Operative Media Archaeology: Wolfgang Ernst's Materialist Media Diagrammatics

Jussi Parikka

Abstract

Media archaeological methods for extending the lifetime of new media into 'old media' have experienced a revival during the past years. In recent media theory, a new context for a debate surrounding media archaeology is emerging. So far media archaeology has been articulated together with such a heterogeneous bunch of theorists as Erkki Huhtamo, Siegfried Zielinski, Thomas Elsaesser and to a certain extent Friedrich Kittler. However, debates surrounding media archaeology as a method seem to be taking it forward not only as a subdiscipline of (media) history, but increasingly into what will be introduced as materialist media diagrammatics. This article maps some recent media archaeological waves in German media theory. The text addresses Wolfgang Ernst's mode of media archaeology and his provocative accounts on how to rethink media archaeology as a fresh way of looking into the use and remediation of media history as a material monument instead of a historical narrative and as a recent media theoretical wave from Germany that seems to not only replicate Kittler's huge impact in the field of materialist media studies but develop that in novel directions. However, as will be argued towards the end, Ernst's provocative take that hopes to distinguish itself as a Berlin brand of media theory in its hardware materiality and time-critical focus resonates strongly with some of the recent new directions coming from US media studies, namely in software and platform studies.

Key words

archive ■ digitality ■ Germany ■ media ■ media archaeology ■ media theory ■ technoculture

In recent new media theory, a fresh context for a debate surrounding media archaeology is emerging. It partly results from a reaction against the narrative as well as the often visual emphases from which media

■ *Theory, Culture & Society* 2011 (SAGE, Los Angeles, London, New Delhi, and Singapore), Vol. 28(5): 52–74
DOI: 10.1177/0263276411411496

archaeology emerged as part of new cinema histories. As a supplement, more of the recent writings focus on, for example, software cultures (Gitelman, 2006; Manovich, 2002; Parikka, 2007), as well as archaeologies of technical and sonic media (Volmar, 2009). (In general, see also Chun and Keenan [2006]).

So far, media archaeology has been attached to such theoretically different writers as Erkki Huhtamo, Siegfried Zielinski, Thomas Elsaesser and to a certain extent Friedrich Kittler. However, the new debates surrounding it seem to be taking it forward not only as a subdiscipline of (media) history but increasingly into what will be introduced below as materialist media diagrammatics. This article will in this context focus on some of the key arguments proposed by the German media theorist Wolfgang Ernst, whose provocative accounts on how to rethink media archaeology represent, firstly, a fresh way of looking into the use and remediation of media history as a material monument instead of a historical narrative and, secondly, a recent media theoretical wave from Germany that seems to not only replicate Kittler's huge impact on the field of materialist media studies but continues that in novel directions concerning modern technical media when Kittler (2006) himself has been recently focusing on antiquity (his music and mathematics research project).

Wolfgang Ernst (1959–) can be named as one important representative of the more recent wave of German media theorists whose ideas have relevance not only to media theorists but also to scholars of history and archives. Trained as a classicist and a historian who was first interested in concrete spatial archives, he finished his PhD in 1989 on historicism and museology and his work started to take a medial turn during the 1990s. Influenced by a range of media theorists and foremostly by Friedrich Kittler, Ernst started developing his own Foucauldean reading of media, history and archives. Books such as *M.edium F.oucault* (2000), *Das Rumoren der Archive* (2002), *Im Namen von Geschichte* (2003) and more recently *Das Gesetz des Gedächtnisses* (2007) lay the foundations for his specifically archival take on media systems, which more recently has been turning in an even further mathematical, or even 'techno-mathematical', direction. Since 2003 he has been the first Professor of Media Studies at Humboldt University in Berlin, and an increasing number of his texts are being made available in other languages, including Swedish (2008) and English, in various anthologies and journals (Ernst, 2002, 2003a, 2005, 2006, 2011).

Continuing some of the emphases of the earlier German media theorists, Ernst has been keen to underline the specifically German or even Berlin style of focusing on concrete, techno-mathematical groundings of modern media. This does not mean that Ernst has been accepted without critique as one of the future export articles of German media theory but, as will be argued later, Ernst's provocative take resonates strongly with some of the recent directions coming from US media studies, namely in software and platform studies. This is why his approach merits a careful

consideration in terms of its new ideas concerning media archaeology, as well as because it potentially bridges media archaeology as part of some other key fields of theoretical inquiry emerging in current media studies contexts. His emphasis on materiality, platforms, and temporal processuality finds a counterpart in the fields of platform studies (Bogost and Montfort) and software studies (Wardrip-Fruin) as well as computer forensics influenced media theory (Kirschenbaum).

This article addresses Ernst in the context of media archaeology, demonstrating the usefulness of his time-focused approach to a rethinking of media archaeology as a method for excavating contemporary media. In this sense, the key concepts and problematics in his work revolve around rethinking materiality in its techno-mathematical contexts and specifically in relation to his archival thinking that demands a move from a spatial notion of archives to what he calls 'time-criticality' as the constituent feature of technical media. Yet, as the article argues, the implicit potential to develop a political critique of technical media culture is not followed through by Ernst.

Materialist Media Archaeology

The field of media archaeology in its more modern form (i.e. not discussing here such forerunners as Walter Benjamin and others) has emerged from a fruitful tension between media history and theory. Not only has it taken a narrative mode of writing histories of media in the empirical mode, but it has also tried to follow a Foucauldean path in articulating the coexistence of continuities and ruptures as elemental components in understanding the 'newness' of digital media. Often media archaeology has been closer to media *genealogy*: writing counterhistories of such practices, ideas and contexts which are not included in mainstream film and media histories. Arriving from a variety of directions, media archaeology has since the 1980s been without one clear institutional home, hovering between cinema studies, the emerging media studies, experimental media art practices and other departments where such historical and theoretical interests could be combined. Indeed, the different ways of reading Foucault have produced (seemingly) two camps of media studies: the German variant of hardcore/-ware media archaeology and the cultural studies Anglo-American style of focusing on content, users and representations (Chun, 2006a: 17; 2006b: 4). Such a division is, to a certain extent, accurate in describing some of the debates and lines of thought through which media archaeology has been divided into some of the more 'media materialist' strands (where Friedrich Kittler is the frequently quoted inspiration) and contextualist strands (such as Tom Gunning, Anne Friedberg and Erkki Huhtamo, for example). Naturally, such divisions that seemingly stem from specific national traditions or at least academic fields differentiated by language are quite crude generalizations and leave out a number of thinkers who do not fit easily in either camp. Such divisions are more like heuristic tools to give clarity to a

field that has not stabilized to such an extent to have institutional grounding.

