set of data that would be stamped onto paper or plaster tablets. Looking at this ambitious machine, the only recognizable feature to me was the comparatively modern looking spool of paper. Standing at the display, I tried to imagine what it would look like when brought to life. I envisioned the pistons, gears, cogs and moving parts whirling quickly into a brassy blur. I wondered if it would be loud and produce a metallic banging noise, or would it be nearly silent? How long would it take for the engine to produce a small amount of data? Could the data be trusted? Why is it so beautiful? Or is its beauty really cast by its "aura" of antiquity?[10] But the question that was most puzzling was, why is it *here*, in *Silicon* Valley? (See Figure 2).

[10] The machine is brought to life regularly during an afternoon tour of the museum, however my visit did not coincide with one of the scheduled demonstrations. In lieu, I was able to download a video of the machine in action from the museum's web site. It is accurate, though limited in its computational capability.

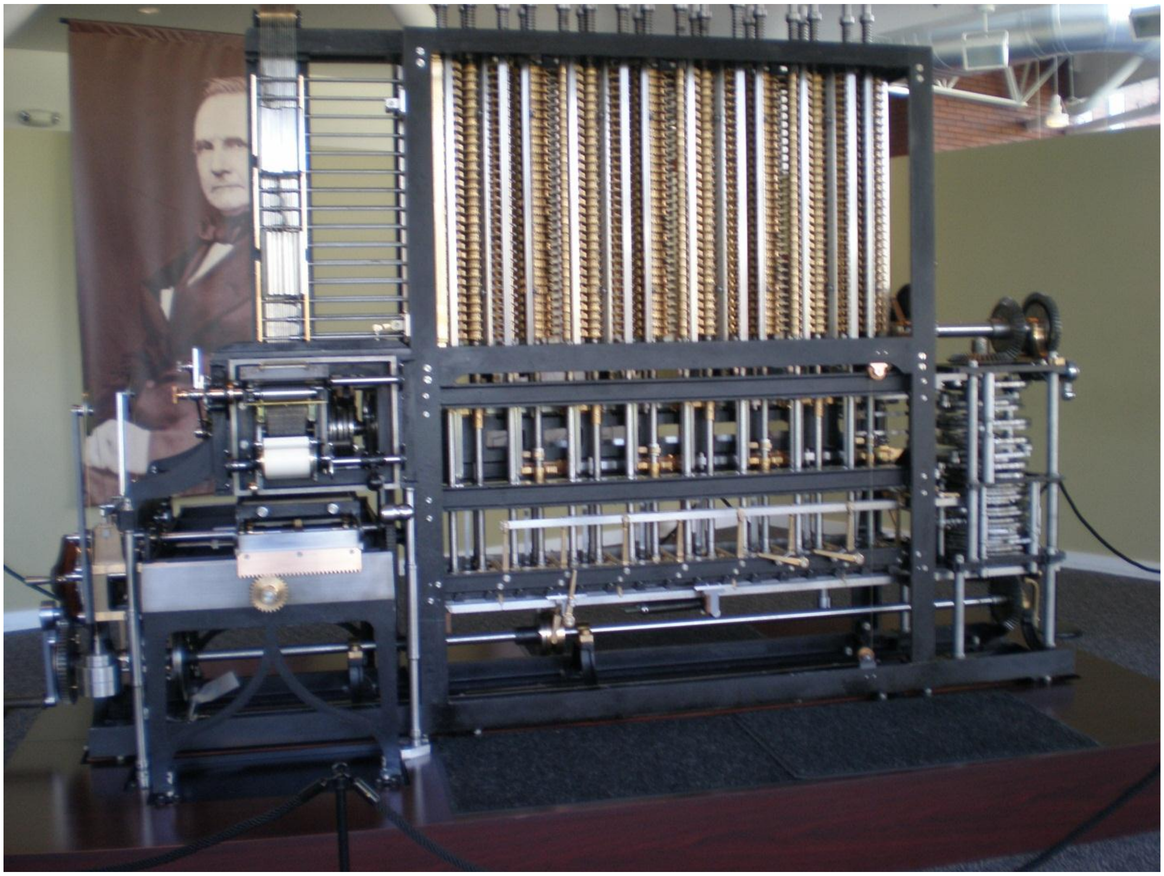

Figure 2: The Babbage Difference Engine N°.2 near the entrance of the Computer History Museum.

The obvious response would be that many computer historians see it as the “first” computational machine and that naturally it should be housed at the Computer History Museum, since it is indeed a computer of sorts. Its placement here at the front entrance of the museum presents a rather blunt starting point for the history of computers. Michael Mahoney, a critic of conventional computing history, has suggested that this history is dominated by a machine-centered view of computing development. He writes, “The computer is not one thing, but many different things, and the same holds true of computing… We blend multiple historical sources into a single stream, treating Charles Babbage’s analytical engine and George Boole’s algebra of thought as if they were conceptually related by something other than twentieth-century hindsight." (Mahoney in Mahoney & Haigh 2011: 5). The Computer History Museum is no different. In this narrative, the Babbage Engine is framed as the direct forebear of the modern computer. It demands that the visitor compare one's own digital devices to this beautiful but impotent mammoth of a machine. It says to the visitor: "This is where the history of computational matter begins."

The Babbage Engine N$^{o.}$2, as the visitor is told, is one of only two complete reproductions in the world. It was a wonder of its day and Babbage promised that his machine would remove much of the time, agony, and inaccuracy of calculating complex equations. It is a moot point that the machine was, by all accounts, a failure because Babbage was unable to build a complete prototype in his lifetime (Priestley 2010). What makes the machine worthy of its prominence in the museum is its oddity and antiquity—particularly evident in its size (colossal by today's standards, though more compact than the first vacuum tube machines) and its nakedness. All of its parts are exposed, though like today's digital devices, its composition or functional operations are exhaustingly confounding to the untrained eye. It is a mystery how it operates, or that it could operate accurately given the vast array of moving parts. It lacks a screen, a power switch, or anything resembling a computer as we think of them today. It is monstrous yet awesome, and while it is not authentic and veritably "old" (it was fabricated in 2008 from Babbage's original schematic plans drafted in 1822), it emulates an aura of antiquity. Digital culture is so fixated on novelty that agedness is a characteristic that carries worth and vitality only in the museum setting where it may be framed as a relic. Antiquity is the garb of meaning for the museum's Babbage display—it allows the visitor to marvel at the ease and power of our contemporary machines. It encourages us to appreciate how much cheaper, faster, smaller, and more competent computers have become. In other words, the heavy metal-laden burden of the Babbage machine encourages the onlooker to feel comparatively and somewhat deceptively liberated, advanced, and clever. Placing the display at the entrance to the museum underscores the modernity (and perfection) of the contemporary. It gives "the future"—a trope almost always tied to advancements in computing—a starting point. The Babbage engine's contribution, I argue, is not that it is a computing forbear so much as it is a tribute to a time when computation was an outwardly material process. The engine's undeniable materiality, both in its bulk and its exposed parts, is antithetical to today's mobile digital technologies whose aesthetic form must be small, contained, concealed, and dematerialized to the point of being mundane and nearly invisible. They lack the presence of the Babbage engine which can never be dematerialized. It would seem that placing this giant at the gates sets the stage for a narrative of shrinkage, underscored by this mammoth point of departure.

Science and technology archives

Much can be said about the politics of archives and museum displays, particularly within the frame of technological history. While archives and collections have long been an arena for ideological assertions (and deletions), archives themselves have only recently become the subject of critique (Macdonald 1998). Even within the field of the history of technology and society, scholars cannot agree on the problematic dimensions inherent in the history of technology as a cohesive narrative. From a postmodern perspective, it may be impossible to frame any artifact without problematizing it. The benign presentation of the history of computers at the museum is similarly exposes its own biases which may be mired by the politics of funding, the demands of offering entertainment, and the burden of archival management. Despites these issues, from a media archaeology position, the museum is a fruitful source of information as it presents rather uncritically the cultural values that surround our relationship with our computational devices and how we choose to represent ourselves historically and otherwise through those objects.

The Computer History Museum's display setting provides my own current research with a useful roadmap for probing the treatment of the materiality of digital technology. The main display area in the museum (a single large room of artifacts arranged along a cordoned pathway so as to create a winding chronological journey through the "history" of computers) is an apt metaphor for the history of the dematerialization of computational materials over time. See Figure 3.

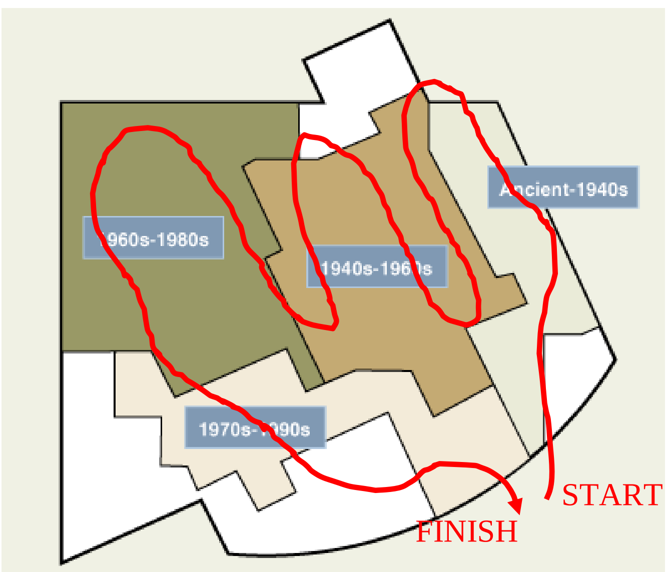

Figure 3: Visible Storage Room Path. The path ends at a display of pocket calculators.

The museum presents a set of values through its revelations and admonitions and this means that the museum itself is also a technology of sorts, a technology that *makes* history. That said, the Computer History Museum is a technology which serves to frame other technologies (the computers on display) and the museum and its archives thus become restricted in their ability to engage in a self-conscious critique (Macdonald 1998). The objects on display are generally arranged chronologically lending an air of direct causality between artifacts (i.e., which objects led to the invention of other objects, effectively rendering the first and last inventions to be of the greatest interest to the viewer). A few objects on display lie outside of the linear, chronological chain of innovations and they are the idiosyncratic artifacts whose historical worth seems to lie in their commercial failure or aesthetic absurdity, by contemporary standards. See Figure 4.

Figure 4: An odd specimen on display from Nutting Associates Inc. 1971. It is an early arcade video game console.

The museum presents itself as a fitting example of Heidegger's evaluation of technology as a process of disclosure. Graham Harman captures Heidegger's observations aptly: "When something is produced, in whatever realm of human activity, it is brought to light from the shadows of its being. Hence, technology is a mode of revealing. 'Technology comes to presence in the realm where revealing and unconcealment take place, where *aletheia*, truth, happens'" (Harman 2002 citing Heidegger 1977). The museum display reveals to us its own technological machinations pertaining to display, affect, and historicity while simultaneously "revealing" what we are to gather from this narrative of computer history. By framing the various obsolesced computers as historical *artifacts*, the social dimensions of each are selectively concealed and unconcealed. As dead objects now sitting in a display case, they cannot speak, function, or perform as computers. Rather, they sit inert and silent and are totally dependent on the plaques to reveal their relevance in a narrow and limited tale of computational progress.

The End Determines the Beginning

Museums are bound by the nature and content of their collections. At the Computer History Museum, the collections are largely procured through individual and corporate donation. Most of the donors have given objects that they designed or worked with in a professional capacity, and a few of the objects were at one time part of the personal collections of technophiles and tinkerers. This makes for a patchy representation of the course of technological developments and yet the collection is among the most comprehensive in the world, perhaps because (astonishingly) so few computer museums exist. The Babbage engine is so prominently displayed at the entrance to the museum because it is its best known artifact. The engine attracts visitors ranging from indifferent children on school field trips to the vaguely curious tourist and to the technology history expert. However, its placement at the front of the museum, like an eroding sphinx, sets the stage for a constructed view on the history of technology. The engine's "unconcealment" as the "first" computer indeed conceals very much about its own origins as a product of its time, serving to frame it as *sui generis* of Babbage's own design. But Babbage did not conceive of the engine in a vacuum. He drew from the inheritance of epistemological endowments available to him in his time and place (Priestley 2010). Indeed, his ambition and his vision were pioneering, but the engine's aesthetics and fundamental construction are representative of the industrial values and needs of early nineteenth-century England. The heavy mechanical form of the machine would have served a number of non-computational functions: the metal parts were probably easy to forge or procure from manufacturers at the time; the industrial aesthetic would have both legitimized the utility of the engine and allowed it to look both advanced and practical to Industrial era observers; and most importantly, it represented a fusion of matter and thought—it was a machine (a progressive, novel yet familiar concept in the early 1800's) that promised to help its users think (Priestley 2010; CHM 2009). In this context, thinking and the products of thinking (i.e., computational data) are rendered as external and materially bound entities. As such, Babbage's engine is convincingly the precursor to solid state computers but this is only a partial narrative or reading of computing history. Its framing as "the first" computer, is an honorary that is pervasive across computer history narratives, it serves to privilege the *industrial* utility and computational purpose of the engine, and of the machines that followed its lead. Its value perhaps lies in its material difference rather than its similitude. The difference between the difference engine and an iPhone, is that its materiality is tangible and comprehensible.

The Computer History Museum presents us with a deceivingly simple arrangement of the history and evolution of our most ubiquitous objects. A chain of velvet ropes guides the visitor through a linear path of inventions whose order implies a relationship based on obsolescence, failures, replacements, improvements, and follows a comforting, if uncritical, path of "Progress." The visitor is presented with a tale of heroes and villains as well as an array of objects whose (now long forgotten) novelty was once considered radical and promising. See Figure 5.

Figure 5: "Steve Jobs and Wozniak using Apple-1 system, ca. 1976" ©Apple, Inc. by Joe Melena. From the Computer History Museum online image archives.

The museum's photographic displays which include quaint, faded photographs of determined computer pioneers working in their garages behind their Valley homes indicates indeed that this history is one of human actors, yet the object-oriented displays neglect to tell us *how* we really got here and how have computers become so dematerialized and why. What is missing is a concrete sense of what products of creativity, ingenuity, and cultural influence went into these objects on display, and the ways in which they are material embodiments of a rich expression of what is fundamentally a very Western project to externalize thought, memory, knowledge and power. The core question posed by this research is, How may we approach digital technologies as material artifacts? And if so, can we move away from an uncritical history of the invention of computers and move toward a more nuanced narrative of the complex influences that shaped both the need for and the result of such innovations?

As the Dead May Speak to the Young

As one passes the Babbage Engine, the Computer History Museum takes the visitor to a room that houses one of the world's most impressive collections of historical computer artifacts. The visitor is encouraged to follow the roped pathways along a chronological journey through the evolution of computing devices. Most of the early models are unlabelled and, due to their antiquity, they are confounding and unrecognizable to the uninitiated visitor; however, small placards serve to give the machines a name, date, and brief history of their invention, use or demise. The majority of the machines are clustered near the beginning of the exhibit. The oldest in the collection were designed for a single purpose and represent the labour and engineering efforts of the laboratory teams which were contracted by the major industrial firms of the early twentieth century (for example, IBM, Texas Instruments, Bell Labs). Apart from their size, their formal composition is the most striking feature of these early machines. Like the Babbage engine, the machines offer a mix of formal aestheticism suggesting that they were designed to be seen—either as models of the leading edge of ingenuity of their day, or to sell future models of similar machines—though most were made in such small quantities (many were one of a kind pieces designed for a singular purpose) that the lack of large-scale parts production is obvious in the aura of uniqueness of each artifact.

Touring through the museum's Visible Storage Room where historically significant computers are on display, it seems apparent that the visitor is presented with an array of artifacts which, when assembled in the order in which they were produced, provides an emphasis on end products rather than on the design processes of the history of computing technology. The visitor is guided along a winding corridor of items that are not behind glass but rather placed almost within reach. Their presence as objects of interest is punctuated by small plaques and a railing that runs along the sides of the path. The room itself is large, modest and vaguely reminiscent of a modular, no-frills 1990's suburban office space cast in an dull pallet of greys, black, and plum.

Aside from the wealth inherent in the artifacts, the Visible Storage Room stands in stark contrast to the bright, sunny and contemporary decor of the foyer of the museum. Walking through the display room, the visitor is presented with a *material* history of computing because the machines are inert, dead, and silent. They cannot be brought back to life, the visitor cannot see their inner workings, and the context surrounding them (offices, homes, military installations) are long gone. In the absence of functionality, their material presence is loud and undeniable. They are lifeless *things* on display, silenced by obsolescence, their materiality has returned in death.

Comparatively speaking, The Gardiner Museum in Toronto offers a selective history of ceramics, the Bata Shoe Museum a history of footwear, and the Computer History Museum a history of computing machines. These institutions house material culture narratives—and this is a point that seems to be somewhat obfuscated by the nature of the subject of computing. To me, it seemed ironic that the room is called the Visible Storage Room, and no explanation for this name is provided. While the artifacts are indeed visible in that they are mounted and framed as exhibits, no *computation* is visible. Computers need to be operative to reveal the information stored in their memory banks, and none of these machines has worked for many years. Thus, while it is debatable whether an inoperative memory device does indeed "store" anything if it cannot be accessed, decoded, or retrieved, it nonetheless is an odd name for a display setting. In a more literal interpretation of the name, one could surmise that it is called a visible storage room because these archives are visible to visitors and the archives stored in boxes in other parts of the museum are therefore in *invisible storage*. The name for this space is too perplexing to go unnoticed, since computers are indeed external memory storage devices, yet at a glance they reveal nothing about the nature of their caches. If they cannot be brought back to life to reveal their stores, then they are truly decontextualized material artifacts far removed from their indigenous habitats and functional states. Figure 6 shows the Cray-3 "Brick" computer. As an object on display, it appears to be an explosion of wires spilling out of a box. Its confounding tangle of innards is an apt metaphor for the general intangibility of computing at large. No greater understanding of the machine is gained through the showcasing Cray-3's inner workings yet the manner in which it is displayed implies that this tangle of wires is significant. It remains a silent, albeit intriguing mess of incomprehensibility (Figure 6).

Figure 6: The Cray-3 Brick.

Viewed broadly, computing is an intellectual (natural or artificial) act that is generally conceived as immaterial and invisible, whether the computing takes place in one's head or inside a machine. However, the very existence and constitution of the museum speak otherwise. The history of artificial intelligence is *inseparable* from its material moorings. We have a tendency to see computing history as a tale of invention and the physical apparatuses that assist those inventions as merely necessary vessels that make pre-existing needs for computation possible. This research seeks to underscore the point that these vessels are holistically and intrinsically *constitutive* of artificial intelligence. Thus, the history of computing can indeed constitute a material culture investigation—and not merely a history of invention and innovation. Yet, the museum's narrative guides the visitor through a tour of intellectual invention and feats of engineering, not of material expression or material design—the materials are framed as things which allow computing operations to take place, not as constitutive of those operations. This is why the museum and its configuration as a dual narrative is important to researchers of material culture and historians of science and technology, yet the emphasis on evidence of chronological progress overshadows an ongoing dyad of material expression of cultural values and science.

The museum represents an overarching problem in the construction and presentation of the history of science and technology. Because it seeks to establish computer history as a fundamental narrative in Silicon Valley's social and economic development, the exhibit reads like a story of heroes and villains and of successes and failures. This problematic framing is in part due to the artifacts themselves as most are the donated personal effects of former employees of the Valley's most influential laboratories. Additionally, the chronological journey that guides the visitor through the exhibit is bound by a curatorial dialogue of technological pathos and eccentricities—visitors are expected to be charmed by the bulky inefficiency of obsolesced machines.

Unlike other anthropological exhibits that have become increasingly sensitive to the inclusiveness of their constructed framings as subjective narratives, computer history displays are often constructed to reflect deeply entrenched notions of the power, knowledge, politics and the capitalistic drive that are entwined with contemporary sentiments of technological progress. Museums such as these are designed to appeal to diverse stakeholders including tourists and benefactors, educators, researchers, and other community interest groups who seek to engage with (or to consume) computer history. Consequently, these displays perform more as celebratory tomes to a narrow view on innovation and effectively mute nuanced dimensions of the history of computer design, material culture, laboratory politics, and broader economic influences. Within such crafted tales of innovation, old digital media, objects whose worth is tied to novelty and power, are at odds with their framing as artifacts when they are showcased as non-functional relics. See Figure 7.

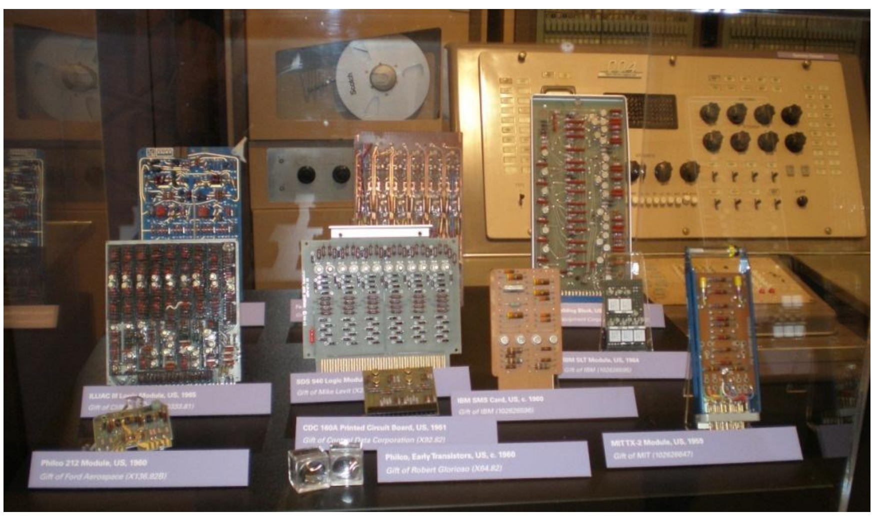

Figure 7: A display of non-functional circuit boards.

Despite the apparent banality of the subject matter, the Computer History Museum presents an unusual paradox of viewing media in an historical context, through the medium of the museum. As Michelle Henning points out, “museum displays parallel the organization and modes of address of modern analog media [in other words], (old media) and new media.” (2006: 304). That is to say, by way of their linear chronological layout and appeal to the eye, museums are old media. The computer history museum offers a juxtaposition of the objects on display in relation to the display itself. As Sharon Macdonald argues, a linear, chronological arrangement of museum space, particularly in the context of a technology exhibit, echoes the values of the cult of science by arranging the exhibit scientifically (Macdonald 1998). This logic rings true at the Computer History Museum where circuitous arrangements of the computer artifacts mirrors the layout of a silicon integrated circuit and the décor is strikingly evocative of a high-tech office in the Valley. See Figure 8.

Figure 8: The author in the office-like décor of the Visible Storage room.

Thus, any researcher may be at odds with the archive and the visual display as both are articulated through the visual rhetoric of computing and within a greater and more problematic narrative of innovation and progress. This makes it difficult for the researcher to ask atypical questions such as: How are computer hardware components, like the IC, expressions of material culture? And, How might one perform a media archaeology of computing if the narrative surrounding computing history is so rooted in local interests? The physical and ontological dimensions of the museum and archives preclude such questions because they cannot fit within the visual and historical rhetoric of the subject matter. To date, most histories of the computer follow a model wherein singular inventors are removed from their deeply rooted cultural underpinnings. They are usually presented as lone geniuses who arrive at new ideas by hazard, in defiance, through competition, or under duress. These histories fail to account for the many nuanced layers of influence that make innovators who they are, or shed light on the cultural parameters that guide practical decisions.

Getting the Backstory on Dematerialization

To supplement my trips to the Computer History Museum and the Smithsonian to explore their archives and oral histories, I sought out a few key history texts so that I might be able to compare the artifacts on display to other historical narratives on the topic. The following subsections explore a few of these texts which provide a conventional backstory to draw from so that I might be able to better understand the historical processes of materiality and dematerialization. There are numerous texts which offer a long-range history of computing but I would like to highlight a few key texts here in order to tease out some of these teleological problems that arise from a conventional computing history. Tom Misa is a leading authority on computing history and in this text he draws a parallel between architectural materials and a civilization's material development at large. In his book, *Leonardo to the Internet: Technology and Culture from the Renaissance to the Present* (2004). He writes,

> The achievement of mass-produced steel, glass, and other ‘modern materials’ around 1900 reshaped the aesthetic experience of working or walling in our cities and living in our homes. These modern materials were the precondition and the artistic inspiration for the modern movement in art and architecture that flourished between 1900 and 1950. (Misa 2004: xiv)

Despite the apparent surface logic of this statement, I would argue that materials are in fact expressions of values, not merely enablers of an artistic movement which might incorporate new technologies. Such a statement assumes that engineering brings forth advancements which, at a later point in time, are taken up as cultural expressions elsewhere in an economy. But perhaps this logic is false. Is it not just as likely that the creation of those materials represents not just a creative act in and of themselves, but that they represent a homogenous and continuous aesthetic and value across engineering *and* artistic planes? And is it possible that the distinction between these planes is moot, or rather, that the distinction serves only to privilege engineering before art and to convince us that synthetic materials befall us and trickle their way down to creative applications after performing more technologically serious roles? There is a prevailing view that technology enables the proliferation of knowledge, ingenuity, and art, as if technology opens a valve through which other forms of progress may flow.

I have presented Misa’s excerpt above because it reflects a generally pervasive tone of causality that spans much of computing history. A similar distortion may be seen in Paul Ceruzzi’s[11] book, *A History of Modern Computing* (2003), which is a major textbook on the

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[11] Paul Ceruzzi is a leading authority on computing history. He has been on the curatorial boards of both the Smithsonian in Washington and the Computer History Museum in California. His involvement in both major museums can be seen in the similarity of their composition.

subject and is regarded as a key resource. Ceruzzi explains that there was a significant shift in computing design with the completion of the first UNIVAC computer in 1951. It was the first computer in which all processes were performed by a single, enclosed machine. What makes this machine unique and of particular interest to my project is that it was the first to conceal its operations, memory, and other process in one metal unit. See Figure 9.

Figure 9: The UNIVAC I, built in 1951. From Vintage Computer Forums (2006).

Ceruzzi speculates that the decision was driven by the US military's needs (the UNIVAC's first customer) at the time which emphasized secrecy and a kind of machinic totality. A UNIVAC is on display today at the Computer History Museum and it is indeed striking for its total concealment of the parts that make it a computer. The UNIVAC also used tape reels to store and retrieve information which made the machine less labour intensive than other machines that used punch cards but the tapes themselves were a precursor to concealing the program and memory. This design preference is still with us today. This concealment, Ceruzzi argues, sets a trend for future computers as well as the perception of computing machines as being significant in their interiors, and their exterior interfaces are designed for operators who may or may not know (or need to know) how it works on the inside. This is still a guiding design practice in computers and other digital devices today, but aesthetically the enclosure and concealment of the "parts that work" is fundamental to the mythical qualities of later digital machines—it reflects and reinforces the overarching belief that computer functions are abstract, immaterial, confounding, and are only to be examined or altered by experts. In Chapter 4 I will return to the design principle of exposure and concealment in the early years of the home computer which follows a similar path wherein early models expose their parts, but over time the computer becomes a closed box. Conceptually, the UNIVAC set the trend for mythologizing and dehumanizing computation. The opaque box encasing the computation both invites users to engage with the machine while still maintaining a distance that is guarded by perplexity. To the uninformed layperson, they are awe inspiring *because* we cannot see how they work.

Comparing the collection of computing machines from Babbage's engine (or even farther back to William Oughtred's seventeenth century slide rule or to the ancient abacus), through the UNIVAC, to today's computing devices like the iPod, iPad, and smart phones, it is hard to miss the significant differences in the machines designed before the IC from those that followed. (See Figure 10).

Figure 10: The G-15 from 1956 *(left)* and the magazine-sized iPad 2, 2012 *(right, show in full and profile views)*. Note the accessibility of the inner parts of the G-15, and the sealed casing of the iPad 2. The iPad 2's tagline was the rather cryptic slogan: "Brilliant from the outside in," which seems peculiar given that the minimization of the iPad's "in."

The IC allowed computers to be smaller, lighter, faster, cheaper, and standardized at many levels of their production and operation. Drawing from his analysis of scientific paradigms and techniques, Thomas Kuhn (1970) might argue that these values (speed, lower cost, reduced size) become validated only *after* the IC makes them possible. Speed, cost, and size become the drivers and qualifiers of the ideal device within the paradigm of progressive computing. Today, we see the IC as having catapulted computing toward miniaturization and hence, dematerialization, a principle crystalized in "Moore's Law" [12]. This law, Ceruzzi suggests, is the

[12] Moore's Law posits that the capacity of integrated circuits doubles every eighteen months, while the price of the chip halves in the same period of time. Gordon Moore never intended his statement to be a fixed law or theory of computing technology and its progress in the twentieth century. Rather, it was a speculative prediction made in 1965 about the coming decade in computer engineering. This "Law" has historically been overstated, misused, and misrepresented as prophetic and *de facto*, and put on part with Newton's Laws of physics as representing a natural law. However, Moore's Law has been the foundation of many design proposals, marketing campaigns, price structures, and the general drive for newer, better, smaller designs making the Law seem prophetic when in fact, it is

true driving force of history for engineers, in that is it frames the evolving phases of computing as if they were ripening fruit dropping from a tree (Ceruzzi 2003: 7). It is often the case that computer engineers look to technological advancements, particularly in the form of materials and technological improvements as the catalysts for future innovations; however, as Ceruzzi argues, the advancement of technology is indeed an assemblage of human creativity, problem solving, responsiveness to stakeholders, and other, less tangible, social conditions. This reflects McLuhan's assessment of the rise of print culture in that the press is really a result of a constellation of pre-existing conditions that are channelled through technological developments, of which only one was the invention of the Gutenberg press (McLuhan 2000). That said, the improved quality and density of the IC over time does allow for broader applications and more computing power, but the selection, impacts, and outcomes of choosing silicon as the material basis for modern computing is understated in the histories of computing. This choice, often framed as an engineering decision, could be productively reframed as a conscientious selection of a medium, rather than as a mere computing substrate. In fact, the material basis of computing, if we may momentarily reduce it to *silicon cum medium*, is overshadowed by other pre-existing constellations of social, economic, and cultural conditions such as the Cold War which created the conditions of technological advancement. The after effects of the technological

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a fair example of a self-fulfilling prophecy (Sterne 2007). It has also played a role in the expedited obsolescence and perceived disposability of computers. In other words, this grossly misused Law has become the motto and justification of the detrimental (i.e., wasteful and self-limiting) drive to place novelty and power as the hallmarks of innovation. This is expanded on in Chapter 3.

developments thus mute the material dimensions of IC development, erasing materiality from the constellation altogether.

