

Digital Memory and the Archive

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Digital Memory and the Archive

WOLFGANG ERNST

Edited and with an Introduction by Jussi Parikka

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For publication information on previously published material in this book, see pages 245–46.

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Archival Media Theory

An Introduction to Wolfgang Ernst's Media Archaeology Jussi Parikka

Traditionally, archives have had an interesting aura despite the grayness of the concrete walls surrounding them. We tend to think of archives as slightly obsolete and abandoned places where usually the archivist or the caretaker is someone swallowed up in the dusty corridors of bureaucracy, information management, and organizational logic that makes the archive a system. What characterizes such systems is that they are not always understandable or accessible to an outsider. We do not often visit archives, but the archives still have a keen interest in us. The Stasi archives, opened after the fall of the Berlin Wall and the German Democratic Republic in the early 1990s, are a case in point. Those archives recorded a large number of lives down to the most boring details, documented in meticulous fashion, including transcribed voice recordings as well as photographs. Getting to an archive is not always that easy, either. One needs to obtain permissions, make arrangements, follow strict rules of conduct, and get introduced to the whole system of how the archive has been organized. For sure, from a theoretical point of view, the postmodern theory surrounding amusement parks, visual culture, spectacle, and so forth was perhaps more exciting than focusing on the archive as a core site of modernity in its gray administration culture.

And yet suddenly archives are popping up everywhere. A lot of our software-based interaction online now has to do with archival metaphors. We see this in ways ranging from the replacement of "Delete" or "Trashcan"

on our e-mail screens with "Archive" to attempts to offer new kinds of storage space—mistakenly conflated with "archives"—for the numerous traces we leave of our personal lives—photographs, sound files, videos, documents. We are miniarchivists ourselves in this information society, which could be more aptly called an information *management* society. Hence we see the business of cloud storage, mobile storage, and such flourishing. We also see this in business models of social media: the so-called free platforms we are using to connect to friends and to share ideas, links, and preferences for films and music are all material for data mining, which is the new form of subsumption of our lives into capitalist production and accumulation of value. This algorithmic unconscious of social media cultures knows a lot about us and is often keen not only to keep but to sell those data to third parties.

The archive-oriented media theory of Wolfgang Ernst (1959–) fits perfectly into the double bind of the modes of storage and transmission between old media and new media cultures. One of the last media theorists not to use a mobile phone, engage in any other form of the latest gadgetry, or even have a home Internet connection, Ernst is, however, completely up-to-date concerning the changes in our regimes of memory in software cultures. He is part of the breed of media theorists who are keen to do their own electronics, repair old media apparatuses, and browse through shops with old computers in order to find material for thought for, in Ernst's case, theoretical writings. Therefore, his way of mobilizing media archaeology into an analysis of the technics of cultural memory, analysis of the technical media machines of nonhuman kinds, and elaboration of theoretical ideas in digital humanities in medium-specific ways is at the same time something that feels new but is also recognizable to anyone who has at least a basic knowledge of some of the arguments of German media theory.

This introduction to the collection of writings by Wolfgang Ernst—the first to come out in the English language—elaborates the main thrust of his brand of media archaeology, as well as the other concepts that are featured in the chapters of the book. The introductory text also addresses their intellectual context as part of new themes in media theory: time-critical media, the archive, and diagrammatics. The purpose of this book is to give voice to one of the names that have appeared in recent waves of media-theoretical debates in Germany. Ernst is not yet so well known in English-speaking academia,

but because of his controversial suggestions his theoretical insights are exactly the food for thought we need in our current debates in digital humanities and new media theory. He is also part of the generation influenced directly by the late Friedrich Kittler (1943–2011), along with such theorists as Bernhard Siegert, Wolfgang Schäffner, and others. Hence the book is not only about and by Ernst but about the alternative ideas concerning media and technology that are arising as part of our humanities culture. These alternative ideas have often been branded as "German media theory," but at the same time they open up a much more heterogeneous set of thoughts, as I want to briefly outline in this introduction to Ernst and the context in which his theories have emerged.

Address Space: From a Historian to a Media Archaeologist

The term *media theory* is often a catch-all term that does not account for the variety of disciplinary perspectives that fit the category. In the case of Ernst, we need to acknowledge his background in more traditional humanities. Reading Ernst's writings from the 1990s to more recent years, one can notice a shift in perspective. He was trained as a classicist and historian, and his background is in the more traditional ways of thinking about history as present in our culture. Yet in media-theoretical debates, most of the texts we might have read from Ernst seem to remind us of Kittler's polemic texts about the emergence, nature, and effectiveness of media technologies for our perceptual capacities, which emphasized the need to see media history through ruptures, not continuity. Media history is not a progress story—or a story of a decline of civilizations—but is continuously written anew and branded by discontinuities. And yet Ernst is not directly a follower or a student of Kittler despite the fact that he is emblematic of what can be seen as the "Kittler effect": the remarkable influence Kittler's theories have had on a range of debates not only in Germany but in Anglo-American countries and internationally, fostering a whole debate on media materialism and technodeterminism.1 As Geoffrey Winthrop-Young notes, the ones who too loyally follow Kittler—the so-called Kittler school—are a less engaging posse anyway. It is more interesting to try to pick up on some of the points of the material and to develop a historically tuned understanding of the contexts of media

for the way we think, perceive, and do things. That is a major task and indeed is not reducible to only one sole figure despite the gravitational centrality of Kittler.

Ernst's approach is a mix from his background as a historian and the later media-theoretical emphasis that started to build on his interest in archives, historicism, and museology, hence the topic of his Ph.D. thesis from 1989: "Historismus im Verzug-museale Antike(n)rezeption im britischen Neoklassizismus." His thesis was published in 1992. And yet his "habilitation" thesis—in Germany traditionally the second major research project and the book one needs to have in order to be eligible for a faculty chair—was very much embedded in regimes of memory and executed in a fashion that a historian might still agree with: Im Namen von Geschichte: Sammeln-Speichern-(Er)Zählen; Infrastrukturelle Konfigurationen des deutschen Gedächtnisses (In the name of history: Collecting, recording, narrating).² Here the focus was on German institutions and modes of memory, but Ernst was already hinting at how he was rethinking narrating not only as narratives but as *counting* and addressing the close bind between erzählen (narrating) and zählen (numbers). Mathematics could actually be connected to the way we understand narratives and, more widely, aesthetics.

Influenced by a range of media theorists and primarily, one has to admit, by Kittler, Ernst started developing his own Foucauldian reading of media, history, and archives. Already the fact that Foucault had turned the cultural theoretical emphasis from archives as concrete places to archives as more abstract (but just as real) conditions of knowledge was significant. It paved the way for such developments as Ernst's gradually emerging media archaeology. Just as important was the fact that the slightly earlier wave of theorists had been applying the French influences of Foucault, Lacan, and Derrida to media theory in the 1980s, hence paving the way for more technical upgrading of poststructuralism into media theory—what Bernhard Siegert has called the Nietzschean "gay science" of 1980s media archaeology.3 Freiburg was known for the presence of Heidegger, of course, but places such as Kassel and Bochum—and then later, from the 1990s onward, Berlin—were more significant for the circuit bending of French theory into German media theory; more recently, research has also been concentrated in Weimar. In this terrain of intellectual debates, Ernst was able to pick up a similar idea: to upgrade philosophy into media theory and extend the idea of the discontinuity of media history into media archaeology.

Through books such as M.edium F.oucault (2000), Das Rumoren der Archive (2002), the previously mentioned habilitation thesis *Im Namen von Geschichte* (2003), and, more recently, Das Gesetz des Gedächtnisses (2007), Ernst lay the foundations for his specifically archival take on media systems, which more recently has been turning in an even further "technomathematical" direction. Before being given his own chair, Ernst taught at various universities that indeed were characteristic homes of media theory in Germany: Cologne, Bochum, and Weimar, for instance. Such experiences can be seen as fundamental for one growing into the media-theoretical framework of German media theory, so instead of having solely a direct relationship to Kittler's theories, Ernst can be seen to have been growing as part of a wider milieu of debate and discourse concerning media materiality and more. In terms of addresses (which, as we will see, are an important context for Kittlerinfluenced media theory), it is easy to track how the Ernst who was still writing about aesthetics of antique collections was characterized by intellectual visits to Rome and London (including the British Museum, of course) and Ernst the media theorist was someone whose significant addresses included the hubs of media theory in Germany.

Since 2003 Ernst 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 and English, in various anthologies and journals. His inaugural lecture for the professorship, "Medienwissen(schaft) zeitkritisch—Ein Programm aus der Sophienstraße" (Timecritical media science—A Sophienstrasse agenda), was emblematic of his interests and his drive to develop a very special kind of approach to media systems. In an age in which humanities, cultural studies, and media studies were increasingly focusing on digital media, creative industries, and emergent media discourses and technologies such as the business-driven "Web 2.0" or, more widely, "social media," Ernst took a left turn. His time-critical emphasis carried forward the historian's legacy but in ways that showed that he wanted to polemically distance himself from historical disciplines, flagging their incapacity for dealing with machine-specific time. Much as Kittler had insisted in his writings that "media" had been forgotten from the Western

ontology,⁵ Ernst was coming to hold as one of his guiding thoughts the idea that media had been forgotten from the ways in which we think through history. Temporalities are conditioned by mediatic frameworks. This is where Ernst's peculiar take on media archaeology stems from. The theoretical ideas from German and French theory were filtered into medium-specific ways to develop archaeologies of knowledge into archaeologies of knowledge in media—or media archaeology that is not to be mixed with considerations of archaeology as represented in media or even with the subdiscipline of archaeology that refers to the various media of archaeological excavations. Instead, this archaeology starts to think through our mediatic world as the conditions for the way in which we know things and do them—knowledge and power.

Media Archaeology: The Cool Way

The idea that there is a Berlin "school" of media theory as a specific style of media-theoretical thinking and tinkering is perhaps again characteristic of some of the ways in which German media theory is branded. As Winthrop-Young has articulated, the whole idea of such a German variant of media theory is problematic and hides the differences between the varia in or of ideas. It has picked up a similar force as an export article to that of German cars or Siemens electronics—or, for that matter, Berlin as the world capital of arts and, well, the twenty-first-century creative industries of "cool." But still, underneath this surface, which is as vague as the prior talk of "French theory" to refer to an eclectic mix of writers from Barthes to Deleuze and Guattari, it includes a lot of different approaches, ideas, and writings.⁶ German media theory is a brand "after the fact," not something that people would automatically recognize inside Germany. Talk of a Berlin school is something that has similarly been used to refer to the hardware materialist, technodeterminist, or even a technofetishist emphasis on the primacy of the machine. Here Kittler's gravitational pull is the key. In terms of "media archaeology," Kittler's institute was located one floor up from the Institute of Media Studies, which moved in 2011). Yet such a gravitational pull always risks losing sight of other things taking place—even in Berlin, where, for instance, Ernst is not the only media archaeologist in town: Siegfried Zielinski (University of Arts) is clearly another influential thinker who also uses the term "media archaeology,"7 as do a range of other people.

But what, then, is the Berlin media archaeology programme à la Ernst? What is so singular about Ernst's media archaeology as to distinguish it from that of Zielinski—or from that of the other established media-archaeological writers, such as Erkki Huhtamo, Thomas Elsaesser, and others?

Ernst insists that media archaeology differs from cultural history. This as such is not a huge surprise, because it stems from the wider adoption of Foucault's methods that characterizes several other scholars as well—the interest in conditions of knowledge and epistemic objects. Think, for instance, about the history of science of Hans-Jörg Rheinberger and the media epistemology of Wolfgang Hagen⁸—and hence, about the influences of Foucault and also the critical cultural epistemologies of Gaston Bachelard and Georges Canguilhem. Again we find the influence stemming from the constant interaction between the heritages of various theoretical insights into history and epistemology even before poststructuralism and the German media theory that emerged as part of the 1980s appropriation of "French theory."

Ernst outlines that media archaeology is less about telling stories or even counterhistories (leaving open the relation of media archaeology to Foucault's genealogy, which insists on the political function of counterhistories). Hence, it is more about how stories are recorded, in what kind of physical media, what kind of processes and durations—and as such, its focus is on the archaeology of the apparatus that conveys the past as fact not just as a story.9 Its object-centered focus is something that does not stem from Bruno Latour, as do the more recent trends concerning object-oriented ontology, for instance, but rather from the media-theoretical tradition and from rereading the works of, for instance, such often dismissed historical characters as Leopold von Ranke. In 1824, in a true positivist spirit, Ranke claimed that a historian should be just a recording surface, a describer of what really happened. Ernst seems to be a happy Foucauldian positivist who focuses just on description and stating that something is already an interesting "content" of theoretical arguments. This happy positivism brands how he wants to emphasize that media scholars should really understand that media are their objects of research; others can analyze cultural characteristics, politics, and so forth, but media studies needs to distinguish itself from other cultural studies disciplines by emphasizing close readings of media. Indeed, for Ernst "the empire of media is the blind spot of the humanities." He seems to imply that media are too often a blind spot for media studies, too.

Whereas cultural histories and new historicism, especially after the 1980s, criticized such ideas for their lack of cultural context and lack of self-reflection, Ernst takes a rather surprising route and reads Ranke as an index of a wider technological way of thinking that was emerging. Cornelia Vismann has in more detail emphasized the same drive in Ranke's theory, which was reading files and records as techno-ontological: they record all that falls outside the official stories, being "comprehensive recording devices" 11 (before phonographic and other technical media really showed what they can record). In a similar vein, what Ernst calls obsessions of unmediated thinking so emblematic of that age (and one could add, still in current digital culture) are actually media effects of the emerging technical media of, for instance, photography.¹² In 1822 Daguerre opened his diorama, following a path paved by the pioneer Niépce. Various pioneers in sound recording were doing their experiments with surfaces of other sorts, registering airwaves. Slowly emerging was a culture of recording—and technical recording as a new age of memory and archives—and agency of the machine (often attributed to nature using its own pencil without human intervention). Ernst writes: "With the emergence of photography, the idea of the theatrical gaze literally staging the past is displaced by the cold mechanical eye, a technologically neutral code rather than a subjective discourse."13

However, for Ernst it seems that agency is not a pure abstraction but attributable to the machines with the help of the "cold gaze" of the media archaeologist that shares much with that of scientists and engineers. ¹⁴ It is "object oriented" in a manner that resembles material culture research and is interested in the physicality of technical media, including computation. But the primary interest is in how the machines act as relays for signal-based technical communication and processes that the machines support. ¹⁵ Indeed, what emerges is not only an archaeology characterized by ruptures and discontinuity but one of recursions, variations, and technics of time registered with the coldness (lack of emotion or semantics) of the machine. This already begs the question of the place of the political or social in this brand of media archaeology—and these are apt points of criticism when it comes down to the material media theory of Ernst. Before delving into the critique, we

need to understand more concretely the ontological and epistemological idea Ernst is proposing in his nonhuman media archaeology: "What sounds like hardware-fetishism, is only the media archaeological concreteness." 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 later), 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 is articulated. This provides an alternative to the literary-based narrativization that historians provide in their epistemological and ontological premises. Ernst's position is aware of the materialist media grounding of contemporary archives that 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 calculation-based ontology of a memory.

This insistence on the cool mechanical eye, the cold gaze, is key to some of the aspects of Ernst's media archaeology—and probably one of the most controversial ideas in his argumentation. The cold gaze as a version of machinic agency is a theoretical figure that Ernst employs to emphasize that even before a historian or a media archaeologist steps in to tell stories about history, past media cultures, and lost ideas, there is a prior level on which the past has been recorded. The documents of the past are such concrete instances of pasts present but even more so of the way in which technical media records time and acts as a time machine between current times and the past. This time machine is nonhermeneutic, which was already Kittler's claim: technical media record not only meanings but also noise and the physicality of the world outside our human intentions or signifying structures. The machine—for instance, an old phonograph—is the first media archaeologist before human intervention.

So in this sense, media archaeology executed through the epistemological figure 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-centered sensory perception. Ernst's idea borrows as

much from a celebration of modern science-based media in its technical characteristics of nonhuman temporalities, the nineteenth-century discourses surrounding especially photography, and early twentieth-century avantgarde discourse such as that in Anton Giulio Bragaglia's treatise *Fotodinamismo Futurista* (1911–13) and Dziga Vertov's film *Man with a Movie Camera* (USSR, 1929).¹⁷

In terms of contemporary theory, such ideas resonate with some of the hardware versions of posthumanist thought we recognize from Kittler. They also fit in with some of the aspects of nonhuman agencies that have gained wider currency through Latour's work (which, more recently, has been cited by Ernst), but they also diverge from some of the aspects of posthumanism, especially those that are more political, for instance, material feminism. 18 Indeed, as an epistemological-rhetorical figure we can also criticize "coolness" as part of a distance-taking, rationalistic subjectivity that has longer roots, especially in German cultural history, and is well analyzed in Helmut Lethen's Cool Conduct, an analysis of the run-up to the technological war of 1939-45 in post-World War I Germany and the Weimar Republic. 19 What if "coolness" is a gesture of distancing, objectification, and as such, detachment that also works to bracket such messiness as cultural practices and politics and focuses too much on the machine as a seemingly self-sustained entity in itself? This is the implication of the example from Ernst that we address later concerning the Volksempfänger. What if the emphasis on media technology as the primary focus of media studies is in that sense a gesture that is countereffective in distancing media studies from the other approaches in arts and humanities, which at the moment are increasingly looking for contacts, proximity, messiness, and hybrids? Indeed, although attempting to offer an insight into the a priori of historical writing, Ernst is in danger of mythologizing the machine as completely outside other temporalities, including the human.

This is the critique that is aimed at some of the aspects of German media materialism more widely. For instance, Lisa Gitelman has insisted that Kittler's arguments already had the problem that they neglected the complex ways in which objects such as Edison's phonograph came to exist in the first place—through the work of invention, engineering, arguing, negotiating, patenting, and more. Instead, argues Gitelman, Kittler assumed too much of

technology as a self-sustaining anchor of history, without a history of its own. The objects of media study are themselves, paradoxically, at times lacking a history, even if through them one is able to mobilize complex investigations into the nature of temporalities.²⁰

Some such arguments can be targeted at Ernst, too, where his object-oriented media archaeology is actually focusing too much on the object—the apparatus. Such apparatuses that in Ernst's case might be important to give us history (as conditions of knowledge) seem themselves surprisingly without history and outside time. This is perhaps the price of the cool. At the same time it is a question of where do we start: do we start from the cultural practices through which machines come to have effects in the first place, or do we start from the machines that condition the ways in which we have cultural practices such as invention, work, leisure, or more general cognitive capacities such as memory or, for instance, perception? In terms of their emphasis on the apparatus, it is clear that Ernst's theories are easily taking us in a different direction, as do those of some of the other "new materialist" thinkers of recent years. However, this potentially problematic figure of the cool gaze can be contextualized as part of the wider program of Ernst's media archaeology.

Indeed, another way to understand the notions that refer to coolness are to be understood almost in their physical sense. To quote Ernst:

The phonograph as media artifact not only carries cultural meanings like words and music but is at the same time an archive of cultural engineering by its very material fabrication—a kind of frozen media knowledge that—in a media archaeological sense—is waiting to be unfrozen, liquefied. Digital archaeology even operates below the sensual thresholds of sight and sound—a level that is not directly accessible to human senses because of its sheer electronic and calculating speed. Synesthetically, we might see a spectrographic image of previously recorded sound memory—a straight look into the archive. The microphysical close reading of sound, where the materiality of the recording medium itself becomes poetical, dissolves any semantically meaningful archival unit into discrete blocks of signals. Instead of applying musicological hermeneutics, the media archaeologist suppresses the passion to hallucinate "life" when he listens to recorded voices.²¹

Hence, the idea of "cool" and now "frozen" actually becomes a figure for the way in which media as time machines "package" sense data in order to endure time. It plays with the idea of the traditional task of heritage, storage, and preservation of freezing time and dynamics of life—or technical media. In a creative rethinking, such notions become an index to a way to understand time, rethink time as something that is at the core of the wider media-archaeological process, and develop concepts to understand the temporal dynamics of technical media. In addition, these notions of time, temporality, and "time criticality" stand as further specifications of Ernst's project of media archaeology. Next we will have a look at how this ties in with the "operational" arm of Ernst's media-archaeological theories: the media-archaeological "fundus" and media archaeology in action.

Media Archaeology Operationalized

As I have already suggested, Ernst is part of a wider academic debate having to do with understanding current digital culture through a media-archaeological lens.²² This is usually executed in differing ways. Huhtamo talks of the recurring topics, or topoi, of media culture; Zielinski speaks of the anarchaeological function that forces us to rethink the constitution of the contemporary; Elsaesser comes from a strong new film history direction; and writers such as Lev Manovich and Wendy Hui Kyong Chun have tackled more closely the digital software culture.²³ Ernst continues the Kittler lineage of media archaeology—even if Kittler distanced himself from "media archaeology" as a specific brand of media sciences.²⁴ What the many scholars share is an enthusiasm for the objects, and hence as collectors many are miniarchivists themselves, frequent visitors of flea markets, antiquariums, and old electronics shops. This type of enthusiasm has formed a crucial part of the career of, for instance, Huhtamo, who has actively engaged in curatorial work, and many of his writings have stemmed from his private collections and are good archives of his empirical research. For Ernst, an interest in collecting—and opening up old media—serves an important methodological function as part of his theories as well.

For Ernst media archaeology is not only a way of writing but a method that has to do with reverse engineering.²⁵ Hence his way of approaching objects is not merely as a collector but as an amateur engineer who opens,

checks physically, tests, and experiments to learn how media function. Foucault became employed as a technician, and media archaeology incorporates DIY. As Ernst writes, "Media theories work only when being tested against hard(ware) evidence." ²⁶

Media archaeologists have vitalized a certain Benjaminian spirit of the collector as a cultural analyst, but the practices of what one does with those collections differs. One of the important contexts for Ernst is the Media Archaeological Fundus²⁷ (see the figure in "Media Archaeology as a Transatlantic Bridge"), which has resided in the cellar of the Institute of Media Studies, the operational arm of Ernst's theoretical work, where with concrete tinkering—at times with a more amateur spirit, at times with the help of engineers from other institutions—old machines are opened up and made operational again. Unlike museum objects, all of the archive's machines are operational—and hence dynamic. I witnessed an old Soviet Russian submarine radio from the 1950s still picking up signals, as well as a simple toy made of original tubes that demonstrated the principle of "flip-flop" and computer memory, and many other objects that are more than gadgets: they are epistemological playthings. In Ernst's words:

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 analog 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.²⁸

It is a mesmerizing idea to follow his logic concerning the transversality of time or objects and apparatuses through time. Obviously it does not come without its problems, as mentioned a bit earlier. It is striking how quickly Ernst moves away from even hinting at any sociohistorical contexts for such devices, emphasizing the objects in themselves—again a demonstration of his cool object focus, which by way of methodological choice saves itself, too, from discussing messy politics of technology. At the same time that this

idea tries to complexify the idea of history as nonreducible to human cultural realms—this is machinic time in action—it simplifies exactly the other bit, that despite their nonhistorical nature, such technologies cannot avoid being embedded and entangled in such human temporalities as well.

At the Media Archaeological Fundus, objects are collected on the basis of their exemplary value: what they reveal of their scientific-technical characteristics (for instance, why an electric guitar links back to early nineteenthcentury discoveries of electromagnetism by Faraday). Play is important when understood as part of didactics—the hands-on approach that allows us to try, to have tactile contact with, to touch and open media and hence, paradoxically, to work in quite the opposite manner to the cool distance-taking machinic methodology. Despite the fact that technical media often work in subphenomenal ways—in other words, their principles of operation are not directly open to observation by the human eye—such a manner of tinkering with media-technological effects forms a circuit with the theoretical work. Hence Ernst's media archaeology forms as part of a three-fold circuit of theoretical work influenced from a variety of directions, such as those of Foucault and Kittler, the scientific-mathematical as well as cybernetic roots of technical media operations, and the engineering approach to tinkering in a manner that we recognize from such practices as hardware hacking and circuit bending.29

What is often lacking, however, is a distinct political emphasis that would be able to talk about the political economy of contemporary increasingly closed (technologically and legally, as in the case of digital rights management) and black-boxed media technologies in which one cannot open devices without breaking them completely. Hence a fascination with old technologies always risks the danger of lending a blind eye to current technological cultures of consumer devices impossible to tinker with. How does one catalyze the media-archaeological interest of knowledge into a critique of the present in the manner that Foucault did? To be fair, there are hints of this in Ernst's ideas as well. He has argued that one important avenue for media theory is building *media competency*—a certain media education that, according to Ernst, should take as its tactical mission to teach not only that media are about mass media surfaces but also that all media are cultural entities that govern our everyday life.³⁰ In this sense the technical can be turned into

a potentiality; referring to Bertold Brecht's ideas about the possibilities of developing radio into an interactive two-way communication system, which never happened because radio took the path we are more familiar with—that of broadcasting—Ernst argues that the technical always includes more than its social uses. In a curious twist of perspectives, here the social is actually seen as reducing the potential of technology.³¹

Instead of placing a sustained emphasis on politics, Ernst is keen to think the implications of the *chrono-logic*. This means, in the spirit of the media-archaeological fundus, to use media technologies as ways to understand the wider epistemological implications of, for instance, time. Therefore, his target is often the way we think history and time, and he offers his theories as a challenge to the theory of history. Ernst is arguing that media archaeology provides an alternative to existing historical theories in taking seriously machine time. This can be taken as a variation of a posthuman theme that grants agency to animals and technology, for instance. Instead of typically emphasizing machine time as repetitious, Ernst is keen to argue for the importance of such time regimes for our general cultural understanding of temporality. This points toward mathematicotechnical notions of time—iterations, recursions, short circuits—as a crucial part of how we should think "history," too.³²

The basis of this operational approach is the idea that we need to see media technologies as dynamic. They are active agents in participating in "media" events" in the way they store, process, and transmit signals³³ and act as a necessary condition of knowledge. Because they are dynamic, they have a special relation to rhythmics, sound, and in general the sonic sphere, which becomes less an index of a relation to the human body (Ernst often distances himself from any "emphatic" emphases in cultural analysis) and instead a way to understand signals in their temporal being. This forms the core of what Ernst attaches to a "time-critical perspective," which basically argues that there is a logic in *chronos* that is irreducible to history. This is clearly visible in the last section of this book, too, where in some of Ernst's more recent writings he talks about the sonic technologies from this temporal perspective. Yet we can argue that media-archaeological theories have made this shift away from historical times already, distancing themselves and their theories from being merely media histories and insisting on the lively, alternative, and nontraditional ways in which they excavate recurring topics or deep

times. Yet instead of such "macrotimes," Ernst wants to elaborate the "microtemporality" at the core of technical media, a theme that is the focus of his forthcoming new book as well.³⁴

Ernst wants to see media archaeology as an investigation into intensive microtemporality that forces us to reconsider cultural memory combined with an understanding of the technical memory as an active process instead of a stable, permanent memory. Memory itself—as a term that refers to a human capacity as well as the social institutions of memory—is problematic because the technical grounding of "memory" functions differently. In Wendy Hui Kyong Chun's words, what characterizes our approach to memory in the digital culture is its conflation with storage, which produces the odd, almost paradoxical idea of enduring ephemerality, of the intimate coupling of degeneration and regeneration that is at the core of how memory functions technically as well as culturally.³⁵ Even in relation to a cultural heritage that has been formed around processes of stabilization and preservation, the dynamic nature of computers is a problem. Memory is not so much a place of rest but part of a wider setting of calculation—working memory—claims Ernst.³⁶ As every museum and archive knows (or should), the labor of how culture remembers and retrieves from memory is shifting from the official institutions to everyday media environments—social media or, more generally, the way in which data are transmitted and stored, even if fleetingly. Indeed Ernst talks not so much of this institutional side and challenges to museums and archives but of the technoarchives that our computerized media are.

This is microtemporality: "Formerly, we saw a museum like crystallization of temporal objects transforming into flow. Demonstrating recycling instead of finality, the length of storage is becoming increasingly more short-term. ROM (long-term read-only memory) is challenged by RAM, by random access. Final storage transforms into interim storage." What Ernst fails to address is that of course storage does not disappear even if it is in our hands (or on our mobile devices or in our computer RAM) for only a very short time: cloud computing is emblematic of the other kind of distancing that takes place when we outsource a range of storage and, increasingly, calculation to external, often proprietary servers with interesting implications for data retrieval (and reuse). Such data, whether from the fleeting messaging patterns of our mobile

cultures or saved on external servers (on clouds) is of course often retrievable as computer forensics applied now to digital cultural heritage practices,³⁸ but the question of who legally has access raises a different set of questions not so often touched upon by the more technologically focused approaches.

Instead of tackling the wider structural issue, Ernst is keen to establish a link between technological frameworks and aesthetics. According to Ernst, music models time. Such perspectives also distance themselves especially from narrative time and the primacy of writing. The sonic and the rhythmic are thus seen as exemplary cases of how we understand algorithmic media, too: how instructions are executed, how the executive operationality of data takes precedence to interpretation or semantics, and so forth. Manovich has already claimed that the logic of the database replaces that of the narrative in digital media, ³⁹ and Ernst applies a similar idea from the point of view of temporality. Referring to Vilém Flusser, Ernst argues that our model of historical time was deeply intertwined with alphabetic writing, "which reduced the multidimensionality of architecture and images to linear, sequential lines." As such, narrativity becomes a dominant model for organizing information and offering a structuration of beginnings, middles, and ends according to the Aristotelian model.

Microtemporal approaches refer to archives in motion.⁴¹ This applies to digital media but also to earlier technical media. Already television is mapped in Ernst's vision as a specific regime of the image that is not static but continuously regenerated in cycles of scanning of the cathode tube ray—line by line, which implies a different linearity to that of the narrative. 42 Digital networks incorporate the temporality of "pings" of the ICMP (Internet Control Message Protocol): echo request, echo reply are the basic communication rhythms that sustain the transfer of information over the Internet.⁴³ This brand of media studies starts, then, from the signal as the basic unit for analysis—and, as Wendy Chun has noted, "signal" affords itself toward both "physical events and symbolic values." This is what Ernst focuses on, too, in both his theory and the practice at the fundus: on showing that our perceptions are dependent on the signal-processing capacities of our devices. This is evident from the example of online streaming, especially with a slightly slower Internet connection that halts at times to load the content. But we can find this reliance on the signal as a time-critical process in earlier mass media as well. Perceptions become a function of the signal processes and the signalto-noise ratio that is governed by complex diagrams usually more familiar to engineers and mathematicians, whether we are talking about the statistics inherent in transmission or the specific color worlds this has related to:

The broadcast of any football game illustrates the signal-to-noise ratio between plays on the field and amorphous shots of the spectators in the stadium only statistically. The archeology of media searches the depths of hardware for the laws of what can become a program. Has not the character of television shows after the introduction of color sets been determined decisively—indeed down to the clothes of the hosts—by the new standard and what it can do in terms of color and motion? Even today, the color blue has a mediatic veto in *chroma key* resolution; the same goes for the *blue screen*, and for manipulations of resolution and color filters. . . . For media archeology, the only message of television is this signal: *no semantics*. ⁴⁵

I suggest branding this as a certain kind of *aestheticotechnics*.⁴⁶ Both Kittler and Ernst, but also, for instance, Bernhard Siegert, share the appreciation of Claude Shannon as the technical father of modern media culture, ⁴⁷ because it is his technoengineering perspective on the primacy of channels and signals that are temporally processed in channels that is the basis 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. They also become frequencies instead of beings, quantities instead of qualities, and functions instead of attributes, to paraphrase Siegert—who refers to Max Bense. ⁴⁸

In Ernst's more than technical definition of media, which gets more nods from people in science and computing departments than from humanities and cultural studies scholars, media are to be understood from the viewpoint of their channel, which "counts with time." It is less about the objects of or in those channels than about the operations that introduce the patterns, pulsations, and intervals through which information becomes a reality of the channels before becoming a reality for the phenomenological viewers, listeners, or readers of media.⁴⁹

Hence the definition of *media* that Ernst proposes is quite strict—and blunt. To paraphrase Ernst, a medium is defined as the physical passage, or place, that mediates something codified and gets decodified at the other end. This definition is itself extremely narrow because it emphasizes the primacy of the channel for the toolbox of the media theorist: the blunt existence of a channel as a physical reality is where media start and constitutes other definitions of media—which Ernst, perhaps slightly dismissively, calls metaphorical.⁵⁰

So in short, Ernst's media archaeology tries to summon perspectives that are not historical in the written narrative sense but are embedded in the other temporalities we know from the phonograph, the television, the computer, and the network. The underlying processes of signal processing, operating, executing, and synchronization form this microtemporality and time criticality that he points to as the other road for media archaeology. Therefore, this other road can be seen to work from a certain epistemological perspective but also from a more meta-level wish to distinguish the uniqueness of *media* studies relative to *cultural* studies. And the uniqueness of perhaps a European, even a German, approach.