More recently another kind of division has been emerging that seems to rearticulate the German vs. Anglo-American divide (cf. Winthrop-Young, 2006). This idea stems from a distinction of macro-temporal analysis from what could be called micro-temporal or time-critical media archaeological ideas and practices. This orientation claims to lead to new kinds of understanding of 'media materialism' that take into account temporality in a more radical, non-human fashion – a materialism of processes, flows and signals instead of 'just' hardware and machines. Hence, the dividing line between Anglo-American approaches and German media theory becomes, in Ernst's approach, time – and time-criticality, to be specific.

One of the strategic moves in Ernst's way of differentiation of the Berlin media archaeology is reliant on distinguishing it from cultural historical accounts of media. This is an important rhetorical strategy for Ernst, perhaps in the same way as differentiation from the Birmingham cultural studies school of media analysis was for some of the earlier 1980s German media theorists.[1] Whereas scholars of media archaeology such as Huhtamo (2008: 38–42) have contextualized themselves strongly in the new cultural histories and new historicism since the 1980s, Ernst insists despite his own background as a classicist that media archaeology differs radically from the mode of writing history. The mode of narrative that haunts history after the linguistic turn is what for Ernst, in his Foucauldean manner, distances a truly archaeological excavation of media pasts from history. Here, even if we can see echoes of an appreciation, á la Hayden White, of being cognizant of the discursive epistemic conditions for different strands of historical writing, Ernst is often strict in his way of emphasizing differences. For him, it is the non-discursive and what he curiously calls the 'agency of the machine' (Ernst, 2005: 591) instead of the mode of narrative from which any understanding of media starts. In a manner that many would be tempted to tie in with theories of posthumanism, Ernst explains that it is the machine in which the past gets archived as a monument and that is the true subject of technical media culture, not the spectre of the human subject idealistically looming between the words and as summoned by modes of literary writing.

Media is for Ernst a mode of recording that takes on itself such characteristics of agency that usually are reserved for human subjects of history. This argument that echoes at least superficially ideas familiar from Bruno Latour is in this case developed more in relation to the German tradition of media materialism. In a more recent text Ernst has articulated media archaeology as media *archaeography*, a mode of writing in itself that resembles closely the Kittlerian argument of media as inscription machines. Hence, in a radical gesture that is meant to distance German media theory from Anglo-American influences, Ernst argues that he is not so much interested in any writing of counter-histories or neglected passages of media history (as media archaeology and imaginary media research more

often has done) but in the epistemological conditions of technical media. He writes:

> Equally close to disciplines that analyze material (hardware) culture and to the Foucauldean notion of the 'archive' as the set of rules governing the range of what can be verbally, audiovisually, or alphanumerically expressed at all, media archeology is both a method and aesthetics of practicing media criticism, a kind of epistemological reverse engineering, and an awareness of moments when media themselves, not exclusively humans any more, become active 'archeologists' of knowledge. (Ernst, 2011: 239)

To paraphrase Ernst (2007: 31), the writing of history and hence memory becomes a function of non-discursive inscription systems (*Aufschreibesysteme*). One cannot help noticing the resemblance to Kittler's media theory which, to paraphrase John Durham Peters (2010: 5), is without people. Claiming that this is the point of divergence from cultural studies, Kittler is offering us different kinds of agency that, to quote Peters, resembles the early Foucault:

> Like the early Foucault, he is interested in historical ruptures and not the slow sedimentation of social change through everyday practices: he gives us evolution by jerks, not by creeps. He prefers to focus on the turning points rather than the long state of play between the drama. Agency Kittler tends to attribute to abstractions such as world war and not to living, breathing actors. He is not interested in audiences or effects, resistance or hegemony, stars or genres; he spends no time on subcultures, postcoloniality, gender, race, sexuality, ethnicity, or class. (Peters, 2010: 5)

It is hard to neglect the similar roots in terms of Ernst and Kittler's grounding assumptions. After all, Ernst is happy to admit that media archaeology is part of the 'Berlin School of Media Studies' that looks at logical structures rather than the British or American fashion which is to 'analyze the subjective and social effects of media' (Lovink and Ernst, 2003). As noted above, this relates to the lack of appreciation that certain brands of British cultural studies received in Germany in the 1980s. However, for Ernst (2003b: 6) it seems that agency is not a pure abstraction but attributable to machines with the help of the 'cold gaze'[2] of the media archaeologist that shares much with the gaze of scientists and engineers. It is 'object-orientated' in a manner that resembles material culture research and interested in the physicality of technical media including computation, even if the primary interest is in how machines act as relays for signal-based technical communication and processes which the machine supports (2003b: 11). Yet, despite such strategic moves that accentuate the specificity of this brand of media theory in mathematical concreteness, it fails to provide a more thorough criticism of politically or socially-oriented analyses. To avoid any too linear explanations and accusations, we need to understand more concretely the ontological and epistemological idea Ernst is proposing

in his non-human media archaeology: 'What sounds like hardware-fetishism is only the media archaeological concreteness' (2003b: 11). Such statements become not only manifestos of separatism but also methodological guidelines, as we will soon see while also flagging their shortcomings.

Even if Ernst insists on the epistemological nature of the media archaeologist as a reverse-engineer (also literally, as elaborated below), his context for the ideas stems from a certain ontological understanding concerning technical media culture. In short, it is the calculation- and number-logic-based ontology of technical (and especially computational) media through which cultural memory gets articulated instead of the literary-based narrativization favoured ontologically and epistemologically by historians through which to think media archaeology. Ernst's position is aware of the materialist media grounding of contemporary archives which do practically engage not only with images and sounds but nowadays increasingly with software-based cultural memory. The issue of 'digital memory' is then less a matter of representation than of how to think through the algorithmic counting ontology of a memory.

Narrating differs from counting in the sense that narratives as stories differ from lists. Yet Ernst is not separating these as two modalities that do not have anything in common but rather explaining how telling is also a mode of counting through differentiation. Telling is not in Ernst's media archaeological vision (that takes its reference point from early medieval Europe's practice of Annales) only a human mode of telling stories through meaningful structures of symbols but a way of counting as well. Telling-as-counting is not only linguistic but has a media technological mode of quantification embedded in it. What Ernst proposes is a media archaeology that ties together such modes of thinking about counting together with algorithmic media as the necessary non-discursive base through which we need to understand 'memory' or history:

> Historical imagination asks for iconic coherence, to be separated from the organization of knowledge about the past in the form of naked data banks. But the registering time does not necessarily require the narrative mode to organize the factual field in a form that we call information. In digital computing, the sequence of operations required to perform a specific task is known as an algorithm. Medieval annalism as well stands for a writing aesthetics of organizing a sequence of events in serial, sequential order. (Ernst, 2003b: 36)