Rebels with(out) a cause

There are countless memoires, biographies, and histories of the invention and rise of the computer. Some focus on the technologies as their point of departure, others trace the pathways of the inventors and laboratories that incubated the technologies. The stories are varied in their nuances, but they depart little from a conventional construction of actors, events, and themes. There is insufficient room here to survey the wide selection of sources that offer a retelling of computer history, but it is worth extracting a few recurring tropes in order to see how the history is typically entangled with particularly American themes which bar alternative views from a greater global project of computer history. T.R. Reid's (2001) book, *The Chip: How Two Americans Invented the Microchip and Launched a Revolution* presents a particularly typical view on the invention of the chip and its impact. As the title suggests, the book focuses on the lone genius inventor(s) Robert Noyce and Jack Kilby who, as the title of the book emphasizes, are *American* men who embody American ingenuity[13]. The title also implies that these two men "launched a revolution" which is a very large claim to attribute to two people who entered a functionally adequate computing industry (proportionate to demand), even if it lacked the IC that would propel the technology past its technological roadblocks of the day. Some significant features of the inventors' personal histories are omitted or bypassed. For example, it seems to go

[13] Wikipedia, for example, offers a Soviet-centered history of the invention of computers as a parallel and valid alternative view.

without mention that Noyce and Kilby were white, middle-American men. The "humble" origins from agricultural pockets of twentieth-century America belies the privilege that such origins indeed offered. The doors of opportunity were significantly more open to them then say women (whose mere presence in the process is already dismissed summarily as a sign of arcane and costly labour), minorities, immigrants, etc. An American heroic tale (especially one of self-made millionaires) requires a humble start in a modest home, in a unmemorable Midwestern town nestled in the corn fields of Protestant sensibility and practicality.[14]

What strikes one as markedly absent from the biography is how profoundly those origins indeed impacted any inventor, but the overarching themes in both the history books and within museums settings is that invention and opportunity are open fields from which lone geniuses rise and revolutionize the world. Just as the western frontier was framed as rugged terrain for brave cowboys claiming the west from the grips of lawless savagery, so must computer history be dressed as a tale of geek-heroes who fought ignorance and liberated us from the "tyranny of numbers." Here, as in other history texts (e.g., Ceruzzi 2003, Reid 2001), computer history is a framed as a crisis in a need of a hero, yet we are unaware of what that crisis was. In computer history in general, we are far more familiar with the key figures (e.g., Brattain, Bardeen, Noyce, Kilby, Fairchild, Gates, and so forth) than with the problems they were attempting to solve.

[14] The link between Protestantism and efficient, logical instruments is an recurring theme in the history of computation. For example, Robert Noyce's father was a reverend in the United Church. There is a strong link between the Protestant preference for silent, individual engagement with texts and mid-twentieth century computer design processes. Chapter 2 abstracts the story of the Protestant Huguenot, Peter Ramus who has recently re-emerged as a significant figure in computing history. His axiomatic visual learning aids present an early form of computational logic.

Unlike most historical tales which begin with a crisis and end with a hero's brave and radical solution to that crisis, the tale of computers begins with the men whose heroism is validated by the success of their invention and its ability to overcome a "crisis" that had been experience by very few people. Thus, computer artifacts on display in the twenty-first century must be sold to the museum goer using each object's capacity *and* incapacity to meet or fail to meet technological demands of the object's day. This then creates a narrative fixed to the notion of progress and improvement towards the present, a linear continuum which excludes other means of evaluating the object as a cultural artifact. Progress, as it is presented in a computing history museum, is framed as an acquisition of computing power rather than say, as a history of media development, material culture development, a tale of economic growth from a local phenomenon in the valley to a global scale.

Computing revolution(?)

There are two kinds of revolution. The first is a true revolt against a present and obvious source of discomfort or discontent. The American and French Revolutions of the eighteenth century were revolts against oppressive regimes but what are we to make of technological "revolutions" in history that have no tyrant other than economic inefficiency? The Industrial Revolution and the Digital Revolution lack a clear tyrant; however, this gap is filled in the future when students of history are guided to see that inventions corrected impediments that may have been mildly inconvenient before the revolution, yet cripplingly irritating afterwards. Returning to the Babbage Difference Engine, we see a machine that would have solved some very specific problems of calculation at the time it was developed, but it is only in hindsight that the engine becomes a "hero" ahead of its time which then creates future problems that it can solve. In the case of computing materials, the tyranny of numbers is a product of the US military's demand for light, small, reliable, and cheap computers to install in military aircraft where size and weight were critical factors. Beneath the cloak of revolutionary innovation lies an untold tale of our complicated and symbolic relationship with material things as expressive of broader overarching values such as power, capital, efficiency, competition, and dematerialization.

Kuhn (1970), a critic of the history of science, suggests that revolutions tend to become invisible over time as they take on a deceptive cloak of a natural progression of ideas that is not prophetic but proverbial. The naturalization of the invention of the IC reveals that the narrative of computer history is skewed in such a way as to present this innovation as a natural, logical, and rather implicit part of the evolution of digital technologies—as if the materials were lying dormant, awaiting revival by a discoverer. This, of course, is not the case. Economic needs, technological restrictions, competitive interests and the spirit of innovation did not conspire to bring silicon forth as the natural contender for the next universal hardware component yet this is how history is written and thus it shapes how the past and present states of technology are perceived. But in a new emerging field, such as computing technology in the mid-twentieth century, a preoccupation with "firsts" leaves little room for critical or historical assessment of events as they unfold. This reflects what Kuhn called a "preparadigmatic" field in which a new field is following an open path without clear end goals or best practices, nor a sense of which events are historically significant until time reveals the winners of the race (Mahoney & Haigh 2011; Kuhn 1970). We would like to believe that great innovations are a response to external forces or to the internal insight of the visionary genius. As Kuhn has argued within the context of the history of science, such narratives allow us here in the present to feel that all previous innovations were made to enable a forward flow of progress, where challenges are conquered and rendered as the wretched inconveniences of the technologically crude past. He called this "Whiggish" thinking, where history is written through the value judgments of the present and not with the views, values, or knowledge of the past in mind. Actors in the past, he argued, could not see the value of their work through a telescope with a view to the future; rather, the future looked more like a kaleidoscope[15]. It is through the selective hindsight of the historian that a linear path of progress may be drawn. Ultimately, this construction of forward-marching progress allows us to feel grateful to be here in the now and not in the cumbersome, technologically undeveloped past. No place is this illustrated better than at the Computer History Museum, where the obsolete machines of the cumbersome days of yore are cast with pathos. See Figure 11.

Figure 11: Screenshot of the Kitchen Computer, from the Computer History Museum online gallery.

[15] Kuhn relayed this aphorism to his student and future filmmaker Errol Morris, who was then a graduate student in physics at Princeton. The conversation between the two men ended with Kuhn throwing an ashtray at Morris. Kuhn was frustrated that Morris failed to see the ways in which the history of science was coloured by the present. (See Morris 2011).

Women, Moths, and other Tyrants in Computing History

If technological progress and invention can solve a society's crisis, computer history then needs its own crisis to validate the trope of the revolutionary turn in computing. Not surprisingly, this crisis could refer to the role of women as they were perceived contemporarily and within conventional computing history. As feminist historian Jennifer Light (1999) has shown in her own examination of women's role in early computing, that women programmers (called operators) played a significant role in computing design. For example, Light explains that the ENIAC, which helped to end World War II by calculating ballistic data, was programmed, tested, and operated by a team of women (Light 1999). They were called the "ENIAC girls." However, the purpose of the ENIAC was to eliminate these same women and other "sub-professional" clerks who calculated trajectories for the US military and put their arithmetic skills to use to help program the military's secret computer. The ENIAC was successful because it performed the same task, though less reliably, than the women who operated it, albeit faster when it was running properly. The team that designed the ENIAC are the fathers of computing, yet the women who made it an intelligent, thinking machine and kept it running are all but eliminated from the history books (Light 1999).

The role of women in the history of computing is very pertinent to understanding the processes of dematerialization in general. First, the nearly complete erasure of women from computing history insinuates that they held a merely peripheral and supportive role. This erasure supports the myth of the dematerialized computer because it denies the very tactile and intelligent work that women performed. Their omission negates the intensive, hands on labour that went into early machines. Second, their erasure is so complete and imperceptible that their presence is dismissed as an inefficiency. That is, rather than being identified directly as problematic, the role of women is intimately bound up in the rhetoric of the financial burden of unreliable computing. They are not women, they are merely numbers—*undesirable* numbers.

The "tyranny of numbers" is a crisis that is frequently referenced in a number of sources (Reid 2001). The tyrant is a nebulous entity cloaked in economic terms such as prohibitive costs and laborious upkeep in the decade after World War II. Reid explains that during the 1950's, computer engineers were united by a common enemy: that of a roadblock situation in which the progress of computer design and development was slowed by an abundance of everything that was wrong with the vacuum tube computers of the day (Reid 2001). There were too many vacuum tubes which resulted in inefficiencies such as too many women's hands fixing broken tubes and too much time, heat, "bugs"[16] and bulk. Accountants, it seemed, were pulling their hair out over a failure to make tyrannical numbers "work"—computers were too expensive, too big, too fragile, needed too many components, and were too laborious to take a specialized industry to mass production. In addition to meeting industrial values of efficiency and economy, the military made its own demands on computing innovation—small size, lightweight, faster than the enemy's technology, and heat resistant—to augment the design of long range ballistic missiles (Ceruzzi 2003). It would seem that computing pioneers Noyce and Kilby were needed to defeat the tyrants. The solution was the monolithic engineering used in transistor technologies

[16] A euphemism for bad code today, but insects were once a real problem. Moths were attracted to the illuminated tubes and would regularly fly into the machines wreaking havoc. Female technicians were generally charged with the task of removing the dead moths and repairing the tubes and other damaged components. It was tedious, repetitive work.

that had been invented in 1947 by Bell Labs' researchers Walter Brattain, William Shockley, and John Bardeen (Reid 2001). At that time, various were parts made from different materials and were soldered together into complex circuitry. These complex circuits meant that if a single component was not attached correctly, the entire circuit could fail. Repairing broken components, solving design and programming flaws, and removing bugs were "women's work" and indicated an inefficiency in the workflow. This led design teams to seek out better design and better materials. The solution was the integrated circuit.

Engineers Kilby and Noyce solved this problem at roughly the same time while working in separate labs drawing from the success of the solid state transistor which had already made significant inroads in other industries (in one technical report, it is referred to as the "Fabulous Midget" [Reid, 2001]). With some modifications the transistor could be transformed into a semi-conductor, which means it could be manipulated to behave as a gate rather than a channel for electrons, thus allowing for binary operations (See Appendix A for more information on the benefits of solid state computing materials). The development of their silicon based integrated circuits (IC) meant that components could be connected through metal circuits printed directly on the wafer or "chip." This solved many problems at once: it reduced the size of the hardware, it eliminated the vast array of vacuum tubes, wires and other parts, it generated less heat, was less fragile and brittle, performed significantly faster than tubes, attracted no moths, required no female hands to solder or mend the parts, it was quiet, and most importantly of all, it was cheap to manufacture, run, and repair—partly because of the absence of moths and women. Pioneering computer engineer Gordon Bell is said to have commented that new machines like his IC-based

PDP-8 eliminated "a whole floor full of little ladies wiring computers" [17] (Bell in Ceruzzi 2003: 180). But it is unclear whether the employment of "little ladies" was problematic before the design improvement; or, if the ladies were identified as a problem only after their elimination became possible. During the war, women were hired to perform complex computing and programming tasks to fill positions while their male counterparts enlisted in military service. Their role was essential to both the war and computing innovation in general yet their jobs were deemed feminine, clerical, tedious, and interchangeable. Senior designers worked on hardware design which was deemed to be masculine and therefore exclusive. The women, however, were seen not as essential, but as a costly support brace for underperforming hardware. An improvement in hardware could lead to practical efficiencies in operations and programming and those practical inefficiencies were represented by the inclusion of women. On that point, Noyce remarked that before the IC, a "large segment of the technical community was on the lookout for a solution of the problem because it was clear that a ready market awaited the successful inventor." (Noyce as cited by Ceruzzi 2003: 180). It is not clear to which "problem" he is referring, other than, at least as Ceruzzi frames it, a room full of female labourers engaging in tedious handiwork was a problem for only for the senior engineers who might view such a

[17] While there is no room here to address the misogynist tone of Bell's remark, it speaks to a general attitude about high-tech processes and products that were generally kept out of the hands of women and associated with women's work or be deemed 'simple' enough for a woman to fix (except in the rare cases where women proved to be cheaper and more reliable workers than young boys, as was the case with switchboard operators). Generally speaking, since Jacques de Vaucanson's (Riskin 2004) eighteenth century automata, machines preserve their confounding aura better in the absence of humans. Human operators, particularly female operators, historically have been seen to degrade the perceived sophistication of machines (and, ironically, degrade the women who make, repair, and use them).

workflow as unduly feminized and seemingly "low-tech" in a high-tech environment. As Kuhn suggests, such "problems" become objectified *after* the course of innovation (framed as Progress) is assembled into a linear tale of continuous improvement. Eliminating women from the workflow is then one of many steps toward the dematerialization of computing.

As Kuhn notes, one of the shortcomings of the history of science and technology is that today's values become superimposed onto yesterday's problems (Kuhn 1970). That said, today we see a computer's bulk and speed as its main sources of drag in the race toward progress because we privilege small, fast, cheap, and reliable digital devices. Similarly, the "problems" that innovations were reputed to have solved may not have been perceived as problems at the time that they were experienced. Thus, Ceruzzi's historical narrative is coloured very much by our modern sensibilities of how the history of computers should be presented; for example, the inclusion of Bell's comment is offered because it stands in opposition to how we wish to see computers today. The historical portrait of a room full of "little ladies" laboriously rewiring broken parts is antithetical to computing as a practice and this is precisely why it is noted at all. This tale seeks to impress the modern reader through the inclusion of women and their intensive handiwork into the fabric of our conception of computing *because* this historical image stands in *opposition* to our contemporary dematerialized image of the perfect computer made by mostly by machines in a sterile lab.[18] It may indeed be useful and informative for the reader of such

[18] Computer manufacturing still involves a great deal of human—often female—labour, particularly in manufacturing facilities in developing nations. In fact, a feminization of the manufacturing processes is well suited to modern scientific management principles since female labour still produces lower cost goods with higher profit margins, particularly in a climate in which equal wages remain elusive. In Bell's time, mass production of computing products was not yet on the horizon. Had he been an astute economist, he might have identified female

computer history texts to learn about women's roles and their unacknowledged labour in the evolution of computers but the construction of the narrative is problematic in that the women's presence represents a tyranny of inefficiencies. Ultimately, by eliminating the women's tactile role in computing (both in practice and in the history books), computing is further dematerialized as it is removed from the material culture sphere of hands-on *manu*-facture. In other words, when female handiwork is eliminated from the workflow because it is a reminder of the thingness of computing, computers may then be set free to orbit as non-material entities.

As Kuhn (1970) explains, histories and philosophies of science are crippled by the textbooks that record and distort the value and contributions of revolutionary moments in scientific and technological practice. Books such as Ceruzzi's fall into a similar narrative trap wherein the development of an object of science (and in this case, technology) reads like a linear and progressive evolutionary tale with "scattered references to the great heroes of an earlier age" (Kuhn 1970: 138). With the exception of a few comical or idiosyncratic failures, computer history selects a string of past engineers and their inventions as if each new machine was informed by those that preceded it. Sometimes this may be the case, but often it is not. More problematic, however, is that the challenges which led to the innovation are always anchored in the present. As such, the present condition of computers thus dictates which of its forebears were of significance. Kuhn suggests that following each new revolution in science or technology, the entire canon of *a priori* knowledge must be altered to incorporate new information in a way that reconstructs that body of knowledge to seem like a seamless, linear progression. In particular,

labour as a profitable discovery rather than a design impediment, and he might have *encouraged* the inclusion of women in order to set the stage for a future mass production.

“the scientists of earlier ages are implicitly represented as having worked upon the same set of fixed problems and in accordance with the same set of fixed canons that the most recent revolution in scientific theory and method has made seem scientific.” (138). Thus, it is only in retrospect or, in the face of an alternative, that a technological development can be framed as a solution to a conjured problem so that we may see ourselves on an endless upward arc towards technological perfection. As critics of science and technology have noted, the problems that are solved and the solutions that are invented to solve them, when placed in the context of history, become relegated to the kingdom of facts (Latour & Woolgar 1986; Kuhn 1970).

Oral Histories, or When Words Fail

Most of the archives that I examined sought to explore events, key figures, and key moments that had transpired thirty years earlier hence they are generally guided by a conventional narrative of survivors. In other words, those whose inventions were successful and were labelled as “precursors” to the significant technologies of the day (at the time of recording) are preserved in perpetuity in the archive. Those that perhaps were not as successful or important are lost to the past. I had hoped to find many instances of engineers talking about materials but I found very little on the topic. Among boxes and reams of transcripts and hours of recorded conversations about schematics, algorithms, laboratory politics and so forth, an oral history of the development of materials was surprisingly hard to locate. In the few transcripts that do make mention of materials, the details are limited and unrevealing. As most archives were in the form of semi-structured, guided interviews, the interviewers often limit the richness of the dialogue by asking closed-ended questions informed by the present; for example, many ask the interviewee to discuss a defining moment in their career, yet the identification of which moments were defining is influenced by a sense of the successes of the present. Thus, the history is shaped by the present and if digital materiality has been dematerialized, so too is the history of materials. That is to say that if the material nature of computing has been denied a place in our contemporary dialogues about computing then it earns little space in oral history as well, the processes of dematerialization reach back into the archives to erase and deny materiality in the past, too.

A media archaeology of the digital also proved difficult in terms of the quality of the interview transcripts, particularly at the Lemelson Center in Washington DC. I discovered that computer scientists tend to be poor communicators, perhaps with the exception of Norbert Wiener. Major figures, like John von Neumann, often offered only one word answers, rendering the interview to be about the questions and not the responses. In one particular transcript, we can hear the interviewer's extensive and pained efforts to get von Neumann to open up and offer richer, more descriptive responses to no avail. It also appeared that many of the interviewers (many were not archivists) often guided the respondent toward favourable responses, or, in some cases, aggravated the interviewee to the point of producing a transcript that is not only scant, but makes the reader uncomfortable to read as we see the respondent become increasingly irritated. Despite the noble intentions of the oral archives, they were difficult to work with and were not illuminating thus I could not use them as a productive source in this research and I could not produce a discourse analysis of materials development as I had hoped. These archives perhaps serve better as a window into the discourse of scientists than into the birth and development of computing materials. It is for these reasons that I found the archives more problematic than helpful, but the problems I encountered allowed me to gain increased critical distance from the practices of preserving and/or crafting this history.

An ephemeral note on ephemera: A digression into debauchery

As a side note, the ephemera collection at the Computer History Museum is a finely preserved archive of material flotsam. The researcher can examine photographs, schematic diagrams, plans, media articles and office papers that range from banal memos to notices of changes in management. One particular piece of ephemera that caught my eye was a memo to workers from November 1954 asking staff to please bring their wives to the upcoming holiday office party, as the previous year's party had degenerated into an evening of drunken debauchery and "gentlemen's" entertainment and that these festivities could not continue in such a manner. While trivial, this bit of social history tells of an industry culture that was both tawdry and raucous when expensive liquor was added to the mix. Nonetheless, after sifting through many dossiers of ephemera, I could not find what mattered most—evidence of dialogue about materials like silicon. While it is clear, given the number of people who dedicate their energy to the museum and the preservation and construction of computer history, the archives are deemed to be a critical community investment. On the one hand, the museum weaves a romantic and heroic tale of computer history in Silicon Valley and paints its surroundings as the epicentre of a major event in recent human history, on the other hand, it is evident that the display and archives also serve to justify the museum's purpose: to validate the objects within it as material embodiments of the culture of the region at large. This is an empire that holds innovation, computation, ingenuity, individual drive and fierce competition at the highest ranks. It is indeed a shrine to American know-how and a capitalistic spirit. Here, Mountain View is painted as a fertile valley of great ideas and great thinkers, not a shark tank of competing giants, or as a corral for randy technologists who behave like sailors on shore leave. The valley which was formerly famous for its pastoral setting and fruit orchards now produces magnificent machines, not weapons or monopolies, or worse—lusty, inebriated nerds. Given that the computer artifacts, ephemera and other preserved materials were donated by firms, former employees and business owners (and their widows), the story has already been shaped before it enters the museum to be preserved. What remains, then, after these scraps of history are catalogued, stored and/or displayed, is a project that has already established its importance within our contemporary experience with computers as well as a narrative that ensures Silicon Valley and the firms that are housed there are guaranteed the status of being the epicentre in computing history. It may be impractical and presumptuous to infer that this memo reflects in any way the nature of computing materials, however, it is an indication that the culture of Silicon Valley in the mid-twentieth century, while progressive in some ways, very much reflected what we now think of as the archetypal egghead incubator: a male-dominated terrain wherein genius is rewarded yet social boundaries and interpersonal exchanges occur mostly in the context of reward (in this case, a bawdy holiday party) exposing a social deficit that cannot be overcome by technological prowess. Interestingly, this small bit of ephemera might represent evidence of what is now recognized as a gender shift in computing culture in the 1950's. Where programming was once considered women's work because it was clerical and tedious up until the 1940's, it was in the 1950's programming became masculinized rather suddenly when the task became valued and elite in a somewhat rare reversal of gendered roles. As programming became more prestigious and on the leading edge of innovation, it quickly became a hub of fraternization because ideas were shared and accolades bestowed upon "firsts" and problem solving. The women were squeezed out of this role and to this day women are under-represented in programming. The fraternizing nature of the programming world, as Mahoney and Haight (2011) suggest, "quickly became a hard-drinking boys club… By the 1950's the men appear to have had the field to themselves." (107). Unlike many professions that lose prestige as women are gradually included, programming gained prestige and the women were pushed or phased out. The holiday office party represents evidence of this masculinization in that it proves that boys' club gatherings were closed-door affairs where self-congratulatory drinking and raucousness both signalled and celebrated the absence of women. Second, we can ascertain that these social events served as vehicles for trade partnerships, the sharing of ideas, and the organic growth and success of the field from its inner social enclaves and informal fraternities. Wives are invited so that morality might be kept in check, but there is no evidence that female employees were invited—to do that might risk bursting the boys' club bubble of boundless innovation and prestige.

Understandably, archivists attempt to save everything so as to not dispose of something that might be of significance in some way, at some future point in time. Thus, no matter how trivial or banal the artifact, its presence here as an archived object asserts that it occupies a *meaningful* place in this linear narrative of remarkable progress. And this is the problem with archives—they necessitate a judgment, on the part of the archivist, to anoint significance as a safeguard against future obscurity. These scraps of office ephemera become objects of importance because they are preserved, not because they preserve. As Latour argues (2005), things are transformed to take on the status of objects when they are imbued with meaning—particularly when that meaning is plastic, contestable, or lends power. As archives, these bits of banality take on the meaning of isolated puzzle pieces leaving the whole of that puzzle unknowable and hence, desirable by virtue of its incompleteness. In this way, these archives may be tantalizing but infuriating in their construction.

The microcosm of the laboratory

Latour has extensively researched the dynamics of laboratory practices from an anthropological view (Latour 1999, 1987), exploring a terrain that was once thought to be as free of contaminants as it is of social values. Latour brings to light what many social scientists have argued for decades, that scientific practices are never free from the complex social rules and hierarchies that prevail outside the lab. Indeed, Latour argues (1999), that laboratories tend to exacerbate social inequalities and arbitrary rules because they are falsely deemed to be outside of such conventions. Latour dissects the lab to take an inventor of the actors, networks, and even the spatial dynamics to prove that laboratory politics are often arbitrary social practices influence everything that occurs within, from the parking lot to the Petrie dish. The laboratories of Silicon Valley are no exception. Little thought has been given to the dynamics of the labs that produced the silicon integrated circuits that have now become the ubiquitous and banal components of almost every digital device. Histories, like the oral computer histories that are currently available, do not penetrate into the social and invisible dynamics that governed laboratory life in Silicon Valley as if it is an irrelevant or worse, a sacrilege, to do so but this is an investigation that needs attention. Because the computer history star players, like von Neumann, Shockley, and even Wiener were not generally asked about non-technologically related questions during the interviews that now form the body of computer oral history archives, a certain degree of inference is required to ascertain the subtexts that comprise the complex dynamics that likely had a significant influence on their patents and end products. Thus the interviews tend to probe computer history related questions in very limited ways, often assuming a conventional model of an individual who has (by chance or by trial and error and, occasionally, by ingenious insight) stumbled upon a material solution to a computational problem. Kuhn has criticized this conception of scientific discovery extensively because innovation rarely is the result of a lone actor acting in a sealed space, free from social, political, financial or other influences, yet the oral histories and museum displays adhere to this model, likely because it guides a singular interview or display piece toward the elucidation of a singular technological event. There are many factors at work behind this construction of oral history but primarily, it seems that such a paradigm, to borrow Kuhn's term, appeals to both conventional technologists including those who are being interviewed, those who seek "factual," but likely uncritical, historical perspectives, and the archivists and their apparatuses. It is more legitimizing and hence more appealing to all parties and participants in the oral history of computers to frame the actors as singular entities working in uninfluenced conditions, arriving at singular (and teleological) discoveries and inventions. That said, everyone has a stake in reinforcing the notion of the inventive, isolated, and immoveable inventor and his (or rarely, *her*) fruits of the mind. This makes critical investigations into the social and cultural influences behind computer design, particularly in the mid-twentieth century, difficult—one must work against several paradigmatic impediments at once in order to assess the impact of influences that originate outside the laboratory.

Emotional machines

By the end of the twentieth century, the number of computer history exhibits increased and collections as these "new" media objects are resurrected as historical objects. While these exhibits paint various narratives of the technical and even socio-economic histories, their significance as communicative material artifacts is somewhat overlooked, primarily, as this thesis proposes, because of the intangible nature of digital media whose material manifestations keep their operative secrets concealed in a garb of confounding yet banal hardware.

The computer museum, then, is in a conflicted state with its artifacts *a priori*. The framing of computers as relics exposes their potential to be old and insufficient, serving to generate gratitude for today's smaller-faster-smarter devices and to evoke pity for the technological impediments of bygone days. It is difficult, if not impossible, for a computer museum to effectively communicate the novelty or achievements that obsolesced machines may represent to generations too young to remember a life before home computers and the Internet. Hence, these machines cannot reveal their functions, logic, or appeal as these are encased within an opaque metal shell and their value as material artifacts of human creativity lay dormant. See Figure 12.

Figure 12: A computer workstation displaying its sterile interfaces but little else.

Their silent presence further drives the processes of dematerialization. Since the artifacts cannot speak, their story is woven out of contextual matters such as the economic, political, and technological conditions of their day that carry some interest value, further muting the material nature of the machines, which are to appear as instruments of power, not as merely manufactured stuff.

Simon Knell (2007) offers some theories on the contemporary challenges that face modern museums. The museum is a product of Enlightenment thinking and was initially conceived to be a place where the masses could learn about history, distant (often colonized) lands, and to discover the superiority of the present place and time in relation to material collections. The museum traditionally provided evidence of progress and ingenuity and were genuinely "collections" of artifacts which supported this argument. In this traditional model, the artifact on display had authority and the interaction between visitor and object was limited to a visual encounter. Sometime in the late twentieth century, museums were called upon to do a lot more for visitors—to entertain and educate, to involve, awe, and expose the fallacy of the more traditional narratives of power, legitimization, and subjugation (Knell 2007: 3). In the age of postmodern museum design, visitors are often offered a variety of dynamic interactions with displays and as such, the artifact may no longer hold a monopoly over the audience's attention. Multi-media interactivity, guided tours, and a process of discovery were—and still are—expected of most museum exhibits today. Knell describes this late twentieth-century shift in exhibition practices as no less bound up in "authoritative and pervasive as the metanarratived modernism which some wished to render dead." (2007: 3). In other words, in our postmodern struggle to make the museum visit an engaging experience, non-judgmental and embracing of subjectivity, museums went too far and clouded an engagement with material artifacts in a hodgepodge of interactive and multi-faceted educational cacophony. Perhaps modes of dynamic engagement overshadowed artifacts in the postmodern exhibit but there has been a resurgence among museums, curators, historians and cultural theorists to bring the artifact back to the fore. Material culture studies has risen again to call importance to the need to support and engagement with *things* in museums and this call is supported by the notion that our contemporary world is characterized by the consumption of things. Knell asks, "So is the museum a cathedral to materialism, the Enlightenment knowledge, to modernity? The buildings and ordered collections that we have inherited speak of such things, but they do so because we can no longer see the makers, only the made." (2007: 3). Because objects are not created to speak for themselves as future museum artifacts, we rely on museum staff to construct a dialogue about and with those objects and like any dialogue, this tale is subjective and edited. But within the challenge of creating a narrative of human history out of objects (as synecdochal referents) we are presented with the reality that ideas inspire the collection of objects rather than the reverse: objects seldom inspire ideas (Carson 1978 as discussed by Knell 2007). That is to say that some objects, particularly the ephemeral and the mundane, are unhistorical until a historian seeks to prove a point and needs those objects to do so (Knell 2007). At the Computer History Museum, we see a living example of a collection in need of an idea that has yet to be proven. While the computers are lined up in chronological order in the display, they speak little about the world that created them, other than the evolution of computing technology as it unfolded to meet changing needs and changing priorities—yet this presentation of "history" begs to be enriched.