The German Question: A Specific Brand of Media Theory?

Now the important thing to remember—as mentioned earlier—is that there is no such thing as German media theory.⁵¹ Kittler claimed in one of his most famous articles that there is no such thing as software, by which he meant that software points us back to operating systems, then back to the BIOS (basic input-output system), and so forth—tracking a "kind of descent from software to hardware, from higher to lower levels of observation."⁵² In the end, we just reach voltage differences. German media theory, if allowed to make this metaphorical jump from computers to academic disciplines, is itself a surface effect that hides a lot that takes place on the ground. In this case it hides a multiplicity of approaches, themes, and debates, which are not expressions of a national spirit or a well-defined research program. Winthrop-Young argues that in the case of Kittler, the German aspect of his theory relates to how much his thinking is embedded in "debates about technology, humanism," and the wider German history⁵³—for instance, after World War II, the continued sense of the nearness of the war and military technologies,

the cold war, and the emergence of the new, post-1968 university system, along with relations to, for instance, French theory, but also the emergence of personal computing and the digital culture. I believe that post-Kittler "German media theory" has to take into account a similar agenda of historical contexts (which more recently have included the intensification of developments relating to the digital culture, cognitive capitalism as an increasingly central mode of production and value extraction, the globalization and neoliberalization of the education system, the changing status of the humanities, and the new discourse on interdisciplinarity, which is one context for the humanities-sciences collaboration), as well as the aforementioned Kittler effect. I also believe that a lot of the theories have in one way or another reacted to challenges and provocations from the Kittler direction, relating to materiality, history, and the discontinuity proposed by Kittler as crucial to understand media (studies).⁵⁴ It is from this basis that Ernst's work finds its context and turns to media archaeology. Yet he is only one of the key names in media-theoretical debates in Germany, among many other theorists yet to be translated: Sybille Krämer, Wolfgang Hagen, Claus Pias, Dieter Daniels, Bernhard Dotzler, Wolfgang Schäffner, Erich Hörl, and Marie-Luise Angerer—and the list could be continued. There are only a few exceptions to an otherwise long list of original theorists whose works have not been published; in addition to the works of Kittler, for instance, those of Siegfried Zielinski, Cornelia Vismann, and Bernhard Siegert, along with a range of writings by Vilém Flusser, have been made available in English.55

Although another debate could be had about the need to establish more sustained ways of translating this rich body of work, it is sufficient to point to how such perspectives are able to bring us new ways to understand the often very Anglo-American way of thinking about media studies. One reason already in itself almost sufficient for this adoption of new perspectives is that a lot of the German perspectives have really been able to open up the list of possible topics for media studies research; Eva Horn lists "doors and mirrors, computers and gramophones, electricity and newspapers, television and telescopes, archives and automobiles, water and air, information and noise, numbers and calendars, images, writing, and voice." That could be one way to bring more life back to the at times too stabilized media studies discussions in Anglo-American countries. And yet, such a list points not only toward

an extension of media (studies) but also toward the notion still waiting to be discussed in Anglo-American academic theory of "cultural technique," which is very important to a range of German theorists.⁵⁷

The various debates, discussions, and reflections relate to the question of the possible difference of the various German approaches. As one of the central names in the more recent wave of German media theorists (it is difficult to escape that term), Claus Pias, notes, the whole question is less about its uniqueness but why we are using such a term at this point in time. What is motivating the questions about "German media theory" and whether it is a sign, as is so often said when referring to national characteristics, of a crisis moment? But what kind of a crisis might this be—an internal one or one due to its sudden success?⁵⁸

Pias maps the notion of German media theory and its epistemological as well as academic role in the German field, making interesting observations. Although he is able to offer a general generational insight into the development of media studies in Germany (with a playful parallel to the three generations of the Red Army Faction), he also shows how things are left out. The notion of German media theory started in the mid-1980s (not least because Kittler's Aufschreibesysteme came out then, along with a range of works such as those of Norbert Bolz and others), and this has left undiscovered—at least by Anglo-American readers—the genealogy of this media theory. This geneaology includes the establishment of media theory at Berlin Technical University in 1972 by Friedrich Knilli, the existing disciplines of communication and mass media research, the birth of television and film studies since the 1960s, and the fact that so often the media theorists were not media theorists to begin with.⁵⁹ This applies even to Ernst: as noted earlier, he was a historian and classicist before becoming a media theorist and archaeologist.

Such kinds of reinventions of academic profiles and genealogies of disciplines are of course familiar in the Anglo-American world too. The new directions in media studies such as software studies, platform studies, media forensics, media ecological research, and indeed media archaeology often share a fair number of references to, for instance, Kittler. In addition, the emergence of digital humanities begs the question of the relations of the various humanities traditions to such a seemingly—as it is claimed to be—new

formation. For instance, Ernst is a humanist turned "posthumanist" because of his methodological preference for the primacy of the machine as the first registration of reality before meanings kick in. Such a perspective is less represented in contemporary digital humanities debates, which are more pragmatic and focus on digitalization, new digital and networked tools for academic research, and, for instance, archives. The adoption of the German import Kittler to the hypertext or posthuman discussions in U.S. academia of the 1990s was not always smooth; it will now be seen how Ernst fits in with the at times less theoretical digital humanities debates that are now one of the central arenas for discussing archives and memory.⁶⁰

In terms of, for example, archives, Ernst is completely in his home territory, and here I believe that his provocative approaches could contribute to a further theoretization and critique of some of the strands of digital humanities and the conservation discourse. It is not for this introduction to critique that notion, but suffice it to say that Ernst's own "digital humanism" taps into the existing traditions out there: cybernetics, art and science collaborations, and the emergence of technical media as a grounding for the way in which memory as well as aesthetics works in modernity. With these voices of German media theory coming from the left flank, some of the blind spots of such discourses can perhaps be revealed and debated. Similar to the way that French poststructuralism has played a key role in the rediscovery of Heidegger in Germany since the 1970s, 61 perhaps we need some German media theory to remind us of the longer traditions in, for instance, the United States and the United Kingdom, of cybernetic thought, material media theory, and the collaboration between art and science. Computation + humanities + media is a familiar equation for many media-theoretical institutions in Germany, nowadays, for instance, in Weimar. German media theory can in this sense be a good detour. It is itself one that is filled with various traditions and exemplifies not only a specific German academic discussion concerning media as the epistemological framework for the post-Fordist digital culture of technical media but also the vibrancy of transnational theoretical flows, which can be traced back to their source. Therefore, I hope this book provides good insight into the media archaeology and "digital (post)humanism" of Ernst and also into possibilities of new kinds of media theory that do not dismiss their longer roots and influences.

Media Archaeology as a Transatlantic Bridge

Media in Between (Transatlantic Methods)

There have been ongoing rumors, legends, and critical remarks about a certain German (or even "Germanic") technology-centric or technodeterministic, that is, machine- and code-centered, school of media studies. If the theoría of media is epistemologically conceived in the sense of a Kantian a priori, technological knowledge indeed remains a precondition for the possibility of understanding media culture. Still, as Kjetil Jakobsen points out, the field of (new) media theory seems split between two very different approaches: "Media archaeologists, like Kittler, Wolfgang Ernst, or Alexander Galloway, describe the non-discursive practices of the techno-cultural archive. Media phenomenologists like Katherine Hayles, Tara McPherson, or Mark B. N. Hansen analyze how phenomena in various media appear to the human cognitive apparatus, that is, to the mind and senses." What is clear, though, from reading this arbitrary list of names, is that the theoretical front is not one simply between continental European media archaeologists and media archivists on the one side and English-speaking cultural critics of media practices on the other but rather an epistemological rupture and positioning—maybe in the best sense of Heraclit's pre-Socratic notion of harmonía.³

The archaeological or archivological approach is as much rooted in Michel Foucault's definitions⁴ as it is connected with Marshall McLuhan's noncontentist media analysis. In his discussion of what is an image in the age of

new (that is, electronic and digital) media, in an explicit Bergsonean tradition, Mark Hansen insists on the coming into being of the mediated image in the "enframing" acts of the human bodily cognition. Somewhat more restricted, radical media archaeology as a form of what Geoffrey Winthrop-Young calls "posthuman cultural studies" takes the point of view of the machine itself. Radical" nondiscursive media archaeology (compared to, for instance Siegfried Zielinski's version of media archaeology, recently rephrased as "variantology" is to be interpreted in two ways: in the sense of back to the roots (which is the archive), to the beginnings (less historic causality but temporal originality, the opening and generation of the time-critical momentum? and of temporal horizons), and in the sense of the mathematical square root as a constitutive force in algorithmic, technomathematical media.

With no overall consensus about its definition, methods, tools, or even its field, 10 there are different ways of practicing media archaeology, many of them "remediating" new media theories with previous ones by extending them. 11 Against this smooth approach, a Foucault-driven media archaeology accentuates discontinuities and primordial differences. A German milieu (rather than "school") of media scholars once emerged in the wake of the late¹² Friedrich Kittler's insistent emphasis on both material ("hardware") and symbolic ("software") factors as prime movers of culture, from phonographic engravings to machine code. The mechanisms of timekeeping themselves remind us of the dramatic discontinuity between cultural (religious, astronomical) timekeeping and the emergence of genuinely autonomous timebased media. The challenge facing the study of interrelations between culture and technology is not to bring them closer together but to rethink their terms and practices, which must therefore remain separate. 13 In order to identify the real protagonists of media culture, a reconciliatory analytical merger of the technologies with the people who created, consumed, and imagined them blurs the decisive differences that are at work here.14 From a decisively nonhumanist perspective, inventors do not figure as the primary agents of a so-called media history, but their creations turn out to be governed by nonrelativistic agencies such as external technological laws.¹⁵ Admittedly, in this media-theoretical bias German prewar engineering culture still shines through, as well as Martin Heidegger's ways of fundamentally rethinking technology. Ernst Jünger once proclaimed the aesthetics of the photographic as the "cold gaze";¹⁶ after the *acoustic turn* and in an age of technically augmented sonospheres, the cold gaze needs to be supplemented by "unpassionate listening": listening to the musicality not only emerging from, but taking place *within*, technomathematical media.

In the Anglo-American world, media studies are to a large degree being associated with the cultural studies style of critique. Although this contextualizing (and historicizing) approach presupposes a primordial binding of media to the social and cultural spaces they occupy, the collection of essays in this book advocates a different, rather focused point of view. Media archaeology exercises a close examination of technical media as they actually operate while maintaining a hermeneutically distancing look (akin to the "passion of distance" that Friedrich Nietzsche once declared to be his method of analysis). A preface to the Anglo-American edition has to address the delicate liaison between media archaeology and cultural studies.

In accordance with Foucault's Archaeology of Knowledge, media archaeology makes us aware of discontinuities in media cultures as opposed to the reconciling narratives of cultural history. In that aim, media archaeology is not strictly opposed to the media-phenomenological approach at all; the ways media affect human perception (in the best McLuhanite tradition) asks as much for cognitive neuroscience as for the microtechnological analysis of signal transfer. In his New Philosophy of New Media, Hansen underlines that no technological necessity presupposes the maintenance of the rectangular screen as the current human-computer interface; the inherited aesthetics of the cinematic format turns out to be a cultural lag from which the mediaarchaeological insistence on discontinuities might help us to become liberated. Lev Manovich, on the contrary, interprets the aesthetics of digital interfaces as already prefigured by the cinematographic avant-gardes of the 1920s—their experiments with jump cuts, animation, and collage.¹⁷ The language of new media¹⁸ is not just what interfaces offer to the human user; it is also machine language on the operative, that is, archaeological, level of computer programming. Such a perspective, without saying, is less discourseoriented than in the social media approach.

In order to thoroughly analyze technological settings, it is vital to suspend the discourses that envelop them and mold their meanings for a heuristic moment;¹⁹ this does not necessarily result in a categorical opposition but



The Media Archaeological Fundus. Photograph courtesy of Lina Franke and the Institute for Musicology and Media Studies, Humboldt University, Berlin.

rather in a complementary strategic alliance between cultural studies and German media theory. A new generation on both shores of the Atlantic interlaces (to use a term from electronic imaging) both approaches, ²⁰ leading to a kind of relation between cultural and media epistemology that acknowledges both their nonhuman agencies (Bruno Latour) and their discursive dependencies. ²¹ With a vibrant media-theoretical discussion in the English-speaking world, there has been a translation barrier for relevant texts so far, different from that in the world of technomathematical engineering, which would cross-culturally wire artifacts into standard operation. What looked like an antithetical configuration in German hardware-oriented and Anglo-American socially and culturally oriented media studies for a long time nowadays seems "sublated" by a Hegelian trick ("List") of media-theoretical reason. So-called software studies²² (which acknowledges the increasing virtualization of programming and its phenomenologization as "apps") and a refreshed materialist (forensic) approach²³ link both cross-Atlantic schools.

Media Archivology

Some of the main subjects in these collected essays have obviously been inspired by Michel Foucault's notions of *archéologie* and *l'archive*. Both notions, though, are being used against the background of archaeology and the archive in the positivistic sense. ²⁴ The author has been academically trained as a historian. Once experienced as the basic agency of source material for historical research, ²⁵ the archive has since turned into a subject of research. Nothing is more deconstructive than the archive itself.

Culture (and its escalations in technological media) is a function of knowledge transfer as well as of storage.²⁶ A certain traditional European archival aesthetics has been closely connected to notions of secrecy (be it in the Roman Vatican or in Prussia), contrasted with a somewhat more liberal attitude on archives in the United States, where it is imperative that archival institutions actively take care to make their contents accessible and known to the public—a core democratic attitude of our *postmodern condition*.²⁷ The mediaarchaeological approach is in fact about the unrevealing of symbols, signals, and information. In the age of technology-driven media, both material archaeological strata and the symbolical order of the archive are progressively being conceived as essentially processual by nature, to be deciphered as operative diagrams—close to what Charles S. Peirce defined as "diagrammatic reasoning."28 Humans almost irresistibly relate to images in an iconologic way, to sound in a musical way, and to texts in a hermeneutic way. But there is a kind of knowledge that can instead be uncovered from within the visual, acoustic, or textual endodata: entering the digitized record itself (data immersion), which is the media-archaeological gaze that can be performed by algorithmic machines of information processing better than by human perception. Such informatized organization of knowledge generates diagrams (which is also the Deleuzean intepretation of the Foucauldean archive)—infomapping. Occidental culture is still dominated by semiotically iconic, musically semantic, literally hermeneutic ways of seeing, hearing, and reading; the twentyfirst century, though, allows for a genuinely computer-generated information aesthetics that is closer to that of processual diagrams than to figurative phenomena within the audiovisual (or textual) regime.²⁹ On the level of cultural analysis and description, diagrams might eventually replace traditional historiography and enable unprecedented types of generative archives (rather than representations).³⁰ Instead of further narratives of media origins in terms of history, this rather leads to the indication of other levels of media tempor(e) alities: their governing principles and archaic essentials. In that sense, media archaeology means archivology as well: taking a "contextualizing" approach, but less in terms of historiography, with its emphasis on social, cultural, and discursive frames, than in those of the technoarchive itself, which is both symbolical (records) and technical (the apparatus).

Jonathan Sterne's genealogy of the MP3 compression standard for audio files is an example of media analysis that succeeds in the balance of remaining close to the medium in terms of computer science and at the same time providing the relatively short history of this apparently "new" medium with a deeper temporal and structurally prehistorical dimension. Thus the MP3 standard is being derived from its (psycho)technical and cultural, even epistemological foundations while consciously avoiding technological determinism.³¹ What looks like the "history" of MP3 transforms into a true media archaeology when the subject is not only related to culturally variant human perception (the historicity of the human senses, as stressed by Karl Marx and Walter Benjamin) but includes the alternative "ear" of the technomathematical apparatus as well—that is, the ways audio signal processing takes place (and is "understood") by the medium itself.³²

The archivological approach focuses on the infrastructure of media-historical knowledge. With an extended concept of the archive, a media-archaeological approach to the past must mean that media cannot be made into "historical" objects of research only. Different media systems, from library catalogs to microfilming, have influenced the content as well as the understanding of the historical remains of the archive itself. Alphabetic writing, which has dominated the archive for centuries, has dramatically been challenged by signal recording (photography, the phonograph, cinematography) and puzzled the archivists at the beginning of the age of media reproduction. But in a way that can hardly be described in terms of linear progress, the alphabet returned as alphanumeric code and literally in binary form in the computer. Knowledge itself has a number of infrastructural conditions that can be taught with the help of an extended concept of media.³³

An archivology of media does not simply analyze the cultural archive but actively opens new kinds of archival action. From the insight into the genuinely different nature of bit-based recordings we derive new options of searching the textual and audiovisual archive that are no longer simply keyword based but operate with the signals themselves, as do phonographic records or the electronic video image on magnetic tape. Once digitized, the electronic sound or image is open to real-time access and new search options such as similarity-based image retrieval. The traditional architecture of the archive has been based on classifying records by inventories; this is now being supplemented or even replaced by order in variation and fluctuation, that is, dynamic access. This "archive" is no longer simply a passive storage space but becomes generative itself in algorithmically ruled processuality. Sound and images at the borderline of digital addressability can be navigated through large amounts of data unfiltered by linguistic words. Images and sounds thus become calculable by pattern recognition algorithms. Such procedures not only media-archaeologically excavate but also generate unexpected statements and perspectives. The audiovisual archive can, for the first time, be organized not just by metadata but according to proper media-inherent criteria—a sonic and visual memory in its own medium. What is being digitally "excavated by the computer" 34 is a genuinely code-mediated look at a well-defined number of information patterns that human perception calls "sound" or "images." Contrary to traditional semantic research in the history of ideas, such an endogenic audiovisual archive will no longer list sound and image sequences exclusively according to their authors, subjects, and time and space metadata of recording. Instead, digital data banks will allow audiovisual sequences to be systematized according to genuinely signal-parametric notions (mediatic rather than narrative topoi), revealing new insights into their informative qualities and aesthetics.

Media Tempor(e)alities

A further major topic that runs through this collection of essays, media tempor(e) alities, stems from the author's obsession with alternative ways of writing the past, having been influenced strongly during his course of studies by Hayden White's *Metahistory*. The need for a refreshed theory of processing knowledge and remnants of past times recursively returns with media studies,

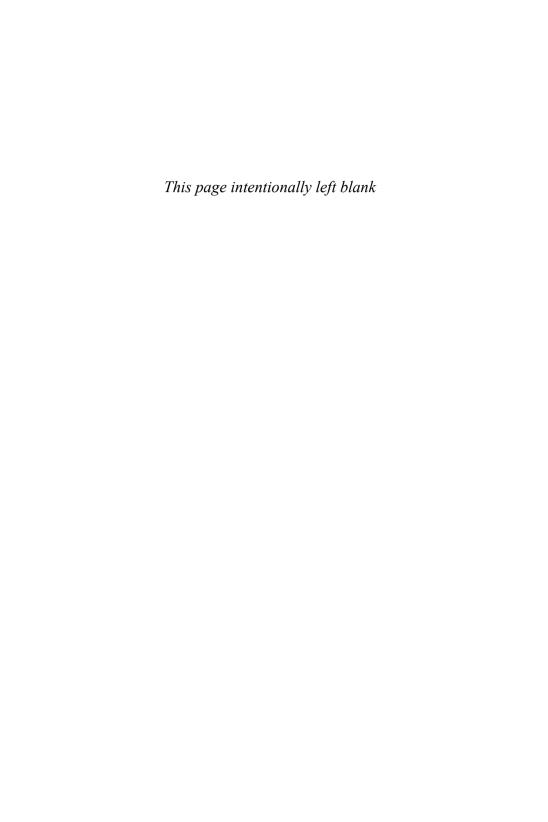
resulting in an exploration of ways of thinking, researching, and writing that detach past media from the overall dominance of the histori(ographi)cal discourse.

Foucauldian archaeology and archivology remain somewhat centered on space, topologically "other spaces." Such analyses autopoietically refer to the alphabet-based world and the symbolic order of textual libraries. But, as Kittler writes, "Discourse analysis cannot be applied to sound archives or towers of film rolls." With the age of so-called analog media such as the phonograph and the cinematograph, signs of or in time themselves can be registered. Not only do they maintain a symbolical relationship to macro and micro time (such as historiography), but they inscribe and reproduce functions of time themselves. It is only with the digital computer that the symbolic regime *dia*lectically returns, this time in a genuinely dynamic mode (which differentiates implementation of software from the traditional Gutenberg galaxy): algorithmic time and operative diagrams.

What is frequently called posthumanistic by now is very much bound to a critique of literary and historiographical narrative.³⁶ In the words of Vilém Flusser, "A new form of thinking based on digital codes directs itself against procedural 'progressive' ideologies, to replace them with structural, systembased, cybernetic moments of thought."37 This leap from one level to another is what currently is associated with the rupture between the analog and the digital. Postmodern critique of narrative in historical discourse, inspired by Hayden White's Metahistory,38 has finally resulted in reflections about alternative ways of writing media in time. White has sharpened the analytical attention. Telling is not just about stories but about counting as well (now familiar as the writing mode of digital media), as becomes evident from an anamnestic reconsideration of historiography. Early medieval forms of registering events (in the annalistic tradition as opposed to chronicles and historiography proper) convey a way of experiencing reality in terms of not continuous but discrete time, 39 thus closer to state-based automata with discrete writing or reading of symbols on an endless memory tape—which is, of course, the diagram of the Turing machine.

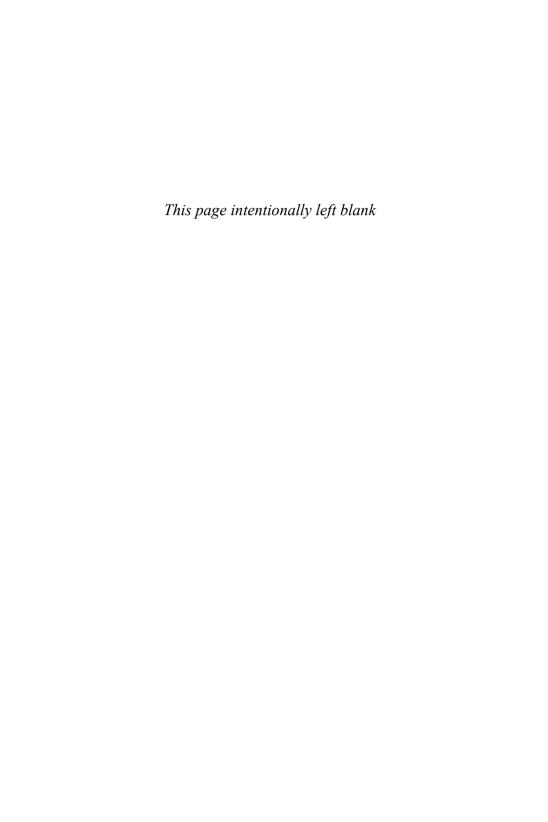
New media phenomenology, combining recent neuroscientific research in brain temporalities⁴⁰ with the Husserlian definition of an augmented experience of presence (pro- and retention), couples the affective (and the haptic)

with specific temporalities. ⁴¹ In Hansen's diagnosis of digital interfaces, vision becomes haptic spatiality, which recalls Marshall McLuhan's notorious theorem of the "acoustic space" opened by the age of electrified media. Hansen relates to media artists like Bill Viola when noting that the "cinema-digital-video hybrid technique exposes the viewer to minute shifts in affective tonality well beyond what is visible to natural perception." ⁴² Let us take this *tonality* literally. There is a sound in electronic media, with the sonic taken not in its physical (acoustic, audible) sense but in its epistemological sense, as an expression of tempor(e) alities. The privileged relation between sound and technological media is grounded in their analogous time-basedness and chronopoietical time-basing. ⁴³ New media articulate themselves in well-ordered, even rhythmical times (whether electrotechnical or algorithmic), which is their music. ⁴⁴



Part I

The Media-Archaeological Method



The Media-Archaeological Method

It is safe to say that there is no *one* media-archaeological method. Some place more emphasis on imaginary media, others on recurring discursive phenomena. The material underpinnings of how German media theory emerged as its own singular take on media history has been called "gay science" by Bernhard Siegert, referring to Friedrich Nietzsche's philosophy and with an emphasis that underlines its spirit of excavation—unorthodox, free in its curiosity, and almost at times anarchist—which was less interested in coming up with a grand theory of media than doing interesting things with media history.¹

Ernst's methodology shares a lot with the work of earlier media scholars as well as introducing his own media-archaeological focus. This book starts with a new text Ernst wrote as a preface to this collection of essays, and then the chapters of this section give a thorough introduction to how Ernst (re)defines media archaeology and how his theories also stem from a relation to cultural history. Although he distinguishes himself, for example, from Stephen Bann's art-historical methodology, Ernst is still keen to map his media archaeology in relation to that. In short, his media archaeology is set against the narrativist emphasis of the other, more Anglo-American products of a 1980s rethinking of history and culture, which provided (new) cultural histories and some key cultural studies perspectives. As we can see, Ernst's insistence on remaining at a distance from narrative persists, replaced by his almost posthuman methodology. History and art history are themselves contextualized

in relation to the media technologies in which the visual is embedded. In general, chapter 1 also elaborates how important the transatlantic exchanges and media theoretical influences have been for the so-called German media theory.

In the more recent text on media archaeography (chapter 2)—how media are themselves a form of inscription, before the human interpreter enters the scene—Ernst sets out to follow scientific experimenters such as Faraday, Maxwell, and Hertz and take their ideas as guides to media archaeology. In short, physical phenomena are the real objects of analysis, and media archaeology, as an analytical tool that transcends the human (with a nod toward Martin Heidegger), excavates the nondiscursive "temporal regime that, to be analyzed, requires an alternative means of description," as Ernst writes. Alternative to what? To the theories of imaginary media, dead media as only represented as an object of nostalgia, to any discursive surface description, would probably be the answer. To refer to the temporality specific to machinic apparatuses, Ernst regularly uses the term "Eigenzeit"—their own time, almost literally. As a way of investigating such machine-specific temporalities, Ernst throws in some controversial and polemical statements such as "Media theories work only when being tested against hard(ware) evidence." More than once, Ernst asks the question "Message or noise?," a question that comes from one of Foucault's shorter texts and which keeps on being repeated in Ernst's texts. Basically, his question is actually about finding what in the semantically noisy is actually still analytically useful when investigated with the cold gaze of media archaeology.

So if our media perform digital signal processing, our media theory tools need to be able to be specific enough to understand that technicality. Technical media concern modulation of the world of physics and engineering, and hence our media-archaeological tools need to tap into that regime, too. If we wanted a slightly more soft-core version, it would mean admitting—as digital humanities seem to be doing—that we need to incorporate new scientific tools into our archival and analysis work. Ernst mentions using ultraviolet photography in ancient manuscript research and using sonic techniques for scanning and restoring Edison wax cylinders, for instance. And yet he is not dismissing humanities theory at all—the chapters in this book are proof of that

1 Let There Be Irony

Cultural History and Media Archaeology in Parallel Lines

Let me begin with a personal remark. When I first met Stephen Bann in the early 1980s during my research year in London, where I was exploring the formation of British collections of classical antiquities in my search for underlying cultural and historiographical theories, his studies on the visual and museological inventions of history in eighteenth- and nineteenth-century France and Britain provided an anchor for my theoretical aspirations because we shared a concern with the metahistorical and discourse analyses of Hayden White and Michel Foucault. At that time I missed an innovative aspect of Stephen Bann's writings, one that I only really discovered after my "media-archaeological turn": his media awareness of different modes of textually or visually processing the past. My present occupation as a media theorist leads me to a kind of retroactive reading of his work, which has always involved a genuine media-theoretical analysis of (art-)historical discourse avant la lettre.

Historical Imagination in the Age of New Media

Media theory, art history, and cultural studies are well aware of the crucial moments when the physical medium of light increasingly became (re)produced technologically. From the point of view of theory, as the name already implies (ancient Greek *theorein* belongs to the visual regime, the theatrical gaze), the process by which modes of visual representation from the late

eighteenth century onward "became," in the words of Stephen Bann, "increasingly inflected with what might reasonably be termed the vision of the past"1 is not a metaphor but rather a proposition that asks for a precise media archaeology of the historical imagination. Visions of the past became technologized through the conscious application of artificial light that is practiced media theory as personified in Louis Jacques Mandé Daguerre, who worked as a panorama painter before he became one of the coinventors of photography. Panorama, diorama, photography, and finally film animated the historical scene by immaterial light, something that painting could never do. The illusion of the moving image lurked behind new museological techniques, as in the Musée Grévin in fin-de-siècle Paris.² Almost contemporaneous with the invention of "writing with light" (that is, photography), the aesthetics of top-lit galleries in museums, exemplified in Hubert Robert's drawings for a new lighting system in the Grand Galerie of the Musée du Louvrein Paris, the so-called dome at Sir John Soane's Museum in London, and the new transparency of architecture (evident in the Crystal Palace at London's Great Exhibition of 1851) indicate the degree to which visions of the past had become a technological function of lighting.

Although light has been considered a physical medium since Aristotle, its technologization turned it into a central tool for representing the historical imagination. At the same time, the use of invisible light sources (painted light and light in actual settings) gained momentum; historical memory became mediatized by light itself. Soane's architectural draftsman Joseph Michael Gandy, for example, created *The Tomb of Merlin* (London: Royal Institute of British Architects) in 1815, remarkable for its phantasmagoric lighting. Here historical imagination in conjunction with lighting technology resembles an anticipation of electric light.

Rivaling painting, photography made light itself recordable—a rupture rather than a soft transformation of the media-archaeological point of view, which is opposed to the perspective of cultural history that tends to privilege evolutionary continuities and soft transformations. According to Roland Barthes, media archaeology emphasizes photography as a decisive mutation in informational economies. Photomechanical reproduction *as* a technology on the nondiscursive level was a rupture in the fabric of preexisting image making ("because it is an indexical as well as iconic form; because

it stops time, because it is machine-made," according to Abigail Solomon-Godeau);³ on the level of discursive interface, it represented a continuation of older traditions in the reproduction of existing works of art and their circulation.

Not only did the early nineteenth century see the invention of new ways of envisioning the past in literature, painting, and museums as an effect of lighting technologies (candlelight, gas lanterns, electric light), but a new quality of cultural transfer was also introduced by electricity, as Gandy, among others, recognized. In a letter to his son in 1837, Gandy praised the electric telegraph, which had just been patented; the telegraph made it possible to "know what is doing in any part of the world as quick as the electric fluid will convey it." This kind of technological organization of public affairs by means of the printing press, telegraphy, and radio was later defined by Martin Heidegger as the essence of historicism itself. In 1843 Alexander Bain invented a "teleautograph" for the telegraphic transfer of manuscripts and images.

Writing about Johann Wolfgang von Goethe's report on his visit to Strasbourg Cathedral in the early 1770s, Bann considers how Goethe "sets up the object in the form of ideal existence," and he concludes, "It is a discursive fact, produced by the cunning strategies of Goethe's verbal art, and not a cathedral that comes into view." For Bann there is a parallel to be drawn with Victor Hugo's novel *The Hunchback of Notre Dame* of 1831, which describes "the long-term transition from a culture in which messages are transmitted by the emblematic façades of public monuments to one where individual creators take it upon themselves to re-create such public values through the medium of the written text" and culminates in a prophecy (made, according to the novel, by the archdeacon of Notre Dame in 1482) to the effect that the public press will destroy the authority of the Roman church: "Le livre tuera l'édifice," or "The book will kill the building." In Hugo's century, communication through the printed word was being overtaken by another media revolution that Bann's sharp eye ironically detects on another Gothic cathedral—that at Strasbourg, imaginatively re-created by Goethe. A late eighteenth-century engraving reveals a semaphore, or telegraphic signaling device, on top of the newly rebuilt octagonal cathedral lantern. Signal processing will replace discourse and cultural semiotics in the age of (new) media.

Parallel Lines

The rise of technological media displaced the traditional visual rhetoric of representations of history by reconfiguring its reality effects—a process that became almost tangible in museums. A museum object is always a term within a system within the syntagmatic plan of the museum, which can be a historical order. Objects in real space are assembled within a paralinguistic structure but also within a *dispositif* of nonlinguistic agencies, such as the media. Stephen Bann's design in 1978 of a "poetics of the museum" (which immediately became a seminal work for international museological studies) applies the theory of rhetorical tropes as a prefiguration of historical imagination (Hayden White's *Metahistory* of 1973) to actual museum space, to material culture, and, more recently, to the technical media of the visual organization of historical discourse.