This points towards the primarily calculational and sequential operations of algorithmic culture in which, as a non-discursive platform, information is processed. Calculation and processing hence provide the foundation of micro-temporal procedures of modern culture. Indeed, there is a risk of misunderstanding multimedia only through the worlds of perception offered to human ears and eyes – a view that misses out on the crucial realization that multimedia do not exist without the temporal algorithmic

processes through which code translates into sights and sounds. Of course, there is a long history of media devices which hide their working machinery from the user in order to create an aura of magic, but Ernst is specifically focused on the workings of code, software and in general the temporal basis of calculation in computers. Despite the turn to spatialization of digital aesthetics and narratives in terms of operating system and gamelike environment spaces, what is primary and grounds such phenomenology is the medium of calculation that is based on algorithms, processes and addresses (Ernst, 2006: 108). In addition to offering clues for analysis of aesthetic and perceptual words of digital culture, this presents a crucial realization to contemporary archival practices and discourses: the archive in the age of online digital collections becomes a 'mathematically defined space' where retrieval – an essential part of reproduction of cultural discourses and identity – is not a matter of interpretative, iconological semantics but computing algorithms (2006: 117). Even more so, archives are not even spaces any more but addresses: 'A necessary precondition for any data retrieval is addressability, the necessity of being provided with an external – or even internal – address' (2006: 119). The implications for the wider set of cultural institutions and museums are radical: the need to think museums and archives as non-places, and as addresses and hence as modes of management of protocols, software structures and patterns of retrieval which potentially can open up new ways of user-engagement as well, and where data storage cannot be detached from its continuous searchability and distribution – data storage on the move, so to speak. Whereas concrete examples concerning archival practices are at times missing from Ernst's writings, for example the increased use of computer forensics testifies to this move towards such an understanding of cultural memory that looks as much at computational traces on material storage surfaces and data structures as it does on narrative forms.

In any case, addresses for such (non-)places of memory are less spatial and more defined by their temporal modulations. This is where the point about the various temporalities inherent in this brand of German media archaeology becomes clearest: time and cultural memory are not only to be understood as the macro-level historical events or narratives accessible to human senses and interpretation. In addition, we need to include the micro-level temporalities or what Ernst refers to as the time-critical element crucial to digital technologies and hence to the non-discursive condition of writing of time for us humans. In a similar way as *discourse networks* rose to be a key concept for interpretations and adaptations of Kittler's work, *systems* for Luhmann, *variantology* for Zielinski, etc., Ernst's work can be seen gearing towards the *archive* in medial contexts but also increasingly towards the notion of *time-criticality*.

Time-criticality is something that stems from the Kittlerian emphasis on the manipulation of the time-axis that modern technical media since, for example, Edison's sound-reversing phonograph (see Krämer, 2006; cf. Kittler, 2010: 166–7) introduce, but which for Ernst relates even more closely to signal-processing capabilities. Both Kittler (2010) and Ernst share

an appreciation of Claude Shannon as the technical father of modern media culture, as it was his techno-engineering perspective on the primacy of channels and signals temporally processed in channels that is the grounding on which data, information and hence cultural forms are being sustained and distributed in technical media culture. Modern technical media are media of mathematical codes, and in their execution they become processes defined by patterns of signals unfolding in time. In Ernst's more than technical definition of media that gets more nods from people in science and computing departments than from humanities and cultural studies scholars, it is to be understood from the viewpoint of its channel which 'counts with time'. It is less about the objects of/in those channels than about the operations which introduce the patterns, pulsations and intervals through which information becomes a reality of the channels before becoming a reality for the phenomenological viewers/listeners/readers of media (Ernst, 2003b: 20).

This leads to a new kind of an approach to the temporal bias of technical media. It is not only a temporal bias in a Harold Innis mode of media theory, but an intensive micro-temporality that forces us to consider the notions of cultural memory combined with an understanding of the technical memory as an active process instead of a stable, permanent memory. Already television is mapped in Ernst's (2002: 634) vision as a specific regime of the image that is not static but continuously regenerated in cycles of scanning, and the computer itself in its storage capacities is far from a static machine of memory (cf. Kirschenbaum, 2008: 73–109 for a close reading of motion and dynamics in computer hard-drives). Digital machines are ephemeral in the sense that they are also based in constant regeneration, as Wendy Chun argues referring to Wolfgang Ernst. This is time-criticality; the computer digital memory is not only a static being of memory but is in need of constant repetition and regeneration also in the technical sense as such early memory technologies as the mercury delay line and the Williams tube demonstrate (Chun, 2008: 165). Critical is not understood in this context in the same sense as 'critical theory' á la Adorno and the generation of German thinkers that preceded the 1980s and began the media theory wave, but criticality as the decisiveness of the temporal event that happens in the engineered channel. Priority is given to the non-semantic signal, just like Shannon emphasized, but without engaging with the alternative theories of early cybernetics, or for example N. Katherine Hayles's (1999) influential exposition of the cybernetic worldview.

The media archaeological method becomes a doubling of the logic of time-critical media. In a similar way that technical media is defined by its capacities to break continuous signals in discrete series through, for instance, the Fourier transformation that is continuously an important reference point for German media archaeologists, media archaeology is itself non-interpretational dissecting defined by three aspects, namely its cold gaze, anti-hermeneutics and a return to a Rankean way of understanding

history that surely puzzles several cultural historians (Ernst, 2003b: 6–7). As controversial moves, or emphases, some of these ideas, especially around the 'cold gaze' and distancing, are what distances Ernst from other neomaterialist accounts emerging in cultural analysis – not least material feminism where the notion of materiality has been addressed quite contrarily as 'entanglement', for example (see Alaimo and Hekman, 2008, cf. Hayles, 1999; Bennett, 2010). Such theoretical moves as distancing have been more or less articulated together with a politically dubious rationalism and neglect of the messy ontologies of the world where things and humans are continuously entangled. However, besides problems in terms of its relation to alternative materialist notions being debated at the moment, Ernst's provocative thoughts relate to how he methodologically wants to suggest a non-textual way of addressing media archaeology, and this merits more attention. The coldness is parallel to William Henry Fox Talbot's 'technological objectivism' expressed in *The Pencil of Nature* in 1844, and stems from the capacity of the photographic image – and more widely any technical media – to record much more than merely the symbolic (Ernst, 2005: 589–91). Whereas, for example, the 20th-century avant-garde (e.g. Dziga Vertov) celebrated similar figures concerning the gaze of the machine, for Ernst it is part of the claim that in the age of technical media, and especially computers, we are engaged in a cultural system beyond that of the human-focused world. Instead of media anthropology, or media sociology, he demands that *aisthetis medialis* is recognized through its constitutive, concrete difference from human perception. Just as with Kittler, there is not much room for humans in the media ontology of Ernst. To use Lacanian vocabulary that has been embedded partly as the post-structuralist legacy of German media theory, it is the real that is the object of the media archaeologist and his method, not the symbolic (except when interested in the algorithmic logic of digital culture) nor the imaginary – a point where he differs from the imaginary media research of another Berlin media archaeologist, Zielinski.