It may be fair to say that as consumers of history, we expect our heroic tales to follow a predictable path. This is the nature of the genre and we seek the identifiable markers along the course of historical tales such as the crisis, the heroes, the villains, the saved and the saviours, and so forth. Perhaps there is a sense among history creators that this is key to delivering a digestible and concise history to the consumer that will not rub against any pre-existing values as museums rarely seek to present radical content but rather to clarify, along identifiable lines, a history that will give validation and context to the present (Macdonald 1997). As Ronald Day argues, “The true history of information and communication in the twentieth century may be understood as a series of struggles around the reification and commodification of knowledge.” (Day 2004:76). But how is information reified and commodified? We are accustomed to the notion that information is a currency and we have become uncritical of the terms “the information economy” or the “information age.” We readily accept that information can be concrete (for instance, knowledge about something, for instance, a company’s quarterly sales reports) or abstract (for example, data which can be used to create new information when organized in various configurations, for example, the downloading habits of Kindle users). Day argues that the information age did not begin with the computer but with the Industrial Revolution where material production created capitalistic and modernist competition *for* information (Day 2004). Our current history of the information age supports a largely economic vocabulary and we have come to see information as an immaterial but highly important commodity, as if it is an evolution or dematerialization of the material commodity of the Industrial Revolution. The Computer History Museum then perhaps suffers from this amnesia and the result is a commodified rather than critical engagement with computer history as a history of human communication practices or of material culture practices.

Given the many oral history files stored at the Smithsonian Institute and the neatly lined rows of obsolete machines at these and other computer museums, investigators of computer history are presented with many objects in need of a cohesive narrative that reaches beyond a tale of technical revolution. And here is where there is a gap between the artifacts collected and the history of those artifacts: there is more to the story of computer history than a timeline of technological advances. These machines reveal to us the dreams, priorities, and values of their creators and that is where much of the true historical value lies. Jules Prown argues that an object captures something of the dream of the moment in which it was created. It is then through a study of objects that we may have access "to a culture's dream world" (Prown 1993). The object is a material embodiment of a moment's greatest material (or technical) aspirations and that the codes of design can be unlocked through careful analysis. As material cultural researchers have examined a people's use of birch bark canoes to understand their modes of transport and use of available natural materials, computers and their development are materials that speak to the changing values of our own time, beyond their operative functions but as material artifacts. But the computer history museums and archives that are springing up all over the world appear to have difficulty negotiating the tension between treating the computer as a museum piece when it is rendered as a non-functioning device that has outlasted its original context.

It is puzzling, therefore, that a material culture view is used in the construction of the history of digital objects. We can agree that old computers tell us something about technological challenges and successes of the past, or that they can trace the evolution of the self-perpetuating need for computation, but historians seem to be at odds with embracing computers *materially* and remain fixated in narratives of inventors, military initiatives, computing power, and pioneering feats of engineering—all valid characteristics of computing history, but all immaterial. Why is it so difficult to engage with computers as objects, or *things,* in Bruno Latour's sense of the distinction wherein things become objects when they are embroiled within greater dialogues of contemporary issues at hand (see Latour 1991a, 2005). All material things made by humans are "incorporated into social interaction and provide an embodiment of social structures reflecting back the nature and form of our social world. All objects are social agents in the limited sense that they *extend human action* and *mediate* meanings between humans." (Dant 1999 in Knell 2007: 16). Thus, computers tell us a lot about how computer designers wished to extend their world and to communicate with others; however, as researchers we are often misguided by the notion that computers were initially designed to process data or to communicate with one another. We fail to see computers as a medium with material properties that were very much a product of their time and place. Also, since computers are the quintessential object of a cycle of replacement (obsolescence) and change (innovation), we quickly lose the meanings entrenched the material production of a given moment in time, focusing instead on the technical or performance improvements of each new generation of tools.

What is it about digital machines that sets them apart from other artifacts? We have little trouble visiting a shoe museum where the display of footwear speaks volumes of cultural practices, material production, social dynamics and as demonstrative specimens of style. Why, then, is it that digital artifacts seem to strike a different chord? Why do curators and archivists approach computer related artifacts with a different purpose and conviction? Is there a fear that placing digital media within our broader cultural practices of material consumption will negate the value that props up not only a powerful industry, but our identity as a technologically advanced culture?

The paradox faced by computer history exhibits lies very much in the nature of the rhetoric of technology and its lack of practical, objective framing. The following chapter probes the role of rhetoric and nomenclature of the digital object and seeks to identify the processes of dematerialization at the noemic level of language which make a critical view of digital materials difficult to render.

Chapter Conclusion

In this chapter I explored the Computer History Museum in Mountain View and the Lemelson Center at the Smithsonian in Washington. I approached these museums and archives with the eye of a media archaeologist in search of a history of computing from a material perspective. In Mountain View I found a material culture exhibit at odds with its own material artifacts. There exists an inherent tension in representing computing history through material artifacts in that obsolete and dormant machines cannot perform and hence cannot vouch for their significance. Their unique worth and place in history may be lost to time which necessitates the construction of a narrative which can lend context and weight to individual historical artifacts.

Digital computing has been dematerialized, that is to say, its material basis has been generally erased or reduced from our engagement and understanding of digital technologies. The Computer History Museum, which houses the most comprehensive collection of artifacts, does indeed present a material culture of computing but the imperative to make dead objects speak forces a dematerialized narrative of genius heroes rather than of material creation. Despite the display setting, the material nature of the machines is concealed in silent stasis because computing objects present such difficulty when they can no longer function and vouch for their own worth. Since computing objects cannot speak for themselves, we rely on a complex narrative to bring them to life, yet the rhetoric of the digital serves to further strip these objects of their matter, as will be discussed in the following chapter.

CHAPTER TWO
POEISIS & NOEMA

BIRTH, DEATH, AND DISTORTION

"Humankind is taken for a complex material system; consciousness, for an effect of language; and language for a highly complex material system" — Jean-François Lyotard (1997b: 79)

It is said that to speak of a thing is to bring that thing to life. It is also said that some silences conceal truths that would haunt the world (Emily Dickinson in Martin 2002). Always confounding and partly concealed within a technical vocabulary unfamiliar to most, computing technology has a paradoxical and somewhat corrosive relationship with language. Like many other discursive technologies, computers are difficult objects to speak of, they are *asignifying*, as Guattari (2001) would tell us. Most of us know how to use our computing devices, but to explain how it works or to name its parts would be very challenging for many. "The digital" and all this term constitutes, is an object *for* rhetoric and object *of* rhetoric—a rhetoric that conceals and occludes the materiality of the objects and their thingness. The following chapter explores some of the rhetorical semiotic processes which dematerialize digital objects so that their constellations of material properties, origins, and ecologies are occluded, concealed, and negated. In the previous chapter, I explored how digital objects and their "thingness" become problematic when treated as historical objects because they are at odds with their enframing as immaterial things. As such, historicity reveals their thingness and exposes some of the concomitant processes of dematerialization which resist treatment as material artifacts. In this second chapter, I explore the ways in which language and rhetoric similarly serve to dematerialize the digital object. Specifically, this chapter examines the digital as a medium for language and memory but also as an object of language. In particular, language and rhetoric are key components in the constellation of elements which shape technology and they may distort our material understanding of computing objects. Using thing theory and a semiotic approach (e.g., Baudrillard) I seek to investigate the relationship of the digital "thing" as a product of a mythologizing discourse of dematerialization. In this mythology, the thingness of the digital object is distorted and stripped of its apparent and real materiality in favour of a mythic immateriality. This process is carried out through metaphor, rhetorical distortions, and a gross mismatch between the signifier (for instance, material computing) and signified (a belief that the digital medium is immaterial).

In the following pages I explore theories concerning the relationship between rhetoric, materiality, and technology through the ideas put forth by such thinkers as Plato, Heidegger, Ong, Baudrillard and others. Much has been written about the metaphors which have provided signifying stand-ins to help computer users navigate through graphical interfaces through the use of metaphor and metonyms (Gozzi 2010; Lawler 1999)[19] but these same metaphors dematerialize the concrete boundaries of digital technologies. This chapter reflects on the

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[19] For example, Apple created the "desktop" metaphor for the graphical interface of its home computers so that users could rely on a visually oriented "real world" simile. Icons depicting non-digital objects (folders, trash bins, boxes, trays, and so on) still guide much of our visual navigation. Once designed to foster familiarity within electronic environments, these icons are now often more familiar than their real-world counterparts.

historical relationship between memory, language, rhetoric, and digital objects and suggests a few of the ways in which the processes of dematerialization are evidenced in these relationships. Language and rhetoric, in the context of digital objects, may operate as concealing technologies that hide more than they reveal. Guattari suggests that some technological systems produce “asignifying semiotics” and that rather than elucidating confounding technologies, they instead “foster [and] manipulate figures of expression that work as diagrammatic machines in direct contact with technical-experimental configurations” (2001: 40). As with Latour’s argument that a gross misrepresentation between blueprints for technology and technology-as-encountered (Latour 2007), Guattari suggests that machinic systems like computers (i.e., *autopoietic* systems which generate their own meaning) reproduce a system of signification which is closed and occluded. To use Baudrillard’s (1999) terms, some objects are like quasi-subjects in that they have a destiny, but unlike true subjects they lack desire. This, Baudrillard argues, is what empowers objects but, less facetiously, it is also what enables objects to be filled with mythic status and to be surrounded by mythologizing discourse. Instead of having a function, he argues, it takes on a virtue and it becomes a sign (Baudrillard 2005: 87). The digital object, then, is arguably a sign for immaterial communicative acts, freed from the burden of material substrata.

A Thing for Words

Early computers were designed to compute algorithms and probabilities, but in the mid-1960’s, computer design turned toward using the machines to communicate information between computers—they became the senders, receivers, and interpreters of their own languages. Indeed, today computers, and digital technology as a whole, are designed for communication, with much less emphasis on computation in the broader sphere of adoption and diffusion. In particular, they are writing machines. As Haraway writes, "The silicon chip is a surface for writing; it is etched in molecular scales distributed only by atomic noise, the ultimate interference for nuclear scores. Writing, power, and technology are old partners in Western stories of the origin of civilization, but miniaturization has changed our experience of mechanism." (2001: 30). Silicon is a medium for writing, albeit writing (or encoding) that, on the atomic level, is too minute to see but this invisibility is significant because it conceals the medium's material function. Haraway continues, "The ubiquity and invisibility of cyborgs is precisely why these sunshine belt machines are so deadly. They are as hard to see politically as materially. They are about consciousness—or its simulation."[20] (30).

Digital technology has a conflicted relationship with language: it is at once a carrier of language and also an object *of* language. It is an object whose confounding material properties are concealed by a lexicon of signifiers which broadly distort our perception and treatment of the digital tools we have integrated into our daily life. That is to say that digital technologies are communication media whose purpose is to communicate, yet our own discourse concerning this technology overlooks the fact that digital communication has a real material basis. In other words, the language that we use in discourse about digital technologies distorts and mythologizes the material presence of those technologies. The myths surrounding digital technologies are so powerful that one could argue that the rhetoric of the digital shapes the evolution of the devices.

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[20] Haraway refers to digital machines as made of "sunshine" because they are powered by the exchange of electrons at the atomic level; in contrast to fossil fuels, she points to their declaration of being clean and nearly invisible and seemingly harmless, like sunlight.

This chapter seeks to tease out some of the iterative and complex relationship between digital materials and language and to expose the mythic power that each exerts on the other.

The earliest computers like the EINAC of the mid 1940's were designed to process numerical information as a part of the Second World War effort. The ENIAC and other early computers of this generation were very large, often occupying whole rooms with elaborate cooling systems to keep the machines from overheating. However, reducing the size of the computer became a key driver of innovation during the Cold War era when the US military sought small, portable, and powerful machines that could be incorporated into aircraft and missiles (Lécuyer & Brock 2010). These necessary features—small size, speed, lightweight, inexpensive and powerful—would continue to guide computer design throughout the twentieth century and they remain the "hallmarks" of effective design today. We do not generally think of these characteristics as militaristic or as part of the more recent phenomenon of the "military-industrial-media complex" (Ross 2001). Instead, these traits are immovable qualities associated with all new digital devices as we adopt them. Every new generation must out perform its predecessors on each of these points to be deemed a success. They are the pervasive, qualifying signifieds of digital technologies. But how is it then that these traits, over other equally valid characteristics, determine our sense of the value of the objects? Why is it that each new generation of cell phone, laptop, or other personal digital device must be smaller, faster, more powerful than the one before? Why is it that the reduction of time, space, and effort are the keys to a successful digital product? These traits have formed the basis of an inflexible continuum of evaluation that is modulated only by our own limits of usability and driven by a desire for ubiquity—and ubiquity necessitates invisibility and "non-thingness."

New Media, Old Anxiety

Computing hardware is essentially an external storage tool. Hardware serves to store digital memory, much like a book stores words, or a quipu of knotted string stores familial history. Anthropologists divide human cognitive practices into four major phases: 1) Episodic culture of proto-humans who live “in the moment” but lack collective, cumulative memory; 2) Mimetic culture which can produce symbolic, non-linguistic but communicative acts like imitation; 3) Linguistic or mythic culture; and 4) Theoretic culture which uses external storage devices like writing systems to store memory in symbolic form for later recall (Renfrew 1998; Donald 1991). Theoretic culture marks a significant evolutionary and cognitive step toward complex systems of the treatment, preservation, and handling of knowledge. From a material culture point of view, computational materials and digital memory are the latest developments of this evolutionary turn because they represent an abstraction of real world experiences into a largely visual and symbolic system of encoding for future use. Framed in this way, these four stages of human cognitive development paint a picture of a linear progress toward externalizing knowledge so that it may be shared, extracted, or amended. From cave drawings to Wikipedia, storing information outside of our brains has been a key human behaviour that allows us to extract, sort, build, share, and contest knowledge. In the twentieth century, digital information storage presented an opportunity for knowledge to be externalized further—not only to lessen the burden on our limited cognitive abilities to store and distribute a growing body of information, but also to make information retrieval significantly easier and faster. Digital objects today are now, more than ever, storage devices with some communicative features. While early computers were designed to predict and prognosticate, the von Neumann model and later, RAM disk memory, turned generalized computing toward storage (Kirschenbaum 2008). External memory storage is not just technological desire, it "is also a kind of imaginary, a focalized expression of the collective impulse underpinning everything from the Web's myriad niche cultures… to the global garage sale of eBay…[it is] an infinite storage system." (Kirschenbaum 2008: 5). Historically, we can see a trend wherein as the body of information grows, the desire to retrieve, transmit, and store it grows too. Developments in new technology present an opportunity to rapidly increase the accessibility of information as well as to find new ways of storing old information, but new media forms always present a familiar return of an old anxiety—one which fears disconnection, loss, and an erosion of an authentic relationship between sender and receiver, and between the past and the present. These anxieties are always tied to the *material* nature of a new medium because it is the material that one confronts first.

Consider, for example, John Peters' (1999) exploration of the dialogue between Socrates and Phaedrus in Plato's *Phaedrus* which grapples with a fundamental change in media forms wherein the oral tradition is confronted by a newer trend: the *written* speech[21]. While Plato's dialogue is impregnated with puns and innuendoes pertinent to their day, the core argument remains intact over two millennia and many media revolutions later. As Peters explains, the dialogue between Socrates and the younger, more "sparkling"[22] Phaedrus (who, significantly, has a copy of the orator and logographer Lysias' tucked into his robes, hidden until he withdraws it) provides what remains "astoundingly relevant for understanding [communication in] the age of

[21] Peters uses Alexander Nehamas and Paul Woodruff (trans.), (1995). I have used the same edition here.

[22] That is to say, handsome and alluring.

mechanical reproduction." (Peters 1999: 36). In the *Phaedrus*, Socrates expresses anxiety and scepticism about the written form of language which broadly reflects a contemporary tension concerning the demise of memory to transmit ideas orally. While Phaedrus expounds the benefits of relying on written words (namely, that he can parlay Lysias' speech in the speaker's absence, without making an error or depending on his limited ability to recite), Socrates senses a loss of authenticity in exchange for corporeal presence—a presence which necessitates two intertwined people in a face to face engagement and where love becomes an isomorph for "pure" communication. Writing and recording words (presumably on a light medium such as parchment or papyrus) allowed the speaker (in this case, Lysias) to be separated from his words, and his words could take on a life of their own in both time and space. The evolution of technologically mediated communication, which encompasses all forms of communication beyond the body (i.e., the voice, gestures, eye contact), seek to do just that: to communicate in absentia, and to store our memories outside of ourselves for later recall. From cave drawings to pencils to email, all acts of communication that employ a medium other than the voice separate the communicator from the communication. For Socrates, this was an unnatural amputation. Peters explains, "The dialogue sketches both the dream of direct communication from soul to soul and the nightmare of its breakdown when transposed into new media forms." (1999: 37). Faced with a new media form, Socrates fears the destruction of the integrity of speech and the remote control of the reader in that a speech reader becomes a puppet for the writer. For the ancient Greeks of the oral tradition, this was a corruption of the very purpose of speech as a communication act which *necessitated* face to face contact, as such contact was integral to the act of sharing information since a dialogue could not take place without at least two persons present. While the dialogue between Socrates and Phaedrus is reflective of a major transition in Western culture and it was indeed the waning of the reign of the oral (see Havelock 1963) and the beginning of a sea-change in the relationship between senders and receivers in communication acts beginning around the fifth and fourth centuries BC, it also marks the beginning of the rise of the non-specific individual as the receiver of messages, and the power of content to take on an independent life in the absence of senders (Peters 1999).

A new medium incites anxiety as it destabilizes the power relations inherent in the act of communicating. As Collin Gifford Brooke tells us, "Memory was held by Plato to be one of the chief casualties of a turn to the written word." (2009: 31). Memoria, one of the five canons of classical rhetoric, requires recall so that the orator can both draw from knowledge at large, but also to apply that knowledge in a dialogical exchange in a two-way communicative act. Writing, Plato urged, would "implant forgetfulness in their souls; they will cease to exercise memory because they rely on that which is written, calling things to remembrance no longer from within themselves, by means of external marks" (Brooke 2009: 31 citing Plato's *Phaedrus*: 274c). These "external marks" are letters on the page and are conceived as inauthentic tools for memory recall.[23] Thus memoria was (and always will be) seen as the first casualty of true knowledge

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[23] Plato's notion of the spoken word as pure is generally no longer accepted, as speech is a medium and pure meaning can never be accessed. More popular is the post-structural theories like those presented by Jacques Derrida and his notion of writing as a second-order signifier which carries its own signification because writing is bound up in its own economy of signs. Thus writing is constitutive of meaning and not merely a conveyor of meaning. Lenoir (1998) extends this argument productively to the context of science and technology wherein the instrumentalizing science through practice and writing is similarly bound up in its own economy of signs. This perspective forms the basis of much of the current research which seeks to explore science as a cultural practice, however, other interesting counter points have been offered by scholars such as Hans Ulrich Gumbrecht who see

because it is the most easily replaced by media. Peters reminds us that Walter Ong drew a parallel between Socrates' criticism of the new medium and similar, modern complaints about new media. Peters writes, "Ong …has argued that Socrates' complaints about writing—that it diminishes memory, lacks interaction, disseminates at random, and disembodies speakers and hearers—are similar to late twentieth-century worries about computers as well as fifteenth-century concerns about printing." (Peters 1999: 36 citing Ong 1982). Similarly, Elizabeth Eisenstein points out that alarmist calls against new media forms and for their presumed losses (authenticity, religious purity, cultural degradation, and so forth) are "symptomatic rather than diagnostic" (2005: xiii) and that a fear of the loss of the authenticity and purity of memory—in terms of both memory as knowledge and memory as a shared cultural inheritance—is really a fear of the oblivion created by ever growing sources of knowledge. Socrates had misgivings about the unbridled and unanchored nature of written speech; Peter Ramus, in the sixteenth century, feared and attempted to remedy a lack of knowledge recall in the face of poorly designed textbooks[24]; McLuhan (2000) posited a return to tribalism in the wake of electric media, and new media theorists warned of "disembodiment" and a post-human world in the face of digital media. Such fears perhaps reflect a side or effect of the dematerialization of digital

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Derrida's project as logocentric and perhaps too narrowly post-structuralist in its privileging of "the text" over materiality. See also Bruno Latour's 2007 article, "Can We Get Our Materialism Back, Please?" *Isis* (98):138-142. This is touched on in the Introduction of this dissertation.

[24] Cf Ong (2004) and McLuhan (2000) who note that early textbooks of the fifteenth and sixteenth centuries were designed for the ear not the eye, with an emphasis on aural technique. Ramus identified that the medium was incompatible with its outdated content. On this point, McLuhan declared famously that new media carry the contents of old media until new, medium appropriate content can be designed. See also Bolter and Grusin's (2000) *Remediation*: *Understanding New Media*. (Boston: MIT Press).

media in that the hard media which anchor authentic communication appear to be sublimated into an unstable ether of hypertext, cyberspace, and other dematerialized constructs of digital media. But this prevailing rhetoric is misleading because it paints a picture of communication released from the supposedly stable bonds of paper. As Socrates may have rejected the written speech because the scroll represented inauthenticity, so too may we reject the authenticity of the communicative act parlayed through digital media because it appears to be dematerialized. To Socrates, the scroll is new and impersonal and when first confronted, the new medium appears insincere. Interestingly, that same Athenian scroll might present a rare and authentic object of study today for understanding Greek thought. Authenticity seems to be something that germinates with time, as will be discussed in Chapter 4.

As much as new technologies strive to increase data memory capacity, we perceive this project to be at the expense of "real" memory—a facet of human cognition often (somewhat problematically) equated with intelligence. For example, Sven Birkerts wrote in 1994 that "Changes in information storage and access are bound to impinge on our historical memory." (Birkerts 1994: 129). Further, he laments that the book represents our collective memory as a "growing deposit of sediment." (129). As it were, anxiety about new media forms is perennial and not the result of more recent media innovations. Memory is the victim of this perceived loss, and this notion of memory operates on the individual and collective levels. Yet this framing of the loss of memory and authenticity is problematic. Plato took issue with the relationship between memory and writing in that knowledge retrieved from a written text meant that the source of knowledge was now external, not internal, and therefore less genuine[25]. To Plato, writing represented an artificial relationship between memory and thought and that communicative tools, like Ramus' mnemonic learning aids, are inauthentic shortcuts to real memory and thought (Ulmer 1985)[26]. Plato is concerned that writing, much like digital memory storage today, would provide a mere prosthetic that memorializes knowledge rather than supports real memory and indeed, true memory would decay (hypomnesia) in the wake of new media developments. From this vantage point, Plato's worries have materialized, yet scholarship makes many assumptions about the capacities and "purity" of the pre- or non-literate person's memory (Brooke 2009) and there may be some degree of overstatement about the integrity of that memory which serves to privilege older media forms. For example, a lament that children no longer read and have little cultural memory may in fact be the literate person's method for privileging the book and securing their own worth in a system that still values and legitimizes the printed form over the electronic. Nonetheless, it is unfair to target the modern, waning memory as insufficient compared to the memories of the ancients simply because there is far more information in circulation today than ever, certainly too much information for any one mind to retain. Indeed, it is widely accepted that our modern brains are physiologically identical at birth to our Stone Age ancestors. These perennial arguments about memory loss might be countered by arguments about innovations in communication technologies: we created mediated

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[25] See Gregory Ulmer's (1985) discussion on the topic in *Applied Grammatology*.(Baltimore: Johns Hopkins University Press). Pp. ix-xvi.

[26] Ulmer is drawing from Derrida's essay, "Plato's Pharmacy." See Jacques Derrida's (1981) "Dissemination," (Trans. Barbara Johnson; Chicago: University of Chicago Press).

communication (writing, digital, electric, and *even* the supposedly pure speech act) in order to overcome cognitive shortcomings that were always already present. Simply put, our intellectual limits in terms of memory are the impetus behind the application of materials to do a great deal of the information storage for us. In the wake of new media innovation there is no loss, there is only compensation. As Michael Heim (2001) argues, Plato's conception of knowledge (mediated by memory), is only a small step away from our contemporary construction of cyberspace[27] and its web of knowledge access. Despite over two millennia of media innovations, Heim points out, that "Underneath, though, runs an ontological continuity connecting the Platonic knowledge of ideal forms to the information systems of the [digital] matrix. Both approaches to cognition first extend and then renounce the physical embodiment of knowledge." (2001: 73). Yet, the digital is not just a new form of Platonic knowledge. As Heim argues, the computer "recycles ancient Platonism by injecting the ideal content of cognition with empirical specifics." (74). This project employs mathematical forms on a digital mold to attain a kind of perfect knowledge sphere, much like what the Platonists sought to achieve through dialogues. Timothy Lenoir takes this point further. He suggests that media, particularly digital media, do not merely extend access of knowledge and that a study of the materiality of media as inscription devices, like computers, "actually constitute the signifying scene" (Lenoir 1998: 12). Unlike McLuhan's aphorism that the medium is the message (McLuhan & Zingrone 1995), which

[27] "Cyberspace" is a term generally avoided in this thesis for its distortion of the material nature of the Internet, but Heim (2001) uses the word to describe the pool of information hosted on the Internet. William Gibson coined the term in the 1984 sci-fi novel, *Neuromancer* (Ace Books). It is distorting and mythic because it insinuates a collective "space," accessible only through digital media, a space parallel to the "real." It connotes an alternate universe that operates on a different dimensional plane.

encourages one to still focus on the message because it is constitutive of—and therefore concealed or indistinguishable from—the medium, Lenoir's claim is more comprehensive. It brings together not just the communicative act and its carrier rather it acknowledges the entirety of the project that brought the medium into its present communicative state. For digital media, the signifying scene encompasses not just text on screen, for example, but the whole of the process of digitizing information and the greater project to digitize information for electronic access, and the complex economy of signs embedded into the acts of encoding, retrieving, disseminating, networking, linking, and so forth are all constitutive of the digital medium because it is only through the digital that we believe we can overcome the material barriers that make these processes difficult. Therefore, to dematerialize digital media is part of the project to overcome the limits of material boundaries, but in truth, these processes are not dematerialized at all. For example, Wikipedia appears to be a free-floating external knowledge source, always at the ready. In reality, Wikipedia entries are stored on servers, on hard computing materials, in Tampa and Amsterdam (Wikipedia.org 2012). To see these concrete sources disrupts the mythic qualities of the wiki project. Rather than ethereal information, unbound and immaterial, we can see that knowledge is stored concretely, externally, and materially; but the concealing and confounding image of black box servers is unsatisfying when compared to the folkloric myth of the cloud-like metaphor of the shared and impermanent encyclopedia. See Figure 13.

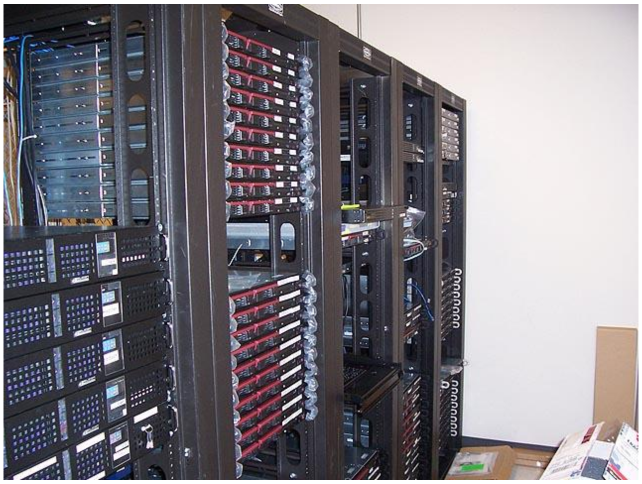

Figure 13: The Wikipedia server in Tampa. (from Wikipedia.org 2012).

Lakoff and Johnson (2003) suggest that some metaphors operate through metaphorical systematicity, which allows us to comprehend one aspect of a complex concept using the terms of another concept. This process tends to highlight the concept that is transferred into the metaphor while actively hiding other aspects of a concept, or concealing them. For example, the metaphor of wireless connectivity highlights the lack of wires, while hiding all other material aspects of connectivity, such as the routers, receivers, and so forth. These metaphors can be productive at simplifying complex computing but they can also serve to profoundly distort one's understanding of systems at large. This distortion, however, carries a great deal of perceived value when certain aspects of computing are routinely highlighted; in particular, those that frame immateriality such as wirelessness or instantaneity, and others such as the requisite material components that must support the illusion of immaterialty, are hidden. And why do computers require so many metaphors at all? Lakoff and Johnson explain that "Metaphor pervades our normal conceptual system." (2003: 115). That is, it shapes our concrete thinking about abstract or complex systems and objects in our daily lives. Metaphors then serve to simplify and universalize our sense of these complex objects, but the pervasive simplifications and distortions that become figures of speech and rhetorical tropes, such as immateriality, can stand for truths rather than abstractions. In particular, new entities such as computers that do not have centuries of metaphors attached to them, are quickly colonized by new metaphors so that their complexity can be approached by everyday speakers. These metaphors of the new tend to employ language that highlights, downplays, or hides their object (Lakoff & Johnson 2003).

Consider the following realignment of the generalized apprehension about new media: while we worry that each new media form distances and abstracts the senders and receivers of information and that it is ultimately our social and intellectual capacities that suffer when new media successfully lessen the necessity of "presence" in any communicative act, consider that these are not impediments to communication, but are indeed our intention. As Peters explains, Socrates' discomfort with the written word in *Phaedrus* is not just about the change in medium, it is about love and the mutual act of communicating. Peters writes, "The dialogue's sensitivity to the wrinkles in new forms of inscription grows from an appreciation of the potential for distance and gaps between people, even in the supposedly immediate situation of face-to-face interaction." (Peters 1999: 37). It is the gaps that trouble Socrates but it is precisely these gaps that drive innovations in communication techniques and media. While Socrates craves intimacy between sender and receiver, the dialogue intimates that the gaps—namely those in time and space, and whose expansion risk distortion, inauthenticity, and passive or indiscriminate reception—are becoming more problematic in a world that is on the cusp of literacy and is craving more communication (Peters 1999). We seek to lessen the burden of presence in acts of communication (i.e., to allow our communicative content to circulate without the sender's presence) and in the task of memory retention and recall. That is, effective media allow people and ideas to be decoupled from voices and minds—they appear to be dematerialized. Peters argues that, for the Greeks, the written word is symbolic of an erotic but degrading act where the writer penetrates the (degraded) reader in an unequal exchange. The alphabet, the book, the telegraph, the Internet and other media allowed speakers to be absent, but the accessibility of digital technologies permits receivers to externalize the content of communication not only because it is burdensome to memorize information, but because there is simply too much information out there to retain with any degree of mastery. As well, our notion of what constitutes information has expanded to include formal knowledge gained through study and theory, but also now includes vast amounts of mundane, useless information (e.g., celebrity news and online cat memes). Hence the popularity of information sources such as Wikipedia.com which offer access to information and lessen the burden of the cognitive retention of that information. But accessibility to information that is free floating and severed from its senders provokes unease with that information's authenticity and earthliness. "Every new medium is a machine for the production of ghosts," writes Peters (139). For many cultures, from ancient Greece to Victorian England, remote communication could conjure the spirits. In the digital age, we have repackaged this notion as "virtuality" and we have become remarkably comfortable with the notion of anonymous, seemingly sourceless exchanges of information through the "ether" on our digital devices.