With Gotthold Ephraim Lessing's Laocoön (1766) we might ask: what difference does a semiotics of media make, as opposed to rhetoric?8 At this point, we arrive at a genuine media argument: Lessing's treatise argues strongly against the traditional critical practice of assuming that poetry and the plastic arts could and should reproduce the same data in their respective media. He held that certain aesthetic strategies were appropriate for an art of time, like poetry, and others for an art of space, like sculpture or painting. Historical content cannot merely be transferred from one medium (text) to another (museum). Do we have to draw the same lesson? Indeed, the ductus of the engraving stylus might be closer to the chisel of the ancient sculptor than a photographic emulsion can ever be. Bann refers to the engraver Bervic (Charles-Clément Balvay), who fashioned the ancient sculpture group of Laocoön (in the court of the Vatican Museum, Rome) after a drawing by Pierre Bouillon, published in 1809. With its effect of sculptural relief, this work displays a technological force. In the light of this uncanny simulation of carved marble surfaces emerging from a gloomy niche, it becomes difficult to accept strictures about the arbitrary syntax of traditional burin engraving.9 Here the engraving becomes more than a translation of a painting or an image. Bann has called attention to the translating episteme on the level of textual, painterly, and historical translation, writing of the specific epistemological aesthetics of self-denial of the author or artist in nineteenth-century discourses of history, of the museum, and of painterly representation designed

to achieve fidelity. Tracing shadows (as did Etienne de Silhouette) in a way that follows the physically or (in Lavater's terms) physiognomically given rather than the pictorial conventions of portraiture opens a fundamentally different regime of signal processing, one that culminates in the daguerreotype, which automatized such literal translation. Media archaeology, which is concerned with such technocultural processes, is both a self-reflexive method and an archival object of research. In this manner Bann compares his historiographical tracing of art-historical practices to the aesthetics of stereoscopic images that were coming into vogue in the 1860s, showing that print making, painting, and photography coexisted on closely parallel planes, as it were, simultaneously with the emerging codes of modern visuality. The *post-histoire* of this story continues today: digitalizing techniques are absorbing the photographic image. Thus photography as a visual technology in its own right could vanish like the image of a face drawn in the sand at the edge of the sea (to borrow Foucault's metaphor). In the post-physical process of the sea (to borrow Foucault's metaphor).

Walter Benjamin's famous essay "The Work of Art in the Age of Mechanical Reproduction" (1936) is based on the photographic paradigm: according to Benjamin, through its reproductive dissemination, the image loses its "aura." ¹² In many ways, though, the art of engraving antedated this effect. Engraving itself was long perceived as an "archaeological" practice based on an association between digging and writing (graphein in Greek). In his history Gravure en bois (1766), the French wood engraver Jean-Martin Papillon connected *graphein* to the physical activity of burrowing or digging into all kinds of level surfaces. 13 Engraving may thus be linked to the act of the archaeological dig—media archaeology, literally. In the Baroque period, antiquarian and archaeological research (the digging mode) were closely connected to the technological performance of conveying visual evidence in print. Bann also emphasizes the role of media changes in the early nineteenth century as a driving force in the development of historical representation, comparing prints as vehicles for the evocation of the past with the new recording medium of lithography, deployed in the representation of ancient monuments. Lithography already pointed to the aesthetics of the diorama and consequently photography, both promoted by Daguerre. The difference between subjective discours and quasi-objective histoire in the representation of the past became a function of their performing media.

The crucial question for media archaeology, then, resides in whether, in this interplay between technology and culture, the new kind of historical imagination that emerged was an effect of new media or whether such media were invented because the epistemological setting of the age demanded them. Or, to put it another way, was there a smooth evolutionary progression from etching to lithography to photography, or was there rather a dramatic break as a result of the difference between genuinely technological media, such as photography, and earlier cultural technologies? There is a strict epistemological difference between light as painted on canvas to create an illusion of history mystically illuminated from within, as in Joseph Gandy's painting Merlin's Tomb or in Daguerre's Ruins of Holyrood Chapel, dating from 1824, and photographic light tracing as "the pencil of nature" (to quote William Henry Fox Talbot). The picturesque effect is still a painterly one, and thus essentially mediated by human action, whereas the effect of the real in photography is technologically automated and human intervention is reduced to the moment of temporary decision (when to release the shutter of the camera). In between lies the gas-lit diorama; in fact, Daguerre's oil painting reproduces, in miniature, the composition of his diorama Ruins of Holyrood Chapel, shown in London in 1825–26. It is worth remembering that the archive as the condition for our knowledge of history becomes dependent on the media of its transmission. And that, as Bann points out, the probability of an oil painting's surviving until the present is much higher than that of a complex scenographic representation like a diorama, an inversion of its former importance.¹⁴ The mechanisms that regulate entry into the discourse of history or exclusion from cultural memory are therefore part of the media-archaeological investigation.

The technological difference between engraving and photography amounts to an epistemological distinction between engraving as an act of interpretation and the media-indexical nature of photography. The secret of photography's reality effect lies in its abolition of the distance between an original and its reproduction. The chemical photons are, in fact, the ectoplastic reflection of a given physical moment; unlike artistic translation, photographic paper registers a genuinely mediatic transfer. Against the media-archaeological perspective that emphasizes this contrast, Stephen Bann insists (explicitly counter to William Ivins's classic *Prints and Visual Communication* and to

Benjamin's claim that technologies of art reproduction sever the present from tradition)¹⁶ that there has been no abrupt discontinuity between earlier engraving practices and the technology of photography but rather a subtle blend of traditions, a reciprocal negotiation between media, exemplified by the artistic practice of Jean-Auguste-Dominique Ingres. With this kind of softened media archaeology, comparable to recent studies on the overlapping and ongoing of manuscript cultures after Johannes Gutenberg's invention of printing in the late Middle Ages, Bann deconstructs what he calls the myth of the sudden invention of photography, pointing to the intermediate position of a painter, Eugène Delaroche. Although he is to some extent open to technological considerations and to the cold gaze of media archaeology, Bann ultimately defends the virtues and virtuosos of art history and art, asserting the primacy of aesthetics over technological form.

In Defense of Antiquarianism

What I am advancing is a media-critical antiquarianism. There has always been a double bind in antiquarian data processing between distance and empathy, resulting from the gap between the physical presence and the discursive absence of the past. Antiquarians have tried to bridge this gap by touching and tasting the immediate, material object. For antiquarians, history is not just text but the materialist emancipation of the object from an exclusive subjection to textual analysis. Antiquarianism acknowledges the past as artifactual hardware, so to speak, upon which historical discourse operates like a form of software. In a digital culture of apparent, virtual, immaterial realities, a reminder of the insistence and resistance of material worlds is indispensable, and all the more so from a media-theoretical point of view. Far from being an imperfect approximation to historical discourse, the antiquarian attitude deserves to be treated on its own terms. 17 The antiquarian's almost haptic taste for the moldy, decaying fragment (mummies, parchments, remnants of bodies and objects) is close to physical data processing: according to André Bazin, the real (le réel) of the photographic image resides with the corpse. 18 If we redeploy the analytical tools developed by the so-called "new historicism" in literary studies from textual analysis to material cultural studies, we find not merely archival data on history (the symbolic regime of the archive, the scriptural regime of sources for historians) but also—as opposed

to the textuality of (narrative) history—the otherness (even resistance to interpretation) of the material fragment, the relic.

A truly antiquarian, that is, data-oriented sense of the past also extends to a methodological preference for rejecting the projection of generalized theories in favor of precise case studies, that is, for embedded theory (an antiquarian virtue, indeed). Like the media analyst, who gazes at objects in the same way as the ethnologist records the practices of a remote society, the antiquarian intends to achieve a *monumental* relation to the past. This method aims to avoid prematurely interpreting archival or archaeological evidence as documents of history but rather isolates this data into discrete series in order to rearrange them and open them for different configurations. The mechanism of human memory is selective, transformative, and thus productive of historical imagination, whereas the general inventory of photography in accordance with media logic registers temporal events without demanding a binding historical narrative.¹⁹

For most theorists, it makes good sense to use predominantly visual examples in analyzing the rise of historical imagination. Although never entirely divorced from the analytical text, Bann's visual examples support his exegesis, which the reader-spectator can follow in a directly participatory way. The self-contained nature of visual evidence (as opposed to an extract from a text) enables the reader to establish an order for the visual in its own medium.²⁰ Indeed, the cold archaeological gaze, in its antiquarian mode (and culminating photographically in publications displaying a technological objectivism, such as William Henry Fox Talbot's The Pencil of Nature of 1844),²¹ is opposed to another kind of aesthetic archaeology, that developed by Johann Joachim Winckelmann in his prosopopoetic concern with animating a stone fragment, the Torso of Belvedere. Bann brilliantly interprets Sir John Watson Gordon's portrait Sir Walter Scott in His Study, Castle Street, Edinburgh, where a full suit of medieval armor behind Scott's back literally represents Scott's historiographic desire to pump preexistent inanimate materials full of new life, a reversal of material culture into the fiction of dialogue and discourse. The phantasm of historical imagination is a misreading of the nature of archaeological artifacts. The antiquarian sense of loss is the melancholic acknowledgment of the allegorical gap that separates the past irreversibly from the present, a sense of discontinuity, as opposed to the privileging of continuity in historical narrative. As Bann concludes in *Romanticism and the Rise of History* (1995): "History certainly abhors discontinuity." The Romantic discourse of history took its stand against the political-revolutionary experience of a rupture in historical continuity after the French Revolution of 1789. In *The Clothing of Clio* (1984) Bann points out that techno-archival media for registering the past belong to a semiotic regime distinct from that of narrative history. ²³

Media archaeology is on the side of the indexical and the archival mode of writing, whereas Bann defends the *discours* (in Émile Benveniste's sense), just as data banks, as a symbolic form of knowledge processing in the age of media culture (in Lev Manovich's sense), differ from Hayden White's plea for the narrative employment of the past in the self-ironic mode.²⁴ The aesthetics of computing (itself within a historical tradition stemming from the Roman and medieval *annales'* registering of events)²⁵ differs epistemologically from historical discourse, because historiography belongs to the symbolic order (operating with alphabetic symbols), whereas photography belongs to the (physically) real: the engraving of light beams onto a chemically sensitive surface (a transmission epitomized by television, which does not store but immediately transfers light).

Admittedly, the registers of the real, the symbolical order, and the imaginary (in Jacques Lacan's sense) are never clearly distinct. Media archaeology concentrates on the nondiscursive elements in dealing with the past: not on speakers but rather on the agency of the machine. In 1824 the historian Leopold von Ranke declared his aim of "just describing what actually happened" in the past.²⁶ This mythic goal, intended to neutralize the subjective stance of the historian, apparently corresponds to the new objectivist aesthetics of photography. If Ranke's historiography tried to efface the author's traces in order to let an objective pastness of the past appear, the new technological media performed this task even more radically. The camera eye displaces subjective vision, which allows for a sharpened reading of Count Paul Yorck von Wartenburg's comment on Ranke's historiographical aesthetics as "ocular." ²⁷ In these terms, the theoria of history becomes a function of optical technology, as Svetlana Alpers delineated in her analysis of the cartographic art of history in Vermeer's paintings. 28 Bann has drawn attention to the interest in optical devices in early curiosity cabinets. Supported by Johannes Kepler's

and René Descartes's interest in the structure of the pupil and the iris, optical devices (prisms, for instance) provided the technological means for what may be called a theoretical practice, perfected by Gottfried Wilhelm Leibniz. John Bargrave's interest in the anatomy of the eye (he acquired "a very artificial anatomy of a human eye") inversely reflects the scientific practices of anatomical *theaters*: the architectural organization of the anatomy theater of the University of Padua, inaugurated in 1595, replicates the structure of an ox's eye.²⁹

It is here that the crucial media-archaeological question arises again: does a discourse favor the development of new technologies, or is this new discourse itself an effect of such a shift in technology? In the early nineteenth century a xerographical idea of telling history, of a document-based, nonconjectural historiography, runs almost parallel with a technologically driven sense of realistic representation. The obsession with an unmediated representation of the past is itself a media effect; the apparent shift of emphasis in nineteenth-century historiography from describing to showing can be deciphered as an effect of the new optical media.³⁰ Indeed Ranke wrote in the presence of innovative optical media: the panorama (Karl Friedrich Schinkel displayed his panorama of Palermo in Berlin in 1808) and diaphanorama; in 1822 Louis Jacques Mandé Daguerre opened his first diorama in Paris, whereas Joseph Nicéphore Niépce's first experiments with photographic representation (dating from the same year) would hardly have been known to the historian. Let me insist, then, on a sharp dividing line between techniques of visualizing history scenically and the strictly technological medium of photography. With the emergence of photography, the idea of the theatrical gaze literally staging the past is displaced by the cold mechanical eye, a technologically neutral code rather than a subjective discourse. The vanishing point in perspectival pictures since the Renaissance (and subsequently in media such as photography and film) has been literally a theoretical formalization, even a mathematization, of the subjective betrayer, an exteriorization by technological optics of the human *I* and *eye*. In his classic *The Gutenberg Galaxy* (1962), Marshall McLuhan, the founding father of modern media studies, recognized that the simultaneous development of perspective theory and printing technology in the early Renaissance imposed an increasing degree of abstraction on Western systems of communication, which substituted an

idealized "vision" for the close conjunction of visual and haptic skills previously characteristic of the reading practice of medieval illuminated manuscripts.³¹ Photography annihilates, apparently, the distance between past and present by pointing to what has been ("ca a été," as famously explained by Roland Barthes).³² The experience of an authentic existential link with the past through photographs is media-critically (if not ironically) undermined in current media art works on memory, such as Christian Boltanski's photographic installations.³³ Visual evidence is a cold medium of the past as opposed to hot historiography (according to McLuhan's well-known distinction in *Understanding Media*).³⁴ As long as the representation of color was not available to photography (until around 1900), the new medium largely remained on the side of the archival, text-based aesthetics of registering the past coldly, in contrast to painterly animation and historical imagination. In the present age, the possibilities of digital manipulation of electronic photography seem to be returning images to a prephotographic quality of painting: that characterized by the painterly brushstroke.

Photography brings the past back to the memory not by means of some mnemonic energy but through a physical event: rays of light that once emanated from a real object touch the viewer when he or she regards the picture. Apart from any rhetoric of metonymy or synecdoche, the chemical essence of photography simply registers the physical trace of light beams that have illuminated the photographic plate. Thus there is a crucial difference between lithography and photography in terms of the presence or absence of the working hand of the artist. The photograph is an assemblage of optical signals. Fox Talbot introduced The Pencil of Nature by emphasizing that the photographic illustrations had been produced solely by optical and chemical means, without the aid of any person acquainted with the art of drawing. Almost media-sympathetically, Fox Talbot insists on the rupture with the aesthetic traditions of visual mimesis, iconographic semantics, and iconic hermeneutics. According to Fox Talbot, the picture, divested of the ideas that accompany it and considered only in its ultimate mediatic nature, is nothing but a succession, distribution, and variety of stronger lights thrown on one part of the chemically receptive paper, and of deeper shadows on another. As the automatic registration and self-inscription of light, photography is a true media-archaeological tool. Following Bann, it may be said that "the

photograph is *histoire* and not *discours*."³⁵ But at this point there arises a crucial split. Whereas historical discourse can simulate achieving *the reality effect* (in Barthes's terms) by linguistic means (rhetoric), the photograph is, in fact, an inscription of the real, in physical (a unique moment of light) and chemical (emulsion as storage) terms.

Photography did what Foucault demands in *The Archaeology of Knowledge*: it liberated the past from historical discourse (which is always anthropomorphic) in order to make source data accessible to different configurations.³⁶ When the literary strategies of historiography are replaced by properly technological means for signaling the purity of the historical code, the rhetoric of media (which is a technological form of *dissimulatio artis*, a dissimulation of the mechanistic apparatus) replaces the former episteme. In the same manner that history in the Romantic period became apparently real through the fiction of the transparency of historical discourse, the blueprint for technological media was set: as Bann puts it, "replication without representation."³⁷ Ranke's ambition to let archival documents speak for themselves and his determination to use nothing but original sources found their visual equivalent in the media-epistemological fiction of an unmediated record of the reality of the past.

Of course, no representation is ever unmediated. Like the rhetorical dissimulatio artis in Ranke's historiography, which aims at the apparent selfexpression of history, the technological media have to make their recipient forget their technical operation at the machine-to-human interface in order to create the illusion of pure content: only at a moment of technological breakdown will the medium become visible. This dissimulation was evident in the museum. In historicist period-room interiors, such as Alexandre du Sommerard's Musée de Cluny, where objects are not just paratactically assembled but reach a syntactical homeostasis within an existing conceptual (history) or physical (the historic ruin of Cluny) space, the illusion of lifelike presence in the museum was implied, corresponding to the photorealistic idea of an unbiased historiography. By rendering a visual equivalent in the notion of an unmediated registration of the reality of the past, the referential illusion of the possibility of outliving the past was created. This Romantic historical imagination, as developed in the Romantic period, tried to annihilate the gap between past and present and at first glance looks like a combination

of discursive and technological strategies. According to Bann, Daguerre achieved in the visual representation of photography exactly what was attempted in textual historiography of the period.³⁸ But from the point of view of a media archaeologist (rather than a cultural historian), an imaginary effect achieved on the symbolic level (the imagination of history, rendered in the medium of writing through the letters of the alphabet) differs drastically from what happens on the level of the real: the physical trace of the past (light instead of imagination) on the photographic print. The desire to achieve historical transparency in historiography is metaphorical, whereas in photography it becomes technologically true.

Of course it can easily be proven that in practice technological novelty was soon perceptively and discursively integrated into established techniques and patterns of visual representation—in print culture, in the museum, and elsewhere. But can it be concluded, as it is by Bann in The Clothing of Clio, that "photographic reproduction aroused no absolutely new types of response"? Photographs could present more distinctive and detailed visions of the external world than had been possible before, but was it the case, as Bann suggests, that "whatever was novel about them could be contained within the existing framework of responses to non-mediated forms of representation"?39 This conclusion is demonstrable only from the historical, discourse-oriented point of view, and it should not prevent someone from stressing the mediaepistemological difference that photography makes. Now is the time not to be lost in historicist relativism but to pursue the question that the present escalation of the media addresses to an archive, library, museum, or a collective memory called "the past." Photography is not only the object of research of media archaeology; it is itself a media-archaeological technique of remembering the past in a way that is radically alternative to historical discourse. All of a sudden, the historian's desire to preserve the original sources of the past comes true at the sacrifice of the discursive. The detached scientific observer is the camera. Past, archive, and history fall apart, as disparate registers and semiotic regimes. From the media-archaeological point of view, it is no surprise that the technological difference between the French daguerreotype and the British Talbotean negative/positive technique corresponds to two different discursive emphases. Although Daguerre in theatrical terms exemplifies the notion of the photograph as "fairy work," construed by Bann

as "in the sense of the projection into an imaginary space," Fox Talbot recognizes the visually generic *imaging* qualities of his new "photogenic" medium; his emphasis on the possibility of "close contact," on (for Bann) "an indexical link between the image and its referent," technologically reactivates an older theory of almost tactile vision according to which the eye actively emits light rays visually to scan the surfaces of physical objects. ⁴⁰ The earlier antiquarian *phantasma*, direct contact with the past via the archaeological fragment, becomes automated, immaterialized, disembodied, and literally "theoretical."

But there is another, even more important, dimension that separates the traditional space-centered semiotics of the visual arts (found in Lessing's aesthetic theory) from the new media of visual representation: photography not only refers to bodies in space but is, as Bann puts it, a reproduction with "a signature in time."41 It is a central criterion of the new media that microtemporal moments are technologically decisive for their operations. Not only is time deferred and sublated in representation, ⁴² but temporal synchronization becomes crucial for the technological process of image generation within the photographic apparatus. Not only is time the referential "content" of the technological image, but the temporal element, according to Marshall McLuhan, becomes the message of the medium.⁴³ With new media, the dramaturgy of time, which had been a theatrical art or a literary device, became technologized. French philosophy, being media aware, elaborated on this around 1900: Henri Bergson's reflections on the duration, compression, and stretching of time in Matière et Mémoire (1896) culminate in the argument that perception is a function of time itself.

Long-time exposure (with its recent aesthetic reentry into media art)⁴⁴ was the archaeological primal scene of the new medium, as evident from Daguerre's early photographic records seen in the *Boulevard du Temple* in Paris (1838). Although highly defined by the precision of visually rendered details, these photographs look uncanny because they lack the presence of human figures. In his report to the *New York Observer*, (failed) painter and inventor of coded electronic telegraphy Samuel B. Morse, who happened to be staying in Paris at the time, noted that moving objects and beings were not fixed by photography. The boulevard, usually filled with a lively crowd of pedestrians and vehicles, looks completely empty, with the notable exception of a stilled individual who is having his boots cleaned.⁴⁵

Photography in its early days (and this "historical index" requires a radical archaeologization of the theories of photography) documents not only the absence of some particularly human moments that have passed but also the absence of any actually passing moments. Let me introduce Stephen Bann the artist. With Bob Chaplin, Bann created A Mythic Topography, a series of prints that includes "Jullieberry Downs: The Absence of the Past,"46 a diptych displaying the photographic presence of a landscape devoid of any evident historical marks but receptive to the injection of historical imagination that can fill that gap. In A Mythic Topography, archaeology is both the object and the subject of representation. The gaze is no longer a privilege of animals or humans (who are always emotionally vulnerable) but is rivaled by the cold camera lens as a new epistemological field that was later cinesthetically celebrated by Anton Giulio Bragaglia's treatise Fotodinamismo Futurista (1911-13) and 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) that have otherwise been inaccessible to humans, whose temporal window of immediate perception of events is neurologically limited to between two and four seconds.

Media Irony

Around 1800, what had been a textual or museological rhetoric of metonymy in presenting the past (a reductive strategy whereby the part stands for the whole in a purely mechanistic way) turned into a visualization in the synecdochic mode, that is, implying a reference to an organic totality in literary representation and integrating a whole set of historical artifacts into a virtual history space in museum collections. Stephen Bann's well-defined poetics of the museum points to du Sommerard's enactment of coherent, almost photorealistic period rooms in his museum of French history in Paris. Museum aesthetics always correspond to the predominant media of representation; in du Sommerard's period, this was marked by the shift from engraving to lithography, which he used for his first volume of *Les Arts au moyen âge* in 1838, one year before Louis Daguerre publicly announced the invention of the daguerreotype. Du Sommerard worked in a key epoch when traditional rhetorical truths became a function of an increased technological virtuosity that progressively narrowed the gap between the original

and the reproduction. Not only did it take vision to make a historical period or concept reappear, but precise technological moves were necessary for the new idea to be born. Nevertheless, if du Sommerard's Romantic arrangement of historical period and theme rooms seems to anticipate the aesthetics of photographic realism, only "the cordial presence of the master rounds off the illusion," as Emile Deschamps noted.⁴⁷ By analogy, Sir John Soane, in his kaleidoscopic, almost Piranesian, museum of cultural history, even went so far as to invent a fictitious reconstruction of a medieval monk's cell; behind the historical referent "padre Giovanni," John Soane himself is ironically present. The "monk's Parlour" in his house-museum, created in the 1820s, while at first glance looking like a product of neo-Gothic antiquarianism, thus turns out to be "a satirical inclusion." ⁴⁸ It becomes a mediacritical museum because it consciously exposes its own technique of display. Whereas the secret of technological media is precisely that they usually hide their mechanisms in order to let their message appear in pure form (on the cinema or television screen, for example), the ironical museum—indeed, any ironical medium—displays its own artificiality, technical fictionality, and artifactuality. The museum turns out to be a creator of media-cultural construction.49

In opposition to the cold aesthetics of the media archive, Stephen Bann is at pains to emphasize the special role of subjectivity in the whole process of historical representation, an indication of his own philosophy of history. Irony is the master trope of cultural historiography: a kind of double vision that sees things from a distance as well as with empathy. Irony is, of course, Hayden White's favorite metahistorical trope, and Bann himself favors the ironic museum. In terms of media archaeology, irony corresponds to an awareness of the medium at work with the message (to recall Marshall McLuhan), the message being an emphatic notion of history. Irony is the trope of media (self-)criticism, as can be demonstrated by the claim to truth in the art and craft of mapping. With artful and fictive maps and antiquarian forgeries, there has always been "the possibility of an ironic reversal," 50 which is the mediareflective mode, because when a fiction is revealed, artificiality is also revealed, and the coming out of media is witnessed. Media irony (the awareness of the media as coproducers of cultural content, with the medium evidently part of the message) is a technological modification of Hayden White's notion that

"every discourse is always as much about discourse itself as it is about the objects that make up its subject matter." 51

The critical notion of the ironical museum (or medium) transfers the discursive analysis of rhetorical tropes from literature and speech to spatial visual regimes and to the technologies themselves. The ironic mode is a contemporary, self-reflexive alternative to the metonymic or synecdochic modes of presenting material culture in the nineteenth century, which ideologically suggested a coherence where there were only disconnected discrete units. Bann's insights into the media-critical irony of the museum as a practice of (re-)presentation is matched by the irony that this knowledge is itself mediated. As Bann states when reflecting on the lithographs showing the Musée de Cluny in Paris, reproduced in du Sommerard's Les Arts au moyen âge: "I am well aware that I have been analysing not the early nineteenth-century museum, but the museum as mediated by different types of visual reproduction."52 Although this difference does not seem to Bann to matter very greatly (because the myth of the visual recreation of the past traverses many modes of representation), media archaeology insists on the difference that the media make in cultural construction. Although to a certain extent the nineteenth-century museum prefigured today's mass media as purveyors of images, myths, values, and modes of representation, the improved technologies of visual reproduction led to the availability of arts and artifacts that André Malraux praised as a condition for the thinkability of notions such as a cross-artistic "style" in his celebrated photo-based musée imaginaire of 1947, where works of art lose their properties as material objects. Media archaeology digs in the museum's ruins.53

Let me return once more to John Soane's kaleidoscopic collection of cultural history at Lincoln's Inn Fields in London. The masterpiece, an ancient Egyptian alabaster sarcophagus of Pharaoh Seti I at the bottom of his museum "dome," symbolically represents the collector's own grave. In museum collections, the idiosyncratic individual resists being absorbed into the neutrality of an objective historical discourse, which makes all the difference between man and machine, historical imagination and media archaeology. A truly archaeological awareness of the past goes so far as to exclude any human presence from the representation of the material past (as demonstrated by Bann in his interpretation of John Sell Cotman's etching *Crypt of the Abbey*

Church of the Holy Trinity at Caen),⁵⁴ whereas, in the seemingly chaotic arrangement of random specimens in representations of antiquarian collections, the antiquary must always intervene by singling out an object and telling its story. Narrative is the medium of history; the technological reproduction of the past (as in Daguerre's early daguerreotypes of a Paris boulevard, considered earlier) works without any human presence because evidence and authenticity are suddenly provided by the technological apparatus, no longer requiring a human witness and thus eliminating the irony (the insight into the relativity) of the subjective perspective. In that way, the museum space, as presented by du Sommerard in his Musée de Cluny, works on its own, in a truly mediatic way, able to resurrect an image of the past without narrative.

Again and again we are reminded of the difference between *histoire* and *discours*. The technologically mediated historical spectacle is often alienated from the subject of discourse in its overriding pursuit of intense, illusionistic effects—literally photorealism. As Bann explains in *Romanticism and the Rise of History*, it aims, paradoxically, to represent the past as past, *wie es eigentlich gewesen*—as it actually was—but at the same time to fill the senses with immediate, "hyperreal" stimuli. Du Sommerard understood that a historical collection required at the same time a replete, responsive environment (such as the Hôtel de Cluny) and a voice to assume the duty of mediating between past and present.⁵⁵

Where media archaeology faces absence and silence, art history listens to the human voice. Looking back on more than twenty years in which I have had the pleasure of knowing Stephen Bann, I am happy that the two methods will continue to supplement each other without effacing their differences in parallel lines.

2 Media Archaeography

Method and Machine versus the History and Narrative of Media

Media archaeology is generally associated with the rediscovery of cultural and technological layers of previous media—an approach that remains on the familiar side of historical discourse. Some authors take the term *media archaeology* at face value, almost metaphorically, as referring to the "digging out" of forgotten machinic visions of the past, of alternative, for example, baroque media, of media that never materialized or that are simply forgotten today.

The archaeological metaphor is difficult to resist and has sometimes led to a fatal misunderstanding of Michel Foucault's notion of an archaeology of knowledge. The media-archaeological method as proposed here is meant as an epistemologically alternative approach to the supremacy of media-historical narratives. Equally close to disciplines that analyze material (hardware) culture and to the Foucauldian notion of the "archive" as the set of rules governing the range of what can be verbally, audiovisually, or alphanumerically expressed at all, media archaeology is both a method and an aesthetics of practicing media criticism, a kind of epistemological reverse engineering, and an awareness of moments when media themselves, not exclusively humans anymore, become active "archaeologists" of knowledge. This means that when media archaeology deals with prehistories of mass media, this "pre-" is less about temporal antecedence than about the technoepistemological configurations underlying the discursive surface (literally, the monitors and interfaces) of mass media.²

Although most current theories of media archaeology aim at formulating counterhistories to the dominant traditional histories of technology and of mass media, their textual performance still adheres to the historiographical model of writing, following a chronological and narrative ordering of events. Admittedly, the claim to perform media-archaeological analysis itself sometimes slips back into telling media stories; the cultural inclination to give sense to data through narrative structures is not easy for human subjectivity to overcome. It takes machines to temporarily liberate us from such limitations. Technology, according to Martin Heidegger, is more than instrumental; it transcends the human.3 Media archaeology understood as an analysis of epistemological configurations (both machinic and logic) does not simply seek a redemption of forgotten or misread media of the past, nor is it confined to a reconstruction of the crude beginnings and prehistories of technical media. Rather than being a nostalgic collection of "dead media" of the past, assembled in a curiosity cabinet, media archaeology is an analytical tool, a method of analyzing and presenting aspects of media that would otherwise escape the discourse of cultural history. As long as media are not mistaken for their mass-media content, they turn out to be nondiscursive entities, belonging to a different temporal regime that, to be analyzed, requires an alternative means of description.

A certain rejection of what cultural history had so far accumulated as technological knowledge was the bias that allowed human beings to produce electromagnetic fields (instead of just leaving electricity to manifest itself in spontaneously occurring phenomena, such as lightning and thunder, that were seen as having natural or supernatural causes). Experimenters and scholars like Michael Faraday, James Clerk Maxwell, and Heinrich Hertz were convinced that they were tracing phenomena that were not simply a question of discursive cultural relativization but indicated physical laws that had a metahistorical and epistemological existence of their own. From the mediaarchaeological viewpoint (which is hypothetically partly the perspective of the media themselves), the cultural lifespan of a medium is not the same as its operational lifespan: 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, because the stable technological infrastructure of broadcasting media is still

in operation. There is no "historical" difference in the functioning of the apparatus now compared to then (and there will not be, until analog 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.

The archaeology of media is not simply an alternative form of reconstructing beginnings of media on the macrohistorical scale; instead it describes technological "beginnings" (archai) of operativity on the microtechnological level. The real media archive is the arché of its source codes; arché as understood in ancient Greek is less about origins than about commandments. Media archaeology is about rereading and rewriting epistemological (rather than simply temporal) momenta. In his Archaeology of the Cinema C. W. Ceram states: "What matters history is not whether certain chance discoveries take place, but whether they take effect."4 When Hertz experimented with electromagnetic waves he meant to prove Maxwell's mathematical calculations of the electromagnetic field; almost by accident he thereby practically invented radio transmission technology.⁵ How can we write media history when media systems create their Eigenzeit? Let us process the past mediaarchaeologically rather than historiographically. Archaeology, as opposed to history, refers to what is actually there: what has remained from the past in the present like archaeological layers, operatively embedded in technologies (the "archaeological" metaphor, as already mentioned, is hard to resist). It belongs to the specificity of technical media that they reveal their essence only in their operation, recalling Martin Heidegger's definition of "the thing" (German Zeug) in Being and Time. "Historic" media objects are radically present when they still function, even if their outside world has vanished. Their "inner world" is still operative. 6 Both classical archaeologists and media archaeologists are fascinated by the hardware of culture, its artifacts—from ancient marbles up to electromechanical engineering products. Both approaches have a fundamentum in re: the hard-edged resistance of material objects that undo historical distance simply by being present. But what drastically separates an archaeological object from a technical artifact is that the latter discloses its essence only when operating. Although a Greek vase can be interpreted by simply being looked at, a radio or computer does not reveal its essence by monumentally being there but only when

being processed by electromagnetic waves or calculating processes. If a radio from a museum collection is reactivated to play broadcast channels of the present, this changes its status: it is not a historical object anymore but actively generates sensual and informational presence.