Interestingly, Ernst, who became very familiar with new historicism and the emergence of new historical discourses in the 1980s and early 1990s, turned later to such figures as Leopold von Ranke – but Ranke read as a media theorist, not as a historian. What Ernst hopes to achieve by referring to Ranke is not *per se* an idea of objective history, but history in objects – history and time that are recorded in the physical sense 'objectively' in material media objects. Ernst's new historicist roots that resonated strongly with the cultural studies directions of those years were discarded in favour of an object-oriented epistemological position where Kittlerian ontology met up with Ernst's enthusiasm for rethinking temporality and the archive. In terms of methodology, this led him to posit more emphasis on what could be called 'operative diagrammatics' as a method of 'writing' media archaeology – or the objects themselves as inscriptions of such archaeologies and time, as we will see in the next section.

Time-Critical Media Diagrammatics

The new generation of German media theorists have followed Kittler, Niklas Luhmann, Wolfgang Hagen, Jochen Hörisch, Norbert Bolz, Siegfried Zielinski and others in their theoretical formulations that already turned to historical ways of questioning the *a priori* of media. As Eva Horn (2008: 9) has illustrated, this related to the earlier neglecting of technology from cultural theory as well as turning into a specific mode of historical criticism against such humanities notions as 'sense', 'meaning', 'interpretation' and 'beauty', while also bridging new cross-disciplinary fields across the humanities and the sciences. Even though, as Horn points out, there might be a confusing lack of clarity of even what media are for such scholars, I would see this 'movement' (if one can call it such and neglect its heterogeneity) as opening up the normalized media studies checklist of broadcast media and digital media into a variety of processes of mediation. Horn agrees on this point, addressing the processual nature of various enterprises under the label of 'German media theory'. In Eva Horn's (2008: 8) words:

> Such heterogeneous structures form the basis, the 'medial a priori,' as it were, for human experiences, cultural practices, and forms of knowledge. Regarding media as processes and events, observing their effects rather than their technological forms or ideological contents, also implies a broadening of their analytical frame, which becomes more a certain type of questioning than a discipline in itself. Perhaps such an anti-ontological approach to media, a radical opening of the analytical domain to any kind of medial process, has been more productive and theoretically challenging than any attempt, however convincing, at answering the question of what media 'are.'

To me, the turn is not anti-ontological *per se*, even if does not settle on a definition of media recognized by one disciplinary and institutional entity. Instead, the processuality of the work feeds into an ontologizing questioning of 'what are media?' (see Münker and Roesler, 2008), and even more provocatively 'what were media?' (Pias, 2011), as well as towards specifications concerning the ontology of the materiality of technical media conditions.

The historical focus of the 'earlier 1980s generation', that is still of course very active and influential, has recently turned towards a further media archaeological turn, as I have been outlining above through Ernst's work. In addition, writers such as Claus Pias (2009) and Cornelia Vismann (2008), to name only two, are increasingly influential in rethinking not only media but also archives and temporality. What distinguishes Ernst is his insistence on the time-critical notion of media archaeology that presents a micro-temporal research agenda with very practice-bent, operational demands for the media scholar. Indeed, this practice-based orientation is an attempt to answer the methodological question of how do you then concretely research micro-temporality – a concept that continuously is in danger of remaining slightly elusive.

What could be called 'operative diagrammatics' refers in the case of Ernst to a specific way of understanding the objects of media studies and the way they feed into theories concerning 'materiality-in-action'. Operative diagrammatics is the level where mathematics is incorporated into our technical media machines, and hence the real world. Instead of the story, narrative, or image, Ernst media archaeology posits the diagram as the starting point for an analysis of technical media culture: diagrams are to be understood in the very technical sense of a visualization of information patterns, circuits and relations which give an idea of how the otherwise so complex machines work. In practical terms this refers to the 'add-on' to his media archaeological theories that reside as part of the Humboldt Institute for Media Studies. The archival is no metaphor for Ernst as a reader of Foucault and who has been very interested in the concrete history/cultures of the former East Germany where the centrality of the archive for the socialist nation-state cannot be overemphasized. The media archaeological collection of old media differs radically from what in the wake of Bruce Sterling's 1990s call came to be known as 'dead media' – a collection of media passed away, forgotten, dysfunctional. In contrast to such indexical collections that list an archive of past media, Ernst's project argues that media archaeological monumentality of the media technologies must be much more than descriptive and indexical. Instead, it needs to address the media technologies in their material processuality – the logical and material infrastructures which are media technological *only if they work*. The difference from museum-displayed technologies becomes evident with the task of the media archaeologist becoming less a textual interpreter and a historian, and more an engineer and specialist in wiring and diagrammatics of circuits. Monumentality is here understood through Foucault: archaeology focuses on the monumentality of traces that do not refer to any underlying hidden message or meaning but are to be taken, methodologically, as such; all is there already to be seen, and presented, and the archaeologist has to focus on the actual inscriptions of what is there (see Foucault, 2002: 122, 125; Deleuze, 1988: 15).

In a very perceptive note concerning media archaeology, Vivian Sobchak has argued that instead of differentiating Anglo-American media archaeologies such as Huhtamo's from the materialist ones of Ernst, the notion of 'presence' ties them to a shared epistemological framework. Both are interested in what Sobchak (2011: 324) calls 'transference or relay of metonymic and material fragments or traces of the past through time to the "here and now"', which accurately captures the way Ernst places emphasis on operational machines carrying a certain transhistoricality (Sobchak's term). Indeed, as a more casual note, the enthusiasm for personal collections of several media archaeologists seems to index the insistence on the importance of the material machine for such excavations, which for Ernst is less about the external design features and implicated interface uses and more about the internal workings of media.

Figure 1: The cellar of media archaeology at the Institute of Media Studies (Berlin), where old machines are received, repaired and made operational. From an old low frequency radio adopted from a Russian submarine to oscillators and optical media, all of the objects are characterized by the fact that they are operational and hence relational, instead of collected merely for their metadata or design value. Image © Lina Franke

The archives of operative media consist of a variety of 20th-century media technologies from radio receivers to oscilloscopes, televisions and computers which all are characterized by the fact that they actually are operational. It is only in the moment of their active articulation of time that media are alive and become in that sense archaeological – transhistorically connecting over time. Far from nostalgia, such equipment is important due to the time-preserving and rearticulating nature that forces us to rethink present and past, and their complex intertwining in old media devices.

> [A] radio built in Germany during the National Socialist regime (the famous *Volksempfänger*, which notoriously was used to broadcast propaganda speeches) receives radio programs when operated today, since the stable technological infrastructure of broadcasting media is still in operation. There is no 'historical' difference in the functioning of the apparatus now and then (and there will not be, until analogue radio is, finally, completely replaced by the digitized transmission of signals); rather, there is a media-archaeological short circuit between otherwise historically clearly separated times. (Ernst, 2011: 240)

Intriguingly, the archive becomes a central node in this mode of media studies. Media become archives themselves in the way they transmit between the past and the present, and those archives need to be thought of as technical media apparatuses where cultural memory becomes technical memory. For the archaeological gaze, already such technical media as the phonograph, photograph and other technologies are able to record and hence transmit much more than human symbolical meanings. Here is the point that Ernst seems to adopt from Kittler's understanding of technical media as defined by noise – i.e. all that which does not seem to fit in with the meaning-making human world, but is recorded by the accuracy of the phonograph; as much as utterances, it is the noises of the larynx and the body that stick on the phonographic plates in their fidelity to the world of the real (Kittler, 1999: 16).