However, despite our chronic anxiety about loss in the context of new media, we fail to recognize that we have been actively developing ways to expand our knowledge and that new media provide new space for knowledge—much in the same way that a storage locker allows one to accumulate more belongings than will fit into one's living space. Newer media allow for more knowledge acquisition simply because our cognitive limits cannot be expanded, hence our project to externalize content has led us to the development of media technologies that support access to knowledge rather than "knowing."

In 1966 McLuhan predicted that the computer's greatest achievement would be that it would allow for "pure discovery":

> The real job of the computer in the future is not going to have anything to do with retrieval. It's going to have to do with pure discovery, because we use our memories for many purposes, mostly unconscious... When you can recall things at a very high speed, they take on a new mythic and structural perception. So the computer... has, in spite of itself... revealed the knowledge of the mythic, pattern, structures, and profiles, all of which are quite excitedly loaded with discovery. (McLuhan & Zingrone 1995: 295)

Yet, we rely on others to produce and share that information, thus it may *feel* like discovery to the individual information seeker, but it is not discovery in the scientific sense of the word. Rather, the computer allows for collective memory sharing of previously discovered information and opinions. We engage with digital information like hunters and gatherers, picking the good bits and passing on the less useful bits. Memory sharing, then, is perhaps less mythic and more primal. Broadly speaking, technological innovation is not driven as much by engineering feats as it is by practical human need, and the success of one technology over another is tied to the suitability of a medium to accommodate this longitudinal Western project to build a greater capacity for knowledge which necessitates an externalization of information and separation of sender and receiver, as both principles transcend time and space barriers.

To summarize, it is human to seek ways of externalizing information simply because we seek to build upon our knowledge resources, but media and the ways we engage with those media present cognitive and material limits. A speech can only be so long before the speaker cannot memorize all of it accurately, a reader can only internalize so much and books can only reveal themselves when they are open and read. Digital media, however, represent a new opportunity to expand both the pool of knowledge and the means to access that knowledge. The consequence of externalizing knowledge digitally, however, is that memory loses its significance and access gains whatever privileges memory loses. Knowledge thus appears to be dematerialized, floating freely in an ether of information. It could also be argued that knowledge, in the digital context, appears to become decoupled from language, where once knowledge and language were somewhat intertwined, to use Socrates' analogy, because knowledge is abstracted to binary code for a variety of multi-sensorial outputs. Further, Socrates' fears about the loss of authenticity remind us that it is the overarching process of depersonalization that sparks anxiety. New media generally seek to diminish direct person to person contact so that information may be retrieved at the receiver's convenience. This marks a kind of dematerialization of information that erases senders from the communication act. Digital media further dematerialize the act of communicating by abstracting multiple forms of content into a universalizing binary code but at the same time, concealing this abstraction process at the atomic level, where these processes cannot be seen.

Peter Ramus: Materializing the visual turn

Walter Ong, like Peters and Plato, engages in a deep exploration of the conflict which arises when a new medium begins to supplant an old medium. Ong (1982) explores a similar moment of friction in the Renaissance when traditional rhetoric, one of the three arts of the medieval educational trivium, comes in conflict with logic—another art of the trivium—and with the printed word. Ong (1982) explores Peter Ramus' experimental pedagogical techniques using the new medium of print and its applications in visual rhetoric. Ong notes that rhetoric and computers have something in common: probabilities. In the Renaissance, the medieval educational system endured an overhaul, particularly as both print and a renewed scientific spirit were changing the landscape of formal education (Ong 2004). Ramus (1515-1572) [28], a French Huguenot and radical reformer of education at the Collège de France, noticed that the new medium of the scholarly textbook was failing to capture and retain the attention of restless schoolboys. These texts were poorly suited to an arcane pedagogy which emphasized oral learning methods in the emerging terrain of print-based informatics. Ramus, eschewing Aristotelian logic and other foundations of medieval education, devised a system of diagrams which he purported could answer any question that could be asked. Using a novel tree diagram format, knowledge seekers could trace the path to enlightenment through a series of yes/no questions to arrive at any answer. Despite the preposterousness of his claims, Ramus' diagrams, in addition to his pictographic and mnemonic cue cards represented a profound discovery—that informatic content could be rearranged to match the medium, and that the new medium of print could be manipulated to arrive at better results. His pupils simply were not effectively learning by the old oral methods, but if he could cater to the eye instead of the ear, he believed he could make education more efficient (Skalink 2002; Ong 1958). Ramus, though not particularly well known, is a key figure in computing history because he is a figure on the cusp of two eras in media: the waning of orality, already in its twilight in the sixteenth century, and the emerging domination of the new, visually-oriented world of books. Rather than responding to this shift

[28] Ramus was decapitated during the three-day St. Bartholomew's Day (August 1572) massacre in France, where Catholic mobs assaulted the Huguenots, particularly those in academic institutions.

with anxiety, like Plato, he adapts his content to suit the new medium of the scholarly textbook. However, rather than leaning on alphabetic text to transfer oral content to the pages of books, he dematerialized the barriers presented by print (i.e., the alphabet) by devising charts, diagrams, and pictographic mnemonics. See Figure 14.

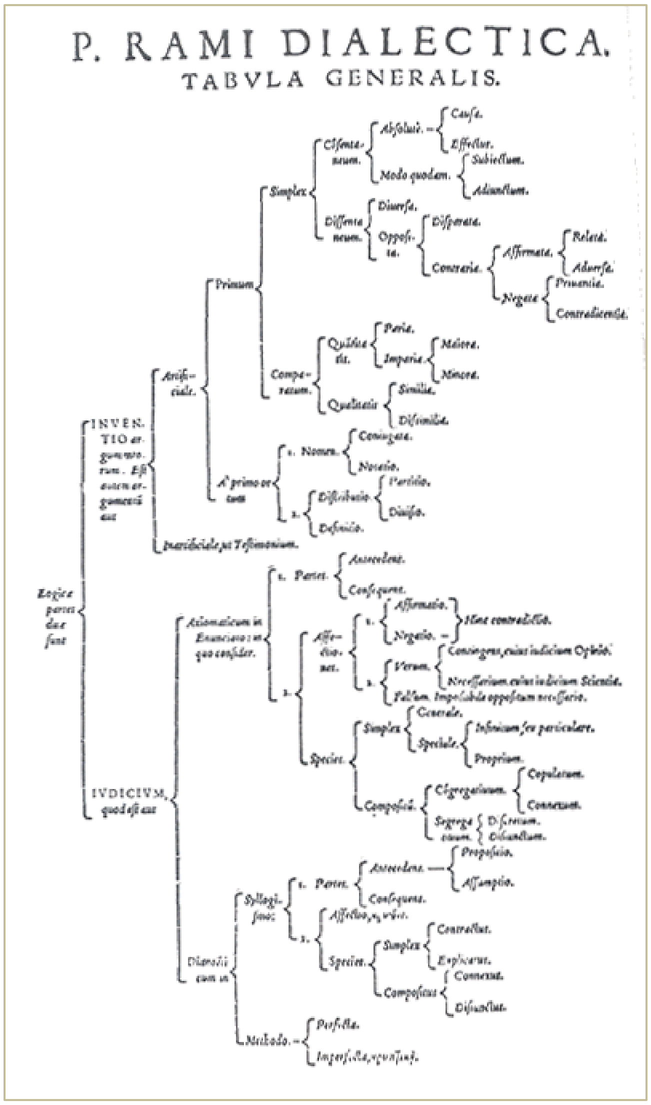

Figure 14: Ramus' Diagrams which portray a series of binary axioms designed to address any question which could be asked. From Ong (1958).

Ramus is worth noting here because his use of axiomatic knowledge trees points to an early recognition that knowledge acquisition, poor human memory, and the preference for the eye over the ear all required an emphasis on access to, rather than retention of, knowledge. For Ramus' pedagogical aids to work, he needed to reduce the materiality of the printed book and faulty memory and therefore his project is an early example of the dematerialization of knowledge. This trend continues in the digital age.

What makes both Ramus and Ong's works pertinent to the present discussion of the dematerialization of digital technology is that the emergence of print in Renaissance pedagogy reflects a similar pattern of knowledge abstraction in the wake of any "new" medium. Ramus' diagrams are reductive in both logical methods and in material form as they attempt to loosen and replace the fixity of alphabetic text in text books with binary abstractions in axiomatic form. Knowledge abstraction is predicated on a system of possibilities rather than certainties. This is reflected in Ramus' diagrams, as it is in computing logic. Possibilities stand against the firmer sense of absolutes required of orality and memory. In his discussion of the tension between rhetoric and logic in *Rhetoric, Romance, and Technology*, Ong suggests that rhetoric differs from logic in that it deals with probabilities rather than the certainties expressed through logic. Yet, despite its focus on probability, rhetoric "drives toward the certainty of formal logic as far as possible."(Ong 1982: 7). He then somewhat cryptically adds: "The computor [*sic*] cannot tell us everything we need to know to make a decision, but it is good to have it tell us all that it feasibly can."(7). He does not mention computers again for the remainder of the book. This subtle nod toward the computer in a book on the history of rhetorical arts stands out as an odd acknowledgement but it represents a point on which he and Norbert Wiener, the "father of cybernetics" meet. Wiener, in his many works on cybernetics and computational logic, reminds us that it is the computer's affinity and suitability to algorithmic probabilities and possibilities that make the machine so convivial to modern life in that it may not provide definitive answers, but rather it offers a technique of *possibilitic* probabilities. Digital theorist Brian Massumi notes, "The medium of the digital is possibility, not virtuality, and not even potential. It doesn't bother approximating potential, as does probability. Digital coding per se is possibilitic to the limit." (2002: 137). And here is where Ramus rhetorical diagrams resurface as forerunners to computing. Possibility and probability are realized through rhetoric and rhetorical methods thus creating a system of knowledge management expressed through (human or algorithmic) language. Computers process language and output probabilities, much as Socrates' speech, Lysias' written words, Ramus' diagrams and mnemonics, and so forth. Lysias' speech which is rolled up and tucked into Phaedrus' robes away from sight, represents two things: the convergence of rhetoric and medium which allows communication to transcend space and time, and the concealment of the medium itself within a garb of novelty and innovation.

Memory loss, medium gain

Some scholars view the perceived progressive decay of memory as a project to actively remove memory, invention and delivery from rhetorical practice and to make them central to dialectical engagement instead (Welch 1999). Welch (1999) identifies this as specifically Ramus' legacy and that during his pedagogical reformation, memory in particular was shifted out of the process of learning and into the domain of the textbook, the new medium of its day. This accusation perhaps overstates the influence of his methods; it may be more accurate to say that Ramus' methods were *reflective* of the rapidly changing needs of his time. Memory had already failed long before Ramus devised his mnemonic learning aids. Welch sees Ramus as a key figure in the general decay of rhetoric as a key method for knowledge acquisition and sharing, to diminishing rhetorical practice as a mere set of delivery tools. Rhetoric is then replaced by dialectic, or a matrix of media and informatic content (i.e., textbooks in Ramus' day or the Internet today) that eliminates the need for memory; or rather, the incorporation of media into the process of knowledge retention and retrieval lessens the need for memory, which often proves to be an unreliable capacity. Other digital theorists point to Leibniz as the turning point in which mathematics and language are united in the greater project to make information sortable empirically, while retaining a linguistic format for access and inquiry (e.g., Heim 2001). Leibniz's works, *De Atre Cominatoria* from 1666 and *Explanation of Binary Arithmetic* from 1703, have led some to identify him as a key figure in logic and binary systems[29]. Leibniz, like Ramus, sought to systematize information. As Heim argues, Leibniz promoted a "group of nodes for an international republic of letters, a universal network for problem solving… a single system that would encompass all the combinations and permutations of human thought." (77). The digital achieves just this—binary coding, or rather, the reduction of all knowledge and experiences—in a single matrix or shared memory bank for recall. The silicon in digital technologies is the is key in this matrix because it is the material that allows for knowledge to be organized in fluid and dynamic ways. New media theories tend to focus on content and engagement but, as this thesis argues, it is the nature of silicon and its affinity to binary processing that makes it a communication medium that follows a longitudinal and overarching project to externalize knowledge; yet this is generally framed in reverse: that silicon allowed for

[29] For this thesis, Ramus is more significant than Leibniz because Ramus attempted to confront issues presented by the material nature of media in the print age, whereas Leibniz is credited for contributions associated with mathematics, logic, and computation.

computation, the Internet, and the “information age.” It was our already present desire as a species to assemble information for recall that has selected and engineered materials that make this project possible.

A Word for Things

The dematerialization of digital objects is a complex process, much of which occurs at an ontic level. As Heidegger argues, technology is not just a matter of instruments and technique. In the modern age, technology is the central way in which we reveal ourselves and engage with our world (Lovitt in Heidegger 1977). When assessing technology, Heidegger sets out to claim that it is a particularly challenging object of study because as it reveals itself to us, “nothing is allowed to appear as it is in itself.” (Lovitt in Heidegger 1977: xxix). Despite technology’s obvious presence in our surroundings, modern technology—and specifically digital technology—does not reveal itself readily to us because of our greater project to utilize technology to mediate every aspect of our life-world. It is only when we feel subjugated to our tools that they reveal themselves as such (Heidegger 1977). As Lovitt writes in his introduction to Heidegger’s key essay, The Question Concerning Technology, “…as is increasingly the case in our time, things are not even regarded as objects, because their only important quality has become their readiness for use.” (xxix). That is to say, our technological objects are ubiquitous perhaps because the act of using an object has become in indistinct act, or as McLuhan famously put forth, they become extensions of ourselves (McLuhan & Zingrone 1995).

Heidegger contends that technology conceals its true essence and that our use of technology reveals nothing of that essence. Further, he grappled with the concept of the metaphor which articulates something which cannot be adequately articulated through regular dialogue (Stellardi

2000). But Heidegger confronts the notion that metaphors often break away from their task of sincere representation, in other words, they can “sabotage the work of representation.” (Stellardi 2000: 144). In particular, metaphors that help us understand the inconceivable in technology may be saboteurs of thought, leaving distorting residues behind rather than clarity. To reveal what technology may really be and to break through distorting metaphors, we need to break down a technology’s causal links between what it is and what it does. He lists the four causes of technology: 1) the *causa materialist* (i.e., the matter which composes it); 2) *causa formalis* (i.e., the form it takes); 3) *causa finalis* (i.e., the end act for the technology, or what it is for); and 4) the *causa efficiens*, the means through which or whom the technology comes into being (Heidegger 1977: 6). It is interesting to note that the fourth, *causa efficiens,* is noted last rather than first. In computing technology we generally think of this “cause” as being the first act which brings a technology to life in that we see the inventor as the first to bring matter to life, but as Heidegger argues for the modern world, the fourth cause is in fact an actor who envisions the three other causes and unites them through a creative act. Heidegger continues with reference to Plato, that the matter out of which a technological object is made (in Greek, *hyle,* or matter which can be made into something else with a purpose) is co-responsible (with *eidos*, or form) for the end product’s ultimate utility. Heidegger points to Plato’s *Symposium* and the notion of *poeisis*, which he interprets as not just a process of making or manufacture, but of bringing-forth (10). He writes, “Bringing-forth brings hither out of concealment forth into unconcealment.” (11). That is, by the four causal elements of making, the craftsperson, through poeisis, brings forth a final object that is the sum of its parts, the act of making and the recognition by others that an object has been rendered as such. This *poeisis* of an object is more than just to “make,” as Heidegger chooses a word that captures the power of utterance. The words given to the object serve to bring it out of its concealed (i.e., unrecognizable, non-object) state. Words aid this process of bringing forth but they also serve to allow for recognition of that object as it enters our life-world.

Heidegger's analysis of a material object's "bringing-forth" is very à propos in the context of digital objects and the processes of dematerialization which surround them. Silica, the key ingredient in silicon chips, is an inert element until it is purified and cultivated into a crystalline form. It is brought forth by the manufacturing processes that transform this sand-like element into a material that can process information. But silicon is unique among other industrial, modern products. It is a substance that was created to bear information—that is, to *speak.* While we cannot see the silicon integrated circuit wafer in action, it is the carrier of information speaking to other circuits, to other computers and networks, and speaking to its human users so that they may speak to each other. Silicon is brought forth into being by *poeisis* and its unseen acts of communication are brought into unconcealment through the digital and are brought to life. Digital technologies, too, as end products, similarly conceal the processes which bring them to life by specifically denying their materiality. As this dissertation argues throughout, the processes of dematerialization, whereby we see past the digital object's material form, are technologies unto themselves. Dematerialization conceals the object's beginnings and endings, revealing only its in-the-moment presence and part of this processes occurs at a noemic level.

Concealing technologies

This thesis is motivated by a need to examine why it is that our digital tools are treated differently than other material things. Their materiality is denied and disregarded at a number of levels. In particular, on a linguistic level, digital objects seem to be concealed, rather than elucidated by language. Heidegger speaks at length on the act of unconcealment (1977). Things in our material world are concealed because they are unrecognizable in states that are non-functioning (i.e., silica looks like inert sand, yet it can be transformed into something useful, complex, and it can enter into an economy of functional objects which forms the basis of the modern, digital world.) Bringing-forth an object, its material, its maker and its purpose allows the technological object to become unconcealed and "knowable." Heidegger writes, "Technology is a way of revealing." (12). It reveals itself to have purpose, worth, and objecthood in the world; yet, it is not totally revealed, either. The finished product conceals its original forms, its processes by which it comes to be, and its greater role in economic, social, and environmental ecologies. Yet digital technology seems to be an exception to this rule. The technology indeed conceals its origins, but it also conceals its end product because digital tools are increasingly confounding and concealed. In the pre-digital, post-industrial world, an object's mechanical workings were a point of pride and worthy of exposure. Consider the engineering "feats" of the nineteenth century like the Eiffel Tower, a skeletal tower lacking a façade and with its rivets exposed to the world so that onlookers could see how the building operates—a fossil of its time (Benjamin & Tiedmann 2002). Or take the example of the traditional pocket-watch equipped with a glass or face that may be opened so that enthusiasts can examine the inner moving parts in action. But for digital tools, the innards cannot be revealed since they say nothing of how the object operates. They are confounding and inaccessible; hence many of the most popular products like smart phones and tablets are designed to conceal everything about their material parts. Like many commentators on computer form, Ross critiques the aesthetics: "As opposed to those days when the design of an object was a stylish commentary upon its function, most information technology today is–what? A flat circuit board inside a generic box with no ostensibly expressive form" (2001: 357). But Ross misses the point—an outward aesthetic is denied because the innards are erased, sheathed, and hidden. This concealment *is* the formal digital aesthetic. The insides must be esoteric, mystical, unfathomable, and most significantly, *out of our reach*. Instead of a corporeal familiarity with the thing that is digital, a language of the digital stands in its place but this is a language and rhetoric that conceals it in a garb of hyperbole and catachrestic metaphors (see Lawler 1999). There may also be a formal metaphor here in that we cannot see our thoughts inside our brains, yet we tend not to think of flesh as the medium of thought—to do so robs thought of its mystical, immortal, inorganic and immaterial status. So too the digital machine conceals its brain because to expose it would be to acknowledge its banal, material form. As Roland Barthes suggests, the "fabricated objects must be precise, mobile, and empty'," (1982: 479) contemporary digital objects in particular are fashioned to be sealed, plain, and precise; for example, the exterior packaging of the iPod, Guy Julier (2009) argues, speaks to its constellation of uses. Again, the notion of constellations resurfaces, suggesting that the more varied the use and application of the device, the more concealed, plain, and confounding is its outward materiality. The plain, sealed exterior allows us to dematerialize its formal qualities and dismiss them as negligible.

Specifically, the rhetoric surrounding digital technologies actively conceals and distorts all four of Heidegger's four causes of a technological object. For Heidegger, technology is not limited to the technological object, but encompasses the whole of technology as a broadly generalized expression. Technology, and its ubiquity in modern life, seems to represent a "mode of truth" (Heidegger 1977), a frame or field of view that makes it difficult to isolate it as an object of study. Ihde summarize Heidegger's position: "Technology is thus elevated to an ontological dimension." (2003: 279). That is to say that technology deeply impacts our way of seeing and engaging with the world in that we have become inclined to see the world technologically yet the framing of such a view is imperceptible. He argues that technology includes the means, the manufacture, the things which are acted upon, the needs that drive and support the use of technological things are all a "contrivance," or an *instrumentum*[30]. This contrivance, I would argue, includes the language used to describe, promote, apply, use and reflect upon technology. While Heidegger believed technology was a form of "revealing" (1977), the language applied to technology, particularly digital technologies, serves to conceal rather than to reveal. Broadly speaking, language *is* a technology which impacts how we engage, perceive, and construct our technological objects yet it also distorts and obscures many of its own truths. Heidegger (1962) notes Edmund Husserl's *noema*[31], or speech, that may be misleading at the surface level and reveals truths when dissected carefully. The digital object

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[30] Heidegger applies this translation from Latin. (From "The Question Concerning Technology," cited in Ihde (2003: 278).

[31] Husserl's use of the word *noema* is contested and complex. Here, the word is used in its classical rhetorical sense and is not intended to reflect Husserl's phenomenological project.

represents the noema of technology in that it distorts our perception of the nature of objects at hand. An objects in use, like our digital tools for instance, "withdraws and is neither objectified nor does it appear as directly present at all."[32] (Heidegger 1962). That is, through use, we no longer see the tools despite our total immersion in a technological framework of activity. Heidegger echoes this in a similar sentiment in his essay, "The Thing"(1971). He writes, "The thingness of the thing remains concealed, forgotten." (170). He puts forth that a thing can never be, and will never be things in our thoughts because science has "annihilated things." We can barely grasp things in their true form because science has transformed things into objects, and much of this has to do with how we speak of things and how the discursive rhetoric of science distorts what Heidegger would call the "thingness" of things. Instead of speaking of things with a clear understanding of their nature or "giving thought to essential matters" (and in our present case, to matter and material) Heidegger argues that we defer to "using the dictionary" and metaphor (174). However, the problem with things, particularly technological things, is that they remain always slightly out of reach. As Bennett writes succinctly: "there is no way for us to grasp it or know it" (2004: 17). This was a point of critique for Theodor Adorno who saw Heidegger's focus on things as real and unmediated by subjectivity as an oversight of the fact that objects are already humanized and thus subjectivized (Adorno 1973)[33]. On the other hand, W.J.T. Mitchell suggests that "Objects only make sense in relation to thinking, speaking subjects, and things are evanescent, multistable appearances; and matter, as we have known since

[32] Ihde (2003: 290) citing Heidegger (1962).

[33] Bennett (2004) citing Adorno (1973).

the ancient materialists, is a 'lyric substance' more akin to comets, meteors, and electrical storms than to some hard, uniform mass." (2004: 231). This sense of the object stands in contrast to Bennett's suggestion that objects do have their own agency outside of the subject's understanding of the object, but nonetheless, Mitchell's concept of "lyric substance" is what makes room for dematerialization—matter may simply disappear from discourse and thinking, making the materiality of hardware, at least in our collective sense of it, disappear.

Nonetheless, because we struggle to understand and grasp things for what they are, we tend gravitate to the easiest route and reuse a convenient lexicon and catachresis that bears little resemblance to our digital things' true material form. Latour, as do many others, sees Heidegger's four causa as detrimentally over-simplified and writes that he finds it "baffling" that anyone would take Heidegger seriously on this point (2007). This is because the four causa speak nothing of the complexities of thing-creation or thing-impact as objects move through many phases of their presence as objects; for example, the silicon object is not limited to its presence as a digital tool; rather, it will move through many life phases perhaps as a tool of war, a tool for social networking, a tool to make a living, a tool that pollutes, and so on. Thus Heidegger's four causa are limited and short-sighted but, as Latour acknowledges, the utility of Heidegger's theories on technology is his notion of enframing, or the active concealing of processes which distort or conceal how that technology came to be. The frame hides the technology's technological presence: "Parts hide one another; and when the artifact is completed the activity that fit them together disappears entirely." (Latour 2007: 141). When stakeholders intervene and point out a technological object's flaws or disruptive or unwanted effects, the technology transforms from "thing" to "object" and acquires a new status altogether—that of the object tied to an *issue* of debate.

Digital rhetoric and metaphor

The rhetoric of computing has always been problematic. In the early days of computing design, the language and terminology for computing was limited to the confines of the laboratories because like any highly specialized lexicon, it was only meaningful to those with a concern for and familiarity with the object. Americans knew that computing technology was a major military advantage and that computing would set the nation apart from its enemies. Computers, being products of war, are already imbued with power and mystique, but the rhetoric of computing capitalizes on this special status and serves to distort the materiality of digital technology. But a momentary return to Plato is useful here if we recall his fictional prisoners who are living in a cave and who are told that the shadows of puppets are not shadows at all, but real things (Cf. Plato's *Republic*, reprinted in Scharff & Dusek 2003). Then, once released from the cave where "things" are distorted by words, the freed prisoners still have difficulty deciphering the true nature of the objects they see as they are *projections*. A similar argument could be made for the distortions that are projected by way of the rhetoric of "new" digital media. The words used to describe the things we think of as digital (i.e., tools built upon silicon) project a sense of the thing that is in direct opposition to those objects' true form. As new media gained attention beyond the laboratory in the 1970's through to the 1990's, words such as *cyberspace, hypertext, disembodiment, post-human, virtual* and more recently *cloud computing, wireless, immersive* and even *social media* are metaphors which reinforce the problematic notion of immateriality. While our experiences and engagement with digital media may feel, in terms of affect, to be without material grounding, all digital processes, content, and exchanges are indeed material, concrete, and very "real" operations that occur materially—on silicon, over wires and waves, through interfaces with our real body parts. Yet the discourse surrounding the digital has always supported notions of immateriality and non-thing status. New media has become entangled in narratives of the "future" and this bond cannot be broken (Zielinski 2006).

For example, as Andrew Ross writes in his essay, "The New Smartness," the rising trend to identify our digital tools as smart and intelligent (of which the new generation of "smart phones" are a case in point) points to a shift in the core ideologies of technology. Ross puts a political spin on the shift in technological rhetoric. In associating digital tools with intelligence and our acceptance of these tools as extensions of memory and knowledge, he suggests that smart, digital machines appropriate the function of the knowledge class, in much the same way that industrial technology once appropriated the know-how of artisans…" (355). He argues that the creation of a knowledge hierarchy is the ultimate goal of the digital project since a more educated post-industrial proletariat threatens the power of those who own material production, thus the appropriation of knowledge into homogenized forms allows for a new kind of resource hoarding. Despite the fact that access to information (supposedly) makes individuals "empowered through knowledge," we actually gain no power since few will be able to control the sources of that knowledge. Google, Facebook, and Twitter have proven this theory to be true and our access to knowledge through their databanks does not empower at all; rather, it makes us as reducible to bits as the reductive bits of knowledge we seek. Ross' article was first published in 1993 and his foresight that smart machines could create a passive "dumbness" wherein people appear to have less and less general knowledge and problem solving skills; a decade later, some might argue that this has come to pass in the paradoxical view that general public seems less willing to think without technology. Consider the popularity of talking GPS devices for driving without planning your route before getting into the car, or the rising trend to consult Wikipedia to solve arguments and share facts using a smart phone in social situations. Knowing is rapidly replaced by accessing, and retention of information is fleeting. Memory has less worth as information availability grows. Ross identified the new pervasive dumbness as an “intentional effect of the [knowledge] hierarchy.” (2001: 357). Instead, it is less likely that this effect is intentional but rather that it is the unintended fallout of ample availability. It is human nature to spend less energy on resources that *appear* to be readily available and in abundance. In the industrial era, manufactured goods may have appeared to be abundant and at relative low cost, hence the trend toward material consumption. The same principle holds true in the context of digitized information which appears to be ready at hand at no or low cost. We cannot (or choose not) to see the true costs—whether they cost money, freedom, privacy, or erudition—because we are convinced of its abundance and think nothing of giving information away, using it casually, or erasing it. This is the result of Lysias’ speech, of Ramus’ diagrams, and Silicon Valley’s digital innovation. The project to make information available is catalyzed by silicon—a material selected and engineered for this task. In this particular light, we are vulnerable to the effects of our own good intentions and silicon is very much the material basis of this effect.