The relation between microprocessual timing (such as the coming into being of an electronic image on a video screen or real-time data processing in computers) and macrotemporal processes traditionally conceived as historical time is not just a relation between a micro- and a macrokosmos. From the development of mathematical stochastics and statistical dynamics in nineteenth-century thermodynamics (Ludwig Boltzmann's and Josiah Willard Gibbs's insight into the nature of entropy) up to Norbert Wiener's *Cybernetics*, the historical mode describing temporal processes has been confronted with alternative modelings of time. When it comes to describing media in time, this aporia becomes crucial, because one can no longer simply subject media processes to a literary narrative without fundamentally misreading and misrepresenting their *Eigenzeit*. Historical media narratives take place in imaginary time. Storage technologies, on the other hand, take place in the symbolic temporal order, and the contingent can now be dealt with by stochastic mathematics as implemented in real-time computing.

Media are not only objects but also subjects ("authors") of media archaeology. The term media archaeography describes modes of writing that are not human products but rather expressions of the machines themselves, functions of their very mediatic logic—just as photography in Henry Fox Talbot's Pencil of Nature registers physical (optical) reality in a way not performed by the painterly hand anymore. Technological media that operate on the symbolic level (i.e., computing) differ from traditional symbolic tools of cultural engineering (like writing in the alphabet) by registering and processing not just semiotic signs but physically real signals. The focus shifts to digital signal processing (DSP) as cultural technology instead of cultural semiotics. Technological media such as photography and computing became active archaeologists of physical realities that are often inaccessible to human senses, as in the case of ultraviolet photography of ancient manuscripts or the reconstruction of "lost" sound signals in damaged Edison wax cylinders by optical scanning and digital processing. For media archaeologists, the recent turn from the epoch of electronics to that of information means that although data-processing media are still rooted in archaeologically accessible materialities (hardware, physics), their archaeology of knowledge requires competence in informatics (mathematical logic, technique, and control). Media archaeology is primarily interested in the nondiscursive infrastructure and (hidden) programs of media. Thus it turns from the historiographical to the technoarchival (archaeographical) mode, describing the nondiscursive practices specified in the elements of the technocultural archive. Media archaeology is confronted with Cartesian and even trans-Cartesian objects, which are mathematizable things. By applying technomathematical analysis, media archaeology accesses the subsemantic strata of culture, being (to quote from a Pink Floyd song) "close to the machine." In a nonmetaphorical sense, this means dealing with the technoarchaeological artifact—and, in a methodological sense, it means performing media archaeology by means of such machines (measuring, calculating).

Media as Archaeologists (A Phonographic Mission)

In contrast to two thousand years of basically written history, the advent of audio-recording media almost immediately led to genuinely media-based projects like the music-ethnological gramophone archives established in both Vienna and Berlin around 1900. But the treasures of culture are just one aspect of such a media archive, because such recordings contain—and thus memorize—a world of signals that operate beyond and below the cultural symbolism intended by the humans involved. Media archaeology (like the membrane of the microphone) dispassionately pays attention to the subconscious qualities of technical media. The moment a singer of epics sings into a current recording device, two different regimes clash as human performativity is confronted with technological algorithmical operations. Although philological analysis of the marvels of oral poetry (Homer's epics in antiquity, Serbian guslari in the present) remains within the logic of cultural technologies (alphabetic writing and musical notation), media-archaeological analysis, by computer-aided fast Fourier computations, of speech below the elementary units of what can be expressed by letters (vowels, consonants) gives access to the material dimension (the physical world) of a cultural moment. Consequently, the cover of a book on the origins of the vocal alphabet shows both an image of the first Greek alphabetic inscription and

the spectogram of the same words in Greek (read and spoken by one of the most original scholars on that subject, Barry Powell).

The phonograph as a media artifact not only carries cultural meanings as do words and music but is at the same time an archive of cultural engineering by its very material fabrication—a kind of frozen media knowledge that, in a media-archaeological sense, is waiting to be unfrozen, liquefied. Digital archaeology even operates below the sensual thresholds of sight and sound—a level that is not directly accessible to human senses because of its sheer electronic and calculating speed. Synesthetically, we might *see* a spectrographic image of previously recorded sound memory—a straight look into the archive. The microphysical *close reading* of sound, where the materiality of the recording medium itself becomes poetical, dissolves any semantically meaningful archival unit into discrete blocks of signals. Instead of applying musicological hermeneutics, the media archaeologist suppresses the passion to hallucinate "life" when he listens to recorded voices.

Media theories work only when being tested against hard(ware) evidence. Let us look at the epistemological revolution that was triggered by the "sonification" of the electromagnetic field for cultural and noncultural use. As soon as the German AEG-Telefunken magnetophone had been developed into a usable tool for recording sound in the mid-1930s, it was applied to ethnomusicological studies and field recordings.9 Because no one can "record" Homer anymore, Milman Parry of Harvard University by analogy went to Serbia and Montenegro to conduct a study in experimental philology, recording epic songs to discover how epics as long as Homer's Iliad and Odyssey have been transmitted in a culture without writing. Although Parry had used phonographic recording on aluminum discs to record evidence of oral poetry in former South Yugoslavia in 1933-35, his assistant and colleague Albert Lord later returned for the same reason, but with an electromagnetic wire recorder for registering such songs. Although these machines were obviously used for philological reasons (with the recorded epics transcribed later for philological analysis), what factually happened on the media-archaeological level was the (unconscious) replacement of the vocal-alphabetic code by an electromagnetic flux of electrons—which opened a different regime of signals operating as a substratum of cultural semiotics. This required not textual analysis but a close reading of the literal "wiring" of the recording machine, of its voice coil and the other techno-logical ingredients of this wondrous mechanism.¹⁰

Media archaeology adds to the study of culture in an apparently paradoxical way by directing attention (perception, analysis) to noncultural dimensions of the technological regime. What is indicated by the flickering lamp while the microphone is recording Serbian *guslari* songs is the event of the voice itself, the very materiality of culture. The wire spool may metaphorically be interpreted as a kind of "writing"—but a writing that operates no longer on the symbolic level (that of the vocal alphabet, corresponding with Ernst Cassirer's definition of culture as a symbolic regime) but electrophysically.

A few years after Milman Parry's untimely death, Walter Benjamin, in his 1936 essay "Der Erzähler," stated that experience, when cut off from epic tradition, could not be communicated in a narrative way anymore. Indeed, cultural analysis nowadays belongs to computing and signal processing and is not narratable.¹¹ Parry and Lord used the most up-to-date recording device in the interest of philological research, finally transcribing the sound recordings into alphabetic texts. But nolens volens (on a level below cultural semantics), the act of electromagnetic recording allows for an analysis of the acoustic event from a media-archaeological perspective that is not exclusively a human cultural perspective (dealing with symbolic acts); the recording device itself becomes a media archaeologist of the signal processing of culture. Only such an electrotechnical recording device can deliver the basis for a sonogram or spectrogram of such articulations, and these are measuring acts at the same time, because the apparatus unsemantically "listens" to the acoustic event, whereas the human ear always already couples the physiological sensual data with cognitive cultural knowledge, thus filtering the listening act. The measuring device, for a moment, suspends human perception from the limitations of its own subjectivity and culturality, though we take into account that any measuring configuration is itself marked by the historic index of its own epoch. This physical layer below symbolically expressed culture can be registered only by media themselves.

The blind spot of Parry's and Lord's research was the technology in which it was implicated. As Powell wrote:

Some songs were taken down on aluminum wire, others on metal discs. In the Milman Parry Collection at Harvard, Albert Lord showed me . . . several rolls of this wire, hopelessly tangled in a drawer—what lost songs does this tangled text preserve? Aluminum wire . . . is not oral song, but a kind of text. . . . Parry's aluminum discs and wire, just as much as a papyrus with graphemes scratched thereon, provide a material basis—obviously liable to corruption—for a code impressed upon it. In either case the text depends on technological innovation: the Greek alphabet . . . , inscribed on parchment or papyrus, and electronic magnetization. . . . All texts are useless without the technology to decode its [sic] symbols: the rules of Greek alphabetic writing . . . , a tape-player. 12

In this instance, media archaeology can sharpen our perception of the fundamental difference between two kinds of recording that might otherwise appear similar. Although the Greek vocal alphabet probably was established for the special purpose of recording poetry (culture as symbolical operations), recording in the electromagnetic field, in a departure from the practices of cultural engineering with symbolic signs (alphabetic writing), builds a technological microworld of its own—media that behave "analogously" to physics itself. Ironically, digital code returns to the first forms of pre-Grecian writing, which were invented for calculating purposes:13 now even poetry can be calculated on the level of digital signal processing with a precision in voice reproduction (according to the Nyquist–Shannon sampling theorem) that equals (literally "emulates," on and in computers) nature itself. Fourier analysis allows for the mathematical transformation of a temporal function or sequence of signals into a spectrogram; fast Fourier transformation is the "analytic" operation performed by the computer itself when translating a recorded voice event into a mathematical regime, thus making cultural analysis calculable in ways that only computing can do. At that moment, the machine is the better media archaeologist of culture, better than any human. At the same time, the results of such an analysis can again be rendered perceptible to humans by being translated into visual diagrams on the computer screen. Only by application of such medial-technological tools can we explain the microtemporal level of such events. What cannot be explained by such analysis is the cultural-semantic meaning of these microevents, because such voice analysis is unspecific and indifferent to "meaning," treating any random noise

with the same technological fairness as it would a high-cultural *guslar* recitation. Taking into account these options and limitations, media-archaeological analysis opens culture to noncultural insights without sacrificing the specific wonders and beauties of culture itself.

Let us turn a notorious motif of Homer's *Odyssey* against itself: Ulysses had to be tied up to resist the seductive voices of the Sirens. The Webster Wire Recorder (type 80 from 1948), as *écriture magnetique* (the French way of naming such devices), is an anti-Ulysses, because the apparatus can resist the temptations of confusing beautiful voices with other kinds of acoustics and can instead pay equal attention to all kinds of sounds without ever being affected by their emotional value. With a cool archaeological sense for signals (instead of semiotics, as in cultural semantics), the machine registers all kinds of electromagnetic vibrations—and thus comes closer to the real world than any alphabet can. Magnetic wire or tape registers signals—whether sound, images (video AMPEX), or data (IBM computers)—and makes no distinction among human, physical, and machinic senders of such messages.



The Webster Wire Recorder (type 80 from 1948). From the Media Archaeological Fundus. Photograph courtesy of Sebastian Döring and the Institute for Musicology and Media Studies, Humboldt University, Berlin.

From a similar perspective, the media-archaeological development period of radio "before radio" was not simply the technological prehistory of the mass medium but its alternative mode of existence, in which the range of the electroacoustic field was not limited to broadcasting. ¹⁴ The media-archaeological level is structural rather than historical, making it possible (in this case) to think about the radio in terms of the electromagnetic field instead of limiting it to the semantics of cultural voices.

Today such continuous data flows of the acoustic world are being translated into discrete, quantified data—a process of digital quantization in which "the continuous" becomes itself a secondary effect of discrete enumeration to be approximated. In the presence of discrete data, "streaming" is a metaphorical disguise. But with accelerated data processing that is faster than what our optical and acoustic senses can consciously follow, discrete operations have become able to represent continuous ones, approaching the reality of physical signals themselves.

Marshall McLuhan emphasizes that the "archaeological" analysis of scientific research has been a by-product of the era of discrete letters; analysis in fact operates by decomposing a text into single elements (elementa, or even stoicheia, the Greek expression for both single alphabetic letters and atomic units in nature). It was a crucial moment—archaeological rather than historical, because it was not immediately reflected in cultural terms—when the invention(s) of the discrete alphabet (as opposed to ideographic writing systems like Egyptian hieroglyphs) broke down human language into its smallest elements, which were meaningless in themselves—from "house" (beth) to "B" (beta). At this moment the machinic took over, because only machines could perform symbolic operations without the semantic referentiality that hindered effective data processing.

A fundamental epistemological gap lies between symbolically coded writing (the alphabet) and the gramophonic recording, which can record as well the accompanying noise (i.e., the index) of the physically real within and outside the recorded voice (intonations, timbre, the "grain" of the voice—as defined by Roland Barthes with respect to early gramophone recordings of Caruso's voice). But "neither Parry nor Lord . . . [was] interested in the nature or history of the technology that had made the text of Homer possible, any more than Parry investigated the history of the recording machine." ¹⁵

A media archaeology of recording is needed—both (and distinctly) for the cultural technology of writing (the alphabet) and for its technological alternatives (gramophone, electromagnetic recording). Although apparently the Phoenician alphabet was modified to the familiar phonetic alphabet for explicitly poetic purposes, the development of phonographic recording stemmed from physiological inquiries into the nature of the voice itself. The electromagnetic field was discovered through experimental chance, mathematical reasoning about the effects of inductivity, and a theoretical research interest (Oersted, Faraday, Maxwell); its application for wire or magnetic recording devices was nothing but a spinoff from diverse self-referential regimes.

Most of Albert Lord's wire spools have been transferred to tape. The wire recording device from the early 1950s in the Milman Parry Collection of Oral Literature at Harvard University is not functional anymore. In such migrations between hardware and software, at any point cultural memory runs the risk of being interrupted. 17 Some of these sound monuments, which have been converted from analog recordings to digital fields, can be listened to on the Web site of the Milman Parry Collection. The special mediaarchaeological interest is in the technological process of how these data were digitized. Such a data migration is a new form of "tradition" that stems from the genuinely inherent options of electronic media, allowing for new forms of reconstructing media-archaeological scenes. Media archaeology in its most obvious sense starts here: on the level of magnetic recording media (chemical tapes, steel wire, wax cylinders). Looked at in a both practical and theoretical way, these recording media reveal a fundamentally new epistemology, giving access to knowledge in the electromagnetic field that not only generated broadcasting media like radio and television but led to quantum physics as well (the most eminent provocation of media transmission theory to date). Thus materialist media archaeology is overlain by a logical level in the information age, when such tapes still recorded physical signals but the signals were encoded as information (bits)—techno-logy in its strictest sense.

Phonovisions: Digital Restoration of Gramophonic Artifacts

With the media mystery of physically real recordings of human voices since the advent of the Edison phonograph, culture experienced a temporal mirror effect that sublated the formerly clear-cut difference between presence and absence, present and past. For decades, early recordings on wax cylinders donated to phonogram archives (established almost contemporaneously since 1900 in Vienna and Berlin) were thought to be untouchable because of the possibility of their destruction by inappropriate technical replay. Strangely enough, today we can listen to these recordings and hear almost exactly the same quality of sound as in the moment of recording by means of the optoelectronic media archaeology of sound, now embedded in cyberspace itself. Message or noise? The media-archaeological operation of reading the inscribed traces optodigitally made the otherwise inaccessible sound recordings audible again—an unexpected inverted reminder of light-based sound inscription in early film. Media trigger media memory according to nonhistorical laws of their own. Synesthetically, by application of an equally virtual visualizing tool, we can see a spectrographic image of sound memory, taking an analytic look straight into the cultural archive. The optodigital close reading of sound as image, however, dissolves any semantically meaningful unit into discrete blocks of signals. Instead of musicological hermeneutics, the media-archaeological gaze is required here.

In the phonographic archives, frozen voices, confined to analog and long-forgotten storage media, wait for their (digital) unfreezing, their "redemption." At this moment the digital reprocessing of such data comes close to the human processing of sensory signals within the neuronal network of the brain itself. In the optoanalytic procedure to regain audio signals from the negative tracks in galvanized Edison wax cylinders, endoscopic recording devices "read" the sound traces graphically, retranslating them into audible sound by algorithmically transforming visual data into sound. Digital memory ignores the aesthetic differences between audio and visual data and makes one interface (to human ears and eyes) emulate another. For the computer, the difference between sound and image and text, if it counted, would count only as the difference between data *formats*. 18

The very first recordings of experimental television by John Logie Baird, called Phonovision, from September 1927, show no humans but instead a wooden puppet, "Stookie Bill" (because the extremely hot light source would have burned human skin). Subsequent early television recordings like the thirty-two-second *Looking In* (April 1933), the first TV review of the BBC

test program, hardly allowed identification of human bodies out of the noisy visual signals. As Don McLean wrote, "From the dawn of our television technology age comes the restored wonders of original recordings made in the era of mechanically-scanned television! Not until the computer era came on us could we study these images "20—media archaeology as practiced by a different medium (computing). A media-archaeological shortcut takes place: "Now they can be seen in as close to their original quality as the latest techniques can take us."

Media-archaeological aisthesis (immediate signal perception as opposed to aesthetics in philosophical and cultural discourse) operates transitively, that is, in direct reference to and contact with its objects—just as technological media operate not within a "deep" hermeneutic space but on a "flat" level, both materially (as instanced by an electromechanic pickup deciphering the grooves of a musical record disk) and logically (as instanced by programming, which has a syntactical rather than semantic mode of operation). Technology knows this avant la lettre. In 1962, in his introduction to the technology of the television apparatus, Heinz Richter coined the term immediate television to define the use of cathode ray—based visual information, developed during World War II as the Elektronenkartograph. Transitive television immediately couples human perception with the signal flow of technological media, with or without their translation into the iconological regime of cognition.

When media themselves become active archaeologists of data, the cold gaze of the machinic eye is an element in cybernetic feedback systems, as expressed in Dziga Vertov's film *The Man with the Camera*, with its emphasis on the camera eye (KinoGlaz) itself. And the radar image as another form of "visual" intelligence is a very precise way of electronically translating the Greek notion of *theoría*. C₃I technologies (command, control, communications, and intelligence) favor the Nietzschean notion of pathetic distance (literally *tele*-visual, "Pathos der Distanz"), as analyzed by Paul Virilio for the conjunction of war and cinema. Media archaeology is more akin to the gaze of the optical scanner than to that of the anthropological observer. Going beyond Marshall McLuhan, the media in contemporary culture can no longer be simply "extensions of man."

Siegfried Zielinski asks for a balance between the "arctic freeze" of computer-centered media systems and "the warmth of strong imagination."²²

The (re)search for the wreck of the ocean liner *Titanic* has been a true act of submarine archaeology and historical imagination at the same time. Although the gaze of the camera can look at the wreck archaeologically (i.e., purely evidentially in the sense of remotely sensing data), the human eye, confronted with an irritating material presence of the past, which by definition should be absent, immediately confounds evidence with magic. The film director James Cameron recollects: "Out of the darkness, like a ghostly apparition, the bow of a ship appears . . . just as it landed eighty-four years ago." Initially Cameron felt like an astronaut who experiences the moon as a series of checklists and mission protocols—the true archaeological gaze. But at a certain point he abandoned this perspective "and allowed the emotional part of my mind to engage with the ship. It made all the difference in the world."

Hermeneutic empathy here clashes with pure data navigation: there is a world of difference between an *archaeology of knowledge* and historical imagination, which seeks to replace positive evidence by an act of reanimation. But sonar echoing in submarine archaeology only rhetorically corresponds to empathetic *resonance*; let us not confuse data streams (even when computed in real time) with moments of live communication.

Sometimes the iconological impulse of human image reading and ear listening hinders knowledge and insight. Suspending human perception for a moment in favor of measuring instruments can reveal insights that cultural codes simply do not perceive—the blessing of the media-archaeological gaze. The electronic tunnel microscope does not actually transfer images of the atomic surface of matter but analyzes its object by matching data statistically and representing these calculations as images. Media-archaeological hearing similarly listens to sound as configurations of data (once oscillations have become calculable).

Immediate Viewing, Immediate Listening

Let us investigate the notion of the cultural sonosphere. In a free interpretation of McLuhan, to listen media-archaeologically is to pay attention to the electronic message of the acoustic apparatus, not primarily to its musical content as cultural meaning. The media-archaeological ear listens to radio in an extreme way: listening to the noise of the transmitting system itself.

The audible difference obtained by changing the sampling rate significantly refers to the noise of the recording device (the ancient wax cylinder) rather than the recorded voice. Here the medium talks on the level of both enunciation and reference. What do we hear: message (the formerly recorded songs) or noise (the wax cylinder scratch and groove)?

In media-archaeological awareness, this recording primarily memorizes the noise of the wax cylinder itself—which is a different kind of archive, not cultural-historical but cultural-technological, a different kind of information about the real. Media archaeology opens our ears to listen to this as well, not to filter it out (as opposed to the "cocktail party effect" of hermeneuticized psychoacoustics).

Technical media have already developed a true media memory that differs from human remembrance. The experiment is very simple: imagine an early phonographic recording. Surely we acoustically hallucinate the scratching, the noise of the recording apparatus; true media archaeology starts here.

The media-archaeological exercise is to be aware at each given moment that when we direct our senses to human voices or images of the past replayed from media recordings, we are not communicating with the dead; rather we are dealing with the past as a form of delayed presence, preserved in a technological memory. Recording media operate in a temporal regime different from that of historical time (which is anthropocentric, as defined by Giambattista Vico in his *Nuova Scienza*). The noise, the scratch of the wax cylinder, is the pure message of medium; in between, the human voice is literally incorporated. But what has continuously been preserved by analog recording technologies becomes quantified in the transfer to digital recoding (CDs) instead of simply being analog recording. This is epistemologically new—and dramatically so.

The media-archaeological desire to be freed by machines from one's own subjectivity (and desire for storytelling) is Foucauldian: in his *Archaeology of Knowledge* Foucault expresses his will to "define a method of historical analysis from the anthropological theme . . . a method of analysis purged of all anthropomorphism." Media archaeology as well is interested in procedures and events that are not "historical" (i.e., narratable) but rather consist of "autochthonic transformations" (Foucault) within the realm of machines and their symbols. Words and things happen within the machine (computers) as

logic and hardware. The media-archaeological gaze, accordingly, is immanent to the machine. Human beings, having created logical machines, have created a discontinuity with their own cultural regime.

Counting by Numbers

The cybernetic epistemology that is implied by the idea of a feedback loop between an analog past and a digital present requires a "cold" reading technique different from "hot" historical (or historiographical) imagination, to use McLuhan's famous distinction in *Understanding Media*.

"Digital retroaction" dramatically takes place, actually, by digitizing analog material in the archives and bringing it into a technomathematicized present, thereby translating an analogous world into a digital matrix. 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.

Media taken as physical channels of communication and as technical artifacts that are mathematically operated by symbolic codes and streaming data must be analyzed differently from cultural texts, art-historical images, classical music, or works of art. The archaeological gaze is such a way of looking at media objects: enumerative rather than narrative, descriptive rather than discursive, infrastructural rather than sociological, taking numbers into account instead of just letters and images. Media archaeology discovers a kind of stratum—or matrix—in cultural sedimentation that is neither purely human nor purely technological, but literally in between (Latin *medium*, Greek *metaxy*): symbolic operations that can be performed by machines and that turn the human into a machine as well.

Henri Bergson insisted on human perception of time as duration (consciousness) as opposed to the chronophotographical registering of temporal processes. Whereas narrative (see Gotthold Ephraim Lessing's argument in *Laocoön*, 1766) once was the art of time (time-based arts and literature), now time is being organized technologically.²⁷ Media archaeology deals with this crisis in the narrative memory of culture. Digital narrative, on a media-archaeological (not interface) level, is linked to discrete mathematics; in medieval German, the words for counting and narrating were etymologically

the same. A computing culture, from a media-archaeological view, deals not with narrative memory but with calculating memory—counting rather than recounting, the archaeological versus the historical mode.²⁸

Media, Mathematics, Archaeology

So far in Western culture, narrative has been the primary mode of processing archivally stored data in the name of history, which, on the surface of so-called multimedia, continues in the form of stories (even in computer games, though in fragmented ways). Media-archaeological analysis, on the contrary, does not operate on the phenomenological multimedia level; instead it sees all so-called multimedia as radically digital, given that digital data processing is undermining the separation into the visual, auditive, textual, and graphical channels that on the surface (interface) translate data to human senses. By looking behind the human—machine interfaces (such as the computer monitor) and by making invisible communication processing evident, an archaeology of media, as the notion implies, follows Foucault's *Archaeology of Knowledge* in not discovering uses of media in public discourse but instead reconstructing the generative matrix created by mediatic *dispositifs*.

Athanasius Kircher's term for his machine for automatically composing music (as we learn from Zielinski's *Deep Time of the Media*) was, not coincidentally, *arca*, a term that in medieval Latin also meant "archive." Here the use of the term is Foucauldian *avant la lettre*; it refers to the generative set of rules and material that produce the musical impression (like the software program SuperCollider, which can be used to create algorithmic audio compositions). Computer programming, the cultural force of today, is nonnarrative; its algorithmic forms of writing—alternative forms of minimal, serial time-writing (as opposed to registering)—are close to the paradigm of computing itself.

Let us consider media archaeology in the sense of a mathematical way of doing Foucauldian "archaeology," one that would deal not only with the audiovisual or textual but with numbers as well, just as at the very origin of the vocalized Greek alphabet the single letters (*stoicheia*) were used for numbering as well, counting in an "elementary" way. Academic discourse in the humanities, we have to admit, is still primarily based on the narrative transfer of knowledge. The computer recalls an alternative mode of communication:

Leibniz's dream of communicating by mathematical formulas, in symbolic language (*characteristica universalis*).

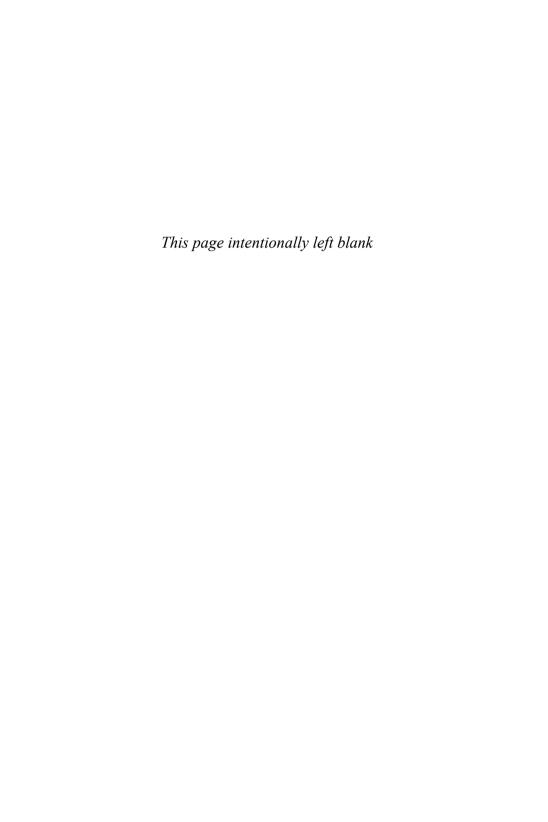
Friedrich Nietzsche once mused on the close relation between mathematics and nature;²⁹ in fact, numbers have developed a culture of their own.³⁰ Quantum physics calculates nature by mathematizing it; nature, by mediatechnological measuring and calculating devices, is almost seduced to reveal its mathematical essence.³¹ Whereas Pythagoras once saw numbers as embedded in nature (as in Leibniz's conception of the *deus calculans*), the computer literally numbers the world processually—closer to mathematical Fourier analysis of physical wave events (sound, light, heat, electromagnetic fields) than to any metaphysical *kosmos*.

Media "theory" recognizes that the links in Western culture between the optical regime and epistemological insight (the visual metaphor of *theorein*) are being replaced by the numerical sublime, that is, mathematical calculation.³² Around 1900 a crisis of intuition in mathematics occurred: David Hilbert's mathematics led to a nonreferential use of mathematical signs, simply operative and thus engineerable (the Turing machine of 1936).

Since technologies changed from tools to machines, these techniques have comprised not only texts and images but numbers as well.³³ Media archaeology, therefore, is close to mathematics. As Martin Kusch says of the use of the term *series* in Foucault's *Archaeology of Knowledge*, the natural way of rendering these passages intelligible "is, obviously, to take the notion of a function at its mathematical face value."³⁴

The media-archaeological aesthetic, so close to mathematics, accords with that of George David Birkhoff, who, in a congress of mathematicians in Bologna in 1928, delivered a lecture proposing a nonphilosophical, mathematical measure for aesthetic impressions (the so-called Gestaltmass as a ratio between order and complexity). Here Birkhoff anticipated Claude Shannon's "mathematical theory of communication" (1948) and philosophers like Max Bense as well as artists who have made cybernetics and aesthetics converge. Human culture does not lose but rather wins by such a nonhuman challenge. Let us employ media archaeology to suspend our subject-centered interpretations for a moment, while at the same time admitting that this technoascetic approach is just another method we can use to get closer to what we love in culture. Media archaeology exposes the technicality of media,

not to reduce culture to technology but to reveal the technoepistemological momentum in culture itself. "Reverse phonography" is an example of acoustic media archaeology, as described in a piece of science fiction: Gregory Benford's novel *Time Shards.*³⁷ Here a scientist at the Smithsonian Institution in Washington, D.C., tries to resurrect voices from AD 1000 by deciphering grooves on ancient pottery, a fiction that has become experimentally realistic with the technological development of microscopic reading of material surfaces on its most elementary, atomic level. ³⁸ Media-archaeological analysis will be rewarded by the sweetness of the human voice.



Part II

Temporality and the Multimedial Archive



Temporality and the Multimedial Archive

As we saw in the previous part of the book, Ernst's writings still retain traces of the earlier years of his long career, which he started as a classicist. He is able to draw on the knowledge and theories that come from the historical discipline that was comfortable talking about ruins and classics in the more traditional humanities sense. Only gradually did those ideas turn into mediatheoretical considerations concerning memory and storage in media cultures. Hence his theories have a specific understanding of time tied both to an emphasis on dynamics and to the archive. This is emblematic through his observation that the long-term archive is giving way to the more processual mode of temporality—whether the production archives of German public broadcasting services or the random access memory of computers.

The chapters in this part address the centrality of temporality for Ernst, and they move from addressing the primacy of temporality to the multimedial archive. Here the temporal ontology offers a way to understand how all computer-based, calculational media are temporal, and this forces us to rethink the spatial emphasis of older regimes of memory (and institutions such as archives and museums) as well as epistemological enterprises such as cultural theory based on representational analysis. This also brings to us a new vocabulary for memory in the age of technomathematical media that, instead of semantics, has to address the themes and differences of read-only and random access, registers, accumulators, buffers, cycle and access times, and

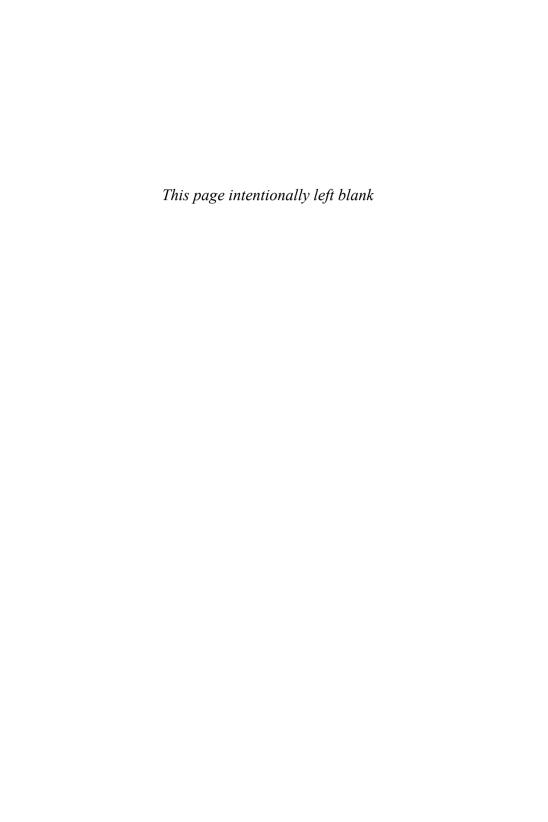
latency, as in the short chapter in this part "Archives in Transition," originally a talk at the Media, Memory, and Archive conference in Brussels (2007), addresses such themes.