Ernst makes this characteristic of technical media a methodological guideline. The phonographic and other similar media carry as much semantics as they carry the sound as a raw phenomenon of noise and scratch as much as the meanings of whoever happens to utter his or her voice on the phonograph. It is at this level of paying attention in a McLuhanesque manner that Ernst says the work of the media archaeologist starts by listening to the noise as much as to the message, to the media as a constellation between present-pasts as well as the mediatic wiring between the human and the technological. For Ernst, any media analysis should be less about the content of a medium and more about the mathematical-statistical existence of a signal that does not *per se* make distinctions between message and noise in the hermeneutic sense. 'White noise does not mean nonsense, but a ceaseless particle stream of information in constant motion' (Ernst, 2002: 629). Hence, what becomes registered with scientific equipment – the fields of pulsations, magnetic fields, waves and such – is something that humanities methodology needs to take into account. Outside meaning, there is a regime of non-meaning, too often neglected only as either 'purely technical' or noise, that itself imposes new demands on humanities in the age of technical media.

Furthermore, it points towards the micro-temporal layers of this brand of media archaeology that seems to be a crucial characteristic of the Berlin School of media archaeology. 'The microtemporality in the operativity of data processing (synchronization) replaces the traditional macro time of the 'historical' archive (governed by the semantics of historical discourse) – a literal "quantization." Our relation not only to the past but to the present thus becomes truly "archival"' (Ernst, 2011: 251). In other words, a focus on archives and archaeology becomes a mode of analysing and engineering contemporary media in the way they channel and synchronize patterns of 'cultural' life.

At the core of media archaeology one does not find history but the previously mentioned cold gaze of the Foucauldean archivist-become-engineer that is as much digging historical material as it is interested in the layered realities of technologies around him/her. Curiously, Ernst suggests combining the objectivist cold gaze methodology of the historian Ranke with the

genealogical method of Foucault, whose theories have been actually a key backbone for new historicism and new cultural historical critiques of Ranke. For Ernst, this paradox remains unaddressed, even if his emphasis on Foucault through the notion of monumental history as well as probably the idea of the positivist in Foucault (that he himself in *The Archaeology of Knowledge* [2002: 141] hinted at by referring to his 'positivism' interested in accumulations, not origin) would be the ways to trace out an interesting if subtle connection.

The idea concerning layerings and accumulated but non-linear and discontinuous temporalities becomes clearer when Ernst elaborates that the media archaeological practices include such media artistic and activist practices as hardware hacking, circuit bending and other techniques of literally opening up technologies. As explained by Ernst, media archaeology is processual, and focuses on the time-critical processes which engineer our lives. This means that media archaeology does not tap only into the past but can dedicate itself to opening up technologies in an artistic/hacker vein. Ernst's examples of media archaeological arts are actually less about artists working with historical material than about hardware hacking, open software and circuit bending. For Ernst (2009), exemplary of such work is the Micro Research Lab (http://www.1010.co.uk/org/) run by Martin Howse.

For such laboratories, excavation into the layered existence of technical media infrastructure in our physical environment media is seen as a hidden language of sorts that needs specialist understanding to be reached. Embedded in the materialist media theoretical considerations of hardware as well as electromagnetism, the Micro Research Lab projects investigate the technical and often ephemeral worlds of perception and sensation involved in high-tech media worlds. From experimenting with computer monitors and keyboards to the task of opening up hardware can be seen as having political importance in the world of increasingly closed electronics. Other projects investigate notions of material but invisible traces such as electromagnetism as emblematic of high-tech culture as well in addition to creating autonomous zones in computer memory (Island2-software project: http://1010.co.uk/org/island2.html).

In general, the practical projects exemplify what Ernst seems to mean by the diagram. Of interest already to Foucault, the diagram becomes a literal crossing-point between epistemologically wired humanities analysis of technical media and the engineering enabled understanding of and tinkering with operationality. In other words, the diagram is for him a perfect gripping point to understand technical media culture as both based in logic but also mathematics-in-action, i.e. engineering. The diagram as a central figure for technical media devices is both an indexical mapping of circuitry which guides both the machine processes and is a way to tap into how temporality – the new regimes of memory – is being circuited on this micro-level. The diagram shows how machines work, but it also is a way to understand how society operates through the diagrams of machines. The diagram is then an operational dispositif, which does not tie it only to Foucault's idea of how power is distributed diagrammatically, non-discursively and in various

forms across society (see Deleuze, 1988: 34–5) but also to a technical definition of the diagram as a way of understanding visually the flow of signals in a structural way. The diagram as it is understood both in scientific usage but especially as 'engineering diagrams' provides a way to tap into the 'blueprints' of machines that offer us cultural content. Already Foucault's notion of the archive emphasized it not as a collection of 'dust of statements' (Foucault, 2002: 146) but as the system of the functioning of statement-things. Ernst brings this realization to the core of his media archaeology.

Despite the obvious differences, Ernst is close to a Deleuzian reading of Foucault here, as well as to Deleuze's concept of abstract machine. The diagram is not a structure, but in its operationality steers away from such stability towards process unfolding. Hence, referring to Guerino Mazzola's *La Véritè du Beau dans la Musique*, Ernst argues that the diagram is not something inserted into a machine but that it actually generates it. The diagram is a generative, active and articulating force expressed on the time axis (Ernst, 2009).

For Ernst, it is exactly what in other debates would be called 'power/knowledge' that becomes circulated through the micro-temporal diagrams embedded in concrete machines and their abilities to process and synchronize temporal processes. Diagram is then not only a representation of what happens but an instructional and hence operational tool for executing time-critical processes in technical environments. Foucault talks of the flow of power circulating and through that circulation constituting its subjects (Foucault, 2001: 180–4), and for Ernst's appropriation of Foucault it is a matter of circulation through signal processing that is the core of technical media culture. Open up the media technological device sitting on your desk, in your pocket, or in your living room and what you find is a circuit board that can also be visualized as a diagram of connections between the technical components in that specific piece of media technology but also through how it opens up to external connections (as with the case of wireless technologies; see Mackenzie, 2010) and social relations.