The qualities of faster, smaller, powerful, and cheap defined the ideal characteristics of digital products from the start, but these traits shaped the language of digital computing and our understanding and evaluation of technologies. We expect each new device we purchase to be smaller, faster, and more powerful than our previous device. These are the measures of an ideal, yet objects can become only so small (and sometimes so small that they become difficult to use, like Apple's 3G iPod shuffle[34]) before they become incompatible with our physical abilities to engage with technology. The early militaristic imperatives, however, have left a lasting legacy on our deeply entrenched notions of value. This legacy comes in the form of metaphors, particularly in those which suggest immateriality. The qualities fast, powerful, cheap and immaterial (used here to denote both the size, presence and portability of a device, but also to denote our overall sense of disposability) are inextricable from the project of computing innovation. Aesthetic appeal, which invariably serves to conceal hardware and interior processes, "ease of use" (i.e., features designed to erase interior processes and errors that might require intimate knowledge of interior functionality), and the growing trend toward a single, multifunctional devices like smart phones and tablets to conduct all digital-based activities, speak to a general trend toward the erasure and denial of matter because matter punctures the mythical qualities of the digital. Outward aesthetics serve to conceal and distort and to

[34]Apple's 3G iPod Shuffle digital music player, released in 2009, was significantly smaller than previous generation models (smaller than an AA battery), yet customers complained that it was too easy to lose and difficult to use because of its small size. Following generations were slightly larger and squarer proving that there are limits to the practical reduction of materials. http://www.pcworld.in/product/review/apple-ipod-shuffle-3g-22242009 See also innovations (image below) which apply a light projection of a keyboard instead of a material interface. (Light Blue Optics 2012)

compensate for the limits of materiality (for example, our bodies limit how small any device can reasonably be) or to drive disposability, as will be discussed in Chapter 3, but distortions of rhetoric and the prevalence of immaterial metaphors are both active techniques within a greater sphere of the concealment and denial of digital materiality. Consider Nicholas Negroponte's 1995 rather benign and optimistic proclamation that the future will offer digital information "at no cost."[35] Picking up on this hollow claim, Grossman identifies this and other unsupported claims as evidence of the ways in which the rhetoric of new media is symptomatic (and causal) of the distorted perception of the immateriality of digitized information (Grossman 2006)[36]. There simply is no such thing as no cost because materials always carry monetary, social, environmental and other costs. "No cost" suggests no matter and no barriers. Cost reduction is a pervasive claim, but so are wirelessness (which may cut down the on reliance of wires but does not reduce the materially grounded sending and receiving technologies and interfaces that allow for a reduction of wires), ethernets, cloud computing, and so forth. "Cloud computing" in particular takes on an esoteric tone by manipulating the already existing mythos of ubiquity, intangibility, and collective access which frame progressive, post Web 2.0 technologies. The cloud metaphor for a pool of resources aggressively enforces a notion of omnipresent access to some sublime, floating digital deity in the sky. This clever metaphor certainly sounds more appealing than a more descriptive word to describe a scattered assortment of small servers located from Idaho to India which will handle your data at a reduced cost. Gabrys argues that

[35] Such a claim is often paired with his contentious One Laptop per Child initiative which seeks to provide laptops to children in the poorest parts of Africa.

[36] Grossman is citing Nick Negroponte's 1995 book *Being Digital*, Toronto: Alfred A. Knopf.

scientific practices of naming and classification seek to filter out myth and spirituality to create a sanitized and subjective view of all things, especially of technological and scientific objects. These practices "delete the 'play' of calling the world into being through language" (Gabrys 2011: 6 drawing from Foucault 1973) but what we see here is a reversal of traditional scientific nomenclature which aims for description—once technological projects leave the lab and enter the public domain of capital and competition, myth and metaphor determine commercial success. Rhetoric and metaphor tell us a great deal about the folklore of the digital object and provide terrain for analysis for the media archaeologist. As such, "rhetoric as much as hardware—becomes a critical type of fossil to collect and study in this natural history." (Gabrys 2011: 34). Metaphors are pervasive in computing not just because they are confounding, but because we have inherited a legacy of distorting language around computing, a language particularly aimed at reinforcing a myth of immaterial technological apparatuses. As Wendy Chun argues, "Because computers are viewed as universal machines, they have become metaphors for metaphor itself: they embody a logic of substitution, a barely visible conceptual system that orders and disorders." (2011a: 56). But the system remains barely visible because it is concealed beneath layers of metaphor and rhetoric, the metaphors of computing then are stand-ins for more concrete understanding of digital operations. As Chun explains, metaphor is a "form of making, of poeisis, that grounds all forms of classification… But if computers are metaphors for metaphors, they also (pleasurably) disorder, they animate the categorical archival system that grounds knowledge." (2011a: 57). The pleasure of the metaphor, I would suggest, soothes the discomfort that comes with the realization that digital objects are indeed just "things" and nothing more.

Chapter Conclusion

Our digital devices serve as a collective memory bank through which we regularly communicate, making withdrawals and deposits yet the materiality of the formal presence of these devices can disrupt the erotic and Platonic intertwining of the personal mind and collective memory. In truth, few of us care to know how our digital tools work, we care only that they do work and with minimal effort. The design of contemporary digital tools and the rhetoric and metaphors surrounding them tell us that we prefer myth over mastery, and as far a knowledge is concerned, we seek access over retention. And while we may be aware that all metaphors enhance our articulation of complex phenomena, we generally accept that metaphors are not to be taken literally (Stellardi 2000). Yet the dematerialized character of the digital seems to encourage us to do just that. Concealing the inner workings of our hardware imparts a faith in the machinery and suspends any critique about the material nature of the digital things we have woven into our daily lives. This is the digital noema. As an archaeological record, our folkloric myths of the digital, constructed and brought to life through language, allow us to look through digital materiality to an immaterial construction that operates in a world of imaginative visions of futuristic immateriality and substancelessness despite a present, concrete reality. But, as Chun reminds us, "… information is always embodied" that is, it always leaves a trace. "Indeed, digital information has divorced tangibility from permanence." (2011a: 5). Thus, digital objects are dematerialized through our metaphors and rhetoric. Thus language is, in this light, a dematerializing technology of sorts.

CHAPTER THREE
DOWN IN THE DUMPS

REFUSE, DETRITUS, AND DECAY

Undead Media

This chapter explores the dematerialization of digital objects as they reach their "end-of-life" phase. As discussed in previous chapters, digital devices conceal their material workings so that they may be seen as dematerialized media, but it is at the end of the device's useful life that their true material nature becomes not just visible and exposed but materially problematic. When digital devices are discarded, their material form "explodes the myth" of the digital (Chun 2011b) and the myth of the immaterial, ephemeral medium upon which modern communication, business, global flows, and personal identities are created and exchanged—the myths are quite literally turned inside out. It is the digital object's so-called end-of-life (EOL) that brings the material character of the digital back into view. Decoupled from ephemeral and ubiquitous utility and futuristic possibilities, a discarded digital object becomes not just garbage, but a toxic nightmare of immense proportions. This section will first discuss the current electronic waste ("ewaste," hereafter) crisis. The discussion will then turn toward an evaluation of some of the current alternative archaeological approaches to analyzing the ewaste issue and the forces that conceal and create our mounting piles of digital refuse. The first force is what Slade and others call neophilism, or the love of the novel and new, and the second dimension is obsolescence. It is the socially constructed concepts of novelty and obsolescence that drive digital devices to a premature death. The next dimension to be addressed in this chapter might be termed pervasive concealment and it is a constellation of techniques that operates at a meta-narrative level to hide, distort, and actively deny the very problematic and materially-oriented ewaste crisis.

This chapter does not present an environmentally-minded critique of the ewaste crisis. Rather, I seek to explore the "terminal" end of the digital device's life because it is inadequately discussed (or completely absent) in the histories of digital computing and this erasure is noteworthy because it points to a significant oversight in our understanding of digital technologies. Our appetite for digital devices is producing immense piles of ewaste, and our rate of consumption outpaces both the formal and informal salvaging, recycling, and repurposing practices. This has resulted in a hidden ewaste economy that is generally concealed from view—it is absent from marketing campaigns, it flows unseen from community "clean" recycling and disposal programs to its end destinations, and consumers cannot do anything about it save from ceasing consumption and retaining devices until they corrode, leaking their toxicities into their homes.

Vannevar Bush warned in the 1940's that we were already buried in our own computing products (Chun 2011b: 79) and that computers, as toxic entities, would inevitably present ecological problems; however, these warnings fall on deaf ears that cannot drown out the perennial need to constantly buy newer models and to quickly dispose of obsolete machines. The "death" of the digital object is fundamentally and conceptually incongruous with the mystique of the digital. "Obsolete" digital objects must be concealed from view in order for the high-tech industry to justify a rapid pace of production which stimulates ongoing consumption. Used computers and smart phones are deposited in "recycling" and ewaste collection bins, often found at the front entrance of electronic stores. A store credit toward a new device might be offered in exchange for the turning in of an old one to stimulate turnover and to quell any guilt one might have about disposing of an expensive device. Consumers are assured that this is the best EOL option and that the dead objects will be properly handled, with minimal environmental impact. But these bins and other community ewaste programs reveal only the very front-end of a long chain of shipping, stripping, dismantling, and disposing that any device will face once discarded. The dirtiest parts of the process at the very end of the chain in a slum in Ghana or a dump in China are hidden and remote. In order for rapid cycling of consumption and replacement to continue, evidence of the object's EOL fate must be hidden because it is not only dirty, it encourages inhumane practices, exploitation of developing countries for their lax environmental policies, cheap labour, a blind-eye toward the irreversible impacts of ewaste, and ewaste will grow exponentially in the coming years. At the core of the issue is not the use of toxic elements and their detriment to the environment or human health. Rather the problem's source lies in our reinforcement of an immaterial or dematerialized myth of the digital, much of which is reinforced rhetorically, symbolically, and through fetishized commodification. The digital device has been the commodity fetish of our age, but like all fetishized objects, we are reluctant to admit that their luster (such as connotative and superficial appeal) tarnishes quickly and we would sooner discard our digital objects and replace them with something new than question the gossamer appeal of the new. An old, obsolete, and discarded digital object is grotesque because it reminds us that the digital mystique and its permanently future-poised potential is fleeting, meaningless, and unattainable. Just as the dead and dying among us are sequestered out of sight in hospitals, morgues, and mortuaries, digital devices similarly find no visible place or worth in the cycle of consumption. Photos of ewaste are the new abject and monstrous images of our time, to use Kristeva's term (Kristeva 1982). "New" media cannot get old, their very worth rides on novelty and improved performance; they are incompatible with age and obsolescence so to see, acknowledge, or embrace dead new media might be seen as quirky and odd. But like morgues and catacombs, the growing piles of ewaste remind us, however uncomfortably, that our fetish for ever newer digital technologies leaves a trail of detritus and debris behind. But unlike human remains, digital remains simply do not disintegrate. Their remains become problematic and material.

What does the ewaste problem look like?

The statistics on ewaste are staggering yet they mirror the rate of consumption. The Environmental Protection Agency (EPA) reports that in the US alone in 2009, "438 million new consumer electronics were sold, 5 million tons of electronics were in storage, 2.37 million tons of electronics were ready for end-of-life management, and 25% of these tons were collected for recycling."[37] These figures are fairly substantial and require some finer analysis to accurately assess the volume, impact, and material realities of ewaste.[38] The EPA reports that in 2009, about 158.4 million digital devices were disposed in the US. Of these, 38% of computer waste (by weight) and only 8% of the mobile phones were sent to recycling facilities. The volume of consumption and disposal overall has outpaced the rate of recycling, which has remained fairly constant over the last decade (EPA, 2010). Further, recycling plants in North America are costly, inefficient, and cannot recycle everything—much of it is non-recyclable and will

[37] The source of these figures is from The Environmental Protection Agency which updates its ewaste figures regularly. For the latest figures, see http://www.epa.gov/waste/conserve/materials/ecycling/manage.htm

[38] Electronic waste, as it is discussed here, is limited to computers, mobile devices like cell phones and tablets, and other digital instruments like calculators, GPS devices, personal entertainment devices like radios, receivers, CD and DVD players, MP3 players, small digital gadgets (PDAs, remote controls, toys with digital features), and so forth. Television sets and specialized professional equipment are omitted.

eventually become landfill. Grossman (2006) asserts that the numbers concerning ewaste are difficult to pin down with any certainty—it is nearly impossible to tally how many computers and other electronics are produced annually worldwide, how many are discarded, how many are gathering dust in basements and desk drawers, and how many are scavenged and recycled. However, we can assume that the number is in the hundreds of millions of units and that there is no end in sight for the production of digital devices as this technology is still in an intentionally protracted and endless growth stage and consequently, so too is the accumulation of waste. But exact figures are not significant here because it is the lure of the digital and its deceptive garb of immateriality that are the real issues, regardless of how many million tons of computers will meet their end-of-life this year (Grossman 2006; Gabrys 2011).

In the developing world the consumption rate of electronics, particularly cell phones, is often higher per capita (UN 2011). The global rates of electronic disposal are likely in the hundreds of millions of tons, and rising every year. While the EPA reports that about a quarter of the waste will be salvaged and reused in some way, “recycling,” however, is a limited term—only certain components like copper wiring and other metals can be harvested to be picked over by recyclers. Digital technologies can do many things, but as of yet, they do not biodegrade.

Nearly half the weight of a computer is composed of metal (Grossman 2006), two to three percent of which is lead. Among the metal and metallic compounds used in computing are, among others, coltan, gold, copper, lead, mercury, silver, nickel, cadmium, chromium, iron, magnesium, palladium, platinum, and zinc (Kluger 2011). Other materials include nonyphenols, polychlorinated biphenyls (PCBs), phthalates, glass, and other plastics (Grossman 2006). The ore, coltan (which is a natural fusion of the elements niobium and tantalum), has spurred civic unrest, financed wars, and caused environmental degradation and human toxicity in the

Democratic Republic of the Congo (DRC). Coltan is a key component of capacitors and while it could be sourced from other countries with less human and environmental damage, it is well known that the DRC's coltan mines provide cheap (child) labour and lax regulations (Gabrys 2011). But because these unpleasant realities tarnish the aura of the digital object, they are concealed from view and we ask few questions about the impacts of our tools and the materials used to make them.

Countries such as the US and the UK export millions of containers of ewaste either via government sponsored communications development programs or via private enterprises, and much of the ewaste is generated by institutions (schools and universities in particular) and government offices (Moukaddem 2011; Babbitt et. al 2009; Kostigen 2008; Iles 2004) who have a high turnover of technological tools. Shipping containers full of old computers, monitors, and other devices are labelled as donations, gifts, and refurbished or second-hand goods in order to circumvent international toxic waste laws. On the receiving end, ewaste purchasers in developing nations such as Ghana, Nigeria, India, Bangladesh, and China unload the cargo into seaside towns where the usable items will be sold and the rest of the waste will be stripped and dismantled until nothing of value is left. It most of these dumping areas, it is the poorest youths and women who will make a meager living stripping down old devices to get at the metals inside and selling any plastic and glass remains to recycling firms. To get at the copper, gold, and other metals, discarded devices must be burned, melted, or dissolved in acids and volatile solvents. As one might imagine, the process is highly toxic and damages the health and environments of those who do this dangerous work. One need only to see some of the photo-essays available on the Internet to get a sense of the desperation and risk that runs through this concealed dimension of the so-called digital age. See Figure 15 and Figure 16.

Figure 15: An elderly woman sorts ewaste in Guiyu, China. Chung (2009).

Figure 16: Two boys in Accra, Ghana sift through the ewaste dump to earn a living. (Parsons 2009, photo from The Guardian, UK). See inhabitat.com for the full photo essay.

These images fracture the aesthetic lure of the shiny new digital device and they expose the harsh and even cruel material basis of our most ubiquitous tools. The photos reveal a grotesque explosion of innards, they are computers at their most "umheimlich." There is plenty of room for a postcolonial or geo-political analysis of the flow of ewaste; for example, consider the odd reversal of resource exploitation that is currently at work in the area of metal extraction in the developing world, particularly in Africa. Where once empires exploited colonized labour to extract precious metals from their lands to be shipped back to the west; now, enterprises not only extract their resources in these same lands, but a circular rather than linear flow has been adopted. Enterprises in the developed world derive their metal resources in the developing world, send them to various places to be manufactured into electronics (for example, China, Mexico, and Thailand), the finished goods are shipped to the west to be distributed to their final customers, and when the goods are disposed of as garbage, the discarded digital items are sent back to African and Asian countries so that the metal component can be salvaged and "remined" from the waste. Women and children in the developing world make up a significant portion of this value chain, though they are rarely the users of the electronics they help to produce or dismantle. From a post-colonial perspective, little has changed in the information age except that the raw materials return to their place of origins, albeit in a transformed state, in a rapidly churning south-north-south global gyre of electronic parts that will spend the shortest phase of their life in the "end-user's" possession. The end-user is not the customer because there is no true end-of-life, the components, once extracted from the ground and transformed into unnatural configurations that never truly meet an end. As Parikka (2012) suggests, electronics are essentially a dust which flows in an endless cycle of suspended states, from mines to machines, into the lungs of the salvager, to the smoky clouds that hang over Accra.

The disappearing act

Discarded electronics are, as Sterne notes, "a monument to the hubris of computing and the peculiar shape of digital capitalism." (Sterne 2007: 17). This peculiar shape is one that boast immaterial data supported by increasingly invisible materials. However, unlike the print revolution before it and its requisite pulp and paper industries, the digital revolution is bound to create a significantly more devastating toxic waste crisis because these supporting materials are born out of unnatural fusions of metals, minerals, and synthetics. "In the alchemy of electronics, silicon is transformed from a relatively common substance into a microchip and from a miniature electronic unit into a massive accumulation of waste." (Gabrys 2011: 28). An enormous amount of innovation, design, and energy goes into the creation of digital devices considering the very short life of these objects. Silicon Valley in particular has paid a high price for its central role in chip manufacture as it is now one of the most polluted and toxic areas of the United States—a status that is mostly attributable to the semiconductor industry (Grossman 2006). The ground beneath the best-known firms like Google and the Computer History Museum bears the chemical signatures of decades of the dumping and leakage of by-products of chip manufacturing (Grossman 2006). The area is also home to a disproportionate number of "Superfund" landfill dumps, so called because their toxicity is so grave that they qualify for greater funding and more urgent cleanup. While chip fabrication is famous for its "clean" processes which ensure that dust and contaminants do not enter the facilities where chips are made, these same processes dispose of countless harmful acids, solvents, rinses, baths and other effluents that end up in tanks which leak, spill, and leach into the surrounding environment. That said, the pristine and optimistic "officeplexes" of Silicon Valley belie a legacy of toxic flows of waste both locally and abroad. To acknowledge this truth, however, would puncture the myth of immateriality and imperatives like novelty which drive electronic consumption. The origins and destinations of digital objects are concealed and, if visible at all, they are sanitized within a framework of environmentally-friendly initiatives that promise the impossible—that ewaste is manageable and that all parts will disappear safely, without a trace. If we recall the Computer History Museum curator's mission to save dead computers from disappearing, we see another instance of dematerialization at work. Computing technology is seen to disappear forever and that it is the historian's goal to resist this inevitability. In reality, such a disappearing act is an illusion because, from an environmentalist's view, the material traces of a computer persist in some form or another, possibly forever. Hence, the historian's notion of a computer "lost to time" is evidence of the dematerialization of the very understanding of digital permanence.

Novelty: Die young, stay pretty[39]

As discussed in previous chapters, computing has always been tied to myth and magic (Pels 2010), ease, convenience, progress, and power. More specifically, computing technologies have always been tied inextricably to novelty. We like our digital devices new and compact, "cutting edge," so to speak. A new device may promise greater mobility (fewer wires, more connectivity), smaller size, and more power. But "miniaturization is not dematerialization," (Grossman 2006: 9) and the piles of ewaste accumulating in landfills is evidence of this. Smaller digital devices simply mean more units, more densely packed with materials, which also means that the salvageable parts are harder to reach, thus requiring dirtier recycling methods to harvest them such as burning, melting, and dissolving the denser layers of components.

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[39] "Die Young, Stay Pretty," from Blondie's album *Eat to the Beat,* Chrysalis (1979) presents a fitting ballad of the aging and discarded digital object:

Die young, stay pretty
Deteriorate in your own time
Tell 'em you're dead and wither away
Are you living alone or with your family?
A dried up twig on your family tree?

Are you waiting for the reaper to arrive?
Or just to die by the hand of love?
Love for youth, love for youth
So, die young and stay pretty

An old device, by way of its *not*-newness, is inherently flawed. After as few as twelve months many consumers are ready to replace their current devices with a newer one, and usually a device is replaced because it is no longer "new," not because it no longer functions. A new computer or digital device is fast, small, convenient, smart, sleek, and competitive. An "old" computer is a bad one, fit for replacement when one can longer tolerate its signs of age: slowness, inadequate memory, dated software, irredeemable, and bulky or tired aesthetics. Computers, like so many disposable products, simply cannot age gracefully.

Slade attributes the success of disposability to "neophilism" (citing Campbell 1992), a term that describes consumers whose buying habits are driven by a desire for new things, either due to a distaste for the old or as a response to endless shifts in fashion, style, and trends. Neophilism is staunchly thanatophobic and associations with death or decay are squared away, out of sight. Landfills and informal piles of electronic waste at curbsides are not just unsightly, but terrorizing as they threaten to sully the new and the neat digital device, reminding us of the fleeting nature of novelty. Novelty, a pervasive theme in computing, is often gauged against Moore's Law (see footnote 12). Moore, reflecting on his statement from 1965, affirmed in 2002 that his eponymous "law" continues to ring true and that by 2012, the time of this current project's writing, Intel would be able to put 1 billion transistors on a chip (operating at 10GHz)[40]—though

[40] Much current research and development in computing is turning toward atomic-level computing which could render Moore's law and the traditional chip technology moot. As physicist Michelle Simmons explains, the more transistors that are put on a chip, the more heat those transistors generate, thus weakening the substrate. This physical boundary makes Moore's endless densification unlikely. Newer technologies are turning toward better substrates to replace silicon—particularly those which can be manipulated at the atomic or quantum level. (Flatow 2012). See also a recent article in *Nature* where researchers claim to have created a programmable organic cell:

this is not the case. As Sterne points out, Moore's Law is not so much a law of probability and proportions as it is a "fantasy the [computing] industry wishes to uphold." (2007: 20). In other words, it is not to be taken as an observation or as a prediction, it is an imperative (Sterne 2007). In truth, it now takes years to double the density of a chip and besides, the race for density is waning as technologists are instead seeking alternative materials to the silicon IC. In 1965 increased density was a necessity to get computers to shrink to a practical size, now it is merely a competitive advantage and an arbitrary benchmark for technological progress in terms of chip design.[41] Unlike other media technologies which eventually stabilize when they reach an equilibrium between performance, form, cost, and diffusion, computers are the exception to the rule. They cannot stabilize and innovations cannot stop. There will be no point of comfortable technological achievement because this is a technology whose industry relies on constant dissatisfaction, instability, and constant change. These characteristics are legitimized and normalized through a discourse of novelty and ideation of unattainable computational perfection (which might look something like a completely dematerialized, limitless, instantaneous, intuitive, ubiquitous, and effortless integration of computing into all systems imaginable). But perfection is not as lucrative as the road to get there, given all the intermediary, sub-perfect and "new"

"Programmable single-cell mammalian biocomputers" by (Ausländer, Ausländer, Müller, Wieland & Fussenegger 2012).

[41] Interestingly, Intel offers the following on its web site (http://www.intel.com/content/www/us/en/silicon-innovations/intel-32nm-logic-and-soc-technologies-general.html Accessed March 7, 2012):

"The Intel® 32nm process continues to transform the way we live, work, and communicate by delivering on the expectations of Moore's Law. With breakthrough 32nm logic technology, users can expect faster processing speeds, better energy efficiency, greater computing capability, improved functionality, and support for more sophisticated applications."

devices that we will be offered along the way. This fascination with newness is getting old (Kember & Zylinska 2012) yet even theorists hold fast to the notion of novelty because it seems to be expected of theory (Kember & Zylinska 2012). But as Chun echoes, newness firmly locates technology within a "progressivism that thrives on obsolescence and that prevents thinking about technology-knowledge-power" (Kember & Zylinska 2012; Chun & Keenan 2006: 9). The following section explores the problematic enframing that novelty and its bedmate, obsolescence, enforce.

Obsolescence—The beginning[42]

"Dying is a wild night and a new road."—Emily Dickinson

Giles Slade (2006) is among a number of researchers who attribute the problem of ewaste to a specific American invention: obsolescence. As McLuhan (n.d.) remarked, "Obsolescence never meant the end of anything, it's just the beginning." (See Appendix C for McLuhan's Tetrad from *Laws of Media*) Most technologies before the Industrial Revolution would meet an eventual end or phasing out as newer innovations addressed new needs or new condition but early machine made goods were intended to last. Repairing, upgrading, and repurposing goods was implicit. Even when an object met its eventual end, new purposes would be found for the remains. Towards the turn of the twentieth century, American consumers became accustomed to purchasing a variety of ready-made goods based on their novelty or ingenuity, but manufacturers needed a way to convince consumers to keep consuming the same good repeatedly in order to maintain sales. Repetitive consumption is best motivated by technological improvements that render earlier models (or “generations”) of a product obsolete. Manufacturers then are pressed to continually improve their products to gain a competitive edge over other products, but also to incite repeat purchases among loyal customers. In the 1920’s and 1930’s, the automotive industry was the first to make obsolescence a regular practice that no longer responded to slower, more natural paths of disuse (Slade 2006) but instead relied on forced obsolescence to drive consumption. The natural bedmate of obsolescence is marketing. Up until World War II it was difficult to convince consumers to discard anything that still worked, but a heavy emphasis on the benefits of new technology and “newness” could inspire people to replace perfectly working objects with new ones. After the war, a general rise in western living standards led to a decline in conservation and frugality. Retaining old objects, reusing, repairing, recycling, repurposing and thriftiness in general were practices that were frowned upon (Slade 2006). Old-fashioned reuse was now associated with Depression Era thrift and went against the post-war spirit of consumption and the improvement of life through industry. Science was constantly bringing new innovations into the home and to resist innovation (through recycling and repair) was no longer a sign of practical ingenuity but rather a dated and frugal practice to be scorned. “Deliberate obsolescence in all its forms—technological, psychological, or planned—is a uniquely American invention,” writes Slade (2006: 3). Today we think of obsolescence as a process that naturally follows innovation and “progress.” As innovations are created, a wake of old, out-dated industrial fallout will be spirited away, out of sight to make room for the new. Decay, death, and detritus are antithetical to progress which privileges the new and conceals the remains of the dead. The abject quality of ewaste punctures the myth of the new and serves as an unpleasant reminder of our short-sighted consumption practices (see Figure 17).

Figure 17: Migrant workers in Guiyu, China disassemble computer parts (photo by Jim Puckett (AP) Guardian, UK 2010).

Obsolescence itself is a technology, one that underlies the myth of the dematerialized digital device. For a device to become obsolete because it cannot support a new feature or function is to render all of its material remains useless.

Functional obsolescence, however, is not the only means by which a device is killed. Slade describes a number of manifest forms of object obsolescence. “Technological obsolescence” occurs when a popular improvement appeals to consumers and quickly obsolesces earlier technologies (2006: 4). But there are more nuanced forms of obsolescence which manipulate consumers into replacing old objects with new. A change in style or aesthetics may encourage consumers to replace working things with “better looking” replacements that appear more up to date. Manufacturers may also deliberately use inferior materials so that objects break, guaranteeing their rapid replacement. Consumers have been weaned off a preference for things that are built to last and instead, are coaxed into replacing broken or failing objects with new ones which will also fail in a few short years or less. Such design practices are termed “planned obsolescence" (Slade 2006) because a short life and *disposability*—another invention of Modernity—are built into the materials and functionality of an object. Digital objects, like many other goods, are made with planned obsolescence in mind but unlike many other goods, the psychological dimensions of their obsolescence is more compelling, more idiosyncratic, and more volatile. Cell phones, laptops, tablets, and other PDAs are still relatively costly compared with one's daily expenses and the devices are more useful, integrated, and even essential—particularly communicative devices—than other consumables. Yet, the average life of a cell phone from purchase to disposal is only about eighteen months (Slade 2006). An average cell phone might cost $100-500 and may be tossed away before it has even shown signs of wear and tear. Rather, it will be discarded and replaced for minor reasons: a new "free" phone is bundled into a newer user plan, a newer model has one or two different features, or a particular aesthetic quality renders it unfashionable. Yet any and all of these are the workings of planned obsolescence. One would not discard a piece of $500 gold jewellery for being a mere eighteen months old, yet a cell phone or laptop of that age has lost its aesthetic or symbolic value. If users were aware of how much gold and other precious metals were embedded into their phones[43], they might not discard them so readily. But our readiness to discard and replace says a great deal about our relationship with technology and our sense of its value. The more integrated and essential digital technologies become in our daily lives, the less likely we are to value the materials that support the essential processes they perform. In other words, their abundance and falling costs lessen our sense of their intrinsic exchange value. Any sense of a growing pile of discarded digital objects furthers our sense of their value as material things and foreshortens their

[43] The total amounts to about 34mg of gold and 16g of copper (eoearth.org 2012).

life, rather than extending it through awareness of the ewaste issue. A digital object now spends the shortest phase of its lifecycle in use, it will take much more time to mine and manufacture its materials and even longer to dismantle it at its EOL than it will likely spend in its user's pocket. It is worth noting that when home computers were entering the mainstream market for household use in the early 1980's, durability and longevity were in fact key marketing platforms. At a time when a computer was both a new addition to the household budget and considered a risk because of its rapid rate of change, computer manufacturers touted the lasting value of a computer that would "grow with the family" over time[44]. Planned obsolescence and rapid replacement are more recent features of a computing industry that has actively cultivated fickle consumers who have been conditioned to buy new in perpetuity.

But what is to blame for the short life of the digital object? Slade (2006) and others (Gabrys 2011) identify a high volume of production (or overproduction), miniaturization, falling costs, and constant development of applications and capabilities for the rapid cycling of psychological and technological obsolescence. In other words, the industry, as composed by manufacturers, product developers, marketers, and other stakeholders drive much of the false sense of obsolescence. As King Camp Gillette, inventor of the disposable razor and grandfather of disposability, wrote of this inverse relationship between the proliferation of goods, their worth,

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[44] The Apple II advertisements from 1977 reassured consumers that the computer was designed to "grow with you" over time and that it could be improved with peripheral accessories and expansions. This is discussed further in Chapter 4. Another Apple ad (see below) of the same era boasts of the "baked Apple," a computer which was caught in a house fire, but still works (wired.com.) This ad promises durability despite destruction, which is somewhat ironic given that burning is one of a few ways to effectively dismantle a computer. Worth noting is that in this ad, attention is called to the material nature of the object as a means of assurance, its material form protects the immaterial data inside.

and our desire to consume them, “overproduction produces want.” (Gillette as cited by Slade 2006: 10). Thus abundance does not sate want but drives it, driving the economic principle of supply-and-demand for a loop. As Acland writes, overproduction speaks to “an economic and cultural orientation toward novelty and innovation… to be followed by intricate modes of accommodating the leftovers.” (2007: xv). These modes find their arena in the heaps of ewaste around the globe. The steady supply of new digital objects and the growing abundance of old objects collecting in drawers and closets further drive want by *reinforcing* a devaluation of devices as material goods. Their abundance is misleading—we cannot help but think of them as mythical when they are prototypes, ubiquitous when in use or available on the market, and worthless when old. In these three states they are immaterial. It is only when these devices are discarded that their material presence becomes apparent and problematic.