A lot of the chapters in this part concern the archive—such a central concept to media archaeology, but so far undertheoretized in media studies. For instance, the chapter "Underway to the Dual System," originally composed in the context of the project Net Pioneers 1.0, which focused on archiving Internet-based art forms, is a good and very accessible summary of some of Ernst's key arguments about this change. It deals with the archiving of media artistic work but opens up to a wider ontological question of what the media are in the age of technical media. The question is answered through George David Birkhoff, who spoke at the International Congress of Mathematicians in Bologna in 1928: aesthetics is, quite simply, about a "ratio of order and complexity" (to quote Ernst's paraphrasing). Again, this is a polemical statement that not only forces us to think about the practicalities of how we archive such science-based art, but also bothers most arts- and humanities-educated scholars, forcing us to think about the ontology of media (art).

In "Archives in Transition" the emphasis on dynamics comes out clearly, with a further elaboration of what is meant by dynamics: for Ernst, this is not a feature of human activity with archives and meaning-making but rather its technological basis through electromagnetism, electronics, and hence the archive in the new media environment. To paraphrase Ernst, the archival *order* gives way to archival *dynamics* and the control structures specific to that.

Hence, Ernst's ideas of how we need to update our notions of the archive in order to understand the specific technicity of contemporary culture is valuable reading not only to media theorists but also to cultural heritage and archival professionals. The articulation of time and the archive mediated by technicity is characteristic of what emerges as the central point of this part. It is well summarized in the chapter "Discontinuities," and its provocative question: does the archive become metaphorical in multimedia space? The question is provocative because the way we answer the question is of significance not only to the understanding of the archive but to a whole range of media and cultural studies topics that relate to visual culture and interface studies. In other words, Ernst's proposition is that if we fail to

address the time-critical, technomathematical modulation of what comes out as the almost like metaphoric surface effect (echoing here ideas that such earlier generation as Norbert Bolz insisted on)¹ we fail to understand where power lies in contemporary culture. Ernst's solution is to approach this issue epistemologically, which also shows in his way of writing, using terms like "memory" that are *inherent* to media, emphasizing specificity often, and at times even describing as a matter of fact the integrality of the technological to our concepts of memory. He is keen to track what is literal in media archaeology—for instance, the secret Nazi medical films thrown into the lake Stößensee near Berlin and then found in the 1990s. The *literal*, the *truly* media archaeological, is Ernst's way of emphasizing his methodological choices.



3 Underway to the Dual System

Classical Archives and Digital Memory
Translated by Christopher Jenkin-Jones

The Digital Archive and Its Generative Algorithm

Converting old media art stock into digital backup formats is technically feasible but highly labor and cost intensive. Instead of archiving the entire stock en bloc, digitization on demand suggests itself as a model. Rather than being a purely read-only memory, new archives are successively generated according to current needs. The method involves using networked digital computers to link existing local digital archives online into intersections such as Europeana, a portal for the written and audiovisual cultural heritage of Europe. Europeana's motto, "Search through the cultural collections of Europe, connect to other user pathways," indicates a certain transformation. Although in advanced search mode one can access, for instance, a manuscript page from Mozart's Requiem in Joint Photographic Experts Group (JPEG) format from http://www.bildarchivaustria.at, classificatory archival criteria no longer prevail, but the information aesthetics of the collections (libraries, mediatheques, musée imaginaires) do. Dynamic information rasters and new search methods that go beyond the rigid indexes of traditional finding aids come into play. An exemplary archive pool with selected attractors provides the requisite basis. Through their queries, users then create further archive elements to be digitized and stored. With the aid of agents and filters, the object-oriented archive thus takes shape cumulatively, entailing a shift from read-only paradigms to

a generative, participative form of archival reading. Source-oriented stock and classical file-oriented archive practices yield to the use-oriented ("to be completed") "dynarchive."

The digitization of mono–media art forms (analog video, for instance, or classical electronic music or tape) for archival purposes is one thing. Born-digital media art is another. An art and archival language has yet to be developed for digitized networked artworks.² At the moment, only the technological dispositives exist. There are few forms of archiving processual works, because the art museum has nothing to offer in the way of a model here.

A processual memory concept already inheres in the computer's so-called von Neumann architecture: namely, a principle of memory programming (also present in a rudimentary form in Charles Babbage's concept of the Analytical Engine) that facilitates the self-accessing of temporarily stored data during computation itself (archival cybernetics [internal feedback])—a dynamic memory culture in contrast to resident archive memory, which is updatable but not permanently and dynamically regroupable. Digital archives are closer to the computer's memory aesthetic than are the traditional (and medium-of-tradition) emphatic coupling of archive and cultural memory. The classical archive is preserved time. But the digital archive has no intrinsic macrotemporal index, as the "year 2000" problem made clear. It operates at a microtemporal level instead.

How does dynamic art archive itself?³ Algorithmic objects are objects that always come into being anew and processually; they do not exist as fixed data blocks. It is a question of archiving the source codes with which, as in fractal picture and sound compression processes, a new whole can be regenerated—a latent archive.

Mathematizing the Archive

So what does *digital archive* mean when the most rudimentary components of classical (state) archives since ancient times⁴ have been tied to written texts—that is, to the letters of the vocal alphabet in discrete symbol groups? It is not the digitality of the so-called digital archive that is new but the fact that what is involved is the binary code, the smallest information unit of which is the bit, through whose duality words, images, sounds, and times

are archivally encodable. Archivalia that happen to be media art thus forfeit their exclusivity (apart from their format) vis-à-vis other forms of data object.

In this sense, digital archives can be said to be at the peak of information theory—informed art itself. At the International Congress of Mathematicians in Bologna in 1928, George David Birkhoff presented a mathematical equation for aesthetics, the so-called aesthetic measure, as a ratio of order and complexity. The following statements of Warren Weaver are particularly true of the operative basis of media art: "The semantic aspects of communication are irrelevant to the engineering aspect," and "information must not be confused with meaning." If art can be defined information-theoretically as a relation of order and entropy—as Max Bense, drawing on Abraham Moles, proceeded to do for information theory and aesthetics (the function of the archive, as of art, is to hold unlikely things; they alone constitute information)—media art discovers its essential feature in the digital archive. For the digital, "calculating space" (Konrad Zuse) is accessible to mathematical operations, whether as search options, for analytical purposes, or for data migration in long-term archiving.

Operative mathematics (in other words, the world of computers) has less to do with concrete numbers than with relations and is thus structurally related to the essence of the vectorially linked digital archive. Hyperlinks to other documents on the Web are no longer external references, as in traditional procedures, but are literally embedded in the document itself: the reference becomes self-operant and self-aware.

The exhibition realized in relation to the research project underlying the publication in which this chapter originally appeared drew attention to the structure of an archive whose essence, the closer one looks, is less the archived material per se than a dynamic conception of the idea of the archive. Conceptual art is on the side of the archive that becomes an object of aesthetic exploration. The group Art & Language, for instance, primarily develops tables, lists, and text-and-photo series.

The new archive's task is to meaningfully link up different information nodes—a veritable archive art. In the case of antiquated Net-based art, these nodes themselves will be the primary object of archiving and reconstruction. Here it is no longer a question of reactivating objects, but of relations.

The primary operations of the archive are no longer the contents of its files but rather their logistical interlinking, just as the Web is not primarily defined by its contents but by its protocols (Hypertext Transfer Protocol, or HTTP). The Internet "archive" is on precisely this level, at once nonmetaphorical because it is nonconceptual and metaphorical because it is "transferent." In 1991, Tim Berners Lee defined the new medium for communicating scientific information as no longer the static accumulation of dossiers but (directly in line with Ted Nelson's hypertext vision) rather as the dynamic connection of documents and links. Although their indexes are primarily search oriented, unlike traditional archive repertoires, they are not passive but themselves constitute a logistical document containing links to the pertinent data records—a finding aid in the documents themselves, a self-referent archive.

The Internet: An Archive or Its Metaphor?

If we disregard the metaphorical use of the word *archive* for all possible forms of memory and cultural memory and use it to mean the specific agency of a memory technology, the Internet is not an archive. Yet the Internet constitutes a new type of transarchive already present in Ted Nelson's conception of hypertext and hypermedia: a dynamic archive, the essence of which is permanent updating, and one that can translate moving images and gramophone records from the classical realm of the alphabet to archive, real-time life itself (webcam culture). But in fact all this takes place in digital space—a radical discretization of the world. The offerings of the Semantic Web and searchengine options are on a par. Net archives are a function of their software and transmission protocols rather than of content, to which technology is indifferent. Beyond the archival principle of provenance, the Internet's cybernetic dispositive itself operates as a command system (arché) far more time critical than classical archives ever were. The sound of the archive is the ping signal of data transmission testing. Here is the place for an informationtheoretical plea for well-regulated disorder, for grasping the cultural and technological opportunity for a new type of generative archive.

On the one hand, the Internet extends the classical space of the archive, library, and museum by an extra dimension. On the other, its technological organization and more (graphical) mathematical than classificatory topology undermine this tripartite division, because digital code renders

commensurate texts, images, and sounds. Through physical modeling it can even resolve physical objects into numbers and then resynthesize them.

The archival infrastructure in the case of the Internet is only ever temporary, in response to its permanent dynamic rewriting. Ultimate knowledge (the old encyclopedia model) gives way to the principle of permanent rewriting or addition (Wikipedia). The memory spaces geared to eternity are replaced by series of temporally limited entries with internal expiry dates that are as reconfigurable as the rhetorical mechanisms of the *ars memoriae* once were.

The Viennese art project HILUS (1991–96), described as "the intermedia information system art + New Technologies," consisted of three sections: "*ARCHIVE*/Library, *ARCHIVE*/Videotheque, *ARCHIVE*/CD-ROM Collection." Every form of signal store and database (analog or digital) is declared an archive here. Mnemotechnically, however, nothing more is meant than the permanent availability of a latent media memory. The inflationary use of the term *archive* for all conceivable forms of memory has long since distorted it beyond recognition. And the equation of Internet and archive leads to the ultimate dissolution—liquidation—of the concept, immersively, like ink used to write on water.

Ostensibly the largest digital archive, the Internet is in fact a collection or assembly. Primary material—classical sources in the sense of archival documents—are increasingly found on the Net. But, as in the case of every other database, they are there for immediate information consumption. The real archive on the Internet (in the sense of *arché*) is its system of technological protocols. The archive becomes a memory only at the moment of its standardization. The codes involved can be stored according to the rules of the archive. But the things actually realized on this basis can be only documented, not archived. A videotape by Nam June Paik and the accompanying technical equipment can be archived with considerable outlay of information technology and restoration. But the actual on-site video installation can only be documented—analogous to the classical linguistic distinction between language as a set of rules and as physically (phonetically) realized speech (langue, parole).

When closed data blocks migrate according to well-defined rules from production site to storage site and are stored in their original context, the archival principle of provenance (the Prussian archive tradition) prevails. The media-art legacy of two decades of Ars Electronica in Linz in this sense constitutes an archive of material that has been quasi-officially generated by a well-defined selection system. If the data blocks in question are divided and rearranged according to subject, the principle of pertinence (according to subject matter, the French tradition since the revolution of 1789) is involved. Contrary to the general assumption, the real work in archival science and practice is a process of selecting out, not of accumulation. According to Arlette Farge, "Working in archives necessitates operations of sorting and separation of documents." This is the fundamental difference between a classical official archive in the strict legal-administrative sense and the Internet as a database. The archive is defined as a given, preselected quantity of documents evaluated according to their worth for being handed down. The Internet, on the other hand, is an aggregate of unpredictable texts, sounds, images, data, and programs.

Once a digital basis archive has been compiled, newly accruing sets of data—which, in the case of media art, make huge demands on computer space—can be memory-economically aligned purely on the basis of differences, in the (postcinematographic) sense of image—data compression. Brewster Kahle speculates: "In future passes through the Web, we will be able to update only the information that has changed since our last perusal." But given access limitations, even the Internet archive as envisaged by Kahle is, at best, only a representative image of the Internet.

"Digital Archives" as Subject and Object of a New Memory

Does the media character of art(ificial) objects come into play only when it is recognized by media rather than people? The digital archives—trivial as it may sound—are compiled alphanumerically so that, unlike traditional archives, they no longer primarily reside in the medium of the vocalic alphabet but have a genuinely mathematical component. Conversely, this means that through algorithms they are accessible to mathematical operations, something unprecedentedly new compared to the silence of the classical archive. The digitization of archives concerns, on the one hand, the textuality of the classical archive by developing new forms of "finding aid" (access via intelligent search algorithms). It is true that the alphabet constitutes a literally

discrete form of storage. But when *digital*, in its-well defined sense, refers to the computer and its operations, rigid text is replaced by an operative mathematics. Archives as the traditional bases for legal, cultural, and historical research of the past can, in turn, be temporalized and accelerated as streaming archives. The microtemporality of the data-processing operations (synchronization) is thus superimposed on the historical archive's macrotime.

The really new archives are microarchives, both temporally and spatially, where data processing takes place in real time in the minutest space, so ultrashort-term fast memory comes into play. However, owing to ultrafast computer and signal-processing clock rates, these time frames are experienced as the present. With the radical digitization of the classical division of analog live broadcasting media, such as radio and television, and analog storage media, such as the disc, tape, and video recorder, fast memory in the form of data caches comes into play. By digitizing video signals, the quality of both sound and image can be improved, although in order to eliminate the surface flicker of analog media times by raising the raster frequency from 50 to 100 Hz, the processing calls for vast memory space that can take up entire rasters at critical moments. 12 But an image memory is not yet an archive. What makes the difference between a memory and an archive is an organized archive barrier. There is no harm in talking of digital (binary) memories. But an archive is an organizational form on the next, higher level. It would be brave to make a principled decision to engage with the transitive level of memory systems in the mathematically and physically real (and to leave all symbolic connections open) rather than with the emphatic archive as symbolic metalevel.

Computers themselves represent "storage and retrieval" systems—for people as users and as an essential part of memory programmability. Apart from sequential access (the old magnetic computer tapes) there is immediate random access (matrix memory). Every computer is already a digital archive. The archiving occurs in the RAM of the familiar computer, not in the emphatic sense but rather as the precondition for any calculating process taking place at all.

The (Im-)Materiality of the Digital

Archiving with analog storage media (for instance, photographed texts on microfilm) has distinct advantages over digitization in terms of quality and

shelf life. The strength of digitized archivalia lies not in their (highly vulnerable) migrability into the technological future but in their substantially potentized present online accessibility. Longevity is rooted in the materiality of archivalia—discourse in their immaterial circulation as information.

Does the power of archives lie primarily in their securing the materiality of their documents (a juridical or cultural heritage), or is it chiefly a matter of their storing information to make it available for present use? The testimonial function of archival records was once firmly rooted in their material authenticity. The same holds in media-art archives with respect to originals. Archival science speaks of the intrinsic value of archivalia when their materiality and form are also conceived as playing determining roles. A medieval document on or of parchment indissolubly fuses materiality and message. This holds for the realm of alphabet-based archivalia. The situation is different with those analog technologies that depend on recording, and hence storage, on wax cylinders, film, or magnetic tape (instead of the alphabet of a fluid electromagnetic field). With the digital, physical signals become information. The intrinsic value of the documents yields to their mediatechnological nature, consisting of alphanumerics and hardware. Logocentrism is replaced by the alphanumeric.

The relation of writing (vocalic alphabet) and archive is reversed; writing dominates online, too; but it is a different kind of writing, an operative command script ($arch\acute{e}ographie$) that facilitates storage and transmission and is both fundamental and foundational. Archival script thus becomes more universal than ever, as every image and software component shows, transmitted in BinHex or gzip mode or read as code. It is the unexpected return of writing in the form of the most minimal alphabet conceivable (o/1). The message of the Internet is thus still primarily archive and library. The HTML Internet generates Web "pages" and "documents" as if paper formats were still fundamental. The whole approach to indexing and automated Web crawlers remains text oriented. "One-nil . . . to the power of print as archived relic of the search," is the verdict of one analysis of the search engine Google. It

Does the classical concept of the archive stand or fall by its literal textuality—namely, paper and the vocalic alphabet? As Trudy H. Peterson pointed out at the XI International Archive Congress in Paris in 1988, the following

holds true still, even for computer-generated documents or records: "The traditional archival principles—evidential and informational values, provenance, levels of arrangement and description—continue." It is not the data here, however, but their metadata that are the archival element. The Commission on Preservation and Access in Washington, D.C., and the Internet Engineering Task Force, for instance, develop technological standards for the permanent identification of digital documents (URNs—uniform resource names) in addition to the familiar URL (uniform resource locator) Webdocument addresses.

Archiving Media Art

A digital archiving of media art that aims to do the media justice and engender a new "art of the archive" will lay bare the algorithms—the *arché*—of the archive. Boris Groys calls this level the submedia space behind the archive's surface, because as media carriers the media apparatuses are as good as inaccessible to the viewer¹⁶—open source. The concept of media art is particularly meaningful when, technologically and aesthetically, it makes the most of its various media qualities, hence of its archival opportunities. The background here is the common origin of media theory and media-conscious art theory.¹⁷

Let us turn Marshall McLuhan's eye for the noncontentual aspects of media science¹⁸ on the media-archival level. Does this also hold for the contents of audiovisual archives that are permanently being translated (technically, "migrated") onto new media for backup purposes, as are Edison cylinders to CD-ROM? The whole distinction between analog and digital media art for the new archives rests in the fact that, in the technomathematical monomedium of the computer, it is no longer the material medium but rather the format that is the message. Fluxus Art of the 1960s (Nam June Paik's and Wolf Vostell's TV and video interventions) aimed at desemanticizing the works. Form and content are no longer hierarchically distinct but are rather equioriginal elements of media-artistic information. Points of light are constellated at once figuratively, then abstractly on the monitors—optical sirens' songs. Bill Viola's thirty-minute video aptly titled *Information* (USA, 1973) takes this to extremes. A hiss is experienced here "not as a mischance but as an aesthetic windfall," in the words of Wulf Herzogenrath—as information

in the spirit of the mathematical theory of communication. Let us dream, then, of search engines that can pick a video out of a media-art archive by classical word/title search but is also at home in the statistical likelihoods of individual image elements.

When it comes to the archiving of media art, there is no reason not to draw on the achievements of archival science, particularly for the evaluation and selection of relevant contents amid waves of information growing to tsunamilike proportions. The question as to the archivability, and the need for archiving, of fleeting media art is more problematic. With Fluxus and Performance, the world was entered by art forms that, by definition, resist archiving. The transience of electronic culture was already materially anticipated on premedia terrain. With code-based artworks the situation escalates into the algorithmic.

The exhibition Deep Storage once addressed the archiving practices in contemporary art. Its approach was characterized by a digital-nostalgic double bind; although the archive in its digital state was robbed of a physical location and of material archivalia, the focus of the exhibition was on objects, pictures, and artifacts. But, as Volker Kahl points out, electronic communication "is based on time. It leaves no traces apart from the result, which lies outside this process, unless traces are deliberately laid. But even when the process is saved to make it reproducible, there are many problems—copies and faxes fade, and data become illegible because operating systems are no longer recognized. Entire generations of data carriers are made obsolete by hardware developments."20 Audiovisual media art is, by its nature, transient and unarchivable. In April 1956, Ampex in the United States presented a magnetic-tape technology that facilitated trouble-free erasure of recorded television images, thus anticipating a culture of video images "destined from the start for erasure," in the words of Jens Schröter.²¹ Analog chemical-based photography as the direct, crystallized result of the action of light was, for the most part, an irreversible, negentropic process. That which, in the sequel, could be more easily erased was the subject in the real world (Oliver Wendell Holmes's notorious argument in 1859). However, digital photography is no longer geared to emphatic memory but to instantaneous Photoshop processing. Does instantaneous art of this kind need archiving?

Genuinely Format-Based Archives

More than any other art hitherto, media art requires archiving that is literally attuned to the media, to the specific technological options of the formats (image-based image search, sound-based tone search, time series—based search of process-oriented works).

Digital computing architectures are not so much involved with different media—in the sense of analog technologies such as film, gramophone, TV, radio—as they are with formats.²² According to Ray Edmondson of the National Film and Sound Archive, Australia, "Marshall McLuhan once claimed that the medium is the message. Replace medium with format. How far does it hold true? And how much may we permissibly change the message in order to give access to it, in a newer format?"²³ The altogether paradoxical price to be paid for the option of a variety of sorting functions (for instance, image-based image search) is a rigorously standardized system. Precisely this formalization and formatting is what art dislikes. Yet media art, insofar as it operates with technologically standardized recording and playback systems in the analog sphere (classical video art) or with standardized coding (in the digital sphere), stands or falls by this.

The object of a genuine aesthetic of knowledge for digital formats is alternative forms of organizing knowledge that facilitate bibliothecarial as well as classificatory collections. The so-called ImageSorter, developed at the Zentrum für Mensch Maschine Kommunikation at the Fachhochschule für Technik und Wirtschaft Berlin, is an example of a genuinely sound- and image-based database. Here image sorting in digital space takes place according to color-gradient similarities of images. Images that are similar from the computer's point of view (those that make sense according to its criteria of similarity but that do not according to the human iconological point of view) are arranged in clusters on a map or on a kind of visual globe.²⁴ The Kohonen algorithm, used among others by George Legrady for his interactive installation Pockets Full of Memories, facilitates the matching not just of identical objects but of merely similar (scanned) objects using a combination of cognitive arrangement and purely external-shape recognition that generates a third, new element. Content-based image-search processes are used not for search purposes here but for the automatic sorting of large image

batches. Here we see the supremacy of sorting machines, of the generative over the static archive.

Archiving Software

The provenance of electronic audiovisual stock is no longer solely archival in nature (the paper archives of broadcasting stations, for instance) but genuinely audiovisual—a "fluid," frequency-based aggregate that, mediaepistemologically, is fundamentally different from the alphabet-based system. The audiovisual archives are thus the real interplay of traditional and digital archives. Analog technological storage devices (such as magnetic tape) operate, anarchivally, in the material sphere of magnet spots and electromagnetic induction (the symbolic ordering, for instance, the counter on a video recorder, is extrinsic and has to be mechanically added). Computer matrix memories, in comparison, are closer to the symbolic ordering of the classical archive, with a clear address structure: they are microarchives and similar to the digital library, where the phonograph record and film were the previous alternatives to the alphabetical library. Alphanumerics herald the advent of a new kind of library expressed in the informatic concept of program libraries. The distinction lies in the difference between audiovisuality and mathematics. In the case of Net art, in particular, this means the emergence of a new work concept (the software source code itself).

The digital commensurability of text, image, and sound means that the digital archive (as a component of operatively linked electronic data networks) is accessible to mathematical operations down to the last detail—with prodigious consequences compared to the hitherto static, classificatory concept of the archive. In a memo of April 23, 1942, George R. Stibitz defined the essence of the digital computer as "the ordering of computation steps in time" (he is referring here to the number train of zeroes and ones). "Digital computation is dynamic in character." ²⁵

Compared to the virtualization of information, an analog-technological audiovisual artwork (monument to the Muses, a literal *musealium*) is like a monument of material resistance. Is it a question of reflecting, at sites (such as a media-art archive) one might term cultural laboratories, the substance loss that has befallen the thing-world in virtual space?²⁶ The Deutsche Denkmälerarchiv (German Cultural Heritage Archive) founded by Albrecht

Meydenbauer around 1900, a photographic (or rather photogrammetric) collection of historical buildings, already anticipated the potential war losses, the past future of the originals. The name is the address. Freely adapting from Joseph Beuys: To name art or cultural and historical objects in archives by name means to name (keep addressable) the potential complicity of cultural memory media in the symbolic exchange of presence and disappearance. Digital storage media are potentially involved in the erasure of data. But it is also the official task of an archive to preserve documents for an indefinite time, or even to bar present access, conserving them for later, unexpected, and hence truly informational use.

Michael Wettengel claims that a digital archive has two embodiments: "In contrast to traditional archivalia, the logical and the physical structure of digital documents are not indissolubly linked but are stored independently of each other. The forms in which data are stored and in which they are presented are distinct." Characteristic of digital archives is the fact that they can be instantaneously erased—faster than by any fire in the library at Alexandria. In the computer, Bernard Stiegler writes, "writing and erasing on an electromagnetic support enabled, as calculation, the processing of information at a speed approaching that of light." 28

A genuinely digital, software-generated media object develops only in the algorithmic process. In a state of standstill, its software documentation fails to show this. New technologies are constantly required to keep it up to date. But the classical art of archiving fails when the medium shapes contemporary culture more profoundly than anything else, as in the case of the signalprocessing machine we call the computer. Media-operative devices are no longer simply bearers of meaning ("semiophors"); they also generate it. As a curator at the Science Museum London has put it, software, while a cultural artifact, is no longer an object, for it develops only in the course of its execution. The computer can be exhibited, but, except in the frequencybased medium of acoustics, its time-critical and "bit-critical" processes cannot. Software, insofar as the computer hardware for playing it is available at all, is one of the generic objects (media) where "one bit wrong and the system crashes," in the words of Doron Swade. "In archaeological terms the operational continuity of contemporary culture cannot be assured." The solution lies in translating the material side of computer culture itself into software by digitally emulating past hardware. This holds especially for media-art production media. Contemporary culture is suddenly confronted with things (operational devices, media) that conduct their own dereification—"logical replication as distinct from physical replication."²⁹ Digital archives no longer involve mnemonic energy in the spirit of cultural studies but rather a present whose decisive novelty is an information economy. In *Cybernetics* (1948) Norbert Wiener formulated the distinguishing feature of this economy: information is neither matter nor energy. The new archive is this cybernetic being with the gift of feedback.

4 Archives in Transition

Dynamic Media Memories

A radical metamorphosis of the aesthetics of storage is taking place in the media-technical field, which demands models for dealing with a new kind of dynamic memory. For example, digital video recorders are designed for the temporally delayed replay of today's television programs and for short-term storage, not for permanent archival storage. In German public broadcast services, the archives are called production archives (*Produktionsarchive*), with the emphasis on almost immediate reproduction and recycling rather than emphatic cultural long-time memory.

This change in archival logic corresponds to a technical discontinuity: the physics of printed or mechanical storage media set against fluid electromagnetic memories. Whereas the traditional symbolic order of memory relied on fixed symbolical inscriptions such as archives and libraries, writing or printing is currently being replaced by volatile electric charges as carriers of signals. Today the physically real is being registered by electrons literally *flashed* into digital memories.

Dynamics in the Archive

Although the traditional function of the archive is to document an event that took place at one time and in one place, the emphasis in the digital archive shifts to regeneration, (co-)produced by online users for their own needs. There is still an archive, the *arché*: in Immanuel Kant's words, the condition for the possibility of the performance to take place at all. The real



Tigris Flip-Flop Demonstrator. This simple toy demonstrates the function of digital memory: the core of digital memory is the single storage element, whose smallest unit is a flip-flop, a binary unit to store or change one bit of information, or a dynamic charge device that constantly needs to be refreshed. From the Media Archaeological Fundus. Photograph courtesy of Sebastian Döring and the Institute for Musicology and Media Studies, Humboldt University, Berlin.

multimedia archive is the *arché* of its source codes, but in a different form of existence: algorithmic dynamics instead of documentary stills.

The transarchival notion of "organizational," cybernetic, feedback-based, instant memory may serve to describe the logic of electronic and Internet memory.¹ But this approach dissimulates the ongoing existence of material memory agencies, both hardware and institutions, which still govern the power of deciding what can be stored legally and technically.

Genuinely media-inherent memory has an epistemological, memorycultural dimension. Media archaeology as a specific mode of media theory describes such nondiscursive practices specified in the elements of the technocultural archive.

A media-archaeological hierarchy of technical memory levels unfolds among the following:

- Read-only storage (protected memory)
- The register (a term well known from traditional archival sciences, now being used to define the smallest intermediary storage element in computing)
- The accumulator as a special register for numeric calculations (and thus in need of cells for the storage of intermediary results)
- The buffer (for explicitly transient data storage when these data are being transferred from one functional unit to another)
- Different modes of access to stored data: direct-access storage; sequentialaccess storage; indexed sequential storage; pushup and pushdown storage; word-organized storage
- Associative storage with its special characteristic that its stored elements can be addressed by content

The cross-referencing of storage and transfer that is characteristic of computer memory becomes apparent with the close coupling of storage to *timing*:

- Cycle time
- Latency (the time it takes in a functional unit for data to be shifted and relocated)
- Access time (by definition,² the sum of latency and transfer time)

On this microtemporal level, memory is literally permanently in transition.

Micromedia Memories: Storage Devices

Let us clarify the relation between this micro and macro level of memories (storage practices versus "social memory").

When we talk about maximized computer memory capacities, this discourse continues an old occidental obsession that culture depends on storage (historic architectures, libraries, museums). But media analysis indicates that the future cultural emphasis will be rather on permanent transfer. There is already an implosion of storage into processual data flows, a different economy of the archive as dynamic agency online. The notion of immediate data feedback replaces the data separation that traditionally made all the "archival" difference.

With digital archives, there is, in principle, no more delay between memory and the present but rather the technical option of immediate feedback, turning all present data into archival entries and vice versa. The economy of timing becomes a short-circuit. *Streaming media* and storage become increasingly intertwined. Differential archives (as we might call this new type) are self-learning, adaptive archives transitive to their respective media (formats), meta*dating* (temporally, rather than static "data"), flexible. Cognition studies abandon the storage metaphor, replacing it with the equation of memory within the system itself. With supremacy of selection over storage, addressability over sorting, there is no memory in the emphatic sense anymore; archival terminology—or rather the archive itself—becomes literally metaphorical, a function of *transfer* processes.

The Archival "Field"

In the age of Net-based information, the static notion of the rigidly coupled archival classification of documents is being replaced by a kind of vector dynamics. This implies not a metaphorical but rather a precise use of a term from analytical mathematics: vector fields, referring to the calculation of Michael Faraday's discovery of the electromagnetic field by James Clerk Maxwell (Maxwell's Equations). The neologism "field" served in the early nineteenth century to describe a phenomenon (electromagnetic induction) that could not be reduced to terms from Newtonian, classical physics such as *matter* and *energy*, representing rather a cross-referencing of both ontologies.

Archival order, in analogy, is being replaced by the *dynamics* of the archival field, which in the new media environment is itself based on the dynamics of electromagnetism and (mathematically as well as logically) mastered by cybernetic reasoning, resulting in electronics. Although the traditional archive used to be a rather static memory, the notion of the archive in Internet communication tends to move the archive toward an economy of circulation: permanent transformations and updating. The so-called cyberspace is not primarily about memory as cultural record but rather about a performative form of memory as communication. Within this economy of permanent recycling of information, there is less need for emphatic but short-term, updatable memory, which comes close to the operative storage management in the von Neumann architecture of computing. Repositories are no longer final destinations but turn into frequently accessed sites. Archives become cybernetic systems. The aesthetics of fixed order is being replaced by permanent reconfigurability. Digital economy nowadays operates with terms such as reframe or re-load. In an analogous way, the cultural techniques of re-activable storage are in a permanent state of latency.

Timeshifting: Transmission Replacing Storage?

The shift from emphatic cultural memory (which is oriented toward eternity) to intermediary media memories becomes apparent in recent mass media. In August 2007 German public TV channel ZDF announced a new online service: the ZDF Mediathek, which allows for online review of programs already broadcast as far back as one week (deconstructing the very format of classical TV itself, which is the strict temporal program "flow," as described by Raymond Williams). A similar service of providing individualized TV-watching time, Entertain Comfort, announced by German Telecom, offers a choice of TV programs from an online archive. When a national German football league game already can be accessed only one hour or so after the event itself—thus almost in the present—near-live (like the live-on-tape concept previously) time shifting for temporally deferred TV at home takes place. Video on Demand results in the online videotheque, technically requiring a media receiver with a time-shift function. The old opponents "past" and "present," "archive" and "immediate event," become submerged in time shifting, which is the temporal essence of electronic digital media operations. Memory is technically defined as "a device into which information can be introduced and then extracted at a considerably later time." This kind of definition of time is close to what is known as a buffer in electronics. Minimal-delay memories are at work in time-based and time-critical media, especially if we do not notice them. Drastically, these binary micromemories dissimulate apparent live transmission by calculation in real time.

The choice between storage versus transfer, once so useful for the analysis of cultural communication (since Harold Innis wrote *Empire and Communications* in 1950) becomes obsolescent. It turns out that storage is nothing but a limit value of transfer. Seen from a media-archaeological perspective, transfer and storage are two sides of one coin: storage is a transfer across a temporal distance. The traditional separation between transmission media and storage media becomes obsolete.