This is again a point where we see how the macro-temporal and spatial understanding of archives turns into an epistemological-engineering perspective into the machines of archiving-as-temporal modulation. In other words, and to clarify, through the practical and machine-focused approach two constitutive notions of the diagrammatic archive emerge:

1. The archive as a central place for collecting and engineering technical media; a site of study in the same manner as the laboratory or the classroom. It refers to a media studies appropriation of the sites of memory for excavations into the constituents of contemporary media culture. This is where Ernst's background as a more traditional historian is clearest, even if such sites as the archive in this sense are specifically cross-disciplinary and dedicated to science-humanities collaboration.
2. The archive as referring not only to the macro-temporal circuits and spatial archives. Instead, archives can also be understood as the diagrammatics of machines which are constantly operationalizing social and cultural functions

> into algorithmic contexts. Media studies should be interested in the micro-temporal archives as well – those that are embedded in the time-critical processes of media, which means incorporating 'intervals', 'temporal architectures', 'real-time', 'algorythmics' and other time-critical concepts at the heart of media studies (see Volmar, 2009).

However, what is missing from this emphasis on the diagrammatics and the potential in combining hacker/circuit-bender methodology into a media archaeology of micro-temporality is the dimension of political economy, or at least its clear articulation. Whereas such writers as Raiford Guins (2009) have recently been able to extend some similar epistemological considerations into a thorough analysis of the political economy of contemporary digital culture and its closed devices, Ernst's programme does not include this dimension and it remains merely an implicit possibility. To note, media archaeology has never been too strong in terms of political economy even if early on setting itself as a counterforce to the logic of the new in the hype around 'new media cultures' can be seen in such a context. Yet, one could argue that part of the 'techno-mathematic' epistemology and the cold gaze remains coolness in the sense of wanting to remain further away from the messy world of political and social issues.[3] Instead of providing media archaeology with a set of epistemological considerations that would try to tie in the constitutive non-humanity of the technical with social and political conditions, it actually is in danger of playing along with ideas about 'two cultures' of sciences and humanities. Indeed, what I want to flag is that despite its great promise in terms of widening media archaeology from a historical method into analysis of contemporary technical media in its operationality, it still needs to articulate more tightly the wider networks in which the techno-mathematics of media take place.

Next I want to conclude by pointing out how the developments concerning time-critical media, archives and temporal materiality are both the unique points about this recent development of German media theory but also themes that tie it together with some Anglo-American trends in *new* media studies. What the emerging links and resonating research agendas demonstrate is that despite having established itself as a very German brand and almost like an export article (cf. Winthrop-Young, 2006), recent media archaeological directions have to take into account that the contemporary generation of media theory addresses similar themes concerning materiality, temporality and historicality.

Software, Platforms and Forensic Excavations

Several media archaeological theories of the past years have had a strong German flavour. Often this has meant an appropriation of Kittler's discourse networks as one important reference point, and development of such decisively media materialist perspectives on modern history. In terms of full-fledged archaeologies of media archaeology we could as easily

extend to Walter Benjamin's excavations into the rubble of modernity and elaboration of an archival mode of cultural analysis, Aby Warburg's image-based thinking of visual culture, or the birth of *Bildwissenschaft* during the early years of the 20th century (Bredekamp, 2003). Yet, I want to restrict myself here to this specifically non-Frankfurt School (non-Marxist) as well as non-hermeneutic mode of German media theory that emerged in the 1980s and which continues to articulate new ideas in media theory and media archaeology.

Wolfgang Ernst's development of earlier strands of Kittler's writings has articulated the concept of media archaeology more clearly. Whereas Kittler himself denounced his affiliation with media archaeology (Armitage, 2006: 32–3), Ernst's way of emphasizing the distinct characteristics of German media theory and archaeology has been a clear continuation of the uniqueness of this 'school' of thought. Yet the emphasized distinction from Anglo-American cultural studies is not as straightforward as with earlier Kittler vs. Williams, or Kittler vs. Birmingham School of Cultural Studies. Despite the at times obvious clash between Ernst's focus on the machine as a relay of temporality with cultural studies approaches to technology which desire to move an analysis of things and apparatuses to their meanings and roles in contexts (see e.g. Siegel, 2007: 32), both approaches to media archaeology seem to rely on Foucault as their main thrust and primary reference. Sharing theoretical groundings in post-structuralism have not guaranteed that media archaeology has developed similar approaches to cultural analysis of technology. Yet more recent developments, concerning especially software studies, platform studies and media forensics, all seem to draw from at least partly similar intellectual terrain and develop toolboxes and methodologies that are not so far from Ernst's media archaeology and offer such approaches that are potentially offering a further bridge to bring varieties of media archaeology into a new dialogue.

A brief survey actually reveals how themes of processuality, materiality and close reading of processes of material inscription in digital culture are very central to the Anglo-American research agenda too. For writers such as Noah Wardrip-Fruin, who also draws on media archaeological methods (Wardrip-Fruin, 2011), process-intensive perspectives extend towards what he actually refers to with a very Ernstian term of 'operational logics' (Wardrip-Fruin, 2009: xi) that is not solely about focusing on the source code. Instead, what is offered is a more dynamic notion of software as expressive not only in the sense of authorship but design as well. Wardrip-Fruin writes:

> Just as when opening the back of a watch from the 1970s one might see a distinctive Swiss mechanism or Japanese quartz assembly, so the shapes of computational processes are distinctive – and connected to histories, economies, schools of thought. Further, because digital media's processes often engage subjects more complex than timekeeping (such as human language and motivation), they can be seen as 'operationalized' models of these subjects, expressing a position through their shapes and workings. (Wardrip-Fruin, 2009: 4)

In other words, the expressiveness of digital culture and its assemblages is not restricted to human authorship but to the various design solutions that gain a semi-autonomous agency. Methodologically, this does not solely mean digging under the surface of the graphical user interface, but also mapping the connections between the various levels of expression and processuality (cf. Fuller, 2005). As Wardrip-Fruin explains (2009: 13–14, 17), such 'operational logics' focus on the digital systems in terms of 'doing' rather than just being, which emphasizes an active and dynamic sense of time-criticality.

The enthusiasm for the materiality of digital systems has been extended to platforms as well. Montfort and Bogost's (2009) approach shares similarities to rethinking media archaeology in terms of their emphasis on the abstraction level where users, interfaces, forms and functions as well as code are being layered. Indeed, similarly as Wardrip-Fruin is ready to extend the focus of digital systems from, for instance, code essentialism to the operationality that spans between uses and machines, the platform approach focuses on computer architectures as the necessary diagrammatics for mapping the specificities of digital culture. Interestingly, the focus on platforms is not only archaeological in the sense of digging into abstractions (i.e. diagrams) through which a variety of levels are coordinated in such assemblages, but also on historical forms of platforms. The first study in the MIT series embeds itself in the archive and history in another sense as well, by focusing on the Atari Video Computer System and addressing the early phases of computer gaming culture and apparatuses of 1977–83.