Concealment and distortion

Planned obsolescence paired with a rhetoric of dematerialization creates a powerful force whose material effects are concealed in landfills and dumps that most consumers will never see. This force, it would appear, can only be countered using rhetoric borrowed from environmental science. Rote legislation controlling manufacturing processes and the use of specific materials it seems are the only voices affording any legitimacy to counter the language of novelty and consumption. In other words, legislative language and environmental and humanitarian calls for attention to the issue are, in a world driven by consumption, are the only (quasi-empowered) voices seeking to reduce the tide of ewaste. This presents an interesting paradox. On the one hand, a streamlined, counter-voice calling for a reduction of consumption or for more EOL-conscious consumption would be the logical counterforce to address a growing disposal problem.

If the piles of ewaste are bad for the environment and bad for human, animal, and ecological life, then the smart solution the mounting pile of “smart” phones and other devices is to reduce our turnover rate and buy fewer devices, less often. Responsible devices should therefore be upgradable, expandable, flexible, and so forth. One source of the problem lies in our consumption habits as well as in our general indifference to the materials used to make these goods as well as in the capitalistic drive to raise growth and profits to satisfy shareholders. Yet, on the other hand, a voice calling for pared down consumption has little effect against the *symbolic* power of computing. The environmental and humanitarian concerns are the *only* tropes that carry legitimacy because a call for slower and material-conscious consumption rubs against the grain of digital technology’s key drivers: novelty, innovation, and immateriality.

In instances where manufacturers develop new digital products with EOL realities in mind[45], their actions may be parlayed into a marketing spin to set their products apart from less eco-conscious competitors. Apple, for example (see Appendix B), claims: “Our entire product line—Mac, iPod, iPhone, iPad, and accessories—is free from many toxic materials.” (apple.com 2012). This claim is qualified by a number of caveats including a fine-print footnote that PVC-free cords are available only “on request” or that the definition of toxic is open to interpretation. Nonetheless, Apple’s environmental page is designed to subdue doubt and encourage a new purchase more than it is designed to bring awareness to the ewaste issue. Its construction implies that environmental concern is the only concern when it comes to ewaste. It serves to encourage you to *buy new with confidence* rather than to hold onto your perfectly working Apple product for a little bit longer.

[45] For example, Philips electronics has been lauded for applying lifecycle thinking (Kluger 2011).

Consumers now have tools available that may help them to make informed (or confident) decisions in assessing the overall environmental impact of a future purchase. One such tool is the EPEAT scorecard which provides consumers with an impact rating of many digital products on the market (Samson 2009; www.epeat.net n.d.); however, scoring systems and an infinite number of modifications, accessories, and variables present a rather tangled picture for average consumers to negotiate. Ultimately, choosing to purchase a laptop that contains a higher percentage of recycled materials and fewer toxic components lends assurance to the consumer that he or she has made a "smarter" choice, and such confidence is parlayed through the rhetoric of environmentally conscious thinking. Thus, the forces of novelty and obsolescence are tempered by environmental awareness resulting in a tension between "new vs. green" but what we are really witnessing is a competition between two enframing discourses: irresponsible and conscientious consumption. To draw a parallel, consider the banana. Many of us in northern climates enjoy bananas and consume them regularly. Yet, if we look at the banana industry as a whole, from the felling of tropical forests for plantations, to the pesticides, labour, and fossil fuels that go into getting that banana to the consumer, one banana is a big deal; yet, our misgivings about eating bananas are easily quelled by the reassurance that they may be "organic" or "sustainable" in some way. All things considered, not eating a banana might be a better alternative but the rhetoric of sustainability (itself an enframing technology, to use Heidegger's term *Gestell*[46]) lends false assurance that bananas are inert. At one time they were a rare sight in grocery stores but various systems and have been interlaced—rhetoric among them—to make

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[46] "*Gestell*" is a view to or the framing of technology that is manifest in our very mode of existence (from Heidegger 1977).

bananas profitably banal. Technologies that can be successfully branded to appear to appeal to both frames (i.e., new *and* green) have greater appeal, yet fighting the forces of obsolescence, the real culprit behind ewaste, is futile. Either frame leaves no room for simply resisting obsolescence as a market "force." Ultimately, rather than addressing the material EOL realities of digital goods or the illogical nature of planned obsolescence, we seek more sophisticated language (and *Gestell*) to validate, justify, and excuse the detrimental impacts of these goods. We keep eating bananas, hoping that the banana industry will take care of its own objectionable practices, we might even believe that buying organic is exerting a positive influence on banana growers, but we are unlikely to stop eating bananas as long as they are available in stores.

Grossman (2006) notes that despite the "world of information" made available to her through her laptop, little to no information or trace is left regarding the worldly origins of her laptop. She writes, "…it's hard to remember that the technology that makes it possible has anything to do with the natural world." (5). But of course, like all manufactured goods, the computer is a composite of natural substances from metals to fossil fuel derivatives like plastic and PVC (polyvinyl chloride). Every part of a digital device can trace its elemental roots back to the earth, yet complex manufacturing processes make most of these substance unable to return to the earth in a normal path of degradation. Most of the components are so transformed through manufacturing that they are altered permanently at the molecular level and cannot be extracted or broken down without releasing hazardous particles.

Grossman (2006) notes that virtually none of the histories of computing even considers the detrimental effects of the industry on our health or on the environment. Not one of the computing history texts consulted in the composition of this dissertation mentions either the mining and natural resource impact of chip manufacture or post-consumer dimensions of computing. The pre and post-manufacture realities of computing are simply erased and denied in even the most comprehensive texts. Similarly, she and Gabrys (2011) point to a pervasive oversight of the material nature of digital things, their thingness is denied even in the most cited history textbooks. The mere mention of the material origins and terminal destiny of computational machines is reductive and generally overshadowed by tales of innovation and industry development. And while it is not uncommon within the histories of invention to omit any mention of the end-of-life realities of manufactured goods, the complex and intensive raw material harvesting (beyond merely the silicon) involved in chip manufacturing and the detritus waste associated at both ends of the life of the chip are rarely noted in the key history texts. This omission, as Grossman, Gabrys, and others have noted, is part of the "curious disconnect" between digital technologies and their worldly, material construct (Grossman, 2006). Their materiality is muted in favour of supporting the myth of the immaterial and the ongoing trope of the dematerialized—that is to say, reduced in bulk through miniaturization.

Gabrys (2011) locates the problem of ewaste within the greater mythic sphere of virtuality. Virtuality supports the unfounded notion that all things digital are "virtual," that is, that they are not bound by physical properties and are hence immaterial. For many years, particularly in the 1990's as digital products promising "virtual reality" flooded the market, the "virtual" became a commodity and a socially constructed myth. Virtuality in the form of games, simulations, social experiences, and so forth further promoted a false sense that digital technologies were ephemeral and immaterial, operating in a kind of non-physical parallel to the "real" of the non-digital world. But as Gabrys suggests, "Virtuality… can even enable more extensive consumption and wasting… this sense of immateriality also enables the proliferation of waste." (2011: 5). Sterne suggests that our civilization's "emphasis on virtuality, the ethereal, ideational, immaterial, and experiential dimensions of new media…lead many writers to accept the myriad strategies that states, institutions, and individuals use to move computer trash into the backspaces of modern life."[47] (2007: 16). Led to believe that digital technologies are released from the problems associated with materials (such as clutter, waste, bulk, the use of synthetic compounds that pollute, and so forth), consumers may be encouraged to see digital objects as immaterial, therefore their waste and polluting effects are incompatible with the myth of immateriality, hence we deny the material nature of our digital objects because the mythic nature of the digital does not allow for it. Thus the myth of the digital denies, conceals, and renders materiality invisible. The myth of the digital then, is a concealing technology itself, one which actively subverts its very real material nature.

Chapter Conclusion

Digital objects have been called the digital fossils of tomorrow (Gabrys 2011; Nesselroth 2004), much like Benjamin called the arcades of Paris the fossils of nineteenth-century capitalism. Acland observes,

> The detritus of capital and commodity serve the dual purpose of announcing their own historicity and residing as a standing reserve, as Heidegger might have put it, for conversion into subsequent artifacts, memories, and stories. As commodities become a type of raw material once again, Benjamin alerts us to the transformative possibilities implied. (2007: xvii)

Following this argument, fossils leave enduring traces of earlier lives, ecologies, and systems of exchange. These residues, particularly those left by media technologies, allow for a renewed

[47] The term "writers" here may be taken to mean theorists, scholars, commentators, etc.

examination of the role of media as objects and artifacts, and not just as intermediary communicative devices (Acland 2007). In no place are the fossils of digital technologies more apparent than in ewaste landfills and it is here that they have these transformative properties that Acland acknowledges above. It is in this setting that these dead objects can be revived as artifacts for museums, as evidence of destructive manufacturing and disposal practices, as nostalgic treasures awaiting rescue by a collector, or as a minefield of discarded materials awaiting their second harvest by salvagers and recyclers. It is specifically in the dumps and landfills that we can see digital objects engaging in "perverse performativity" (Gabrys 2011 citing Brown 2004), or acts and states which were never intended. Digital objects were never meant to be old, but like anything, they meet an inevitable end to their usefulness, and it is in the piles of waste that their perversion of novelty, value, and technological prowess are stripped and exposed, revealing their material innards and presenting themselves as environmental "problems."

This research has argued that the "digital," for all this word may encompass, does not leave room for materiality. Our notions of the digital promise liberation from the bounds of material limits and they promise the impossible—they are dematerialized so thoroughly that we deny that there may serious long-term effects left by digital material by-products. But digital technologies are indeed made of substance which can be touched, seen, held, fabricated, and dismantled. The myth of the immaterial digital exchange of meaning and information is powerful yet wholly false. One need only to look at the lifecycle of a digital object to reveal its very material forms. Any digital device is the product of mining, extraction, fabrication, soldering and assembly, pollution, waste, disintegration and decay. But sealed inside the dense packaging of a laptop or cell phone, we are charmed and misled into thinking that their operations (particularly communicative operations) are immaterial, uncorporeal, and fleeting. As Gabrys writes, “These processes of pollution, remainder, and decay reveal other orders of materiality that have yet to enter the sense of the digital” (2011: vi).

Chapter Four
Resurrection

And the dead walk with the tender-hearted

We all like to remember the past as generally better than it really was. We wax nostalgic about the good old days when life was simpler. Our nostalgic inclinations lead us to collect, save, and acquire material things that remind us of this past so that the warm feelings we associate with a given time in our life might be accessed concretely, through the possession of an object that reminds us of an idealized past. Years after a digital device has been retired from use, if it is not destined for the ewaste heap, it may find its way to a thrift shop or roadside curb, garage sale, flea market, or other location at which collectors reclaim otherwise unwanted digital remains where it may have little use value, rather it will be treasured as a memento. I call this process the nostalgic "redemption" of the dead digital object. Part of the allure of those dead digital object that are reclaimed is that residual magic that persists beyond (and in response to) obsolescence. The following chapter explores the ways in which dead and obsolete digital objects from the past, having endured a dematerialized life, are "rematerialized" in death.

In this dissertation I have argued thus far that a media archaeology of digital objects may reveal a pervasive pattern of dematerialization that becomes problematic when such objects are obsolesced and "dead" and must be confronted as historical artifacts, rhetorical illusions, and as consumer waste. The following sections explore a different kind of death: the nostalgic afterlife. I suggest that when old digital devices are reclaimed as memorializing pieces, their material nature is finally revealed through a process of nostalgic semiosis whereby personal meaning becomes tied to the thingness of the dead digital object. The nostalgic redemption of obsolesced digital objects then serves a two-fold function: to both reveal (or unconceal, as Heidegger might suggest) the object's material form against the grain of dematerialization, but it also reframes the object's materiality as evocative of a digital past, as opposed to the always impending digital future. In this final chapter, I discuss the unlikely and anachronistic nature of the digital machine as nostalgic object and I present some ways in which nostalgia may be a productive frame through which the thingness of the digital may be foregrounded. I pay particular attention to digital media technologies and semiotic analysis provides a useful companion to thing theory, material culture analysis, and media archaeology in this present exploration of memorializing practices. Semiotics is a useful counterpart because nostalgia operates through the fluid generation of shared meaning. As such, the dead digital object can operate as a floating sign, and "It is not through any intrinsic quality of the sign but rather through the interpretive acts of members of a sign community that the sign comes to have meaning." (Stewart 1984: 33). In the case of digital nostalgia, it is the acts of collecting, showcasing, and treasuring old, dead devices which are the concrete practices that generate new meaning for these objects. While Susan Stewart (1984) suggests that this meaning is independent of the object's physical properties, I would argue that in the case of the reclaimed or saved digital object, it is the physicality of the object that is the key to its signifying power. Its materiality is the very force that revives the dead media object from the garbage pile because it is those material properties, combined with the affective significance generated by the collector, that establish nostalgic meaning and value.

Nostalgia(s)

The Computer History Museum visible storage room tour ends with a display of old pocket calculators. These range from the oldest which are large and unwieldy, to an assortment of children's calculators and other digital educational toys from the early 1980's. A crowd had gathered in front of this display and the visitors were pointing out which models they had owned and many remarked how small and cheap calculators have become in recent years. What was once a specialized scientific instrument now can be bought for a few dollars. The toys on display strike a particular chord (see Figure 18). They are nostalgic and familiar.

Figure 18: A Speak & Spell on display.

Linda Hutcheon describes the process of nostalgia as a trick of memory and that this is "the ideal that is *not* being lived now is projected into the past" (Hutcheon 1998: 1). We select and omit memories, rearranging distortions and reorganizations of moments and sentiments. Thus, nostalgia operates through an "historical inversion." Through this kind of longing we are "Simultaneously distancing and proximating, nostalgia exiles us from the present as it brings the imagined past near." (1). We are able to reorder the past, even pasts that preceded our own births, into a crystallized concept of a better, simpler time. Today, we are immersed in a highly socially networked and demanding mediascape; our present immersion in digital ubiquity can seem frantic and unstable at times and dematerialized, as this dissertation has argued throughout. As such, “nostalgic distancing sanitizes as it selects, making the past feel complete, stable, coherent, safe… in other words, making it so very unlike the present.” (1). In contrast, the present seems chaotic and incomprehensible. Through objects we reassemble the past the way it never was, capturing an essence of an era that is sentimentalized and periodized. György Lukács (see Lukács 1962) identified periodization as a narrative mode of historical fiction and Fredric Jameson has applied it more contemporarily as a bourgeois and largely nineteenth-century habit of projecting a past or future onto objects, thereby creating a distinct narrative that separates them from earlier subjects of history (Jameson 1991). In this way, a triumphant middle class and its fetishization of manufactured objects can project an idealized past onto itself, through its obsolesced cultural products. Jameson (1991) argues that this kind of nostalgia has been emptied of any real meaning, but this dismissal overlooks the fact that it is through the sentimental lens that wishes, past and present, are made visible. Further, the productive practices of salvaging and showcasing keepsakes, such as the collecting and repurposing of otherwise dead objects signal a yearning to access memory by material means. As Stewart observes of such objects, “Only the act of memory constitutes their resemblance. It is in this gap between resemblance and identity that *nostalgic desire* arises” (Stewart 1984: 145). This nostalgic desire, she argues, is essentially driven by a vague sense of loss. It persists as “a sadness without an object” in which sentiment is transferred to objects in lieu of a more appropriate relocation of emotion (23). This vague sense of loss of something unknown is likely due to an increasing tendency toward present-mindedness in a world of immediate connectivity and rapid technological change. In particular, Innis' warning that as media collapse the time bias (by becoming instant), they extend across space, expanding the reach of power structures and cultural dominance to the outer margins of the empire, which today is essentially a global entity (Innis 1991). This imbalanced ratio in power along the axes of space and time induces this present-mindedness, which is a fixation on the present and immediate future with little knowledge drawn from the past, and little investment made toward the future (Acland 2007; Innis 1991). That gap in knowledge about the past drives nostalgic desire because it serves as an access point to an elusive "pastness," and in the context of collecting dead media and digital objects, buying and salvaging dead objects provides access to an imaginary past via the gratification of consumption. Nostalgic material practices are not just gratifying; they signify a great deal about the social construction of objects when they were new, as well as in the afterlife of obsolescence.

Pre-digital Nostalgia: A love for the analog

As digital media technologies such as gaming consoles, laser disks, and compact disks (CDs) entered into mainstream consumer markets in the 1980's, they quickly dominated and largely replaced the extant analog technologies and carved out new markets that previously did not exist. For example, as CDs entered the music media market, they rapidly displaced cassettes, the lingering 8-tracks and, to the perturbation of many, vinyl record were relegated to a specialty niche market for diehards, professional DJs, and neo- luddites. Those resisting the music CD might have been labelled as luddites or connoisseurs of more "authentic" recordings since CDs generally lack the depth and richness of vinyl LPs. In other circles, mediaphiles might have preferred film over digital photography, or a typewriter over a word processing program. In the flow of technological advancements, resistance against the new can take the shape of a nostalgia for the old. But true nostalgia is not limited to a favouring of the old or a distaste for the new. Nostalgia is a neologism which combines *nostos* and *algos*, meaning a heartache for the home. It signifies a deep yearning for the past, or more precisely, for "pastness," which is a periodized and reductive essence or idea of an imagined and idealized past. Since the past cannot be recovered, the nostalgic collector projects pastness onto objects as representative of an inaccessible yesterday. These objects promise authenticity in that they were made without self-conscious irony and awareness in mind; rather, they offer a sincerity that the present lacks (Outka 2009). Nostalgia is a powerful signifying force because it operates on two levels. At one level, the memories and pastness are materialized onto things, and at another level, these projections of pastness must represent Otherness in relation to the present. A nostalgic object must represent or connote something fundamentally unlike the present or else the object slips into the grey void of obsolescence. These objects offer an aura of naiveté, they represent pastness itself (Hutcheon 1998).

Much has been written about a growing nostalgia for the pre-digital (See Davis 2007). Those longing for vintage vinyl records, rotary phones, dictaphones, gramophones, and so forth can find a bounty of artifacts in antique stores and garage sales where only a few years ago these might have been considered old, dead media fit for the trash. Such sentimentality is often driven by a longing to have a more tactile experience with media; to touch the medium, to see it on a desk or shelf, or because it seems authentic, personal, somehow more real than its digital successors. As Socrates dismissed Lysias' written speech in favour of the authentic and intimate exchange that could only be captured by speech, many collectors of older, pre-digital devices similarly tout the authenticity of the analog machine. In addition to offering a more tactile experience with technology (and the mastery that tactility may bring), much of the nostalgic embrace of the analog comes from memory, sentiment, and personal connection to dead media. As Doron Swade remarks, “We bequeath objects to posterity as vessels of partially decoded meanings.” (2000:139). It is through these objects that collectors can access a bit of their past and, more importantly, that these objects can produce an emotional rekindling of the same joy, optimism, or engagement that they once sparked.

I ❤Junk: Digital Nostalgia

Nostalgia for the *analog and pre-digital* has received a good deal of attention in media and cultural studies; however, little has been said about nostalgia for the old, *dead digital*, and this is the focus of the present discussion. Digital nostalgia, unlike that for the analog, is entirely new and it is emerging as a growing market as more young adults who “grew up digital” are seeking a connection to their digital past. Digital nostalgia presents a number of superficial, anachronistic dimensions and is tightly bound not just with memory, but with the digital myth. This myth is framed by novelty, immateriality, magic, special powers and wizard-like remote control or omniscient power (Pels 2010).

In the following sections I explore the two dimensions that may motivate nostalgic redemption of digital artifacts: longing for the new and the future, and a longing for materiality. There may be other motivations for salvaging dead digital things, but these four play upon the living digital object’s capacity to signify novelty, the future, and the immaterial and how these significations may be inverted and played upon in that object’s afterlife. In particular, I focus on a few examples of nostalgic redemption and repurposing in the following sections.

Nostalgia for the new and the future

Historically, digital technology has been framed as an materialization of "the future" and suspended in a state of eternal novelty, as is the case with the term "new media." Acland (2007) points to a particular moment in time—post-1994, to be precise—when the "new" of new media was thoroughly evacuated of any real meaning. After decades of overuse in a multitude of forms, from marketing copy to the christening of countless "new media" studies, labs, and departments, the term has become so overused that it means nothing other than to imply that some kind of digital technology might be at work at some level of coding or encoding. New media, as Acland argues, are pushing fifty years old and no other medium has ever declared itself new for so long. New media are perhaps only new in relation to themselves (i.e., new generations of products bearing new functional improvements), but cannot be fairly treated as new. Acland suggests that "If there is a resigning myth of media, it is that technological change necessarily involves the 'new' and consists solely of rupture from the past." (2007: xix). Or, put another way, new media breaks from the "old" media of the past, but it is disconnected from any sustained link to the future because it *is* the future. As soon as such media become familiar, their newness does not just fade, the entire value of the object degrades quickly into obsolescence. And here is where myth finds its place in the digital world. It is the "myth" of the new that sustains an entire economy of digital technology consumption. Newness itself makes for a mythical holy grail—untenable, fleeting, glimmering but always just slightly out of reach, like a moonbeam or a rainbow. Or, as Chun writes, "to call something new, after all, is to guarantee its obsolescence, and this hopeful return to the future as future simple… constantly recedes and disappears." (2011a: xii).

However fleeting this novelty may be, its elusiveness adds, rather than detracts, from the digital object's allure. In fact, it underscores the mythical qualities of the digital object. As discussed in the previous chapter, overproduction is the result of a sustained emphasis on novelty and innovation. As Acland writes, and this "overproduction helps sustain a gargantuan accumulation of materials, to be followed by increasingly intricate modes of accommodating leftovers." (2007: xvii). Amidst the ewaste piles are treasured "specimens" that collectors will salvage, repair, resell, and treasure like mementos. The new and the old operate as polar points on a compass, in a suspended state of tension with one another. As Miles Orvell points out, in America, piles of garbage represents both vitality and disorder, and from this tension arise artistic and emotional attachments to the stuff others have discarded (Orvell 1989). Technological garbage offers "the thing with history, the mass-produced object become individualized." (Orvell 1989: 287). As such, "The discarded object carries a semiotic richness ripe for appropriation." (Acland 2007: xvii). What may be appropriated from these dead objects is, somewhat ironically, their suspended newness. This may seem idiosyncratic, but digital objects embody novelty and this novelty can be recaptured after the object's obsolescence and the longer the object has been dead, the better. A dead digital object is clearly not new, rather it retains the power to connote past novelty and to recapture the memory of newness and all of its rich potential.

Newness and magic work in tandem. When a digital object was new, it promised magical solutions and new potential. Recall the sensation of receiving and setting up a new computer or upgrading to a new cell phone. That object offered endless possibilities which required only a little mastery before its magic could be revealed. Material culture scholar Peter Pels suggests that people may refer to computers as magical things that perform “magic,” or make the impossible real but instead of magic as divination, digital magic comes from “a material thing—a box wired with gadgets, chips, and batteries” (2010: 629). Pels argues that this comes out of a kind of folk theory and is both a product and reinforcement of a fetishized view of digital technologies. Pels attributes some of the myth of magical computing to a trend in 1980’s fiction and films in which skilled computer users were likened to wizards, and hackers to omnipotent masters of information and power, much like the film *War Games* in which a young teen’s hacking skills nearly prompt World War III. Early tinkerers, in this frame, were geek heroes who, like alchemists, might solder unremarkable computer parts into weapons that could start a nuclear war. The “nerd” finally had the potential to be omnipotent and feared or revered. It was the era of the radical geek, slight in body but rich in brains and promising potential—the geek would inherit the earth, after all. They were magicians who held intimate, secrete knowledge that could animate computing machinery into a digital golem. But the magic of the digital fades with its fleeting novelty, leaving behind the trace memory of the magical power that being a young computing savvy pioneer once had. Let’s look at a concrete example of nostalgia in practice. A few years ago I bought a Commodore VIC 20 at a thrift shop. The VIC 20 was a popular home computing console released in 1981 that was one of the first inexpensive household computers which could be connected directly to the user’s television presents little, if any utility today. The one I found at a local Salvation Army in Toronto in 2007 was a complete specimen in its original box with all of the original parts. It appeared to be barely used. I also managed to find a game cartridge for it at another thrift shop. I had never personally owned a VIC 20, so I had no claims to a personal memory of having used one, but nonetheless, the entire material package— the console, the box, the manual, etc.—represented futuristic potential and technological naïveté in its brown and cream aesthetic, its tiny memory capacity (3.5K of RAM), and most of all, it projects a distinct sense of a family-oriented investment in technological preparedness that was characteristic of the early 1980's. In other words, it was full of kinetic potential and promise as a family-oriented learning project in the home. The ad copy and packaging of the VIC 20 frames the family as a unit facing the computer age, together. It was a new thing on multiple levels in the sense that the VIC 20 represented the adoption of computing as a novel household practice. I set it up on my 52" plasma TV and its slow speed made it too irritating to use productively; however, whatever it lacks in utility is made up for in its nostalgic power. Its dissimilarity to contemporary computers is its new site of worth and fascination. Nostalgia, then, revives the dead object and breathes new life into it, one devoid of function but full of signifying power that recalls the moment and wonder of novelty from the past.

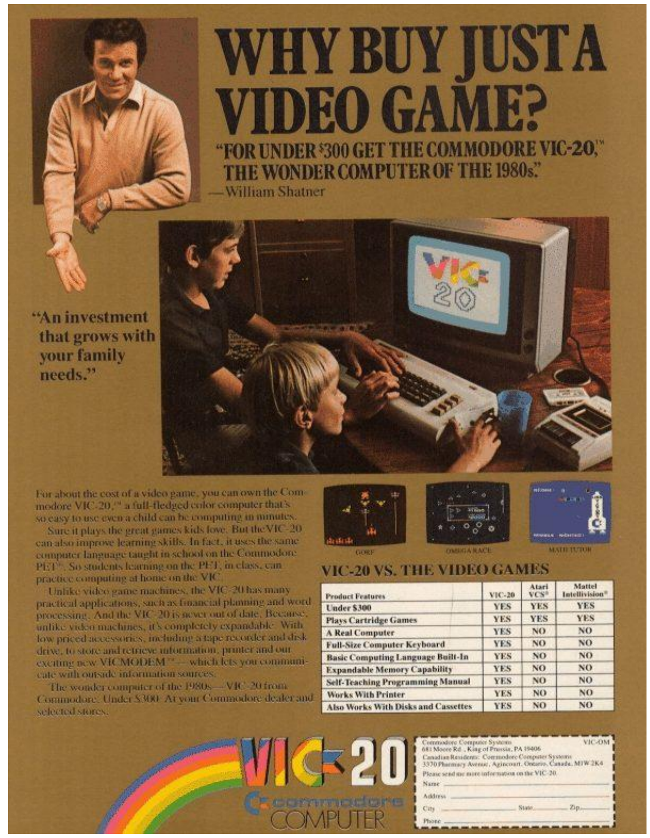

Figure 19: *(left)* VIC 20 ad from Canadian Tire, c. 1982 (commodore.ca); *(right)* VIC 20 ad emphasizing its gaming features for children (hatsrack.com).

High-tech goods like the VIC 20 were, and still are, marketed as the bridge between the present and the technologically advanced future. But because one can never actually arrive at the future, it persists only as a stylistic trope, suspended permanently in a sea of possible outcomes that morphs over time in step with contemporary aesthetic conceptions of the future. When confronted with the present, past projections of the future seem so much more appealing. These are the conditions that evoke nostalgic sentiments for older, obsolesced objects. The collector seeks to recapture that promise of a bright, digital future full of possibilities.

Figure 20: So many possible futures with computing. (Scanned from *The World of Tomorrow: School, Work and Play* (c. 1981), from thepointlessmuseum.com, n.d.)

Figure 21: The Mac Cube and Cube G4 (2000-2001), designed to be semi-transparent embody the dematerialized aesthetic. While on one hand the transparent casing seeks to convince the viewer that opaque materials have been erased, the materials that are visible are sealed and neutralized in a minimalist and mute aesthetic. This design might have seemed radical when compared to the metal and PVC CPU casings of the previous two decades, its radical aesthetic did not just revamp CPU packaging, it sought to dematerialize and erase computing hardware from the visual plane.

It has become commonplace to see analog and early digital media objects in particular (typewriters, rotary phones, Nintendo and Atari gaming systems, and so forth) surfacing in antique shops and flea markets. Dead media objects have become what may be called a *semiaphore*: these are “objects which do not have, or no longer have, a general practical use… but which, being endowed with meaning, represent the invisible” (Buchli 2002: 6). The invisible may represent one’s own past or it may represent a collective sense of a past that was filled with the excitement of almost reaching “the future” through digital technology. Objects that can be revived through nostalgia, however, are framed anew and their materiality is a key site for signification. Unlike the new digital object that seeks to diminish, erase, or deny its own materiality, the nostalgic object calls upon its materiality and reveals it with sentimentality. Take, for example, Apple’s Mac Cube series. These computers were fairly radical in form when they were released in 2000. The transparent chassis seeks to minimize its material presence and emphasize immateriality. They are designed to be nearly invisible and, failing that, they seek to confirm that some portion of their materiality can be denied through transparency, while other parts are concealed in white, mysterious boxes. They are at once visually transparent but operationally opaque (see Figure 21). They embody dematerialization.

Now obsolete, they have been revived through a nostalgia that recaptures a personal association with the objects and a ludic and very material re-representation of their former immateriality. The Mac Cube’s transparency is playfully inverted as its clear cavities are often repurposed into fish tanks, lamps, and various other household containers. Such repurposing plays upon the evacuated meaning of transparent space. When new, transparency might have seemed novel, radical, even mysterious. After the object’s death, that same transparency is framed to showcase its "thereness" and materiality. Thus, in obsolescence, nostalgia and creative repurposing reframe the object's materiality, bringing it to the forefront of the object's presence while simultaneously mocking its naïve dematerialized aesthetic. After all, Davis (2007) reminds us, obsolescence is a "discursive construction that involves the technological aspects but is not necessarily determined by them; rather, whether a medium is obsolete depends largely on its status as shaped by structural forces" (224).