With the retroconversion of past analog media into digital storage (mostly for preservation reasons) there will be different ways to hack into these digital memories because the digital archives, once online, are no longer separated from the actual infrastructure of Web-based data circulation. In a way, of course, this means the disappearance of the emphatic notion of the archive; it dissolves into electronic circuits, data flow. This also means that the "deep" archives are transformed into "flat" archives—flat in the sense of the microchip architecture. There has always been data circulation between the needs of an inquiring present and the archival documents; only online does this circulation become a closed circuit.

There is an increasing spatiotemporal entanglement: the gap between traditional resident emphatic archives and ultra-speed transfer narrows; emphatic memory is progressively undermined by a shift of emphasis toward *memorizing*, the dynamic process based on a network of micromemories and interacting micromemorial hierarchies. The archive recedes into the coding and protocol layer, the truly media-*arché*ological (media-archivological) layer (with *arché* used here in Michel Foucault's sense as the governing rule for the emergence of sensible phenomena at all).

Also, transmission needs a protocol, which is the archival element at work in transfer: the essential archive. Nowadays law equals code (according to Lawrence Lessig).

Feedback Memory and Time Shifting

Cybernetic memory is not, as in traditional archives, clearly separated from present operations (such as administration as a symbolic form of the bureaucracy) but becomes cybernetically a feedback ingredient of present operations itself, its basic condition: an almost invisible system of short-term memories (like cache storage) is the condition for digital data processing.

Look at a magnetic core matrix memory device in an early digital computer, a media-archaeological dinosaur of early computer memory. In our brain there is nothing comparable to an archive. Memory is rather an enactment of immediate synchronization of distributed electromagnetic charges in the neuronal net.

On December 6, 1896, Freud wrote to W. Fließ about his assumption of a psychic mechanism that does not diachronically consist of layer above layer but from time to time reconfigures the order of memories;⁶ this corresponds to media memory in synchronous layers. This dynamic of addressing and assembling signals as data into "memory" almost exactly corresponds to the way this magnetic core matrix is addressed and configured by a mesh of copper "nerves" (resonant with digitally switched electricity). The analogy even extends to the codecisive role of chemical processes within the transmission lines (nerves), compared to inductance in electric cables. Dynamic storage turns out to be closer to human neuronal memory than to cultural memory agencies.

5 Between Real Time and Memory on Demand

Reflections on Television

Turbocharged media studies observes the effects of electronic mass media independently of the fixation on program content in traditional televisual analysis and deciphers these effects as functions of programming in the sense of computer science. Even before the Internet, Hans-Magnus Enzensberger wrote about the "zero-medium" television: "What is new about the new media is the fact that they are no longer dependent on programs." Therefore, take a programmatic look at the future perfect of television, that is, at TV as subject and object of cultural memory. For as soon as audiovisual transmissions remain accessible online in digital archives, they constitute a challenge to the common practice of live broadcasting. This has certain consequences for the media culture of memory and for the more traditional philological inquiry into cultural narrative as such.

Perhaps it is not only the forms of narrative that change along with the technical media; the apparently anthropological constant of narration is also put into question as a whole. Although narration maintains an affinity to film, relentlessly linear technically as well as temporally, this is no longer true for media of electronic transmission, whose message will have been the medium, not man. A crucial witness to this argument is Walter Benjamin: "One might consider these things eternal (e.g., storytelling), but one can also see them as temporal and problematic, dubious. Eternal things in narration. But probably totally new forms. Television, gramophone and so forth make all these

things dubious." And in these early notes for his storyteller essay, Benjamin also articulates the fear "that it is all repudiated: narration by television, the hero's words by the gramophone, the moral by the next statistics, the storyteller by what one knows about him. . . . *Tant mieux*. Don't cry. The nonsense of critical prognoses. Film instead of narration."²

Media archaeology of the present begins right at this juncture, without transition. That electronic technology is capable of generating its own new forms, not autopoetically but qua medium, is demonstrable particularly when TV becomes archival and available for montage—the "cut" is nothing more than a metaphor for copying.3 Digital imaging generates new pictures "by itself," a kind of "inner montage" perfected in the music video. 4 Narrativity is eliminated, as Knut Hickethier demonstrates: beneath the starkly elliptical constructions, narrative elements remain, and the video may show traces of a plot, but in fact the aesthetics of video have undermined the space of the story. Gaps are equal means of expression; transitions are no longer linear but serial. In a staccato of cuts, the electronic medium (television) initiates a dissolution of continuous imaging spaces; "televisual narration itself has long migrated into the cinematic means of production."5 The content of the electronic medium is the message of its predecessor: narration. In MTV's video-clip aesthetics as well as in CNN's immediacy of breaking news, cable TV has discovered the mediality of television, the quick cut and the focus on live transmission, and the discovery of the medium by itself appears as a liberation from the heavy-handed content programming of public broadcasting.6 What would change if the so-called Web portals managed to reintroduce the old mode of programming familiar in broadcast media?

Does it make sense for media studies to apply the information theory of Claude Shannon and Warren Weaver to the analysis of TV series? Perhaps Stuart Hall's concept of a critique of the ideology of *decoding* and *encoding* of television may be transposed from cultural studies into the vocabulary of information systems. Already in 1926, in his essay "Ding und Medium," Fritz Heider insisted on the fact that media transmissions such as light rays "bring tidings of things." Applied to electronic rays, this yields an alternative concept of news. At the same time, the suggestive power of televisual images over the human eye defines itself in analogy to the neurophysiological constitution of images. The rows of the cathode tube correspond to human

perception. Similarly, the concepts of redundancy and information correspond in their application to television: this is how media studies analyzes TV as a medium in its disclosure, understood here as the function that generates cultural semantics, while cultural studies declares itself in charge of televisual content and its ideological effects.

Thus while (tele) visual studies tend to analyze the program of TV's cultural texts, media studies descends to the level of a subsemantic information theory of television. "Even cats watch TV," James Monaco writes; obviously, hermeneutic understanding is not required. Therefore, trash TV, for instance, becomes readable not only along the lines of Michael Thompson's Rubbish Theory but also by way of media studies, deciphering the phenomena as entropic relations between signal and noise, which does not mean reframing the discourses of popular culture academically but formalizing them mathematically, statistically, with the aid of Michael Foucault's discourse analysis.9 Knut Hickethier may protest that a concept of information in its association with the criteria of singularity seems practicable only for an aesthetic theory of avant-garde media, "but not for radio and television, since they know different uses also of redundant messages."10 However, the broadcast of any football game illustrates the signal-to-noise ratio between plays on the field and amorphous shots of the spectators in the stadium only statistically. The archaeology of media searches the depths of hardware for the laws of what can become a program. Has not the character of television shows after the introduction of color sets been determined decisively—indeed down to the clothes of the hosts—by the new standard and what it can do in terms of color and motion? Even today, the color blue has a mediatic veto in chroma key resolution; the same goes for the blue screen and for manipulations of resolution and color filters.

Samuel Weber raises the question of a "distinctive specificity of the medium," in opposition to the content-determinism of current television analyses: "What we most often find are content-analyses, which could just as well apply to other media, for example, to film or to literature." According to Marshall McLuhan, a medium has meaning not independently but only in relation to other media. Firefighters in François Truffaut's *Fahrenheit* 451 who search for books in order to burn them detect a stack of books inside a TV set—it is merely a hollow space without function, a box without

its proper content. For media archaeology, the only message of television is this signal: *no semantics*. Once trash TV is no longer observed as to its content but as to its medium, we see noise—a qualitative equivalent to technical interference, or what French media studies indeed call *parasite*.¹²

The arrival of a new medium changes the relation between noise and information. For example, the technical dispositive of video no longer aims at referential, semantic, content-related categories but at the transformation of perception as such.¹³ And this is exactly where Nam June Paik started, in his early installation *Zen for TV*: with an electronically modulated, simple band across the monitor. More recently, the arrival of virtual studies has again offered media artists the challenge not to try to eliminate the remaining technical defects but to use them artistically, as the difference between draft and machine.¹⁴ The magic phrase from Aristotle's work *On the Soul*, which we now translate as "medium" was *to metaxy*—the interstice of the in-between, analogous to the Greek prefix *dia-*, which is something like the screen of computers and television sets, as Samuel Weber reminds us:

The medium is here distinguished on the one hand from a simple emptiness, on the other hand from the impenetrability of matter: it divides and connects at the same time, more precisely: it only makes the connection possible as division. Since Aristotle talks of sensual perception, the medium becomes condition not only of contact, but also of *transmission*.¹⁵

In contrast to the cybernetic concept of media transmission (the channel of information systems), this in-between does not manipulate the signal but makes itself apparently disappear and thus continues a familiar figure of dissimilation, that of the disappearance of the translator. According to Niklas Luhmann, information happens only in the unexpected—namely, as the opposite of the redundant or predictable. In this way, the unexpected corresponds to the disturbance that is television proper: the paradoxical structure of the medium demands extraordinary events that can appear only within the ever-same schematics; live broadcast would then be the condition of possibility of disrupting an otherwise imperturbably streaming flow. Autopoetically, television double-binds such disturbances back onto itself when mishaps and errors are thematized serially. It is precisely their exhibition

within their own genre that makes the paradox of television as a medium apparent: constantly having to provide the unexpected. The intimate relation of the medium to accidents and catastrophes can also be recognized in war coverage. But this association of the unexpected with the event—and thus with historic discourse—is still operating on the semantic and narrative levels. Media archaeology observes the TV set as a signal machine that provides disturbance in the technical sense as its information. Hence the proper relation of the medium of TV to war is not a matter of content but a consequence of the development of this media technology itself: radar for its hardware, mathematical information theory and its *random-to-noise ratio* for its software.

From this perspective, the most expressive television image of war is the interruption of transmission, the sudden halt of all images: the empty screen immediately documents the explosion of a bomb, for instance, in Belgrade's state-owned TV station, and becomes an allegory of death, which itself is not visible. In the age of technology, the image of the real comes into its own. At this point it is the intervention of media archaeology to resist any and all allegorizing, semantic readings.

Can the language of literature express this transformation of cultural aesthetics into audiovisual, noisy surroundings? Can the audiovisual media be interrogated by semantics? Don DeLillo tries it in his novel *White Noise* (1985), taking as his title the acoustic and visual background of a running TV set without reception that has become the constant background of American life. White noise means not nonsense but a ceaseless particle stream of information in constant motion. Indeed white noise permanently carries the memory of that moment of media archaeology when the images were not yet stable:

In these early prototypes, a transmission could be considered successful as long as an image took shape against the choppy grey static. . . . But if these images rush to make a claim on reality, it rests on the fact of transmission—reproduction at a distance—not on the veracity of its representations. ¹⁶

This noise exists in the optical realm as much as in the acoustic one. When Philip Jeck was spinning records at *Intermedium I* on portable players, it was

not about the music but about the noise in between: "Let vinyl do the talking!" Crackling is no longer an aesthetic problem; for media art, the technical defects of the apparatus offer the chance to investigate differences, in contrast with the perfected versions of packaged editing software.

In contemporary music as well as photography, we find a tendency to return to the imperfect image, the imperfect tone. Early techno recordings are badly produced, on vinyl, with amplified crackle and pop, and this goes so far that it becomes a pink noise and the hiss of the record is the real thing: we hear only the noise and the interstices of the record grooves. 18 The technical impulse itself becomes the message. In the hissing we hear the medium itself—the basis for a transharmonic understanding of music also in rap culture. Zapping and scratching means to surf the medium, in the transitive sense; thus what Walter Benjamin wrote about language (à propos the selfreferentiality of proper names) here becomes true for all media, namely, that they communicate primarily themselves. 19 Video scratching reminds us even more drastically of the materiality of the medium; it practices in the realm of the visual what has become familiar to us from the treatment of vinyl by disk jockeys. Feedback creates images that hurt the eye. V. J. Safy (Assaf Etiel, Israel) regularly shows his *Live Scratchworks* in Berlin, using damaged, skipping laser players for image and sound. The relation between the signifiers and the signified is eliminated—it is a work of desemanticizing, and here meaning itself turns into media-archaeological material under the conditions of data manipulation.

Filmmakers used to exclude the unexpected by means of repeated takes of the same set. But immediate electronic broadcast also makes possible the inadvertent recording of material that may seem significant with hindsight. In the words of Kay Kirchmann, "Ideal television is the unpredictable under total control of its mise-en-scene." In sports broadcast, this may show itself as the "record." Better still, everything is *recorded*, but only the surprise, the *record-making performance*, is broadcast, as Samuel Weber writes. ²¹

For years, the Offener Kanal in Berlin—a so-called citizens' channel, or "open channel"—kept a spot for broadcasts that were not professionally produced as programs. They offered a high degree of the unexpected, but, as Jeanette Goddar explained, "Critical viewers who zap through occasionally comment that the recognizability of the channel has nothing to do with its

broadcast, but with the catastrophic quality of its sound and image."²² The catastrophic, however, is what is closest to the medium itself, from the point of view of media archaeology. In the United States, radio amateurs supported the U.S. Army Signal Corps when natural catastrophe interrupted power and telecommunication (telephone, telegraph)—and, in its dependency on "storage batteries in order to maintain communication," radio is reminded of its lack of storage on the operative level.²³ This state of emergency is also transferable to television. In 1963, Max Egly compared the "ridiculously small gray image" of television to its contemporary competition, technicolor cinema; while watching TV "one always has to expect it to disappear or to shrink to a small dot"—just as the magic eye might in searching for radio transmitters, quasi radar. However, because the division of sound and image on TV is a function of its technical transmission, sound is "almost as good as on the radio" even when the quality of the image is inferior.²⁴

As Terry Winograd pointed out, it is exactly in such *breakdowns* that we can observe the nature of media practice. TV is a radio medium, and it would be nice to be able to zap around not only among different contents but also among different materialities of the broadcast. In its technical defects, prototelevision reminds the observer drastically of its mediality, which, however, is made to disappear aesthetically in perfected reception—and puts some "under a dangerous hypnosis," as Egly warns. Temporarily disturbed images make us strain to see better, so the mediality of even the *cool* medium of TV, as McLuhan might have agreed, encourages active participation not only on the level of content but on the level of media archaeology. Yet once these technical interferences are eliminated, media art strives to reintroduce them.

As a new democratic platform, the Internet may serve as one argument against continuing the open medium of the Offener Kanal. Exactly at this interstice, the difference between TV and the Net becomes manifest. Already a large percentage of what is broadcast on this citizens' channel is actually transmission of video streaming from the Net; taking the place of the broadcast and the program are digital video broadcasts and, literally, electric power. In the Italian version of *Big Brother*, a pay-TV channel called Stream takes care of the live transmission of the experiment and thus reimports the effect of the webcam into the medium of television.²⁶

The evening news as a fundamental element of the TV format has long been lagging behind the competing news media of morning papers and radio—not so much for editorial reasons but because of the technical channels: the broadband signal of TV could not be transported over thin wire in the same way as a telephone conversation.²⁷ Only after the acceleration of transmission did the evening news broadcasts become the informative programs we later came to consider them, not yet distinguishing between an event and the news of an event or between *res gestae* and *historia rerum gestarum*. According to the same logic, news programs were the first to use video once the U-matic became available—exploiting the paradox of magnetic storage and *live effect*. If it took a while for television news shows to emancipate themselves from the weekly review in cinemas; this was a simple consequence of the recording on film that TV incorporates even today, despite all digital advances.

But now digitally archived TV news texts can be found online, if only as text, for instance on Footage.net.²⁸ What is broadcast in Germany as evening news (Tagesschau) at 8:00 p.m. appears half an hour later on the ARD national network Web page as text and is available as a digital video stream by 9:00 p.m.—though the delay is no longer owed to technical but rather to dramaturgical considerations. Decisive for digital TV is not the different resolution of the image but merely the fact that the transmission is not one of analog electrical streams but of precisely coded bits, thus allowing discrete time management—counter to the classic opinion of TV flow that harks back to Raymond Williams. Hence digitality hits on a fundamental insight of cybernetic communication theory, namely, that communication is the decision between positive and negative of the binary code of a suggested meaning. The only difference between this and Claude Shannon's mathematical theory of information is that Shannon completely excludes the semantic aspect; as formal operations, however, news transmission and communication are identical. Shannon defines a medium not only by way of signal transmission but also in terms of its (interim) storage of data; early TV, like radio, is characterized by its lack of storage abilities—it shows a tendency toward amnesia. Thus the formatting of so-called content, the semantic message, is essentially an effect of the mediality of hardware and software

In the case of Berlin, TV as a broadcast medium became political because the former eastern part of the country did not allow the installation of radio relays, so experimentation with different means of transmission became necessary.²⁹ Transatlantically, the idea of a flying television bridge was being discussed, as was a direct radio connection between New York and Berlin across Labrador. The intercontinental delay was put into the service of an almost live broadcast of the crowning of Queen Elizabeth II on June 2, 1953, with the aid of what Albert Abramson called "television film recording for time delay," a technology later replaced by video. 30 Again, the conscious use of a technical defect foregrounds the differences of time and storage. Thus the sheer geography of North America generates the practice of creating minimal time delays that coincide with technical options of transmission as a timebased process. This makes manifest that the authorization of live as a quality for the observer is not a matter of the technical artifact: since the introduction of magnetic recording in 1959, images alone give no clue whether we are seeing a direct transmission or a recording.³¹ That information has to be provided on the margin; it is parergonal—a temporalized (and temporally distorted) variation on the concept of the original. As Samuel Weber writes,

One can no longer distinguish, visually or aurally, between that which is reproduced and its reproduction . . . not even discern *that* or *when* reproduction or repetition, in the manifest sense of recording or replaying, is taking place. We must be informed whether or not what we are seeing is "live." . . . We cannot distinguish through our senses alone between what we take to be simply "alive" and what as reproduction, separated from its origin, is structurally posthumous . . . what Derrida called the irreducible "iterability" of the mark.³²

The result is a certain distortion of time between (a)live and recorded on tape: "That is perhaps most uncanny when you hear a program about someone who is dead, and that person's voice is broadcast and is as 'real' sensorially, as 'present' as those who are speaking 'today' and who are alive." On TV, an image that could be from the same day or from years ago makes news once someone says about it: This happened today. If there were no other means of verification, it would be feasible to supply us with news from archives for years. The Benjaminian historic index of images therefore resides not in

their iconic referentiality but in their textual reference. Only interactive digital TV makes it possible to test the veracity of what is or is not *live* by dint of technical and communicative feedback. Indeed feedback would be the question of control from receiver to sender; in its immediacy it would be the last veto of the present versus the space of the archive. Inversely, once television cameras are embedded in bombs, as in the Gulf War, the event and its transmission and reception implode; *res gestae* and their reading as *historia rerum gestarum* become one.³⁵

We are made oblivious to the amnesia of TV in the enduring flow of transmission. Accordingly, much of contemporary media culture demands a turn away from privileging storage and toward an aesthetics of the permanent broadcast. However, the path of media archaeology is exactly the inverse. Without any extant films, all early TV programs would be lost to our cultural memory. It was precisely the live character of the medium that excluded its memory at first. The CBS Evening News of November 30, 1956, marked a technological breakthrough: it was "the first network news program recorded on videotape for rebroadcast on the West Coast." Thus the historical project would be to seek the first instance of instant replay, that oxymoronic relation between presence and its storage that, in the age of TV on demand, had to become the brand name of a company, Replay. Television images, unlike earlier images, are no longer static and as such accessible but have to be regenerated and kept in each instant. As Dienst wrote:

With transmission, images and sets of images pass the time and fill out the current: in this sense television is always "live." . . . Scanning cannot deliver an image all at once—its composition is always in process, and a "stable" frame can be instantaneously switched midway through. Although pixels can retain luminosity long enough to await the next scanning cycle and thereby approximate the succession of discrete filmic images, the fact that no image is ever constituted entirely in a single instant grants television a range of technical options for framing and editing, including incision and torque of the image's surface.³⁸

TV is defined by the contrast between the technical and the aesthetic quality of live transmission and cinema—a property owed initially more to

a defect than to a programmatic concept. The broadcast was largely produced, sent out, and received live because there was a lack of recording possibilities. The transitory character of television programs yields the "aura" of artistic products of this medium, although it is founded on the technical reproduction of original events and thus, according to Walter Benjamin's theory, ought to be devoid of all aura. Arguably, the fleeting transmission as live event seemed appropriate to recuperate the aura of the singular and unrepeatable for TV and its artistic forms in particular. One may believe that this aura has been lost in the cinematization of the content and due to the switch to electronic recording as the basis of most broadcasts.³⁹ However, Weber testifies against this critical statement of loss and argues, with Benjamin, in favor of a dynamic concept of aura—split into the smallest moments (*Augen-Blicke*)—that coincides with the fleeting *time to live* of the electronic dots of the monitor itself:

The aura, despite all of its withering away, dilapidation and decline, never fully disappears. Far from it, since it returns with a vengeance, one might say, in those forms of representation that would, according to Benjamin's account, seem most hostile to it: film, for instance, and we can now add, television as well. . . . What is condemned in the age of technical reproducibility is not aura as such but the aura of art as a *work* of representation, a work that would have its fixed place, that would take its place in and as a world-picture. What remains is the *mediaura* of an apparatus whose glance takes up everything and gives nothing back, except perhaps in the blinking of an eye.⁴⁰

6 Discontinuities

Does the Archive Become Metaphorical in Multimedia Space?

In this chapter I address (multi) media archaeology in two parts: first, an epistemological reflection on the term *media archaeology*, and second, literal case studies. But, before I begin (arché), I want to reflect on the term archaeology of multimedia. Having been trained as a historian, a classicist, and an archaeologist (in the disciplinary sense), I have always felt uneasy with the predominance of narrative as the unimedium of processing our knowledge of the past. Theoretically, works like Michel Foucault's L'Archéologie du savoir and Hayden White's seminal Metahistory helped me express this unease with the rhetoric of historical imagination. It took a new infrastructure of communicating realities—the impact of digital media—to put this critique of historical discourse into media-archaeological terms and practice. But caution: even when we claim to perform media-archaeological analysis, we easily slip back into telling media stories.

The archaeology of knowledge, as we learned from Foucault, deals with discontinuities, gaps and absences, silence and ruptures, in opposition to historical discourse, which privileges the notion of continuity in order to reaffirm the possibility of subjectivity. According to Sven Spieker, "Archives are less concerned with memory than with the necessity to discard, erase, eliminate." Whereas historiography is founded on teleology and narrative closure, the archive is discontinuous, ruptured. Like all kinds of data banks, "it forms relationships not on the basis of causes and effects, but through networks";

instead of being a medium of cathartic memory, "the archive is traumatic, testimony not to a successful encounter with the past but to what Jacques Lacan has referred to as the 'missed encounter with the real'"3—that is, an allegory of the impossible bridging of a gap.

Archaeology, as used by Foucault in a somewhat playful, delusory way, is a term that does not imply the search for a beginning; it does not relate analysis to a kind of geological excavation. Thus it differs substantially from what the Oxford English Dictionary defines as archaeology, "indicating the material or substance of which anything is made or consists." Media archaeology is not only about rediscovering the losers in media history for a kind of Benjaminian messianic redemption. It is driven by something like a certain German obsession with approaching media in terms of their logical structure (informatics) on the one hand and their hardware (physics) on the other, as opposed to British and U.S. cultural studies, which analyze the subjective effects of media, such as the paternalistic obsession with worldwide order and hierarchies in current hypertext programming languages as opposed to digital options of—female?—fluidity.⁴

An Epistemological Reflection on the Term "Media Archaeology": Prehistories of the Computer?

So, how does media archaeology differ from media history? To answer with an anecdote: Hewlett-Packard has now acquired the garage on which the company based its advertising campaign The Garage Principle. This garage is the primal hut of the Californian Silicon Valley, where, in 1939, Bill Hewlett and David Packard began constructing technical apparatuses out of which emerged the Eldorado of microchips. This garage is now listed, under the number 976, as a monument of American heritage (inventories count memory rather than narrating it). The tragedy of this media monument is that, although the garage has survived, the first technical instruments produced by these pioneers have not.⁵ That is, the empty frame remains, but the more tricky technological artifacts, which are always just temporary configurations and not tightly coupled things, are lost.⁶ This difficulty culminates in the fragile endurance of computer programs, which only recently have become the objects of archives.⁷ Media archaeology describes the nondiscursive practices specified in the elements of the technocultural archive without simply

reducing the archive to its technical apparatuses. Media archaeology is confronted with Cartesian objects, which are mathematizable things,⁸ and let us not forget that Alan Turing conceived the computer in 1936–37 basically as a paper machine (the most classical archival carrier), not necessarily dependent on its electronic implementation, which is a question of speed in calculating.

The so-called 8-bit Museum, the homepage for 8-bit computers and video games, is an example of the computer-based Internet developing an archive of its own genealogy (an unbroken lineage so far), reminding us of the wonderful archaeological epoque of the 8-bit computer when *computer* did not automatically equal *Windows-PC*:

In this mythical time before the MByte had been invented, interaction with the computer was somewhat different from today. Valiant users fought through endless listings to glean a few tricks from others, one wrestled mercilessly for every single bite, programs were relentlessly optimized until they could be run on a 1 MHz chip, tragedies unfolded when a cassette with important data stubbornly signalled ?LOAD ERROR, and in general, fighting the computer was not always easy.⁹

As Konrad Lischka has noted, "There are no archives for computer games." The real multimedia archive is the *arché* of its source codes; multimedia archaeology is storage and rereading and rewriting of such programs. As opposed to the copyrights on software programs, which extend for seventy-five years in the United States, software piracy successively creates a kind of anarchical archive, an *anarchive* of otherwise abandoned software as cultural evidence. Media *history* is not the appropriate medium to confront such an archive and to perform such a rereading and rewriting. Media history seeks to privilege continuities instead of counting with discontinuities, because any implicit narrative, which is always a linguistic operation, permanently produces connections between heterogeneous parts.

Consider, for example, two examples in current media research: *The Renaissance Computer*, edited by Neil Rhodes and Jonathan Sawday, and a Frankfurt Literaturhaus conference called *Book Machines. The Renaissance Computer* expressly draws a parallel between the media revolution from

manuscripts to printing in Europe, enabled by Johann Gutenberg in 1455 and Martin Luther's use of printed text for the distribution of Protestant messages (theses) in 1517, and the actual digital technology era. The symbolic machines of the sixteenth-century "methodizer" Peter Ramus (Pierre de la Ramée) are presented as a pendant to the computer of today, and Rhodes and Sawday claim that there is "an indisputable resemblance between the effects of the printing press and those of the computer . . . in the increased volume of information."11 This claim still thinks media from the vantage point of alphabetical texts, but audiovisual data banks make all the difference. The authors want to "explore the technology of the early printed text to reveal how many of the functions and effects of the modern computer were imagined, anticipated, or even sought after long before the invention of modern digital computing technology,"12 but computing is not about imagination and texts but rather about the alliance of engineering and mathematics. Here a well-known historiographic trope (synekdoché) lurks around the corner: the desire of occidental man to privilege continuity against the experience of ruptures, thus saving the possibility of an unbroken biographical experience. Against such analogies, however, media archaeology insists on differences. In this context, this means highlighting the fact that the Renaissance ars combinatorial, unlike the universal discrete machine named the computer, was not able to calculate on its own, even less to store data in random-access memories or registers. The coupling of machine and mathematics that enables computers occurs as a mathematization of the machine, not as a machinization of mathematics. Although the book has, for half a millennium, been the dominant medium of storing and transmitting knowledge, the computer is able, for the first time, to process data as well. What separates the technological chance in the fifteenth century from the digital epoque is the computer's genesis in World War II, driven by the need for fast number crunching; the difference is between the symbolic (in Lacan's sense: writing, letters) and the mathematical real (computing).

In 1999, the Frankfurt Literaturhaus organized a conference on book machines (a term coined by Thomas Hettche). On this occasion, the media archaeologist Friedrich Kittler pointed out the differences rather than the continuities between memory media: he argued that analog broadcast media, which are linear-sequential and base their storage on the principle of the

tape, should be afraid, for they would be swallowed by the Internet. According to Kittler, books, however, share with the computer "the deep quality of being discrete media." Both are combinatoric machines; the only difference is that books are resident memories, whereas the computer can automatically read and write. On the Internet, texts are, for a while, not falling silent, which is why "Internet archaeology" is necessary (Denis Scheck). But who is responsible for this kind of documentation? Classical archives and libraries do this kind of documentation only exceptionally; for the new kind of memory there are no longer fixed *lieux de mémoire*, not in the sense of institutions, but rather in the sense of rhizomes within the net itself. Although the stability of memory and tradition was formerly guaranteed by the printed text, dynamic hypertexts—the textual form of the Internet—will turn memory itself into an ephemeral, *passing* drama.

A Forerunner of the Internet?

Historian of science Rolf Sachsse describes Wilhelm Ostwald and his "organisation of organisers" (Die Brücke in Munich between 1911 and 1914) as a "multi-mediatic" forerunner of the Internet. 14 So, too, does Jonathan Sawday when he asks if our contemporary "idea" of the "Net" or the "Web" was "foreshadowed in the Renaissance, at least as a conception." Does this imply a history of ideas instead of media archaeology? But how can media of the past be addressed? Narratively or by discrete alphanumeric ciphering, such as signatures of documents and objects? These questions are tricky because the answers themselves depend on the very agencies being thematized: the archive, the library, and the technical museum. Whatever will be said has already passed a process of selection, transport, inventarization, and storage according to classification, a signal-processing circle best described in terms of cybernetics and information theory. Significantly, the archaeologist of knowledge itself, Michel Foucault, made the signal-to-noise ratio—the relation between message and noise—the subject of a talk in 1966, reminding us that "Freud turned the verbal expressions of illness that were until then considered as noise into something that could be analyzed as a message."16 Some of Foucault's own talks have been recorded on tape. In this audio archive, the signal-to-noise ratio enters the memory of Foucault itself—a kind of techno-corpse with Foucault's recorded voice that conveys both message

and noise because of material corruption. We are dealing with what history calls *tradition* in the sense of transmission of signals, which the media archaeologist sometimes can decipher from noise only when technical filters are applied. At this point, media archaeology replaces philology as the art of deciphering texts.

Sven Spieker recalls the link between the media archives of the early twentieth-century avant-garde and its contemporary, the emerging science of psychoanalysis, a connection theorized by Benjamin in his conception of "the optical unconscious." In Benjamin's conception, imaging media are archaeologists of images that could otherwise never be seen by the human eye (ranging from telescope to radiological scans). The unconscious archive, though, is rather close to the computer, as defined by Jacques Lacan ("ça compte" rather than a "raconte"):

The Freudian unconscious . . . must (also) be understood as a media theory whose centerpiece, the "psychical apparatus," belongs in the same context as other storage media, such as the camera (to which Freud often compared the psyche) or cybernetics (Lacan). Significantly, the Freudian archive-unconscious is capable of storage only to the extent that it crosses out or makes illegible the signatures on other objects stored in its archive, which means that the unconscious is not a machine for remembering but, rather, a machine that continuously erases previous entries in order to replenish its storage capacity. ¹⁷

Multimedia?

When using the term *multimedia*, we have to remember that we are already victims to a discourse inaugurated by the Microsoft Corporation when it started to release its Windows aesthetics. *Multimedia* describes the way or method of production, the forms of its transport, not its object or content. Whereas a printed letter can carry the meaning of only one phonetic unit, one byte is open to encode 256 different textual, acoustic, or visual options. The term *multimedia* is thus an interfacial betrayal on the computer screen: in digital space, the difference between the aesthetic regimes exists only for the human user, simulating the audiovisual human senses under one surface. A close reading of the computer as medium, though, reveals that there is no multimedia in virtual space but just one medium, which calculates images,

words, and sounds basically indifferently because it is able to emulate all other media. The term *multimedia* is a delusion. By flattening the differences among print, sound, and image and technically sending them on one standard channel only, such as the telephone line (a sequential operation that separates this procedure from spatial bundling), the computer makes these data accessible almost instantaneously. It effaces the resistance to access characteristic of the traditional archive thus far, though in practice there is still delay caused by a multimedial multiplication of data transfer resulting in traffic jams. With RealVideo and RealAudio, for example, delayed transfer, which is "tradition" in the terms of Jack Goody in the age of print, is substituted by the asynchronous transfer mode (ATM), media-archaeological discontinuity in its most technical sense. Although we see one part, the video on screen, the next part is already loaded in the background—a coupling of storage and transfer in real time, a flooding of the World Wide Web by the archive itself.