This double sense of the archive as a mode of opening up the abstraction layers of technical media and as a focus on historical forms is present as much in Matthew Kirschenbaum's *Mechanisms: New Media and the Forensic Imagination* (2008). Without again being able to map meticulously points of convergence and divergence, it suffices here to note how Kirschenbaum seems to point towards similar epistemological challenges for media and literary studies in his close reading of the storage mechanisms, focusing especially on 1980s' and 1990s' technologies. In what he calls a neglected field of interest, Kirschenbaum refers to Kenneth Thibodeau's threefold characterization of digital objects as physical, logical and conceptual. Turning away from the quite often found new media studies interest in the third category to the physical and logical, Kirschenbaum is able to open up a new way of tackling the interactions between such layers. The forensic focus on dead bodies does not deal with dead media in the indexical, historical fashion of just telling stories, but shares a media archaeological interest in the dynamic (as with a close reading of the motion-centred workings of the hard drive) materiality of computer technologies. In this, the supposed discursive immateriality is only a function of meticulous engineering which builds such effects into it (Kirschenbaum, 2008: 137).

Conclusions

After the initial realization of converging research agendas, what needs more work is a mapping of such emerging studies in connection firstly with

media archaeology in order to help it develop as a set of material methodology and secondly with the new directions in German media studies such as Wolfgang Ernst's. Despite the continuous rhetorical distancing from Anglo-American cultural studies and critiquing its emphasis on class, culture and social construction as well as representational thought, the more recent modes of conducting media studies have already taken on board the 1980s and 1990s implications for the need to take materiality of media networks seriously, as originally flagged by Kittler. In terms of the link with the US, one possible point of connection could be between the textual orientation of US-led cultural studies with the philological background of German media theoretical perspectives, not least Kittler (Winthrop-Young, 2006: 88). With such literature-scholars-become-media-theorists as Kittler welcomed on curricula and university reading lists both in the old Europe as much as in the new world, especially US-led media studies is very much grounded in the same intellectual synthesis of media theory and post-structuralism which further raises interesting prospects of how different but still resonating solutions the various traditions might develop. What is, however, striking is that some of the Anglo-American developments that have taken into account the material underpinnings coming from Germany have been able to combine them with the traditional strong points of cultural and visual studies, including power, gender and even political economy (see e.g. Chun, 2006a). Such combinations are clearly something that needs to be addressed by the new generation of media archaeologists too, as flagged above. Hence, an acknowledgement of media archaeological themes outside the canon of media archaeology might be able to feed back to the hardware-centred (to use the old cliché concerning Kittlerian perspectives) approaches so as to develop material but politically fine-tuned approaches to technical media cultures and apparatuses.

What are the implications then for media archaeology? For sure, such converging paths indicate how many media archaeological ideas are constantly in proximity with a wider methodological set of ideas in media studies. A key part of this is formed through ideas of temporal materiality as well as a keen interest in close readings of the machine and its infrastructure. Hence, such new modes of media studies take the archive as an increasingly central concept for their studies that informs material methodologies. Yet the archive is not only understood in the macro-historical fashion of past media excavations but increasingly as tapping into the machine itself as a layered, temporal and time-channeling machine of synchronization of culture and its structures of power. A historical mode of writing finds itself rejuvenated not in a narrative historical interest of knowledge – not only writing counterhistories of media – but in looking at temporality as a complex object of media cultural analysis as well as a driver of such processes of technical media which characterize software cultures.

Acknowledgements

A warm thank you to all the peer-reviewers for their wide range of meticulous, critical and helpful comments. Thanks also to Shintaro Miyazaki, the Anglia Ruskin University

sabbatical scheme, Humboldt Stiftung fellowship for the possibility to work at Humboldt University in Berlin, and Jason Grice for copy-editing.

Notes

1. However, for example Siegfried Zielinski (1999) did not denounce the influence of British cultural studies and also the influence of Raymond Williams for his archaeologies of audiovisions.
2. The trope of the 'cold gaze' is for Ernst a way of stepping outside a human perspective to the media epistemologically objective mode of registering the world outside human-centred sensory perception. Ernst's idea borrows much from a celebration of modern science-based media in its technical characteristics of non-human temporalities as well as the early 20th century avant-garde discourse:

   > The gaze is no longer a privilege of animals or humans (who are always emotionally vulnerable) but is rivalled by the cold camera lens – a new epistemological field which was later cin-aesthetically celebrated by Anton Giulio Bragaglia's treatise *Fotodinamismo Futurista* (1911–1913) or Dziga Vertov's film *Man with a Camera* (USSR, 1929). Thus theoría truly becomes media: the camera actively renders insights (such as long-time exposure) which have otherwise been inaccessible to humans, whose temporal window of immediate perception of events is neurologically limited between two and four seconds. (Ernst, 2005: 597)

   Naturally, the posthuman argument concerning machinic vision which we find in other theorists, such as Paul Virilio and Kittler as well, does not automatically resolve the various networks in which technological modes of non-human perception are sustained. This, one could argue, is a question of media ecology (Fuller, 2005) and political economy.

3. One of the referees for this article pointed out an important context for the distance-taking, rationalistic subjectivity in German cultural history. Helmut Lethen's (2002) *Cool Conduct* analyses the interminglings of politics of affect, distance/proximity and theoretical thought in Weimar Germany, offering another kind of characterization of 'coolness' and distancing gaze as part of a demand for rational objectivity. A thank you to the referee for pointing out this source.

References

Alaimo, S. and S.J. Hekman (2008) *Material Feminisms*. Bloomington, IN: Indiana University Press.

Armitage, J. (2006) 'From Discourse Networks to Cultural Mathematics: An Interview with Friedrich Kittler', *Theory, Culture & Society* 23(7–8): 17–38.

Bennett, J. (2010) *Vibrant Matter: A Political Ecology of Things*. Durham: Duke University Press.

Bredekamp, H. (2003) 'A Neglected Tradition? Art History as Bildwissenschaft', *Critical Inquiry* Spring: 418–28.

Chun, W.H-K. (2006a) *Control and Freedom: Power and Paranoia in the Age of Fiber Optics*. Cambridge, MA: MIT Press.

Chun, W.H-K. (2006b) 'Introduction: Did Someone Say New Media?', pp. 1–10 in *New Media, Old Media: A History and Theory Reader*, ed. W. Chun and T. Keenan. New York/London: Routledge.

Chun, W.H-K. (2008) 'The Enduring Ephemeral, or the Future Is a Memory', *Critical Inquiry* 35(1): 148–71. (also pp. 184–203 in *Media Archaeology*, eds E. Huhtamo and J. Parikka. Berkeley, CA: University of California Press, 2011).

Chun, W.H-K. and T. Keenan (eds) (2006) *New Media, Old Media: A History and Theory Reader*. New York/London: Routledge.

Deleuze, G. (1988) *Foucault*, ed. and trans. S. Hand. Minneapolis: University of Minnesota Press.

Ernst, W. (2000) *Medium Foucault. Weimarer Vorlesungen Über Archive, Archäologie, Monumente und Medien*. Weimar: VDG.

Ernst, W. (2002) 'Between Real Time and Memory on Demand: Reflections on/of Television', *The South Atlantic Quarterly* 101(3): 625–37.