The nostalgic technological artifact is not just a trace of the dead. There has been a recent trend, particularly in the gaming and music industries, of retrograding technologies to analog or early digital standards. Video game manufacturers have re-released versions of their late 1970's and early 1980's gaming consoles, replete with single button joy sticks and crude, blocky graphics. Why would any consumer with a modern sound system or a large plasma television want to connect their digital systems to these retrograde apparatuses? In truth, most of the retrograde devices are not manufactured in the same manner as their true analog forbears. For example, the retro Atari Flashback 2.0 system offers the original ASCI processing system whose computing power would be dwarfed by a modern digital egg timer.

Figure 22: The Atari Flashback (*left)* and original 1977 Atari system *(right)*.

In fact, the first version of the retro Atari system looked like an original 1977 (Figure 22) console but contained a processor from 2004. Fans were disappointed by the lack of authenticity of the inner workings of the console, hence Atari released version 2.0 which promised authentic retrograde equipment under the hood, so to speak.[48] Essentially, buyers of this product were purchasing 1977 computing technology manufactured in 2005 and 860,000 units were sold in the first year of its release (Wen 2007). The appeal of these objects lies in their nostalgic power to engage adults in their thirties and forties who have fond memories of playing an original Atari system. The game console, however, is not just a sentimental throwback to one's misspent adolescence. The system captures an essence of early video gaming when the medium was new, bursting with potential and promise. The gamers who grew up on the Atari were among the first home video game players, it was a distinct badge of their generation; they were the trailblazers in the coming digital revolution. The Flashback 2.0 is a simulacrum of the original system, to use Baudrillard's (1994) term. It simulates the form of the original, but is loaded with connotative meaning about the "1970's" as a totalizing period which can be reduced to the material experience of playing with an old, obsolete system. The original 1977 Atari 2600 lacked irony about its own form, it was after all, new at the time. Perhaps the nostalgic sentiment attached to the Flashback is the expression of a wish—to go back to a time when the future of the computer was bursting with romantic possibilities and "new" really meant new, and players could feel that they were engaging with a novel and somewhat elite kind of technology on the cutting edge of an

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[48] The main difference between the original Atari 2600 and the Flashback 2.0 is the inclusion of the games within the console, eliminating the need for single game cartridges. This was a change probably designed to make this a single-purchase product. Nostalgic items are often impulse buys.

unknown future. The advertising tagline, "*The future is here*" has been attached to a number of marketing campaigns for emerging digital technologies; for example, it was the Mac OSx slogan in 2001. If the future is here, there is nothing to look forward to but the past, when *the future* was still out of reach. As Baudrillard posits, "When the real is no longer what it was, nostalgia assumes its full meaning." (1994: 6). In this sense, the "realness" of the present (and the discomfort it entails) is emptied out, and nostalgia fills the void. However, despite the drainage of real memory and meaning in nostalgic objects themselves, new idealized meanings offer a simpler, if synthetic, past. Nostalgia for the "real" is projected onto the dead, discarded digital object.

The Atari retro console also appeals to a tactile pleasure. It allows the user to feel and touch "the past," to collect and use bulky cartridges, to recapture the material tactility of older systems. The things that were once material inconveniences such as wired joysticks, large cartridges that often needed to be blown on to work, and crude, single-purpose buttons seem grounded and simple compared to contemporary systems that have endured years of streamlining and dematerializing. For the gamer who grew up on Atari and other early consoles, the retro systems is the old-fashioned and "authentic" way to play. It is the digital generation's proverbial "5-mile walk in the snow to school," so to speak. The very arduousness of using an obsolete system is a way to access the intrinsic materiality of the digital that had been concealed when the object was new. It is only through its obsolescence and re-emergence that the materiality is not only tangible, but desired.

There has also been a recent trend in which artists incorporate "Lo-Fi" early digital technologies into their creative practices. In this vein of creative retrograding, musicians integrate early digital sounds, like those derived from 1980's video games, or use otherwise obsolesced synthesizers in their music. For example, the bands (The Islands, Crystal Castles, to name just two) use samples and synthesizers to serve two purposes. On one level, the use of 1980's and early 1990's sound samples creates a "retro" feel and appeals to an ironic aesthetic, on another level, the use of obsolesced technologies in an age where computer-generated effects are otherwise very good puts a creative limitation of the work, often forcing more original and creative outputs. The self-imposed use of old technology and refusal to incorporate newer, Hi-Fi technologies may generate a greater sense of authenticity. This is an ironic turn given that in the 1980's, the use of synthesizers instead of real musicians and instruments was viewed as a kind of technological indulgence which threatened authenticity (Maier 1999). Today, the use of low-quality, low tech synthetic sounds is cast in a nostalgic light as it evokes the novelty and originality of the first uses of digital sounds. Because we have become so accustomed to digital effects in sound and visual media, we've become less likely to critique those effects as artificial and inauthentic and it is precisely this habituation that makes room for a nostalgic embrace of early synthetics because they no longer appear inauthentic, rather, they take on the air of naïve pioneers and trailblazers.

Nostalgia for Materiality

Dematerialization is rendered visible through a historical lens. Consider the images below in Figure 23.

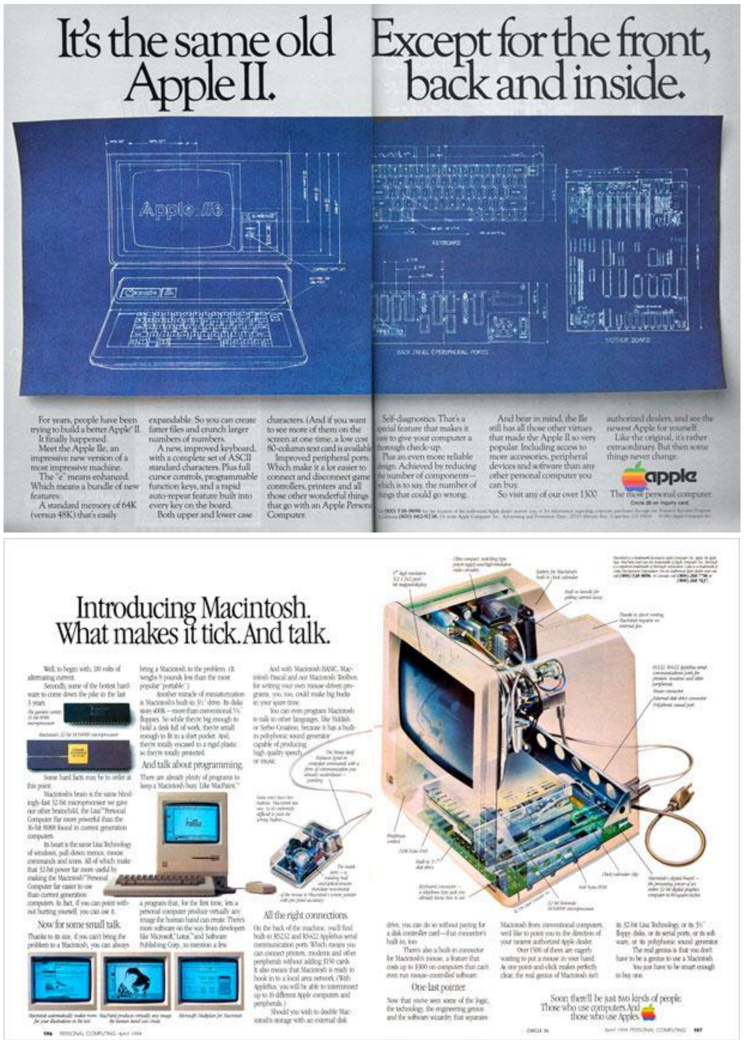


Figure 23: Ads for the Apple II *(above)* and Apple Macintosh *(below)*, note the emphasis on the inner parts.

Consider that, as Kirschenbaum writes, "…even the modest temporal distance [of a decade] serves to defamiliarize certain key cultural aspects of computing, for example, storage technologies and disk handling practices differ markedly from what is the norm today…" (2008: 8). Today, average household computer users likely have little interest in learning how a hard drive works and graphical interfaces such as Windows have eliminated the need for a working or intimate knowledge of computing materials. "In 1981, the Apple II DOS Manual began by telling its readers that it would teach them 'how to use the [hard] disk,' an injunction that surely seems strange in the wake of two decades of ubiquitous and largely invisible hard drive storage."

(Kirschenbaum 2008: 8). The success of "user friendly" devices precludes material comprehension; one needs only to navigate choices and menus to use a computer effectively today. Thus it would appear that material comprehension was at odds with developing mass-market level ubiquity and the computing experience was foreshortened to a familiarity with the interface-as-computer, rendering the rest of the hardware invisible and inaccessible since it might have appeared to be too intellectually demanding of average users. However, it is precisely this acknowledgement of materiality that provokes a nostalgic impulse in that the vintage computer, like the Apple II reminds the collector of a time when material comprehension was a part of the process of incorporating computers into one's home, life, and life-world. An Apple II, particularly if it was the owner's first home computer, required a set of new material accommodations that may not have already had a place either in the physical and social arrangement of the home. For example, the computer would have needed a place in the home, in the owner's financial plans, rules for the use of the computer, particularly if there were children in the home, and so forth. As such, a sense of how to use the material components of the Apple II, including its hardware, is a natural assumption since its entire material presence as a new addition needed to be addressed so that it could be integrated into one's life-world. It required total material integration into a life that may have had little previous experience with computing. The Apple II manual shows us how far we've come, not in terms of our improved familiarity with computers (while this is true), but rather it shows us that a physically-grounded comprehension of computing has been largely removed from engagement altogether for the sake of mass-consumption and "accessibility" as few manuals today would promise to familiarize the reader with their new machine's inner workings (see Figure 24). Furthermore, what on the surface may appear as a collective gain in tacit experience with contemporary computers (in contrast to the Apple II) might actually be evidence of years of systemic dematerialization, disguised as improvements in "user-friendly" and plug-and-play design. As a nostalgic artifact, the Apple II reminds the collector of a time when such knowledge had value; it offers a quaint, naïve, and simple recapturing of a lost material experience with computing.

Figure 24: An ad for the Commodore PET computer (1977), showing off its inner workings as a selling point.

Chapter Conclusion

Drawing from thing theory, Brown suggests that nostalgia allows the technological object to be "released from the bond of being equipment, sustained outside the irreversibility of technological history, the object becomes something else." (2004: 15). What it becomes is what it never was: historically and materially grounded. In death and obsolescence, digital nostalgia create historicity. By collecting dead digital objects, a visible timeline may be assembled that suggests order, progress, successes and failures, the familiar and the profane in material form. As Brown suggests, the dead digital object "transforms a dead commodity into a living work and thus shows how inanimate objects organise the temporality of the animate world." (2004: 15).

For Jameson, our relationship to the present is defamiliarized therefore creating a distance that allows us to view ourselves best from a historical perspective (Jameson 1991). If our present conception of digital technology is dematerialized, then perhaps we seek to recapture materiality through the harvesting, collecting, and preserving of old digital devices whose thingness, now visible and approachable, is finally tangible, if only through the frame of its "pastness." An old digital object like the Atari gaming console can now be approached productively as an artifact, a memorial, a tangible thing with hard components which stands in contrast to the dematerialized digital present which cannot yet embrace its material boundaries and limits because the pervasive dematerializing of the digital prohibits such an understanding. To this point Jameson suggests that we reify the past and withdraw from our present, hence periodizing our sense of history and reducing it to a thing, or a commodity unto itself (for example, a totalizing conception of the "1980's"). Old digital objects serve this purpose very well because when they were new they were loaded with the promise of technological possibilities but these possibilities are instantly emptied out and revealed as hollow at the moment of obsolescence, creating a rapidly cycling pattern of promises and disappointments. This condition is somewhat unique to digital objects because of their futuristic and novel imperative. The fact that the *new* digital or electronic objects of the 1970's and 1980's would soon be rendered useless, outdated garbage is antithetical to the very nature of digital objects, so it seems all the more ironic that these obsolesced objects would be resurrected as nostalgic collectables. It is only through nostalgic redemption that digital objects may be more truthfully framed as always already old. This irony, a hallmark of late modernity (see Hutcheon 1994), drives the nostalgic impulse, actively seeking to rematerialized the dematerialized by productively redeeming the aging “always already new” digital object.

Conclusion

This dissertation sought to explore the processes of dematerialization of digital technology through an examination of four possible states or afterlives of obsolesced objects. It is in these afterlives that the digital object's material nature is suddenly revealed and problematized. Digital objects are unlike other objects in that they defy "thingness." A pervasive and unchallenged rhetoric of immateriality, ubiquity, and reduced size and substance has created a false construction of the digital object as a non-material entity. This pervasive myth of immateriality is complimented by planned obsolescence and an overvaluing of novelty which together drive the consumption of digital goods. Any critique of consumption practices are counteracted by the myth of immateriality, further quelling any misgivings about a mounting accumulation of problematic ewaste or about inhumane or environmentally detrimental raw material procurement practices. As this dissertation argues throughout, digital objects are socially constructed as immaterial, non-things without physical properties or material ramifications. It is only when we dissect and critique the many processes of dematerialization that we can see that not only are these objects indeed material, but that the myth of the immaterial digital is extensive, pervasive, and ultimately corrosive. As Brown (2004) argues through the lens of thing theory, the thingness of an object is often only visible when that object becomes problematic; in his words, "the thing badly encountered." (5). In this dissertation, these bad encounters may be particularly pronounced after the object's obsolescence. When in use, the digital object's aura of immateriality is suspended by a matrix of rhetoric, marketing, and myth but in obsolescence and death, these frameworks give way to the concrete realities of material presence. In Chapter 1, I explain that at the Computer History Museum in Mountain View, California, I witnessed the problematic framings of dead digital objects on display in a museum setting. Unable to perform in a meaningful way, these mute, inert artifact depend heavily on a narrative of computing history which emphasizes heroic invention, lone geniuses, American values, and the systematic elimination and concealment of women from production processes. In Chapter 2, I explored the dematerialization of digital technologies as it occurs through and may be revealed by the two-fold relationship of language and rhetoric and how digital objects are dematerialized through metaphors. But some metaphors, when taken literally, may spark anxiety. For example, the metaphor "cloud computing" implies immaterial memory and transfer of information. This in turn seems volatile and vaporous. It is innovative yet threatening as it implies that our data is everywhere and nowhere at once, like a fog. It evokes anxiety which compels the curious and repels the wary. We have witnessed a long history of media-related anxiety, first expressed in Plato's *Phaedrus* dialogues and revisited in the wake of "new" digital media. Given that our civilization embraces and values an endless reduction of computing materials in our digital goods, our rhetoric about the digital similarly favours a rhetorical emphasis on immateriality. This pervasive emphasis creates metaphors of immateriality which further distort and conceal the digital object's real material boundaries. In Chapter 3, I discussed the ways in which planned obsolescence and novelty serve to create an ewaste crisis which is further concealed through a variety of technologies and global flows. Ultimately, when rendered as garbage, the materiality of digital computing becomes its most problematic. As such, complex systems of rhetoric, waste management, and political maneuverings are set in place to support the myth of dematerialization so that the quickening pace of consumption is maintained. Finally, in Chapter 4 I presented the notion of digital nostalgia, a site at which the digital object's materiality is reframed as emotionally evocative and celebrated anew, only after its obsolescence.

This dissertation applied three methodological frameworks in order to both explore the difficulties inherent in assessing digital objects as things and to approach their "thingness" by dispelling the myth of dematerialization. In particular, media archaeology provides a useful object-oriented template for media analysis. The field resists the more common subject-oriented lenses that are more widely applied in communication and cultural studies (i.e., 'new historicist' critiques, such as those derivative of Marxist and Foucauldian schools of thought [Huhtamo & Parikka 2011]). As Law writes, "Foucault's interest in the processes of decomposition, recomposition, normalization, and self-monitoring that enact modern subjectivities is well known. However, the modern episteme can also be seen as a strategy that tends to generate specific versions of materiality." (2010: 182). Social actions and human practices lead to a "mode of mattering" through processes of what Law calls rationalization, or ways in which things are incorporated into ontological practices and systems. Media archaeology seeks to address these processes of rationalization. In the present project, dematerialization represents this process of rationalization, as our ontological practices and treatment of digital objects deny and systematically conceal their materiality. As a method, media archaeology allows researchers to forensically inspect the dead object to reveal those powerful albeit flawed rationalizations that are distorted in life, but become apparent in the afterlife. Similarly, an examination of the rhetoric of the dematerialized digital object allows one to identify the pervasive mythologizing of the digital which is reinforced through language and which reinforce our ontological engagement with those myths.

Material culture studies also inform this project, as it is necessary to engage with digital objects as key characteristic and emblematic material artifacts of our age. While a few studies have positioned digital technologies and their manufacturing cultures within an archaeological framework (e.g., Finn 2001), none has identified and treated digital hardware as a material cultural artifact. This dissertation seeks to lay the groundwork for such an investigation by first foregrounding the digital object as an object, which enforces and underscores a materially grounded approach to an object that is generally barred from being treated as a material *thing.* Material culture methods and critiques provided some of the theoretical background for this project, particularly in the context of the digital object as museum artifact. The works of key material culture scholars (e.g., Law 2010; Macdonald 1998) were used here as a guide for the examination of digital objects as artifacts in the museum setting.

Finally, thing theory, which is a subset of material culture studies, provided a philosophically informed methodological framework for this study. It is through thing theory that the problematic object is approached and critically assessed. Thing theory is productive as a method because it enables a broader scope of thing analysis which incorporates the broader networks (Latour), constellations (McLuhan), and vibrancy (Bennett).

Together, these three methodological approaches provide an object-oriented framework with which to engage with digital objects as things, rather than as merely platforms for content or as vehicles for economic modelling. The use of only one of these methods would not have provided the multidimensional approach that this project required given that the work seeks to engage with a variety of lenses ranging from philosophy and semiotics, to anthropological and sociological theories.

Limitations

This study was limited by a number of factors. When first developed, the research plan had included a detailed discourse analysis of the ways in which early computer engineers spoke of computing materials. The archives at the Lemelson Center at the Smithsonian Institute and at the Computer History Museum both provided insufficient materially-oriented discourse to make this a fruitful endeavour. I acknowledged this deficit in Chapter 1; however, in the future, I would like to revisit the topic of discourse and materials in a more exploratory context.

The project was also limited in its exploration of an object's afterlife. I have addressed only a few here, but other afterlives such as a creative redemption of digital waste would be an interesting and exciting path. Since the use of digital hardware and art is a broad topic with many fine examples, there isn't sufficient space to explore the topic in depth here.

Looking Forward

As discussed previously, new media and digital technologies are no longer new and after half a century of development and diffusion, it is time to move beyond a celebration of novelty and wonder and to approach these media as the concrete, material things that they are. Dematerialization is a destructive force as it decouples consumers' engagement with digital objects from a holistic understanding of the material processes and properties that make these technologies possible. This includes an understanding that incorporates a sense of the material origins of their goods and what happens to them once they are deemed obsolete. A holistic understanding also includes an embrace of productive historicity of digital technologies and while projects like the Computer History Museum and the Lemelson Center are active in this endeavour, the history of computing would benefit from a critical and creative view of its own past rather than its current narrow and idealized narrative that privileges novelty, ingenuity, and the design imperatives “smaller-faster-smarter” that drive planned obsolescence and dematerialization.

Finally, future explorations might include an engagement with the numerous and emerging collaborative projects between engineers, artists, and theorist which broach the topic of digital materiality. Some such projects include Matsuko Yokokoji and Graham Harwood’s (2011) Coal Fired Computers (http://yoha.co.uk/cfc/) in the UK, and creative gaming applications which bring the detrimental costs of digital hardware to the fore (see “Phone Craft,” a gaming app which depicts Congolese children mining coltan at gunpoint, phonestory.org 2011). These creative interventions seek to reveal the human and environmental costs of digital hardware production and disposal and as grassroots movements, they are among the first groups to actively dismantle the myths of digital immateriality through artistic and interactive projects. Not surprisingly, the Phone Craft app was banned by Apple, underscoring the threat that such interventions pose to the computing industry. I could not effectively engage with these types of groups and their work in this dissertation, I do, however plan to explore these and others in future projects.

POSTSCRIPT

As the market for mobile digital technologies becomes increasingly awash with similar products offering only marginal differences, advertisers may be turning toward a new, materially grounded platform to differentiate one product from another. For example, a recent television advertisement for the Dell XP13 Ultrabook depicts a laptop being built from the inside out as the material qualities of the interior materials are described in detail. The benefits of the silicon body, its ultra-tough “gorilla glass” screen fabricated by Corning, and other material components are explained to the viewer (see Dell.ca). And while the laptop’s thinness and computing power are mentioned, the ad’s emphasis is on the material components as they are depicted from the inside out. This ad is unique and is evocative of the early 1980’s ads which showcased the computer’s innards to both impress those in the know, and to prove that the home computer was more than an expensive box. It is unclear if the ad was commercially successful, as the laptop was still on store shelves at the time this dissertation was written but nonetheless it does indicate a renewed interest in treating digital products as material things with material qualities that may be gauged against material values (i.e., the quality and durability of the gorilla glass, the heat-resistant silicon base which makes it more comfortable to use in one’s lap, and the product’s overall durability and resilience should it be dropped or knocked about). Perhaps the speed and computing power of consumer laptops is reaching a ratio of maximum efficiency against cost, and perhaps consumers are inclined to learn of the material properties that make one product more advantageous than another, or perhaps consumers have dropped and broken enough laptops to recognize their own devices as a "thing badly encountered." Nonetheless, this ad may mark the beginning of a return to a recognition and evaluation of materiality in digital objects. The ad, however, still leaves much materiality out of the picture. No mention is made of from where or by what means those materials are made, nor of its end-of-life materialities as harder, more durable materials could reasonably imply a more arduous and toxic dismantling process. Ideally, the next decade will bring a greater mindfulness of digital materials to the forefront of both consumer advertising and ewaste awareness campaigns so that consumers may develop a more productive critique of their own engagement with digital products.

Appendices

Appendix A

Monolithic parts are solid state semiconductors, meaning that the materials perform like gates or switches that allow a current to pass through the material (literally conducting or resisting electrons as they jump from atom to atom in the chip [Kean 2010]). When an electric current is passed through the material, it can be manipulated to amplify or resist the current. Transistors were quickly adopted and applied to a variety of technologies, particularly radios because they allowed for small portable units with significant amplification power. The US military also took an interest (and made significant funding investments) in transistors as they were seeking small, portable, and reliable technologies to augment missiles, space exploration and other weaponry which required accurate remote control (Reid 2001).

Appendix B

Apple's Environmental Communications

Appendix B presents a direct excerpt from (http://www.apple.com/environment/), Retrieved February 28, 2012.

Toxic substance removal.

Designing greener products means considering the environmental impact of the materials used to make them. From the glass, plastic, and metal in our products to the paper and ink in our packaging, our goal is to continue leading the industry in reducing or eliminating environmentally harmful substances.

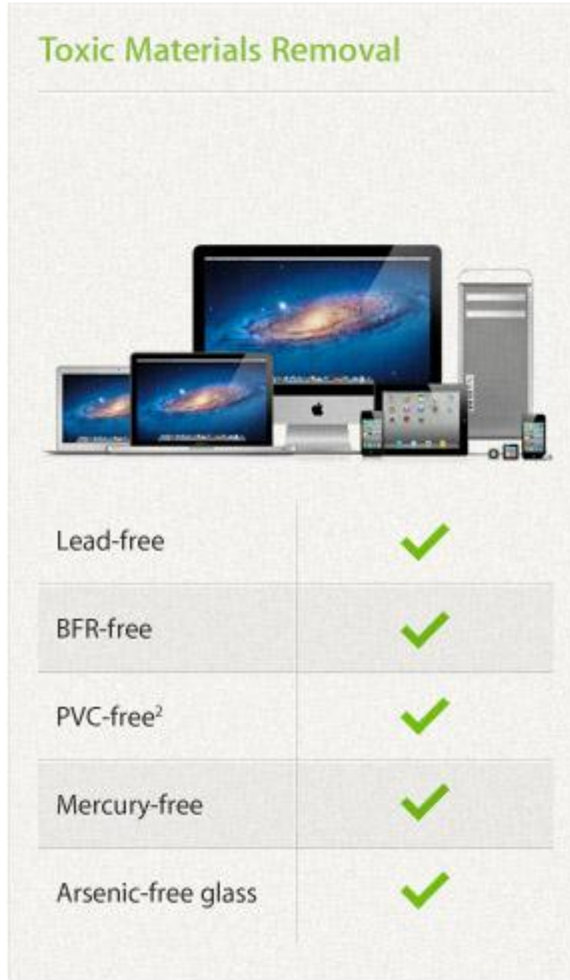
One of the environmental challenges facing our industry today is the presence of toxic substances such as arsenic, brominated flame retardants (BFRs), mercury, phthalates, and polyvinyl chloride (PVC) in products. Although most countries still allow use of these substances, we have worked with our manufacturing partners to eliminate them from our products. Not only is every product we sell free of BFRs and other harmful toxins, we have also qualified thousands of components to be free of elemental bromine and chlorine, putting us years ahead of anyone else in the industry. In addition, every display we make — whether it's built into a system or available as a stand-alone — features mercury-free LED backlighting and arsenic-free glass.

Environmentally conscious materials.

In addition to eliminating toxins and designing products with highly recyclable aluminum enclosures, Apple works with environmentally conscious materials including recycled plastics, recycled paper, biopolymers, and vegetable-based inks. We have also found ways to reengineer secondary materials to the high standard of our designs. For example, our fan assemblies use advanced materials derived from repolymerized plastic bottles. And millions of speaker assemblies and internal brackets are now made from recycled PC-ABS. Our packaging designs use pulp fiber from post-consumer paper streams, and we use vegetable-based inks for our product user guides. Millions of iPhone packages are made from renewable tapioca paper foam material. And iTunes gift cards are made from 100 percent recycled paper.

Material use.

Over the past decade, Apple's designers and engineers have pioneered the development of smaller, thinner, and lighter products. As our products become more powerful, they require less material to produce and generate fewer carbon emissions. For example, although today's 21.5-inch iMac is more powerful and has a much larger screen than the first-generation 15-inch iMac, it is designed with 50 percent less material and generates 50 percent fewer emissions. Even the iPad became 33 percent thinner and up to 15 percent lighter in just one generation, producing 5 percent fewer carbon emissions.



Responsible manufacturing.

Apple is committed to ensuring that working conditions in our supply chain are safe, workers are treated with respect and dignity, and manufacturing processes are environmentally responsible. View our Supplier Code of Conduct as well as our supplier audit reports at the Supplier Responsibility site.

Apple's attention to product design has led to significant reductions in carbon emissions compared with previous-generation products — even though new products are more powerful than ever.

Our entire product line — Mac, iPod, iPhone, iPad, and accessories — is free from many toxic materials.

APPENDIX C

McLuhan’s tetrad which proposes the obsolescing effects of the computer.

			COMPUTER
“…you tell me what it is you say the computer can’t do and I’ll build you one that will do it …” (harried designer)			General systems
	[enhances] Speeds of calculation and retrieval	**[reverses] Anarchy via the overlay of bureaucracy**	
	[retrieves] Perfect memory – total and exact	**[obsolesces] Sequence, approximation, perception, the present**	
Projections of present as future, of future as present: retrieval of now as alltime			Obsolescence of hardware via the new etherealizing speeds and sizes, e.g., micro-dot library; minute programs

Modified from McLuhan & McLuhan, *Laws of Media*, (1988: 188-189).

BIBLIOGRAPHY

Acland, Charles R. 2007. *Residual Media*. Minneapolis: University of Minnesota Press.

Adorno, Theodore. 1973. *Negative Dialectics*. New York: Continuum.

Akrich, Madeline. 1992. "The De-scription of Technical Objects." In *Shaping Technology/Building Society Studies in Sociotechnical Change*, ed. Wiebe E. Bijker and John Law, 205–223. Cambridge, MA: MIT Press.

Anane, Mike. 2009. "Mike Anane Interview, Silicon Valley Toxics Coalition." http://svtc.org/tag/mike-anane/

Anonymous. n.d. "How It Works... The Computer." http://www.pointlessmuseum.com/museum/howitworkscomputerindex.php

Anonymous. 2007. "The Victorian Computer: The Babbage Difference Engine." *Core* Spring/Summer: 29.

Appadurai, Arjun, ed. 1986. *The Social Life of Things*. Cambridge, UK: Cambridge University Press.

Apple. 2012. http://www.apple.com/environment/

Apple Insider. 2010. "Review: Apple's Aluminum Mac Mini and Mac Mini Server." http://www.appleinsider.com/articles/10/07/07/review_apples_aluminum_mac_mini_and_mac_mini_server_2010.html&page=4

Babbit, Callie W., Ramzy Kahhat, Eric Williams, and Gregory A. Babbit. 2009. "Evolution of Product Lifespan and Implications for Environmental Assessment and Management: A Case Study of Personal Computers in Higher Education." *Environmental Science & Technology* 43 (13): 5106–5112.

Bal, Mieke. 2002. *Travelling Concepts in the Humanities: A Rough Guide*. Toronto: University of Toronto Press.

Barthes, Roland. 1982. *Empire of Signs*. New York: Hill and Wang.

Basel Action Network. 2012. http://www.ban.org/

Baudrillard, Jean. 1981. *For a Critique of the Political Economy of the Sign*. St. Louis, MO: Telos Press.

Baudrillard, Jean. 1999. *Revenge of the Crystal: Selected Writings on the Modern Object and Its Destiny, 1968-1983*. Ed. Paul Foss and Julian Pefanis. Concord, MA: Pluto Press & University of Sydney.

Baudrillard, Jean, and James Benedict. 2005. *The System of Objects*. New York: Verso.

Benjamin, Walter, and Rolf Tiedmann. 2002. *The Arcades Project*. Cambridge, MA: Belknap.

Bennett, Jane. 2002. "Thing-Power: Toward and Ecological Materialism." In *American Political Science Association*. Boston.

Bennett, Jane. 2010. *Vibrant Matter: A Political Ecology of Things*. Durham, NC: Duke University Press.

Birkerts, Sven. 1994. *The Gutenberg Elegies: The Fate of Reading in an Electronic Age*. Boston: Faber and Faber.

Blondie. 1979. *Die Young, Stay Pretty*. (Lyrics by Debbie Harry and Chris Stein). EP. Eat to the Beat. Chrysalis.

Bogost, Ian, and Nick Montfort. 2009. "New Media as Material Constraint: An Introduction to Platform Studies." In *Paper Presented to Digital Arts and Cultures*. University of California, Irvine, CA.