How can the notion of multimedia be applied to the cultural technology of archiving? As in traditional culture, multimedia first requires archival space, a large storage space like an optical disk for audiovisual data to be kept for processing.²⁰ But multimedia is not just the extension of the textual archive; hyperlinkability, the very virtuality of multimedia as defined by Ted Nelson, involves the interconnectivity of different media. This option is blurred by the notion of hypertext, which just extends what every academic text already does by connecting the textual flow with the apparatus of footnotes. HTML as a protocol means more than just texts.²¹ As Nelson says of Vannevar Bush's 1945 design of an associative, microfilm-based memory machine, the famous Memory Extender (MEMEX): "Bush rejected indexing and discussed instead new forms of interwoven documents."²²

Importantly, Nelson coined the term "docuverse," which in a way is responsible for the iconic desktop metaphor of current Windows interfaces and which, rather than instigating a genuinely media-archaeological thinking of the computer, prolongs the metaphor of archival spatial order. The German media scientist Hartmut Winkler made Nelson's terms the basis of his computer-archaeological book *Docuverse*, which took for granted the language-based structure of the Internet. He wrote this a few years before the pictorial turn in the Internet took place, a turn made technologically possible by data compression algorithms and broadband transmission of real

audio and real video (streaming). Significantly, downloaded images generated by webcams are no longer called an archive (a term that belongs to paperbased memory) but rather a gallery (a term from the visual realm). That is why the U.S. visionary of digital architectures, David Gelernter, points toward the data flow (lifestream) as a future alternative to the current desktop metaphor of present interfaces that still carry, with filelike icons, an anachronistic archivism dating from old European times of secretaries and offices instead of rethinking digital storage space in its own terms. Temporal dynamics will thus replace spatial metaphors and catachrestic uses of terms from architecture.²³ A media archaeology of the file has been written by Cornelia Vismann:

This archaeology of law is at one end being framed by predecessors of files like the administrative lists in Babylon, at the other end by file-like text administrating systems in computer programs. There it becomes evident that filing technologies have always been the prehistory of the computer as well, who with his *stacks, files* and *registers* inherits diverse occidental administration practices.²⁴

Emphatic memory (on hard disks) in Gelernter's scenario is being replaced by a future of the computer as a place of intermediary, passing storage: "The Lifestreams system treats your own private computer as a mere temporary holding tank for data, not as a permanent file cabinet." Future, present, and past are but segments, functions of marking differences within a data stream that is time based rather than space based.

Fahrenheit 451

Now for an interruption to remind you of another utopia, a film classic that has probably been prematurely classified as science fiction, François Truffaut's *Fahrenheit 451* (1966). In it, a new medium—film and its technoallegorical other, TV—takes the burning of its mediatic predecessor, the book, as its object. And indeed, the light points of digital signals on the screen literally efface the classic book format as the dominant storage medium.

Another key element defining multimedia, namely, interaction, is an aspect Bertolt Brecht highlighted in the 1920s for the emerging medium radio, insisting that it could be used bidirectionally rather than being broadcast only unilaterally.²⁶ The unidirectional communication of books still dominated

the user experience. The computer, through its possibilities for interactivity, "play," and the creativity of hypertext, is now rapidly undoing that idealization of stability and returning us to a kind of textuality that may have more in common with the pre-print era. Thus Vincent Gillespie has argued that the contemporary user's experience of hypertext "seems... to be similar to a medieval reader's experience of illuminated, illustrated and glossed manuscripts containing different hierarchies of material that can be accessed in various ways." With different hierarchives, a network is not a text anymore but rather an archi(ve)-tecture. As long as the keyboards of computers are alphabet based like those of typewriters, the paradigm of printing remains dominant; progressively, though, the mouse click is replacing the keystroke as the device for directing the monitor and the orientation is shifting to visually perceived information landscapes.

The fundamental difference, though, between a classical print-based archive and multimedia storage is interaction—which at the same time increases the memory capacities of the user, in contrast to just reading or looking at things and commemorating them. The traditional archive has, so far, been a *read-only memory*—printed texts reproduced through inscription, not rewritten by reading (a concept still maintained by the CD-ROM). In multimedia space, however, the act of reading, that is, the act of re-activating the archive, can be dynamically coupled with feedback.²⁸

In multimedia space, sound and images can be shifted, cut, stored, and reloaded as in word-processing software. Thus the archival regime is being extended from text to audiovisual data. At the same time, however, and as a kind of revenge by audiovisual data for being subjected to texts, this extension changes and dissolves the very nature of the archival regime. Consider, for instance, the necessity of compressing digital video streams in order to make them storable and transmittable. Although in occidental tradition every letter counts in the transmission of an archived text—which is the lot of a whole discipline called philology—by compressing and decompressing digital images, subtle amounts of data are being lost. This might be almost undetectable to the weak human eye, an organ that has been deceived in its perception since the origin of time-based media such as film, but in the world of military target calculations this one bit of absence or difference might lead to fatal errors. Multimedia, then, is for human eyes only.

The Relation between Print and Multimedia

The usual vantage point from which we talk about the archive—at least from a European cultural point of view—is still the notion of the print-based, paper-formatted archive. The media-archaeological task, then, is to rethink archival terminology in order to embrace a multimedia concept of the archive. The book belongs to the first external memory devices through which culture as memory based has been made possible, ²⁹ but the book now has lost its privilege as the dominant external memory of alphabetic knowledge. Europa is still fixated on the book, that is, the library and archive; in contrast, the media cultures in the United States have already cultivated a culture of permanently recycling data rather than eternally fixed memories.

Although traditionally the archive has institutionally, and even legally, sealed off a data bank from immediate access, "there is no ending online," as Mark U. Edwards Jr. has said. "There's no closure, no linear basis. It's about bringing it in, checking it out, constantly evaluating."30 Thus the archival media memory is demonumentalized, just as Erasmus perceived when he put together his *Adages*: "I could add things even during the printing, if anything came to hand which should not be left out"—due to mobile letters. But then, in his comment Sawday falls back onto a media-historical analogy that is inherently teleological or rather symbolic rather than allegorical: "What Erasmus had was the new technology of print. What he already knew he needed was a computer." This anachronism corresponds with what even Rhodes and Sawday must finally admit is a difference between the effects of Renaissance print and contemporary computer technologies: "Print culture tended to produce a concept of the text as a relatively fixed and stable entity: the book. The great, multi-volumed, 'standard' editions . . . stand as monuments . . . and . . . are also monuments to a belief in the stability of the printed word, and the possibility of freezing, for all time, that which has been thought and said."31 This freezing is opposed to the constant dynamic flow of information in cyberspace. So if archaeology deals with monuments, is it still the right method for analyzing digital topologies?

Of course there is a constant and permanent movement between the media-archaeological layers of writing. This text of mine has been written and processed on a computer, then evidently printed out on paper. This printing gave it, for a moment, the aura of a "final version" and an archival

stability and authority against constant rewriting. On the way to Brown University, where I first presented the material in this chapter as a talk, I added a lot of handwritten notes that returned it, in part, to a manuscript. The steps from then to this publication, the editorial practice, confirmed the recognition that "there is no last word in textual matters." ³² Media archaeology replaces the concept of a historical development from writing to printing to digital data processing through a concept of mediatic short-circuits; the discreteness of digital data, for example, started with the ancient Greek alphabet's already providing a model of elementary analysis of both speech and writing.33 Of course multimedia computing makes the medieval chart reprocessible in its multimedia semiotics, no longer reducing it to its literal information by printing the document. In the Renaissance, the media format book—and multimedia archaeology is about formats—in contrast to the sequential reading of rolls (volumen), offered new options for data retrieval by supplementary tables of contents and indexes³⁴ because, for the first time, numerical data (page numbers) were combined with discrete text units (the single page), which facilitated a rapid alphabetical search (as a classificatory system). In digital space, however, every bit can be addressed on a multimedia level (text, image, sound).

Addressing is no longer limited to sentences, words, and letters. Images could never be directly addressed by book retrieval unless indexed by words. Image- or sound-based retrieval of pictures and music would lead to a genuinely multimedia search-engine culture. Maybe, in North America, the Indian culture and the ideological opposition of the first immigrant generations to old literate Europe has preserved a sense of orality that has made it easy for the second-order orality of gramophone, telephone, radio, and TV broadcast to spread rapidly. Marshall McLuhan's media utopia of the wired global village could originate only in America, while Europe's book-oriented media culture stays on the side of writing.³⁵

For the longest time in cultural history, storage of data and the means of operating them have been kept separately. The symbol-processing machine (the computer in its von Neumann architecture), though, does not separate data and programs anymore; rather both are deposited equally in the working memory of the machine, to be differentiated only in the actual moment of data processing. Suddenly a psychoanalytic insight becomes technically

true—the dialectic of archive and transference: as Samuel Weber has said, "I think the challenge is to think the two as convergent: as two interdependent and inseparable moments perhaps in a single process." The difference, though, between all old media like the book and the computer lies in the simple evidence that books cannot be (re)programmed once printed. Thus the computer cannot easily be made compatible with a (media) history; it rather has an *arché*, a (archeo)logics of its own.

The Silence of the Archive

The invention of printing distances the reader from the text, the beholder from the image, creating a kind of "silence of the archive" through the silent reading situation. This situation corresponds with the media-archaeological insistence on confronting absences and silences, as opposed to the multimedia phantasy of a "talking" archive (Leah Marcus). Today another desire for historical continuity over all discontinuities emerges: "the computer bridges the gap between manuscript and print" again.³⁷

An inscription above the entrance to the Vatican Library in Rome demands without ambivalence: *Silentium*. As Leah S. Marcus writes, "We associate libraries, collections of knowledge, and systems for memory retrieval with silence and hence with permanence." It is exactly this kind of silence that the archaeology of knowledge learns to confront while resisting the temptation of turning silence apotropaically into the discourse of historic talk. In ancient and medieval times, reading was performed aloud. The printing press silenced the voice, which returned as an inner hallucination again and again. Milton, for example, "thought of the perusal of printed volumes not as a purely visual activity but as a form of displaced orality—a conversation with kindred spirits who were long dead or at great distance." This corresponds with the archival phantasm of history as a function of printing.

Our attitude toward phonographically recorded sound sources⁴⁰ matches the situation of every historian: both strive to make an archive (in the broadest sense) of scriptural bodies (texts, partitures, wax cylinders) resonate. Activation of the archive in the pre-media age meant an energetic charging by reenactment (Collingwood): Jules Michelet, historian of the French Revolution, believed he heard in the archive the murmuring of the dead, as if documents were already the logocentric derivates of a gramophone. By means

of his writings, he himself became a resonant body, a medium for the voices of the dead. Instead of apparatuses, it was historical discourse that functioned as a drogue of imagination, helping him to this kind of self-perception: "In these solitary galleries of the Archives where I wandered for twenty years in profound silence, some murmurs came to my ears." Is this now being replaced by the multimediatic interface illusion of the computer? "In recent years, the computer is no longer silent"; audiovisual perception supplements the traditional "reading" of texts—an "assimilation via the ear as well as the eye. Such a multi-leveled"—that is, multimedia—"talking' archive would do more than make a significant number of early books conveniently available for downloading. . . . It would allow us to begin to reenter a mind set that was endemic to the early modern era, even though it has long been lost to us in the era of silent libraries." That refers to (multi) media archaeology, no longer "literally" but synesthetically.

Global Memories

Although the term archive seems to describe all sorts of data banks on the World Wide Web almost universally, it also blurs the (dis)similarities between old (print) and new (digital) archives. It is exactly the *multi* of *multimedia* that separates old from new archives. In contrast to two thousand years of basically written history, the advent of audiovisual recording media has led to genuinely multimedia "global memory" projects like the music-ethnological Berlin gramophone archive (E. M. v. Hornbostel) around 1900 and the film Archive de la Planète of world cultures (A. Kahn) around 1930, resulting in the Encyclopaedia Cinematographica of moving nature (Institute for Scientific Film in Göttingen after World War II), which turned the archive into a discrete matrix of life itself. Encyclopaedia Cinematographica has been the name of a film project of the German Institute of Scientific Film (Göttingen), which, under the guidance of the behavior studies scholar Konrad Lorenz, has attempted to fix the world of moving beings on celluloid (up to four thousand films). Like the medical films produced at the Berlin hospital Charité between 1900 and 1990, which the media artist Christoph Keller has secured from being thrown away as trash, this visual encyclopedia forms an archive that gains its coherence not from the internal but from the external criteria of classification.43

As opposed to multimedia aesthetics, digital archaeology tries to get beyond sight and sound because, behind the images and noises, we are confronted with "practices in which visual images no longer have any reference to an observer in a 'real,' optically perceived world," but rather refer to electronic mathematical data in which abstract visual and linguistic elements coincide and are circulated. 44 Finally, the Human Genome Project reminds us that the apparent multimedia images and sounds of life are being replaced by a strictly numerical archive calculating rather than narrating life; if a German pun may be allowed: zählen (counting) instead of erzählen (narrating).

Case Studies in Media Archaeology: The Virtual Reactivation of a Lost Sound Storage Medium, Hornbostel's Phonogramm-Archiv

Occidental phonocentrism has always strived to find the means to store the human voice in the memory apparatus, perhaps as the "dialogical" hallucinations of speaking with the dead in historical imagination. New technical means since the late nineteenth century have made it possible to inscribe traces of the human voice both literally in the already established archival institutions of cultural memory and in the epistemological "archive" (Foucault) as dispositive of cultural (re)cognition.

The notion of the archive is in transition, moving toward the audiovisual. As long as there have been archives, the phantasma of recording the acoustically real (i.e., the nonwritable) has generated rhetorical, symbolic, and scriptural forms of memorizing sound in supplementary ways. Despite the emergence of the phonograph, this new type of record was still subject to forms of inventorization and administration developed in the context of paper-based archives. (Multi)Media archaeology seeks to reconstruct phantasms of memorizing sound in a pretechnical age and point out the discontinuities, which arose with audiovisual records' invasion of traditional archives, libraries, and museums in the twentieth century. It culminates in a plea for rethinking the options of retrieval under new media conditions—transcending the notion of the archive itself.

In Germany, the Edison phonograph's invasion of the Gutenberg galaxy of cultural memory inaugurated a century that, for the first time, was also gifted with an audiovisual memory. In the same year that Sigmund Freud fixed his psychoanalytic interpretation of dreams,⁴⁵ the psychologist of acoustic



The Excelsior Phonograph. From the Media Archaeological Fundus. Photograph courtesy of Sebastian Döring and the Institute for Musicology and Media Studies, Humboldt University. Berlin.

phenomena Carl Stumpf and, following in his steps, the music ethnologist Erich Moritz von Hornbostel founded at Berlin University a phonographic archive of worldwide wax-cylinder recordings of people threatened with extinction.46 What appears rather unique, even idiosyncratic in the case of Hornbostel's ethnophonographical archive, should be read as part of an overriding multimedia practice of global classification, data processing, and information storage leading to early twentieth-century efforts to create a universal science of cultural documentation (like Paul Otlet's Mundaneum in Brussels for metabibliography). As an example of a cinematographic global memory project striving to make the memory of the world (later the obsession of the United Nations Educational, Scientific and Cultural Organization) audiovisually recyclable, consider the project of Parisian banker Albert Kahn (d. 1940), which from 1910 sent cameramen around the world to register images that might soon vanish.⁴⁷ Today, after two world wars have effaced a lot of these objects, this collection is being preserved in Boulogne-Billancourt as Archives of the Planet. This memory, currently being made accessible on

digital videodisc, addresses a past from which no material archaeological relic has survived.

At the end of the twentieth century, the destiny of von Hornbostel's phonographic archive has been reversed, returning the collection to dissemination once again, and it is difficult to reassemble this archive scattered by World War II.⁴⁸ Frozen voices, banished to analog and long-forgotten storage media, wait for their (digital) defreezing.⁴⁹ At this moment, the fact that technical memory is audiovisual for human ears and eyes only manifests itself; the digital processing of such data equalizes the sensoric notion of multimediality itself. The Berlin Society for the Enhancement of Applied Informatics has developed a procedure by which to regain audio signals from the negative tracks in galvanized Edison wax cylinders by optoanalytic deviation: endoscopic recording devices "read" the sound traces graphically, retranslating them into audible sound by algorithmically transforming visual data into sound. Digital memory ignores the aesthetic differences between audio and visual data and makes one interface (human ears and eyes) emulate another. For the computer, the differences among sound, image, and text, if they counted, would be only the differences among data formats.50

When the ethnologist M. Selenka visited the Wedda tribe in Ceylon in 1907, she made the natives speak or sing into a phonograph, which she instantly played back to the speakers' joyful recognition.⁵¹ With the media mystery of physically real recordings of sound and images, humans receive a multimedia mirror effect (in the Lacanian sense) that sublates the clear-cut difference between presence and absence, present and past. Strangely enough, we can to listen to this playback today and hear exactly the same quality of sound as the Indian natives could in 1907: an example of the previously mentioned optoeletronic archaeology of sound can be appropriately experienced via the World Wide Web. 52 Message or noise? Only the media-archaeological operation of reading the inscribed traces optodigitally makes the otherwise inaccessible sound recording audible again. Synesthetically, we can see a spectrographic image of sound memory—and look straight into the archive.⁵³ The optodigital close reading of sound as image, though, dissolves any semantically meaningful unit into discrete blocks of signals. Instead of musicological hermeneutics, the media-archaeological gaze is required here—a reminder of light-based sound inscription in early film.

Retrograd: Excavating an Archive of Medical Films

The term *archive* is frequently assumed to cover all activities of storing. "Yet archives are not," according to Spieker, "collections, and their media-archaeological specificity and reproductive (mnemonic) strategies have to be carefully evaluated."⁵⁴ What, then, is an archive?

An archive is not an arbitrary quantity, not just any collection of things can be an archive. The archival regime of memory is not an idiosyncratic choice but a rule-governed, administratively programmed operation of inclusions and exclusions that can be reformulated cybernetically or even digitally.55 Still, an intended archive can be subject to deformation, as illustrated by the collection of medical films produced at the Berlin hospital Charité from 1900 through 1990. Once intended as a film archive on general medicine, 56 the lot was not reassembled and published multimedially until recently. As a result of German reunification, the film institute of the Charité was closed within three days. Some material was lost, and the rest was packed into sacks and placed in the Charité attic. Here a filmmaker searched for the last piece of evidence of what was once there.⁵⁷ Media archaeology, unlike media history, deals with absence. When looking at these films, it becomes apparent that images are weak, because they dissolve into nothing without archival authority.⁵⁸ Thus a Foucauldian archaeological gaze, that is, an active regime of ordering, is needed. Buried in analog media, these images remain irretrievable for the moment; only the Web site performs this act of memory as media archaeology: we digitally (re)move the cinematographic stills.59

This example demonstrates that the archaeology of multimedia no longer takes place in ground archives but rather in virtual space. Without a fundamental, material support, however, it is no longer arché-ology in the classical sense but rather cybernetic archaeologistics. Consider more closely the Quick-Time movie of a surgical operation on a patient's calf in the Berlin Charité clinic from 1903. ⁶⁰ Here the camera gaze allies itself with its object: it doubles the chirurgical gaze; ⁶¹ the anatomy of the body corresponds to the discrete, jumping images of early film. The ultimate media-archaeological gaze is optotechnical. The surgical amputation and the filmic cut coincide. Surprisingly, at the end of this short film, the surgeon, Professor Bergmann, looks at and bows toward the camera (whose cameraman was Oskar Meßter, later founder

of the German Universum Film AG industry) as though he is addressing a theatrical audience. This gesture recalls the arenalike situation of the anatomical theater established since the Renaissance. Keller's archival time cut reveals a media archaeology of medical films, thereby generating a parallel memory not of recordings of past reality but of the ways images are consciously and apparatively constructed. In the multimedia archive, code and culture coincide.

An offspring of this medical film archive, the collection resulting from the secret Nazi medical film project carried out between 1941 and 1945 at the Charité was later thrown by the SS into Lake Stößensee near Berlin when the Red Army approached. There was literally a media-archaeological moment when divers detected these films in 1993 and rescued them; just three of several hundred film rolls could be deciphered at all, one of them showing (on heavily damaged film material) a naked man who performs several movements, apparently directed by outside orders. Correspondingly, a film by the Greek director Angelopoulos called *Ulysses' Gaze* (1995) is about a filmmaker who wanders through the Balkans in search of three reels of film from the early 1900s that were never developed. The final scene takes place in the ruins of Sarajevo, where the reels of film are magically developed by an archivist barricaded underground. When the filmmaker finally gets hold of the undeveloped film reels and they are developed, nothing can be seen on them anymore but blank frames.⁶⁵

Media archaeology deals with gaps and confronts absences. Of course every film is always already itself an archive of movements, conserving modes of motion. Nevertheless, the pioneer of film montage in Russia, Vsevolod Illarionowitsch Pudowkin, who with the Leningrad behaviorist Pavlov made a film in 1928 with the title *Functions of the Brain,* insisted that each object that is being recorded and projected by film is dead, even if it once moved in front of the camera.

Between Reading and Scanning

The computer does not literally read texts anymore but rather scans them, thus perceiving writing as an image, a cluster of signals (whether or not they may be finally recomposed to form a text page or an image). Signal processing replaces pure reading. The computer reduces signals to the smallest possible

alphabet; still, as Friedrich Kittler wrote, "The two most important directing signals which link the central processing unit of the computer to external memory are being called READ and WRITE."66

The media artist Angela Bulloch uses a key visual, a sequence from Michelangelo Antonioni's film Blow Up (1966): the protagonist, a photographer, hiding behind a tree, takes photos to discover a murder; but the closer the camera looks in order to identify the spot (of the murder?), the less the photo serves as evidence of an apparent murder. As the German critic Karl Kraus once argued, "The closer one looks at a word, the further it looks back." 67 The artist extends this process of identification by yet another magnification, enlarging the digital scan of this scene in great blocks of single pixels and thus exploding the image within a sequential modular system of her so-called pixel boxes, in which one pixel is represented in a 50 × 50 centimeter monitor attached to complex RGB (red, green, blue) lighting systems that can be generated and programmed with any digital information.⁶⁸ This disillusion of the image's betrayal of the human eye reveals the mediaarchaeological scanner gaze of the computer looking at a different kind of archive, no longer looking for just letters. The pixel modules also point to the fact that digital images are composed hyperindexically of pure information, unlike referential images like those of classical photography, which still suggest a prediscursive real. The modules developed by Angela Bulloch and Holger Friese reveal that multimedia archaeology requires technical skills. A pixel, which is the smallest conceivable picture element, makes sense semantically only when it appears within a group. To discern an image, the distance between the viewer and the group of pixels must be large if the light square made by a single pixel is 50×50 centimeters. In this situation, close reading can be performed only by the computer, and the computer is thus the true media archaeologist.

As Andreas Menn writes, "I want control over every pixel." He continues:

In digital space the elements of files are discrete states. For digital images this means: There is nothing between one and its adjacent pixel. Discrete states though are unperceivable by human senses; the physiology of human perception and body are being characterized by the analog, the continually floating. The digital thus arrives with the disappearance of the body therein. ⁶⁹

But, at the other end of this expulsion, the body reenters. While interrogating the materiality of the pixel, the media artist Menn decides to produce each pixel manually with his own body: "I work with my body in front of a digital camera; my appearance in the visual field equals 'one,' my disappearance equals 'zero.' I am being scanned by the camera." From a distance, the writing, performed by pixels based on images of his body, reads: "I only want to work digitally."

What looks like an image on the computer monitor is nothing but a specific actualization of data (imaging). The computer thus renders data visible in a time-based way; the static notion of the image is being replaced by a dynamic one. As Claudia Reiche writes:

This variability marks a fundamental chance of imagery. As opposed to classical image media like photography and film in the case of the computer-generated image the visual recording is not fixed invariably on a physical carrier, the negative, but always "fluid." . . . At any point of time digitally stored "images" can be manipulated, thus making the notion of the "original" state redundant.⁷¹

Visual Archiving: Sorting and Storing Images

Cultural memory of images has traditionally linked images to texts, terms, and verbal indexes. Confronted with the transition of images into digital storage, nonverbal methods of classification are gradually gaining importance. Rather than the archival question, the search methods used to find pictorial information pose a problem to video memory, for they are still limited to models developed for retrieving text. What new kind of knowledge will exist exclusively in the form of images? What part of traditional knowledge can be transformed into images, and what part might just vanish? Techno-image archaeology⁷² seeks to rethink the notion of images, considering the process of archiving as organizing all that can be visually accessed as knowledge. In terms of technology, an archive is a coupling of storage media, data format (content), and address structure. Methodically this implies leaving behind the description of single objects in favor of an investigation of data sets.

In his 1766 essay *Laocoön* G. E. Lessing discusses the aesthetic conflict between the logic of language and the logic of images in terms of a genuinely

multimedia semiotics: pictura is no longer—as declared by Horace—ut poiesis; time-based media (like dramatic speech and linear narratives) differ from space-based media (like simultaneous pictures).73 Walter Benjamin, from a different perspective, reiterates that history appears in sudden images rather than narrative stories. Jules-Étienne Marey and Eadweard Muybridge chronophotographically transformed an otherwise temporally experienced sequence (movement) into a spatial series (of discrete moments), close to the present aesthetics of the mouse click. The digitization of images today provides a technical basis of inquiry into this conflict (i.e., the rather simultaneous aesthetics of Web sites as opposed to the moving image on the TV screen), so that the computer medium can ground that investigation. It would not make sense to retell a teleological story of image processing that finally reaches its aim in digitization; on the contrary, this history of images needs to be revised from the digital point of view. For example, how can archives be related to algorithms of image processing, of pattern recognition and computer graphics?

In sharp contrast to hermeneutics, the media-archaeological investigation of image archives does not take images as carriers of experiences and meanings. The relation between vision and image cannot be taken as the guideline of investigation, because image processing by computers can no longer be reenacted using the anthropological semantics of the human eye. The methodological starting point is rather an archaeology of multimedia based on Claude Shannon's mathematical theory of communication, as well as the practices and concepts of data structure-oriented programming, amidst the insisting ruins of the Gutenberg galaxy. The artes memoriae have been visual techniques of memorization from the rhetorics of antiquity to the Renaissance. Museums—collections, images of picture galleries, catalogs have since then always dealt with programming material image banks. The struggle for visual knowledge in (literally) the age of enlightenment in the eighteenth century led to visual encyclopedias and their visualizations (like the planches, i.e., the visual supplements to the large French Encyclopédie edited by Diderot and d'Alembert). Photography, then, has been the medium for switching from perception to technology, creating the first technical image archives, and movies themselves (Hollywood and the rules of image sequences) have been archives.

When it comes to (re)programming image-oriented structures in the digital databases of given image archives, priority has been given to the development of a visually addressable image archive. By combining multiresolutional image representation with simple Octree structures, a variable archive module might be applied. This would allow us to test algorithms by creating different visual sequences and neighborhoods. Most operators of image processing and pattern recognition, such as filters and invariant transformations, can be integrated into the structure of a database in order to make accessible a cluster of images. The next step might be the development of an interactive and visual agent capable of "intelligent" retrieval of images by graphical sketches.

Archival terminology, however, still carries grammatocentric notions of data storage, but image and sound memories should no longer be subjected to unimedia, text-based retrieval. Usually a subject index refers to categories that themselves refer to a register that, in just the same way as a conventional book library, assigns film titles a catalog number. The catalog number, in turn, refers to an actual film at one particular spot within the corridors of the storeroom, or in virtual space: a link refers to an actual Web site. But the alphabet as the guide to the indexical order of image and sound inventories is today being replaced by the algorithm—a kind of writing that is not just written language.⁷⁴

It was writing that enabled cultural memory by storing remembrance outside man; at the same time, though, it reduced tradition to one channel of communication. Is this still true for the seemingly polyphonic multimedia age, when audio and visual data can be transmitted without scriptural metadata? In digital space, when not only every film, but every still in every film or, even more—every pixel in every film frame—can be discretely addressed, titles no longer subject images to words, but alphanumerical numbers refer to alphanumerical numbers. Thus the archive transforms into a mathematically defined space; instead of being a passive container for memorizable data, the technoarchive (as dispositive) actively defines the memory of images.

Digital space is no longer an anthropological prosthesis to man but is rather a genuinely medially generated form. Whereas cinematographic forms of narrative still conform to human ways of perception by translating themselves into technical operations as instrumental extensions of human senses (eyes

and ears), electronics directs images according to its own rules, only remotely connected to human perception. The montage of images is being replaced by invasive digital intervention into the image itself, replacing narrative with calculation. Thus a genuinely image-based image retrieval is possible—an archive beyond iconological semantics, based on computing algorithms that perform similarity-based image sorting. On a new technical level, this brings us back to the visual administration of knowledge in the age of similarity (the Renaissance, the Baroque), which in the meantime had been replaced by the age of classification (the Enlightenment, neo-Classicism) as described by Foucault in *Les mots et les choses*:

Clearly, . . . there is a tension between a system in which bite-sized pieces of information could be manipulated and rearranged and that sense of the "order of things" (the structure of correspondence), which underpinned the world views given a new lease of life by the medium of print. Here again there is a strange resemblance to modern conditions. . . . The early modern version of field theory and chaos theory is Montaigne's observation that "toutes choses se tiennent par quelque similitude" (similitude binds everything together) and this is where poetry . . . enters the realm of the Renaissance Computers. ⁷⁶

The Renaissance and Baroque curiosity cabinets performed an aesthetics of pre-multimedia collecting, which leads Claire Preston to draw "an analogy between electronic search operations and the methods of the *curiosi* of early modern science and antiquarianism" — with *analogy* itself a figure of resemblance as opposed to the Cartesian notion of difference, which can be (mathematically) calculated. Collectors in the seventeenth century "imposed structure on the apparent disarray of the phenomenal world by searching for 'matches' . . . amongst the otherwise jumbled elements of their study." Systems of resemblance—visual patterns that may appear to us entirely fortuitous—were expressed by "horizontal or vertical contiguity" in the cabinets and illustrations. These efforts were driven by the belief that creation was coherent and that the task of the scholar was to uncover and display this lost coherence—a kind of theological archaeology of knowledge based on the assumption that what appears contingent to men is a hidden coherence, a kind of pattern recognition in God's eye:

In a world which seemed to present itself as a wilderness of forms, a variety of analogous or synonymous systems could provide the equivalent of a visual search-engine, much as we search a modern electronic database by finding an exact alphabetic or ASCII match for a flagged semantic item. . . . Dominique du Cange, the sixteenth-century French philologist, suggested (incorrectly) that the words 'musaeum' and 'mosaic' were cognate. . . . What all the cabinets and their encyclopaedias share is a syntax of resemblance or identity which is nearly always signaturist in its insistence on occluded and idiosyncratically selected likeness; their patterns are to be read as comparative contingencies or juxtapositions, as a system of potential *matches*. ⁷⁸

Is the notion of the printed encyclopedia as an alphabetical order of things still useful, or is it a hindrance to thinking the cultural image banks of the future? Similarity-based image retrieval, according to Stefan Heidenreich, is much more like a "senseless formal principle, which is exactly because of its dullness as useful as the alphabet is in a lexicon."⁷⁹ The Italian art historian Giovanni Morelli praised such a senseless method of comparing images as scientific, because it was objective; that is why, William Vaughan believes, a current image retrieval program is named after him: "Its salient feature is that it matches, sorts and classifies pictures exclusively on their visual characteristics."80 The characteristics that it uses are derived directly from the process of digitization, and here the system differs from the historical Morelli method: "The automated 'Morelli' system is not concerned with establishing authorship. It is concerned with providing an objective means of describing and identifying pictorial characteristics, such as form, configuration, motif, tonality and (ultimately . . .) colour."81 Because the comparison of images here is of a simple overlay kind, and points of similarity and difference are recorded during the process of comparison, the central criterion is a simple matching process—a visual equivalent of the media-culturally well-known word search, which is a standard feature of every type of word-processing and database computer software. This process of similarity-based image retrieval is possible only due to the fact that the digitized image is an image that is stored as a set of quantifiable elements.82

René Descartes once criticized the category of resemblance as the fundamental experience and primary form of knowledge, denouncing it as a confused mixture that must be analyzed in terms of identity, difference, measurement, and order. Likewise, the data transfer compression program MPEG7 tries to establish standards of *content-based* audiovisual retrieval. According to the Ircam Web site, "The goal of MPEG-7 is to provide novel solutions for audio-visual content description." A multimedia content description interface, though, is no longer a print-based archive. Media archaeology thus necessitates rethinking the notion of the archive subversively, hyperliterally, even at the risk that it might be more useful to replace it mediaculturally in favor of agencies of dynamical *transfer*.