Ernst, W. (2002) *Das Rumoren der Archive*. Berlin: Merve.

Ernst, W. (2003) *Im Namen von Geschichte: Sammeln – Speichern – (Er)Zählen. Infrastrukturelle Konfigurationen des deutschen Gedächtnisses*. München: Fink.

Ernst, W. (2003a) 'Telling versus Counting? A Media-Archaeological Point of View', *Intermédialités* 2: 31–44.

Ernst, W. (2003b) *Medienwissen(schaft) zeitkritisch. Ein Programm aus der Sophienstrasse*. Antrittsvorlesung (inaugural lecture): Humboldt University, 21 October.

Ernst, W. (2005) 'Let There Be Irony: Cultural History and Media Archaeology in Parallel Lines', *Art History* 28(5): 582–603.

Ernst, W. (2006) 'Dis/continuities: Does the Archive Become Metaphorical in Multi-Media Space?', pp. 105–23 in *New Media, Old Media: A History and Theory Reader*, ed. W. Chun and T. Keenan. New York/London: Routledge.

Ernst, W. (2007) *Das Gesetz des Gedächtnisses*. Berlin: Kadmos.

Ernst, W. (2008) *Sorlet från arkiven. Ordning ur oordning*, ed. trans. T. Andersson. Göteborg: Glänta.

Ernst, W. (2009) 'Method and Machine', lecture at Anglia Ruskin University, Cambridge, 18 November.

Ernst, W. (2011) 'Media Archaeography: Method & Machine versus History & Narrative of Media', pp. 239–55 in *Media Archaeology*, ed. E. Huhtamo and J. Parikka. Berkeley, CA: University of California Press.

Foucault, M. (2001) 'Cours du 14 janvier 1976', pp. 180–4 in *Dits & ecrits II, 1976–1988*, ed. M. Foucault. Paris: Gallimard.

Foucault, M. (2002) *The Archaeology of Knowledge*, ed. and trans. A.M. Sheridan Smith. New York/London: Routledge.

Fuller, M. (2005) *Media Ecology: Materialist Energies in Art and Technoculture*. Cambridge, MA: MIT Press.

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

Guins, R. (2009) *Edited Clean Version: Technology and the Culture of Control*. Minneapolis: University of Minnesota Press.

Hayles, N.K. (1999) *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. Chicago: University of Chicago Press.

Horn, E. (2008) 'There Is No Media', *Grey Room* (Winter) 29: 7–13.

Huhtamo, E. (2008) *The Roll Medium: The Origins and Development of the Moving Panorama Until the 1860s*. PhD dissertation, University of Turku. (book version forthcoming from MIT Press in 2012).

Kirschenbaum, M. (2008) *Mechanisms: New Media and the Forensic Imagination*. Cambridge, MA: MIT Press.

Kittler, F. (1999) *Gramophone, Film, Typewriter*, ed. and trans. Winthrop-Young G. and M. Wutz. Stanford, CA: Stanford University Press.

Kittler, F. (2006) *Musik und Mathematik. Band 1: Hellas, Teil 1: Aphrodite*. München: Wilhelm Fink.

Kittler, F. (2010) *Optical Media*, ed. and trans. G. Winthrop-Young and M. Wutz. Cambridge: Polity Press.

Krämer, S. (2006) 'Cultural Techniques of Time Axis Manipulation: On Friedrich Kittler's Conception of Media', *Theory, Culture & Society* 23(7–8): 93–109.

Lethen, H. (2002) *Cool Conduct: The Culture of Distance in Weimar Germany*, ed. and trans. D. Reneau. Berkeley, CA: University of California Press.

Lovink, L. and W. Ernst (2003) 'Archive Rumblings: Interview with Wolfgang Ernst', February. Available at: http://laudanum.net/geert/files/1060043851/index.shtml?1236078592 (accessed 20 January 2010).

Mackenzie, A. (2010) *Wirelessness: Radical Empiricism in Network Cultures*. Cambridge, MA: MIT Press.

Manovich, L. (2002) *The Language of New Media*. Cambridge, MA: MIT Press.

Montfort, N. and I. Bogost (2009) *Racing the Beam: The Atari Video Computer System*. Cambridge, MA: MIT Press.

Münker, S. and A. Roesler (eds) (2008) *Was ist ein Medium?* Frankfurt: Suhrkamp.

Parikka, J. (2007) *Digital Contagions: A Media Archaeology of Computer Viruses*. New York: Peter Lang.

Peters, J.D. (2010) 'Introduction: Friedrich Kittler's Light Shows', pp. 1–17 in *Optical Media*, ed. F. Kittler. Cambridge: Polity Press.

Pias, C. (2009) 'Time of Non-Reality. Miszellen zum Thema Zeit und Auflösung', pp. 267–79 in *Zeitkritische Medien*, ed. A. Volmar. Berlin: Kadmos.

Pias, C. (ed.) (2011) *Was waren Medien?* Zürich: Diaphanes.

Siegel, G. (2007) 'Babbage's Apparatus: Toward an Archaeology of the Black Box', *Grey Room* (Summer) 28: 30–55.

Sobchak, V. (2011) 'Afterword: Media Archaelogy and Re-presencing the Past', pp. 323–33 in *Media Archaeology*, ed. E. Huhtama and J. Parikka. Berkeley, CA: University of California Press.

Vismann, C. (2008) *Files: Law and Media Technology*, ed. and trans. G. Winthrop-Young. Stanford, CA: Stanford University Press.

Volmar, A. (ed.) (2009) *Zeitkritische Medien*. Berlin: Kadmos.

Wardrip-Fruin, N. (2009) *Expressive Processing: Digital Fictions, Computer Games, and Software Studies*. Cambridge, MA: MIT Press.

Wardrip-Fruin, N. (2011) 'Digital Media Archaeology: Interpreting Computational Processes', pp. 302–22 in *Media Archaeology*, ed. E. Huhtama and J. Parikka. Berkeley, CA: University of California Press.

Winthrop-Young, G. (2006) 'Cultural Studies and German Media Theory', pp. 88–104 in *New Cultural Studies*, ed. G. Hall and C. Birchall. Edinburgh: Edinburgh University Press.

Zielinski, S. (1999) *Audiovisions: Cinema and Television as Entr'actes in History*, ed. and trans. G. Custance. Amsterdam: Amsterdam University Press.

Jussi Parikka is Reader in Media & Design at the Winchester School of Art (University of Southampton) and Adjunct Professor of Digital Culture Theory (University of Turku, Finland). He is the author of *Koneoppi* (2004, in Finnish), *Digital Contagions* (2007), and *Insect Media* (2010), and the co-editor of *The Spam Book* (2009) and *Media Archaeology* (2011). His new book *What Is Media Archaeology?* is forthcoming in 2012 from Polity Press, as well as his edited book of Wolfgang Ernst's writings from the University of Minnesota Press. [email: j.parikka@soton.ac.uk; website and blog: http://jussiparikka.net]