Bolter, J. David, and Richard Grusin. 1999. *Remediation: Understanding New Media*. Cambridge, MA: MIT Press.

Bourdieu, Pierre. 1977. *Outline of a Theory of Practice*. New York: Cambridge University Press.

Brandstötter, Rudolf. 2012. "Alker33 – Vintage Computing | the Adventures of a Vintage Computer Collector." http://alker33.wordpress.com/

Brody, Florian. 1999. "The Medium is the Memory." In *The Digital Dialectic*, ed. P. Lunenfeld. Cambridge, MA: MIT Press.

Brooke, Collin Gifford. 2009. *Lingua Fracta: Toward a Rhetoric of New Media*. Cresskill, NJ: Hampton Press.

Brown, Bill. 2004. "Thing Theory." In *Things*, ed. Bill Brown, 1–16. Chicago: University of Chicago Press.

Buchli, Victor. 2002. *The Material Culture Reader*. Oxford, UK: Berg.

Buck-Morss, Susan. 1989. *The Dialectics of Seeing: Walter Benjamin and the Arcades Project*. Cambridge, MA: MIT Press.

Bush, Vannevar. 1991. "Memex Revisited." In *From Memex to Hypertext*, ed. James M. Nyce and Paul Kahn, 197–216. Boston: Elsevier Science/Academic Press.

Bush, Vannevar. 2001. "As We May Think." In *Reading Digital Culture*, ed. David C. Trend, 9–13. Malden, MA: Blackwell.

Campbell, Colin. 1992. "The Desire for the New: Its Nature and Social Location as Presented in Theories of Fashion and Modern Consumerism." In *Consuming Technologies: Media and Information in Domestic Spaces*, ed. Roger Silverman and Eric Hirsch. London: Routledge.

Candlin, Fiona, and Raiford Guins, eds. 2009. *The Object Reader*. New York: Routledge.

Carey, James. 1997. "The Roots of Modern Media Analysis." In *James Carey: A Critical Reader*, ed. Eve Stryker Munson and Catherine A. Warren. Minneapolis: University of Minnesota Press.

Carson, C. 1978. "Doing History with Material Culture." In *Material Culture and the Study of American Life*, ed. I.M.G. Quimby, 41–64. New York: Norton.

Ceruzzi, Paul E. 2003. *A History of Modern Computing*. Cambridge, MA: MIT Press.

Chouliaraki, Lilie, and Norman Fairclough. 2002. *Discourse in Late Modernity: Rethinking Critical Discourse Analysis*. Edinburgh: Edinburgh University Press.

Chun, Wendy H.K. 2011a. *Programmed Visions: Software and Memory*. Cambridge, MA: MIT Press.

Chun, Wendy H.K. 2011b. "Enduring the Ephemeral, or The Future is a Memory." In *Media Archaeology: Approaches, Applications, and Implications*, ed. Erkki Huhtamo and Jussi Parikka, 184–205. UC Press.

Chun, Wendy H.K., and Thomas Keenan. 2006. *New Media, Old Media: A History and Theory Reader*. New York: Taylor & Francis.

Chung, Chien-Min. 2009. "China's Electronic Waste Village - Photo Essay." *Time*. http://www.time.com/time/photogallery/0,29307,1870162_1822158,00.html

Commodore, and Up & Running Technologies Inc. 2011. "Gallery." http://www.commodore.ca/gallery/adverts_other/adverts_other.htm

ComputerHistory.org. http://www.computerhistory.org/press/babbage-engine-extension.html

Computer History Museum (CHM). "Visible Storage Room," archives and display. [Museum]. Visited March 2009.

Connor, Steven. 2009. "Thinking Things." http://www.stevenconnor.com/thinkingthings/

Dant, Tim. 1999. *Material Culture in the Social World: Values, Activities, Lifestyles*. Buckingham: Open University Press.

Das, Mitras, and Shirley Kolack. 2008. *Technology, Values, and Society*. New York: Peter Lang Publishing.

Davis, John. 2007. "Going Analog: Vinylphiles and the Consumption of the 'Obsolete' Vinyl Record." In *Residual Media*, ed. Charles R. Acland, 222–237. Minneapolis: University of Minnesota Press.

Day, R.E. 2004. "The Erasure and Construction of History for the Information Age." In *Memory Bytes*, ed. L. Rabinovitz and A. Geil, 76–96. Durham, NC: Duke University Press.

De Certeau, Michel. 1988. *The Writing of History*. New York: Columbia University Press.

Deibert, Ronald J. 1997. *Parchment, Printing, and Hypermedia: Communication in World Order Transformation*. New York: Columbia University Press.

Derrida, Jacques. 1996. *Archive Fever: A Freudian Impression*. Chicago: University of Chicago Press.

Donald, Merlin. 1991. *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition*. Cambridge, MA: Harvard University Press.

Drucker, Johanna. 1994. *The Visible World: Experimental Typography and Modern Art, 1909-1923*. Chicago: Chicago University Press.

Dunne, Paul E. 2005. "History of Computation - Babbage, Boole, Hollerith." http://www.csc.liv.ac.uk/%7Eped/teachadmin/histsci/htmlform/lect4.html

Dunne, Anthony, and Fiona Raby. 2001. *Design Noir: The Secret Life of Electronic Objects*. London: August.

Eisenstein, Elizabeth. 2005. *The Printing Revolution in Early Modern Europe*. Cambridge, UK: Cambridge University Press.

Eoearth. nd. "Cell Phone Recycling." http://www.eoearth.org/article/Cell_phone_recycling

EPEAT. nd. http://www.epeat.net/

Ernst, Wolfgang. 2005. "Let There Be Irony: Cultural History and Media Archeology in Parallel Lines." *Art History* 28 (5): 583–603.

Feingold, Mordechai. 2001. "English Ramism: A Reinterpretation." In *In The Influence of Petrus Ramus: Studies in Sixteenth and Seventeenth Century Philosophy and Sciences*, ed. Mordechai Feingold, Joseph Freedman, and Wolfgang Rother. Basel: Schwabe.

Finn, Christine. 2001. *Artifacts: An Archaeologist's Year in Silicon Valley*. Cambridge, MA: MIT Press.

Flatow, Ira. 2012. "Reaching For The Limits of Tiny Transistors." http://www.npr.org/2012/02/24/147356630/reaching-for-the-limits-of-tiny-transistors

Foucault, Michel. 2002. *The Archaeology of Knowledge*. New York: Routledge.

Foucault, Michel. 2006. *The Order of Things, An Archaeology of the Human Sciences*. New York: Routledge.

Foucault, Michel, and Paul Rabinow. 1984. *The Foucault Reader*. New York: Pantheon Books.

Fredkin, Edward. 2003. "An Introduction to Digital Philosophy." *International Journal of Theoretical Physics* 42 (2).

Freiberger, Paul, and Michael Swaine. 2000. *Fire in the Valley*. Toronto: McGraw-Hill.

Gabrys, Jennifer. 2011. *Digital Rubbish: A Natural History of Electronics*. Ann Arbor: University of Michigan Press.

Gillespie, Tarleton. 2003. “The Stories Digital Tools Tell.” In *New Media Theories and Practices of Digitextuality*, ed. John T. Caldwell and Anna Everett, 107–126. New York: Routledge.

Gitelman, Lisa. 2006. *Always Already New: Media, History and the Data of Culture*. Cambridge, MA: MIT Press.

Gozzi, Raymond. 2010. “The Metaphor of Cloud Computing.” *Et Cetera* 67 (1): 119–120.

Graves-Brown, Paul. 2000. *Matter, Materiality and Modern Culture*. New York: Routledge.

Gronbeck, Bruce E. 1991. *Media, Consciousness, and Culture: Explorations of Walter Ong’s Thought*. Newbury Park, CA: Sage.

Gross, Daniel M., and Ansgar Kemmann. 2005. *Heidegger and Rhetoric*. Albany: State University of New York Press.

Grossman, Elizabeth. 2006. *High Tech Trash: Digital Devices, Hidden Toxics, and Human Health*. Washington, DC: Island Press.

Grosz, Elizabeth. 1999. *Becomings: Explorations in Time, Memory, and Futures*. Ithaca: Cornell University Press.

Grosz, Elizabeth. 2009. “The Thing.” In *The Object Reader*, ed. Fiona Candlin and Raiford Guins, 124–138. New York: Routledge.

Guattari, Felix. 2001. “Machinic Heterogenesis.” In *Reading Digital Culture*, ed. D. Trend, 38–51. Malden, MA: Blackwell.

Gumbrecht, Hans Ulrich, and Karl Ludwig Pfeiffer. 1994. *Materialities of Communication*. Stanford, CA: Stanford University Press.

Hamilton, D. 2003. “Instruction in the Making: Peter Ramus and the Beginnings of Modern Schooling.” In *The Proceedings of the American Educational Research Association*. Chicago.

Haraway, Donna. 2001. “A Manifesto for Cyborgs.” In *Reading Digital Culture*, ed. David Trend, 23–37. Toronto: Blackwell.

Haraway, Donna. 2003. *The Haraway Reader*. New York: Routledge.

Haraway, Donna. 2004. “Cyborgs, Coyotes and Dogs: A Kinship of Feminist Figurations.” In *The Haraway Reader*, 321–343. New York: Routledge.

Harman, Graham. 2002. *Tool-Being: Heidegger and the Metaphyics of Objects*. Chicago: Open Court.

hatsrack.com. “Old Computer Advertisements.” http://pictures.hatsrack.com/?Directory=Old%20Advertisements&PicturePage=1

Havelock, Eric A. 1963. *Preface to Plato*. Cambridge, MA: Harvard University Press.

Hayles, N. Katherine. 2002. *Writing Machines*. Cambridge, MA: MIT Press.

Heidegger, Martin. 1962. *Being and Time*. Malden, MA: Blackwell.

Heidegger, Martin. 1971. “The Thing.” In *Poetry, Language, Thought*. Toronto: Harper Colophon.

Heidegger, Martin. 1977. *The Question Concerning Technology and Other Essays*. Ed. W. Lovitt. Toronto: Harper Books.

Heim, Michael. 2001. “The Erotic Ontology of Cyberspace.” In *Reading Digital Culture*, ed. David Trend, 70–86. Toronto: Blackwell.

Henning, Michelle. 2006. “New Media.” In *A Companion to Museum Studies*, ed. Susan Macdonald, 302–318. Malden, MA: Wiley-Blackwell.

Hicks, Dan, and Mary C. Beaudry, eds. 2010. *The Oxford Handbook of Material Culture Studies*. Oxford, UK: Oxford University Press.

Horn, Eva. 2007. “There Are No Media.” *Grey Room* 29: 6–13.

Huhtamo, Erkki, and Jussi Parikka. 2011. *Media Archaeology: Approaches, Applications, and Implications*. UC Press.

Hutcheon, Linda. 1994. *Irony’s Edge: The Theory and Politics of Irony*. London; New York: Routledge.

Hutcheon, Linda. 1998. “Irony, Nostalgia, and the Postmodern.” http://www.library.utoronto.ca/utel/criticism/hutchinp.html

Ihde, Don. 1990. *Technology and the Lifeworld: From Garden to Earth*. Bloomington: Indiana University Press.

Ihde, Don. 2003. “Heidegger’s Philosophy of Technology.” In *The Philosophy of Technology*, ed. Robert C. Scharff and Val Dusek, 277–292. Toronto: Blackwell.

Iles, Alastair T. 2004. “Mapping Environmental Justice in Technology Flows: Computer Waste Impacts in Asia.” *Global Environmental Politics* 4 (4): 76–107.

Innis, Harold A. 1991. *The Bias of Communication*. Toronto: University of Toronto Press.

Innis, Harold A. 2007. *Empire and Communications*. Toronto: Dundrun Press.

Jameson, Fredric. 1991. *Postmodernism, or, the Cultural Logic of Late Capitalism*. Durham: Duke University Press.

Johnson, Bobby. 2010. “UN Calls for Action on Growing Electronic Waste.” *The Guardian*. http://www.guardian.co.uk/environment/2010/feb/22/electronic-waste

Julier, Guy. 2009. “Inside and Outside the iPod.” In *The Object Reader*, ed. Fiona Candlin and Raiford Guins, 477–479. New York: Routledge.

Kean, Sam. 2010. *The Disappearing Spoon*. New York: Little, Brown & Co.

Keane, Webb. 2005. “Signs are not the Garb of Meaning.” In *Materiality*, ed. Daniel Miller, 182–205. Durham, NC: Duke University Press.

Kember, Sarah, and J. Zylinska. 2012. *Life after new media : mediation as a vital process*. Cambridge, Mass.: MIT Press.

Kirschenbaum, Matthew G. 2008. *Mechanisms: New Media and the Forensic Imagination*. Cambridge, MA: MIT Press.

Kittler, Friedrich A. 1995. “There Is No Software.” *Ctheory.net*. http://www.ctheory.net/articles.aspx?id=74

Kittler, Friedrich A. 1999. *Gramophone, Film, Typewriter*. Stanford, CA: Stanford University Press.

Kittler, Friedrich, A., Dorothea von Mücke, and Philippe L. Similon. 1987. "Gramophone, Film, Typewriter." *October* 41: 101–118.

Kluger, Jeffrey. 2011. "The E-waste Blight Grows More Dangerous Than Ever." http://ecocentric.blogs.time.com/2011/11/01/the-e-waste-blight-grows-more-dangerous-than-ever/

Knell, Simon. 2007. *Museums in the Material World*. New York: Routledge.

Kopytoff, Igor. 1986. "The Cultural Biography of Things: Commoditization as Process." In *The Social Life of Things*, ed. A. Appadurai, 64–91. Cambridge, UK: Cambridge University Press.

Kostigen, Thomas. 2008. "The Underbelly of Globalization: Our Toxic Wastes Exported to Developing Countries." *Basel Action Network*. http://ban.org/ban_news/2008/080925_the_underbelly_of_globalization.html

Kristeva, Julia. 1982. *Powers of Horror: An Essay on Abjection*. New York: Columbia University Press.

Kuhn, Thomas S. 1970. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Laha, Somjita. 2011. "Transboundary Toxic E-Wastes Flow: Environmental Injustice Through Neo-Ecological Imperialism." *Nature Inc. Conference Proceedings*, The Hague.

Lakoff, George, and Mark Johnson. 2003. *Metaphors We Live By*. Chicago: The University of Chicago Press.

Lanham, Richard A. 1969. *A Handbook of Rhetorical Terms*. Berkley: UC Press.

Latour, Bruno. 1999. *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, MA: Harvard University Press.

Latour, Bruno, and P. Weibel. 2005. *Making Things Public: Atmospheres of Democracy*. Cambridge, MA: MIT Press.

Latour, Bruno. 1987. *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge, MA: Harvard University Press.

Latour, Bruno. 1991a. “The Berlin Key or How to Do Things with Words.” In *Matter, Materiality and Modern Culture*, ed. P.M. Graves-Brown, 10–21. London: Routledge.

Latour, Bruno. 1991b. “Materials of Power.” In *A Sociology of Monsters: Essays on Power, Technology, and Domination*, ed. John Law, 103–130. New York: Routledge.

Latour, Bruno. 1993a. *The Pasteurization of France*. Trans. John Law and Alan Sheridan. Cambridge, MA: Harvard University Press.

Latour, Bruno. 1993b. *We Have Never Been Modern*. Cambridge, MA: Harvard University Press.

Latour, Bruno. 2007. “Can We Get Our Materialism Back, Please?” *Isis* 98 (1): 138–142.

Latour, Bruno, and Steve Woolgar. 1979. *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ: Princeton University Press.

Law, John. 2010. “The Materials of STS.” In *The Oxford Handbook of Material Culture Studies*, ed. Dan Hicks and Mary C. Beaudry, 173–188. Oxford, UK: Oxford University Press.

Lawler, John. 1999. “Metaphors We Compute By.” http://www-personal.umich.edu/~jlawler/meta4compute.html

Lécuyer, Christophe., and David C. Brock. 2010. *Makers of the Microchip: A Documentary History of Fairchild Semiconductor*. Cambridge, MA: MIT Press.

Leith, Philip. 1991. “Postmedieval Information Processing and Contemporary Computer Science.” In *Media, Consciousness, and Culture: Explorations of Walter Ong’s Thought*, ed. B.E. Gronbeck, T.J. Farrell, and P.A. Soukup. Newbury Park, CA: Sage.

Lenoir, Timothy. 1998. *Inscribing Science: Scientific Texts and the Materiality of Science*. Stanford: Stanford University Press.

Light, Jennifer S. 1999. “When Computers Were Women.” *Technology and Culture* 40 (3): 455–483.

Light Blue Optics. 2012. “Light Touch.” http://lightblueoptics.com/

Lovink, Geert. 2003. *My First Recession*. Rotterdam: V2/NAi Publishers.

Lovink, Geert. 2004. “Enemy of Nostalgia, Victim of the Present: An Interview with Peter Lunenfeld.” In *Uncanny Networks: Dialogues with the Virtual Intelligentsia*. Cambridge, MA: MIT Press.

Lukács, György. 1962. *The Historical Novel*. London: Merlin Press.

Lukács, György. 2009. “The Phenomenon of Reification.” In *The Object Reader*, ed. Fiona Candlin and Raiford Guins, 32–38. New York: Routledge.

Lyotard, Jean-François. 1997a. *The Postmodern Condition: A Report on Knowledge*. Minneapolis: University of Minnesota Press.

Lyotard, Jean-Francois. 1997b. *Postmodern Fables*. Minneapolis: University of Minnesota Press.

Macdonald, Sharon. 1998. *The Politics of Display: Museums, Science, Culture*. London: Routledge.

Mahoney, Michael S., and Thomas Haigh. 2011. *Histories of Computing*. Cambridge, MA: Harvard University Press.

Maier, Jonathan. 1999. “Lo-Fi: In Search of an Honest Aesthetic.” http://www.mindspring.com/~jmaier/honest.htm

Martin, Wendy. 2002. *The Cambridge Companion to Emily Dickinson*. New York: Cambridge University Press.

Massumi, Brian. 2002. *Parables for the Virtual, Movement, Affect, Sensation*. Durham, NC: Duke University Press.

Maxwell, Richard, and Toby Miller. 2008. “E-Waste: Elephant in the Living Room.” *Flow.org*. http://flowtv.org/?p=2194

McClellan, James E., and Harold Dorn. 2006. *Science and Technology in World History: An Introduction*. Baltimore, MD: The Johns Hopkins University Press.

McHoul, A. W., and Wendy. Grace. 1997. *A Foucault Primer: Discourse, Power, and the Subject*. New York: New York University Press.

McLuhan, Eric, and Frank Zingrone. 1995. *The Essential McLuhan*. Concord, ON: House of Anansi.

McLuhan, Marshall. 1964. *Understanding Media: The Extensions of Man*. Toronto: McGraw-Hill.

McLuhan, Marshall. 2000. *The Gutenberg Galaxy*. Toronto: University of Toronto Press.

McLuhan, Marshall, and Eric McLuhan. 1988. *Laws of Media: The New Science*. Toronto: University of Toronto Press.

Mergel, Maria. 2011. "The Facts About E-waste." http://toxipedia.org/display/toxipedia/Electronic+Waste+%28E-Waste%29

Miller, Daniel. 1987. *Material Culture and Mass Consumption*. New York: B. Blackwell.

Miller, Daniel. 2007. "Artifacts and the Meaning of Things." In *Museums in the Material World*, ed. Simon Knell, 166–186. New York: Routledge.

Miller, Daniel. 2010. *Stuff*. Cambridge, UK: Polity Press.

Misa, Thomas J. 2004. *Leonardo to the Internet: Technology & Culture from the Renaissance to the Present*. Baltimore: Johns Hopkins University Press.

Mitchell, W.J.T. 2004. "Romanticism and the Life of Things: Fossils, Totems, and Images." In *Things*, ed. Bill Brown, 227–244. Chicago: University of Chicago Press.

Molleindustria. 2011. "Phone Story - Android/iPhone Game." http://phonestory.org/

Morris, Errol. 2011. "The Ashtray: The Ultimatum." *New York Times*. March 6. http://opinionator.blogs.nytimes.com/2011/03/06/the-ashtray-the-ultimatum-part-1/?scp=1&sq=ashtray&st=cse

Moukaddem, Karimeh. 2011. "Children on the Frontlines: The E-Waste Epidemic in Africa." http://news.mongabay.com/2011/0909-moukaddem_ewaste.html

Mumford, Lewis. 1963. *Technics and Civilization*. New York: Harcourt, Brace & World.

Negroponte, Nicholas. 1995. *Being Digital*. New York: Knopf.

Nesselroth, Eva J. 2004. "Sublimating the Message: Mapping the Digital Age." Master's Thesis, Toronto: York University. http://search.proquest.com/

O'Gorman, Marcel. 2006. *E-Crit: Digital Media, Critical Theory, and the Humanities*. Toronto: University of Toronto Press.

OldComputers.net. "The Obsolete Computer Page." http://oldcomputers.net/

Ong, Walter. 1958. *Ramus: Method, and the Decay of Dialogue; from the Art of Discourse to the Art of Reason*. Cambridge, MA: Harvard University Press.

Ong, Walter. 1971. *Rhetoric, Romance, and Technology; Studies in the Interaction of Expression and Culture*. Ithaca, NY: Cornell University Press.

Ong, Walter. 1982. *Orality and Literacy: The Technologizing of the Word*. New York: Methuen.

Ong, Walter. 2004. *Ramus, Method, and the Decay of Dialogue*. Chicago: University of Chicago Press.

Orvell, Miles. 1989. *The Real Thing: Imitation and Authenticity in American Culture, 1880-1940*. Chapel Hill: University of North Carolina Press.

Outka, Elizabeth. 2009. *Consuming Traditions: Modernity, Modernism, and the Commodified Authentic.* New York: Oxford University Press.

Parikka, Jussi. 2002. "Saving the Material: Towards Rhizomatic Reading of Texts." In *Historical Representation,* Proceedings from the History in Words and Images Conference, 73-80. Turku, Finland: University of Turku.

Parikka, Jussi. 2012. "Dust Theory: Media Matters as Ecology" Presentation given to the Canadian Communications Association, Wilfrid Laurier University, Waterloo ON.

Parks, Lisa. 2007. "Falling Apart: Electronics Salvaging and the Global Media Economy." In *Residual Media*, ed. Charles R. Acland, 32–47. Minneapolis: University of Minnesota Press.

Parsons, Sarah. 2009. "Discarded Electronics Are Poisoning African Children." *Inhabitat - Sustainable Design Innovation, Eco Architecture, Green Building*. http://inhabitat.com/discarded-electronics-are-poisoning-african-children/

Pearce, Susan. 1995. "Collecting as Medium and Message." In *Museum, Media, Message,* ed. E. Hooper-Greenhill, 15–23. New York: Routledge.

Pelkey, James. 2007. “Entrepreneurial Capitalism & Innovation: A History of Computer Communications 1968 - 1988.” http://www.historyofcomputercommunications.info/

Pels, Peter. 2010. “Magical Things: On Fetishes, Commodities, and Computers.” In *The Oxford Handbook of Material Culture Studies*, ed. Dan Hicks and Mary C. Beaudry, 613–645. Oxford, UK: Oxford University Press.

Peters, John Durham. 1999. *Speaking into the Air: A History of the Idea of Communication*. Chicago: University of Chicago Press.

Pfeiffer, Karl Ludwig. 1994. “The Materiality of Communication.” In *Materialities of Communication*, ed. Hans Ulrich Gumbrecht and Karl Ludwig Pfeiffer, 1–12. Stanford, CA: Stanford University Press.

Plato. 1995. *Phaedrus*. Trans. Alexander Nehamas and Paul Woodruff. Indianapolis: Hackett.

Plato. 2003. “Republic.” In *The Philosophy of Technology*, ed. R.C.D. Scharff. Toronto: Blackwell.

Priestley, Peter Mark. 2010. *Science of Operations: Machines, Logic and the Invention of Programming*. New York: Springer.

Prown, Jules David. 1993. “The Truth of Material Culture: History or Fiction?” In *History from Things: Essays on Material Culture*. Washington, DC: Smithsonian Institution Press.

Reid, T.R. 2001. *The Chip: How Two Americans Invented the Microchip and Launched a Revolution*. New York: Random House.

Renfrew, Colin. 1998. “Mind and Matter: Cognitive Archaeology and External Symbolic Storage.” In *Cognition and Material Culture: The Archaeology of Symbolic Storage*, ed. Christopher Scarre, 1–6. Cambridge, UK: McDonald Institute Monographs.

Riskin, Jessica. 2004. “The Defecating Duck, or, the Ambiguous Origins of Artificial Life.” In *Things*, ed. Bill Brown, 99–134. Chicago: University of Chicago Press.

Ross, Andrew. 2001. “The New Smartness.” In *Reading Digital Culture*, ed. David Trend, 344–363. Toronto: Blackwell.

Roszak, Theodore. 1986. *The Cult of Information: The Folklore of Computers and the True Art of Thinking*. New York: Pantheon.

Rowlands, Michael. 2005. “A Materialist Approach to Materiality.” In *Materiality*, ed. Daniel Miller, 72–87. Durham, NC: Duke University Press.

Samson, Ted. 2009. “Does Apple Really Have the Greenest Notebooks? Apple and Other PC Makers Are Overdoing It When They Flash Their EPEAT Gold to Prove They’re Green.” http://www.infoworld.com/d/green-it/does-apple-really-have-greenest-notebooks-729

Scharff, Robert C., and Val Dusek, eds. 2003. *Philosophy of Technology: The Technological Condition*. Toronto: Blackwell.

Sekimoto, Sachi. 2011. “Materiality of the Self: Towards a Reconceptualization of Identity in Communication.” In *Matters of Communication : Political, Cultural, and Technological Challenges to Communication Theorizing*, ed. Timothy Kuhn. New York: Hampton Press.

Serres, Michel. 2007. *The Parasite*. Minneapolis: University of Minnesota Press.

Serres, Michel. 1989. *Statues: Le Second Livre Des Fondations*. Paris: Flammarion.

Shallis, Michael. 1984. *The Silicon Idol*. Oxford: Oxford University Press.

Siegert, Bernhard. 2007. “Cacography or Communication? Cultural Techniques in German Media Studies.” *Grey Room* 1 (29): 26–47.

Skalnik, James V. 2002. *Ramus and Reform: University and Church at the End of the Renaissance*. Kirksville, MO: Truman State University Press.

Slade, Giles. 2006. *Made to Break: Technology and Obsolescence in America*. Cambridge, MA: Harvard University Press.

Sloterdijk, Peter. 2005. *Im Weltinnenraum Des Kapitals: Für Eine Philosophische Theorie Der Globalisierung*. Frankfurt am Main: Suhrkamp.

Smith, Brian Cantwell. 1996. *On the Origin of Objects*. Cambridge, MA: MIT Press.

Smith, David Woodruff. 2006. *Husserl*. Florence, KY: Routledge.

Sobchack, Vivian. 1994. “The Scene of the Screen: Envisioning Cinematic and Electronic ‘Presence’.” In Materialities of Communication, ed. Hans Ulrich Gumbrecht and Karl Ludwig Pfeiffer, 84–106. Stanford, CA: Stanford University Press.

Spicer, Dag. 2007. "Rescued Treasures: A Curator's Personal Account." *Core* Spring/Summer: 4–9.

Stein, Lynn Andrea. 1999. "Challenging the Computational Metaphor: Implications for How We Think." *Cybernetics and Systems* 30 (6): 473–507.

Stellardi, Giuseppe. 2000. *Heidegger and Derrida on Philosophy and Metaphor: Imperfect Thought*. Amherst, NY: Humanity Books.

Sterne, Jonathan. 2007. "Out with the Trash, On with the Future of New Media." In *Residual Media*, ed. C.R. Acland, 16–31. Minneapolis: University of Minnesota Press.

Stewart, Susan. 1984. *On Longing: Narratives of the Miniature, the Gigantic, the Souvenir, the Collection*. Baltimore: Johns Hopkins University Press.

Straw, Will. 2002. "Value and Velocity: The 12-inch Single as Medium and Artefact?" In *Popular Music Studies*, ed. Kieth Negus and David Hesmondhalgh. London: Edward Arnold.

Swade, Doron. 2000. "Virtual Objects: Threat or Salvation?" In *Museums of Modern Science Nobel Symposium 112*, ed. Svante. Lindqvist, Marika. Hedin, and Ulf Larsson. Canton, MA: Science History.

The Environmental Protection Agency. 2010. "Statistics on the Management of Used and End-of-Life Electronics." http://www.epa.gov/waste/conserve/materials/ecycling/manage.htm

The Mothership. 2006. "Apple Ads." http://www.wired.com/gadgets/mac/multimedia/2006/04/appleads?slide=1&slideView=6

Tilley, Christopher, and Michael Shanks. 2007. "Material Culture." In *Museums in the Material World*, ed. Simon Knell, 79–94. New York: Routledge.

Ulmer, Gregory. 1985. *Applied Grammatology*. Baltimore, MD: Johns Hopkins University Press.

United Nations. 2011. "Information and Communication Technology - Statistical Yearbook for Asia and the Pacific 2011." *United Nations Statistical Yearbook for Asia and the Pacific 2011*. http://www.unescap.org/stat/data/syb2011/IV-Connectivity/ICT.asp

Vintage Computer Forums. 2006. "UNIVAC I / II Console Video." http://www.vintage-computer.com/vcforum/showthread.php?3252-UNIVAC-I-II-Console-Video

Welch, Kathleen. 1999. *Electric Rhetoric: Classical Rhetoric, Oralsim, and New Literacy*. Cambridge, MA: MIT Press.

Wen, Howard. 2007. "Curt Vendel: The Escapist Interview." http://www.escapistmagazine.com/articles/view/issues/issue_100/555-Curt-Vendel-The-Escapist-Interview.2

Wiener, Norbert. 1973. *Cybernetics or Control and Communication in the Animal and the Machine*. Cambridge MA: MIT Press.

Wikipedia. 2012. "Wikimedia Servers." http://meta.wikimedia.org/wiki/Wikimedia_servers

Zielinski, Siegfried. 2006. *Deep Time of the Media*. Cambridge, MA: MIT Press.

Žižek, Slavoj. 2003. "Not a Desire to Have Him, but to Be Like Him." *London Review of Books* 25: 13–15.