The multimedia archive deals with truly *time-based media*⁸⁴ (images and sound), with every image, every sound, existing only for a discrete moment in time. Freezing an electronic image means freezing its refresh circle. Already, the temporal order of film is an effect of a range of discrete, in themselves static (photographic), series of images one after another, unlike their correlative digital images, which are not simultaneous spatial entities but in themselves already composed by lines that are refreshed permanently, that is, time based. In both cases, human perception is cognitively betrayed; the better knowledge, though, is on the side of the apparatus. As in the case of the Williams tube in early computing, where images were used for data storage because the picture elements died with a certain temporal deferral, the effect of an electronic "image" for humans is based on the minimal afterimage intermediary memory—turning the image into a slow memory function.

Archival Phantasms (the Internet)

The emergence of multimedia archives has confused the clear-cut distinction between the (stored) past and (the illusion of) the present and thus is more than just an extension or remapping of well-known archival practices. The archival phantasms in cyberspace are an ideological deflection of the sudden erasure of archives (both hardware and software) in the digital world. According to Jacques Derrida, "The twentieth century, the first in history to be exhaustively documented by audio-visual archives, found itself under the spell of what a contemporary philosopher has called 'archive fever,' a fever that, given the World Wide Web's digital storage capacities, is not likely to cool any time soon."85

Does the archive become metaphorical in multimedia space? This is a plea for archiving the term *archive* itself for the description of multimedia storage processes. Digital archaeology, though, is not a case for future generations but has to be performed in the present already. In the age of digitalizability, that is, when we have the option of storing all kind of information, a paradoxical phenomenon appears: cyberspace has no memory.⁸⁶

Cyberspace is not even a space but rather a topological configuration. That is why the metaphorical application of the Renaissance ars memoriae to Internet memory is a misapplication. There are no lieux de memoire; rather, there are addresses. On the Internet, the address structure of communication and the address structure of archival holdings merge into one. From place to pure address: traditionally, writes Harriet Bradley, "only what has been stored can be located"—and vice versa. Today, on the contrary, the Internet generates what Howard Caygill calls a "new culture of memory, in which memory is no longer located in specific sites or accessible according to traditional mnemonics, and is no longer a stock to which it is necessary to gain access, with all the hierarchical controls that this entails" (called "archontic" by Derrida).

A necessary precondition for any data retrieval is addressability, the necessity of being provided with an external—or even internal—address. In Plato's dialogue *Meno*, Caygill writes, "it appears as if the matter of memory is but an effect of the application of techniques of recall" *is there no memory?* Is the World Wide Web simply a technique of recall from a global archive, or does it mark the beginnings of a literally *inventive* relationship to knowledge, a media archaeology of knowledge that is dissolving the hierarchy traditionally associated with the archive?

As a machinic net of finite automata, the Internet has no organized memory and no central agency, defined rather by the circulation of discrete states. If there is memory, it operates as a radical constructivism: always just situationally built, with no enduring storage. This invokes the early notion of *museum* as a cognitive and empty rather than an architectural or institutional space. In the words of Paula Findlen, "*Museaeum* was an epistemological structure." Can the Internet itself be separated from the notion of *an archive* at all? If an archive is a hallucination of a comprehensive lot, is the Internet an archive? The Internet is no archive indeed but rather a collection. 91 The

function of archives exceeds by far mere storage and conservation of data. Instead of just collecting passively, archives actively define what is at all archivable, insofar as they determine as well what is allowed to be forgotten, because "the archival operation first of all consists of separating the documents. The question is to know what to keep and what to abandon." Such is the difference between a paper-based (state) archive in the strict, memory-institutional sense, and the Internet: the archive is a given, well-defined lot; the Internet, on the contrary, is a collection not just of unforeseen texts but of sound and images as well, an anarchive of sensory data for which no genuine archival culture has been developed so far in the occident. I am talking about a truly multimedia archive that stores images using an image-based method and sound in its own medium (no longer subject to verbal, i.e., semantical indexing). And finally, for the first time in media history, one can archive a technological dispositive in its own medium.

(Dis)Order

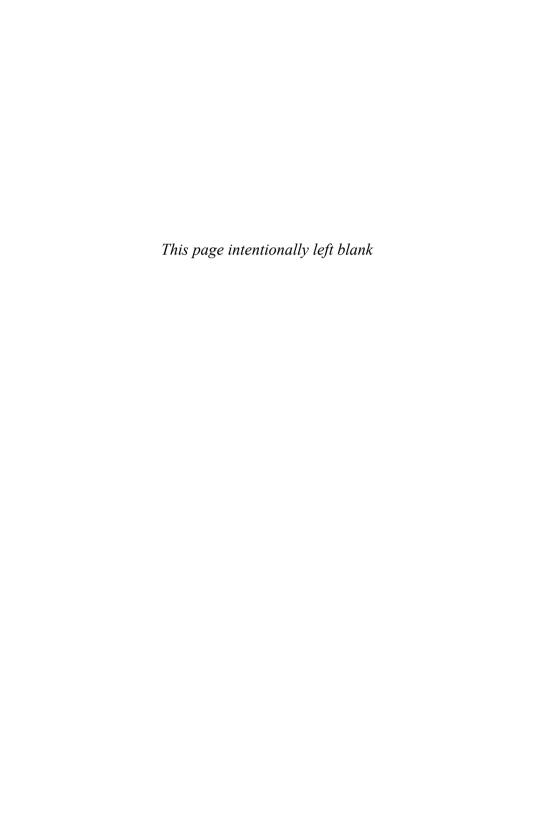
What separates the Internet from the classical archive is that its mnemonic logic is more dynamic than the cultural memory in the printed archive. Although the Internet still orders knowledge, apparently without providing it with irreversible hierarchies (on the visible surface), the authoritative archive of protocols is more rigid than any traditional archive has ever been. Thus the remaining Internet somewhat adopts the so-called *chaotic storage* method in economy. According to an editorial in *Scientific American*, "The World Wide Web and the rest of the Internet constitute a gigantic storehouse of raw information and analysis, the database of all databases. The more serious, longer-range obstacle is that much of the information on the Internet is quirky, transient and chaotically 'shelved'"95—leading to archival phantasms of disorder.

Data transfer is incapable of transmitting noninformation, whereas, Steven Jones agues, "In face-to-face interaction, much of what is most valuable is the absence of information, the silence and pauses between words and phrases." Cyberspace is based on the assumption that unused space is economically wasteful—a result of the scarcity of storage capacity in early computing. Is the Internet really a medium through which self-organization produces the first comprehensive cultural memory?

This anarchoarchive is rather a fluid intermediary random access memory. Who, then, archivizes the Internet? Abandonware Community Triumph is the name of such an initiative, which archivizes software and keeps it accessible. However, this quickly leads to a conflict with copyright law, as exemplified by the current discussion over access to the most important of all archives: the files of the Human Genome Project. With the print fixation of the traditional archival terminology, we run the risk of overlooking the fact that a different kind of archive is being built in nonpublic, proprietary ways by entrepreneurs like Bill Gates with his Corbis image bank, which holds the digital copyright of a lot of European historical imagery. This image bank, opposed to copyright law and the "legalistic infrastructure" so well developed for textual authorship (the institution of the dépôt légal, or national libraries), is based on different digital copyrights. 98 Probably two kinds of memories will remain. One will represent a radical rupture: as in Ray Bradbury's Fahrenheit 451, a new memory will burn an old one.99 This nostalgia is, of course, a phantasm surviving from the age of print. The alternative is a media culture dealing with the virtual anarchive of multimedia in a way beyond the conservative desire of reducing it to classificatory order again. Data trash is, positively, the future ground for media-anarchaeological excavations. 100

Part III

Microtemporal Media



Microtemporal Media

Throughout the book, Ernst has been addressing the question of how we think and deal with time. This question is quite obviously at the center of media archaeology. This applies to other writers, too, who have pushed our understanding of the temporality of media culture in new directions. Erkki Huhtamo's idea of the cyclical time of topics that constantly return in cultural media discourses or Siegfried Zielinski's deep time methodology are examples. For Wolfgang Ernst, time assumes a slightly different function in relation to technical media culture. Less the time of human actions or social phenomena, time is specifically internal to the workings of technical media. In a volume published in German and edited by Axel Volmar in 2009, Zeitkritische Medien, this concept of time criticality becomes a central way to think the machine time of contemporary culture and hence develop media archeology in new directions that challenge existing historiographical writing.¹ Whereas history is a discourse governed by a symbolic and meaning-making logic, media archaeology is seen as the temporal processing closer to nonsemantic technical machine logic.

Continuing from the previous section, the focus here is more specifically on microtemporality, which emerges as a key concept in Ernst's more recent work. By tying together mathematics, sound media, and technical media, we can see a unique way of addressing the complex calculation processes of media. While supplementing earlier sections of the book and taking the

reader in new challenging directions, the chapters of this part address specific media technologies (such as radio) as well as processes of experimentation and sonicity. Media as measuring instruments have exposed the various time regimes of life since the nineteenth century, but media themselves also have their own duration and time, which go much beyond what we could perceive as temporal with our bare eyes.

The first chapter addresses temporality as a structure of telling. Without reducing telling to the narrative form of production of knowledge, as has been the preference in the humanities, Ernst suggests that we can understand telling as counting. In this way, he is able to establish a link between the contemporary understanding of calculation and data and earlier forms of cultural techniques such as listing, timekeeping, and the writing of annals, for instance.

The focus on the micro level is evident in the "Distory" chapter on electron tubes. The chapter is basically an exemplification of how we can write media history from the point of view of the scientific ideas and technological discoveries—such as the tube—instead of the established media system of broadcasting. One can say that this is transverse media archaeology in action and exemplifies once again the scientific way of approaching modulations of sound and speech as a precondition for the emergence of the macrolevel media systems. Media are experimental and epistemological devices before they become mass media, an argument that runs through various of the chapters in this section. Indeed, as elaborated in Ernst's take on "sonic articulations," humanities and the technical media emerged around the same time and share some epistemological ground. In his words, "The empire of media is the blind spot of the humanities." This is the reason that media analysis can provide analysis of the epistemological grounding of humanities such as historiography and thus tools for its critique. In the chapter on sonic articulations, this critique proceeds from the point of view of sound, hearing, and time, all coupled to a technical a priori.

The final chapter shows the centrality of the Pythagorian monochord for Ernst's thinking. Whereas Thomas Macho has picked up on the importance of the number to the Pythagoras school, and hence as an important part of the cultural techniques of time and calculation,² for Ernst the mathematicomusical instrument becomes a way to demonstrate an alternative historical approach that is "invariant toward entropic, historical time" (chapter 9). Ernst

writes of the short-circuiting that the mathematical principles of even such simple technologies enable. They short-circuit from their time to ours, establishing an operational link. Whenever we listen to or play the monochord, we also share at least a bit of that past world that is actually not past but non-linearly "here." This could be seen as a sort of a re-presencing of the past, as Vivian Sobchak has argued.³

Continuing such ideas, the final chapter, "Experimenting with Media Temporality," is itself a more experimental, probing take on the scientific backgrounds of modern media. Originally most often designed as measuring devices, modern media incorporate this possibility for reverse experience (from reverse engineering) that allows us to investigate such scientific genealogies. Much as other writers, such as Wolfgang Hagen, have emphasized, media technologies crystallize in themselves their long genealogy of scientific-technological roots, Ernst takes this as a challenge to investigate the media epistemologies from Pythagoras to Turing via Heinrich Hertz. We are provided with philosophical and media-archaeological tools and concepts with which to think through the physics of microtemporality and its significance for any media studies agenda that wants to take technical media seriously.

The book ends with an appendix that contains an interview with Ernst conducted by the network culture theorist Geert Lovink in 2003. Despite the fact that it is from that earlier period, it outlines very well some key points about Ernst's thinking and, importantly, about the specific way in which German media theory positions itself as slightly different in the international field. In the wake of Friedrich Kittler (1943–2011), the specificity of the Berlin brand of media studies—often labeled quite technodeterminist—is highlighted. And yet, at the same time, Ernst hints here of the importance of political themes in articulating the (dangers of) consumerization of memory through archives and how the whole debate about digital economy and intellectual property has a close connection to media archives, and hence to media archaeology.



7 Telling versus Counting

A Media-Archaeological Point of View

Between the cultural practices of telling and counting, one finds both an affinity and a disjunction; narration and the numerical code can be seen as functions of alternating conditions of the media. The numerical order, the basis of digital technologies, has always already been performed as a cultural practice before becoming technically materialized. Rather than attempting a linear chronological trajectory, the changing historical relation between telling and counting can be described as reconfigurations affected by different media or even media theories.

It was a decisive act of cultural engineering in the occident when an unknown adaptor of the Phoenician syllabic alphabet, somewhere in Greece around 800 BC, invented additional elementary symbols to register spoken vowels in order to store and transmit Homer's epics. This brings us close to a media theory of (ac)counting: oral traditions privilege the narrative mode; on the level of letters, though, every linguistic unit becomes countable. The form of the Homeric hexameter already provided a mnemotechnical tool, a skeleton that performance could fill with narrative flesh.²

In the recently discontinued online edition of the Microsoft encyclopedia *Encarta*, we can even hear a spoken rendition of the very literal entry *tell*, a reentry of orality filtered by digital procedures.³ *To tell*, we learn, as a transitive verb, means not only "to give a live account in speech or writing of events or facts" (that is, to tell a story) but also "to count things" (to tell a

rosary, for example). The very nature of digital operations and telling thus coincide.

Annals

The old English *tellan* derives from a prehistoric Germanic word meaning "to put in order" (both in narration and counting). We find this kind of non-explanatory and paratactic mode in the epic discourse.⁴ Homer, in his *Iliad*, already used the form of listing in the appropriately called "Catalogue of Ships"—literally counting the ships and their leaders by names (see especially verse b 493). Thisset-piece description is paradigmatic of a narrative pause, "a passage at the level of narration to which nothing corresponds at the level of story. The plot does not advance, but something is described." How can such a form of listed knowledge be culturally transmitted over centuries? Did the bard actually inherit the form of memory kept by military lists of troops in the Mycenaean age, written in *linear B*, that is, a muster list that he turned into verse? Here telling is counting —a practice well known from ancient oriental lists of rulers.

Narration assimilates information by recounting it in the synecdochical mode.8 To narrate, we learn from Webster's Revised Unabridged Dictionary (1913), is etymologically related to knowing. Knowledge is in fact coupled to the very act of telling, that is, providing a narrative sequence when apparently insignificant facts are being interwoven into a complex reality that cannot be observed directly. Between counting and telling, such sequences are well known from nonliterary accounts of history. Gregory of Tours, in the early medieval period, wrote a history of mankind year by year (cunctam annorum congeriem connotare), with the connotation of connotare being both "telling" and mathematical counting in discrete leaps. Today historiography rigorously separates narrated time from calculated time, but early medieval Europe read them together.9 For example, in Regensburg, a supplement to the Annales Fuldenses comments on the year 884: "Instanti anno, quo ista conputamus . . ." (In this very year when we are telling this story . . .). 10 The conjunction between telling stories and counting time is more than just a word game: verbs like conter, contar, raccontare, erzählen, and to tell are testimonies to a way of perceiving realities that oscillates between narrative and statistics. As Wolfgang Pfeifer writes:

In medieval German, *erzählen* (telling) originally meant counting in a sequential order. For example, in the representation of events, which in legal matters got the meaning of *public declaration* as well. This meaning shifted to what we mean by telling today, while *zählen* got restricted to counting, even if both uses could overlap until the 18th century.¹¹

In later medieval times, telling-as-counting was not restricted to the linguistic. The hourly ringing of bells in monasteries—an acoustic medium of structuring time—also reminded hearers of a technologically enhanced rule-governed, almost algorithmic symbolic order. The meaning of the Latin *computus* thus encompassed a mechanical order as well as a symbolical one, and the quantification of time was transformed from an ancient counting to an allegorical interpretation.

To tell as a transitive verb means "to count things." When all sensual dimensions are quantifiable, even the temporal resolution, telling gets liberated from the narrative grip—a media-archaeological amnesia of cultural techniques like that of the early medieval *annales*, sequential notations of temporal events with no metahistorical, narrative prefiguration. We get a glimpse of a way of processing cultural experience that does not need stories (not yet? not any more?). Modern historians, though, are obliged not just to order data as in antiquaries but also to propose models of relations between them, to interpret plausible connections between events. Here the difference between *tableau* as statistical form (annalism) and as painting (historiography) becomes evident. According to George Kubler, it is the historian's task to recognize *the shape of time* and to describe it appropriately on different kinds of *tableaux*.¹²

The Annales Sangallenses, figuring as an early medieval form of record of events in the 1826 scholarly edition of the Monumenta Germaniae Historica (series Scriptores), render events (like the medieval recordatio) as a list of entries but also of nonentries, empty storage spaces that provide gaps for reading, silence as statement. Chronometrics count with nonevents as well—the serial character of human existence.

As we learn from Lessing's 1766 treatise *Laocoön*, only such gaps make readers or betrayers participate actively, because they project their own visions (letters, images) into the voids—the condition for aesthetic experience.¹³

It was with the invention of printing that Gutenberg could, in a mediaarchaeological context, literally calculate with empty spaces: in printing (as with typewriters and computer keyboards), even the empty key counts. In digital o/1 computing, even absence counts as value—*nulla rosa est* (as expressed in medieval scholastics). As Jean Passerat writes, "But lo! while turning in all directions my muse has found nothing / do not despise the gift / For nothing is more precious than jewels / Nothing than gold."¹⁴ Does something like "human nature" really ask to avoid semantic *vacui*?¹⁵ Even annalism, with all its discrete gaps, implicitly imposes a narrative form on events by means that are poetic nature.¹⁶ As Ernst H. Kantorowicz argues:

The Middle Ages stood by the archaeologist. His ability to look at mere fragments in a glass case and yet see the whole vessel as it should appear and to forget completely its fragmentary state, this ability was native to the medieval mind. . . . The medieval mind set the Whole before the parts and found it easier than we do to acknowledge a totality, even an imaginary one. The absence of unity was considered a momentary defection, which could be overlooked because sooner or later the unity would have to be restored. 17

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 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.¹⁸ Medieval annalism also stands for a writing aesthetics of organizing a sequence of events in serial, sequential order, and Pierre Chaunu invented the notion of serial history for the nonnarrative histories of the Parisian Annales School.¹⁹ Here diachronical *clustering* serves as a memory operation beyond the narrative unification of data. François Furet has written that, just as in early annalism, "quantitative history's most general and elementary object is to form historical fact into temporal series of homogeneous and comparable units, so that their evolution can be measured in terms of fixed intervals, usually years."20 Here there can be order without stories, because documents and data exist not for themselves but in relation to the series that in each case precedes or follows—without being subjected to

romance, where causality and the foregrounding backgrounding of events are expressed through explicit narrative subordination. Is the narrative vantage point, the point of view (the "Sehe-Punkt")21 or focus, a cultural side effect of the painterly mathematical perspective invented in the Renaissance (Brunelleschi, Alberti)? Machiavelli, for example, originally got the order to write annalia et cronacas. Instead he provided his composition with divisioni, that is, leaps backward and forward within an all-encompassing historical perspective. This might indeed be compared with the discovery of central perspective in the optical arts.²² In the early nineteenth century, the historian Barthold Niebuhr reflects upon annalism as a semiotic index of temporal processes: a marking of events year by year, without historical horizon. Then Niebuhr contrasts annalism with historiography, "a comprehensive narration whose object has been accomplished and fulfilled . . . stories describe and explain."²³ His use of the verb *schildern* (to provide a pictorial description) already indicates an intermedial change from alphanumerical listing to the iconic realm. In his fragment "Apokatastasis panton," the philosopher Gottfried Wilhelm Leibniz actually mused on the option to calculate a virtual protocol of the world by counting, not narrating: combining and recombining every letter that has ever been written in world history. Once registered in discrete symbols, events could be literally processed: "Thus I found everything which needs to be told."24 This form can match every object, every referent.

Is there really something like an anthropological need to link unconnected, contingent experience into narrative wholes? The author of an autobiography recalls that once he had discovered in the *New York Times Index* what else had been happening at the time of some personal event, he could scarcely resist connecting the lot into one coherent whole—"connecting, not subsuming, not creating historical-causal entailments, but winding it into the story."²⁵ Historical discourse tends to deflect attention from data to structures of consciousness. The narrative construction of reality is a cultural sensemaking pattern; thus common universal history is a hybrid made from legends and annalistic handbooks.²⁶ The discrete counting of data "factualism," according to Gérard Genette,²⁷ instead of its narration, resembles a diagram rather than a picture and requires anonymous pattern recognition instead of the personal narrator. Between the discrete entries, though, there is always space left for biographical micronarrative information.

Chronology may supply order in the temporal arrangement of events, but it does not supply explicit patterning, and that is what separates proper history from chronicles and annals. The explicit plotting of time describes, organizes, and explains events, persons, and actions in the past all at one and the same time. As Robert Berkhofer Jr. explains, chronicles offer their readers "one thing after the other"; proper histories provide their readers with "one thing because of the other."²⁸

Lessing's Laocoön

When Lessing published his essay Laocoön oder über die Grenzen der Malerey und der Poesie, he revolutionized meditations on the semiotics of the arts by providing them with a media theory (as opposed, for example, to Immanuel Kant's rather abstract notion of a spatiotemporal a priori). Lessing discusses the different aesthetic qualities of one and the same subject (the death of Trojan priest Laocoön and his sons) in sculptural versus epic representation (Homer's Iliad, Virgil's Aeneid). Thus Lessing has become a theoretician of "intermediality" avant la lettre by insisting that—based on their respective media qualities—painting cannot simply be translated into poetry and vice versa. According to Lessing, "Succession of time is the province of the poet just as space is that of the painter."29 His argument of space-based versus time-based arts seems more actual than ever (at least as a media-analytic question). Whereas in art-historical iconology literature and the visual arts seem to be interchangeable in ekphrasis, the archaeological gaze registers their discontinuity; classical archaeologists refuse to compare the Homeric epic with the figures on the Dipylon vase. Homer's description of Achilles' shield seems to fulfill Lessing's aesthetic claim, for instead of a verbal picture he gives us the genetic story of how the weapon is being made by the god Hephaistos. In this literary description of a work of art, we find traces of both linearization and nonlinearization. We find a similar situation in Book I of Virgil's Aeneid: when the protagonist is thrown on the shore of Carthage, he is surprised to see scenes of warfare with which he is familiar on the painted panels that decorate the temple of Juno. In fact, he sees his own past as part of the Trojan War. Diskin Clay believes that in the logic of Virgil's epic this leads to an ekphrasis, with Aeneas telling the stories of what he sees:

In this... Virgil has confused the pictorial and the narrative, and in so doing he subordinated the art of Dido's Punic painters to the art of the *Aeneid*. In Virgil's *ekphrasis*, we begin with spatial markers.... These are qualified and finally replaced by the strictly temporal habits of the narrative ...; significantly, Aeneas is pulled into the temporal, not painterly, narrative by this sympathetic response.... The Virgilian narrative gains ascendancy over the pictorial.³⁰

Description is at odds with narrative, as accentuated in the appropriate entry in the Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers (1751–80). In natural history it means a discrete mode of representation ("The more parts an organism has, the more necessary it becomes to describe the details of its organization in order to expose its workings and mechanics"), and in geometry it refers to "the action of drawing a line, a surface, etc." Finally, in literature

description is the enumeration of the attributes of a thing, several of which are incidental. . . . At first glance, description seems like a definition; a description is even exchangeable with the thing described, but the thing described cannot be completely known because a description does not fully contain or fully expose the essential attributes of the thing.³¹

That is, description remains exterior to the essence of things—by virtue of the archaeological (instead of the historicizing) gaze.

Space, Movement, Cinematographics

Is film the media-dialectical conjunction of the two semiotic regimes Lessing tried to separate categorically? Cinematography has created a new perception of central temporal categories like simultaneity and the spatialization of time; "thus," in the words of Walter Hagenbüchle, "film has merged Lessing's separation of spatially and temporally performative arts." In his theory of cinematographic montage, Sergei Eisenstein refers to El Greco's painterly representation of *Laocoön* in order to describe his idea of the "ecstatic" moments in film. And any attempt to put the *Laocoön* sculpture onto film would have to refer to Virgil's narrative in order to get to a dramatic climax of the figurative constellation and picturesque pose of the Trojan priest and

his sons at the moment of their deadly outcry (as action).³⁴ Lessing's differential media theory of spatiality (painting, sculpture) versus temporality (verbal narrative) has indeed been translated into film theory by Rudolf Arnheim. His essay "New Laocoön" tries to defend the art of silent movies against the new age of film plus sound, that is, from the moment when text, in the form of voices and voice-overs, enters not only the space between the images but the images themselves. Only with silent movies did Arnheim see the chance for the appropriate representation of "pregnant moments" (as Lessing called them) that require implicit rather than verbally explicit expression.³⁵ How close is film to theater (Lessing's telos)? Jean-Luc Godard's movie Passion (1982) freezes the temporal succession of moving images into the painterly stillness of pregnancy (gestures of passion, in Aby Warburg's sense) by letting his actors perform tableaux vivants of famous pictures like Rembrandt's Die Nachtwache (1642). A "still" composed from moving images is uncanny, however, resulting in a cognitive dissonance. Dynamic stasis is a paradox, a nonnarrative.

The media archaeology of cinematography frequently refers back to the kind of events depicted on the Tapestry of Bayeux, where the story of the Norman invasion of England is rhythmically interrupted by the painterly interpolation of trees and towers that both link and separate the "frames." This is a precinematic form of cutting that has often been added to film or comic strips, with abrupt changes of place, jumps in time, and flashbacks (while the tapestry, in fact, guides the eye successively through time and space). Film, in the sense of Lessing's *Hamburger Dramaturgie* and Hugo Münsterberg's *Photo-Play*, remembered for its close connections with theater, cannot show the simultaneous coexistence of action in space; a dialogue, for example, is represented by a sequence of shots and countershots, thus cutting homogeneous space into segments. At this point, a virtual space is created on a cognitive level in the viewer's mind. Physically, though, film puts sequences one after another on the celluloid reel—just as on the Bayeux tapestry.

Similarly, the tripartite video projection *You Never Know the Whole Story,* by Ute Friedrike Jürß, in the Museum for Contemporary Art (ZKM Karlsruhe, 2000), presented electronic images in narrative recess; Thomas Levin suggests that the apparent *lack* of motion resulted from the different media pattern: "In spite of Lessing's *Laocoön* claim, the press-photography—different

from sculpture and painting—by its very nature as a momentary snap-shot, is already, by its very mode of production, an image of time brought to a stand-still."³⁷ The theatrical or filmic *tableau vivant* differs from a classical painting exactly in being time-based. Levin calls this media crossover, this paradoxical translation of Lessing's paradigm into the age of electronic media, "hybrid intermediality."³⁸ Does installation art return us to the spatial dimension of the image? Thomas Elsaesser writes:

What better place than the museum to confront the cinema once more with itself and its history? A curious set of parallels has evolved between the museum as a space of contemplation, and the electronic vision machines . . .; the museum as a site of aesthetic distance and reflection, and scientific instruments of calculation, of mathematics as means of measuring and monitoring.³⁹

The very technical a priori (more or less twenty-four frames per second) of any film or video projection of a *tableau vivant* undercuts the apparent visual simultaneity. The indexical basis of technical images is no longer space but time (and its time-axis manipulation), which links it with narrative in a way that Lessing wanted to exclude. But there are forms of reentry for space, a kind of second-order return to Lessing's theorem. Montage, as the internal operation of moving images in Mike Figgis's movie *Timecode* (2000), takes place not only in time but in space as well, on the squared screen, thus surpassing Robert Altman's *Short Cuts* (1993). In a dialogue at the end of the film, this form becomes ironically self-reflexive in a kind of parody of early Soviet theories of cinematographic montage: "Beyond montage. Digital video has arrived at last."

The Spatialization of Telling: Digital Aesthetics

Against cinematographic sequencing, digital interface aesthetics privileges spatialization again, with its Windows perspective and hypertextual logic. Pixel-based media lead to the reentry of narrative as calculation and, in the acoustic realm (technomusic), allow for sampling and intervals by time stretching and time compression.⁴⁰ Narrative on the emphatic literary level (*raconter*) is being replaced by literally counting microevents on the media-archaeological level. Among the attempts to spatialize digital communication,

Virtual Reality Modeling Language was conceived for virtual worlds hyperlinked with the World Wide Web. And computer games, though apparently performing stories or at least plots on the surface level, are no longer based on linear narratives but strictly on algorithms and processual trees. Maybe from a deep cultural-technological perspective, this is no contradiction. As Ley Manovich writes:

In many computer games, from the original *Zork* to the best-selling cd-rom *Myst*, narrative and time itself are equated with movement through space (i.e., going to new rooms or levels). In contrast to modern literature, theater, and cinema, which are built around the psychological tensions between characters, these computer games return us to the ancient forms of narrative where the plot is driven by the *spatial* movement of the main hero, traveling through distant lands.⁴¹

The coordinates of three-dimensional space become the medium of (ac)counting—beyond writing. Is this the return to an ancient Greek, topology-based notion of narrative *diegesis*, which effectively meant routing?⁴² Augmented reality plays with this practice when the user in real (urban) space is being equipped with a minicomputer, a GPS receiver, and audiovisual devices.

In the digital era, with its reentry of narrative as calculation, the question arises as to whether "intermediality" is not already a perspective of the previous media age, because in digital space all sensual differences among images, sounds, and texts are equally dissolved into strings of numbers. Thus it is worth remembering once more a different, nonnarrative meaning of telling: "to be able to distinguish things," "to be able to *tell one thing from the other*"—the very nature of binary calculations. This addresses the core problem of digital mediality, with its smallest units (bits) arranged in differential sequences. Angela Bulloch slows down Michelangelo Antonioni's movie *Blow-Up* (1966) and at the same time greatly enlarges the single pixels, thus making the media-archaeological level of digital narrative transparent by geometrizing the traditional cinematic frame (even more radically than the video by Les LeVeque, 4 *Vertigo* [2000], which sequentializes Alfred Hitchcock's movie down to the level of one frame per second). Temporally serial data are thus

being retranslated into spatial orders again—reminding us of the premodern cultural engineering of memory (ars memoriae).

Behind the celebrated *pictorial turn* we find nothing else but the calculating space from Gotthold Ephraim Lessing's textually expressed theory of time- and space-based arts to Peter Greenaway's experimental movie *Drowning by Numbers* (1988) and Bulloch's media archaeology of discrete pixels. *Theoría* wanders from the visual to the numerical. Digital media, in fact, reduce everything to numbers, with profound consequences for the nature of visual realism. As Manovich writes: "When all dimensions that affect the reality effect—detail, tone, colour, shape, movement—are quantified," reality itself can be related to a set of numbers⁴³— a worldview well known from Pythagoras, a cultural-technological Möbius-loop between Greece in the fifth century BC and the present. Thus Lessing's essay *Laocoön*, when revisited from a media-archaeological perspective, is worth reading against its own logic; the opposition between space-based visual media and time-based literary media collapses when telling becomes counting by numbers again.

8 Distory

One Hundred Years of Electron Tubes, Media-Archaeologically Interpreted, vis-à-vis One Hundred Years of Radio Translated by Dawn Michelle d'Atri

Reginald Fessenden's "radio broadcast" on Christmas Eve, December 24, 1906, may still echo in our ears, but regular entertainment radio (meaning radio in the mass-media sense) did not start even in the United States until November 1920. Not until then did radio in the classic sense begin, ending the media-archaeological epoch of radio, in which the primary message of the medium was not the structured, macrotemporal programming flow (the "flow" defined in cultural studies)¹ but rather the electromagnetic frequencies oscillating in the time-critical range literally as "sparks."

It is not the inherent time of electronic media but instead the old-fashioned historical discourse that engenders the logic of calendrical cycles of memory according to the law of symbolic figures in our decimalized culture ("one hundred years," whereas the ancient Babylonians, for example, would have celebrated after "sixty years" based on the sexadecimal system). What meaning do these advent-of-radio dates have besides the fact that they—to the delight of today's institutions such as ORF (Österreichischer Rundfunk, or Austrian Broadcasting)—produce a whole series of "anniversaries" (from 1906 into the 1920s), thus up to the year 2020 and beyond; in Vienna, the state-owned RAVAG (Austrian Radio and Traffic Company) has been broadcasting official news and music for detector receivers since 1924. According to my thesis, all of these dates fail to mark the beginning but rather signify

the end of radio as a producer of media knowledge: the beginning of radio as mass medium refers to yet a different type of radio.

One Hundred Years of Radio?

I still remember well how in Germany "seventy-five years of radio" were celebrated in (approximately) October 1998 on the part of the Deutsches Runkfunkarchiv (German Radio Archive) with special radio shows and multimedia Web sites featuring the first public radio broadcast from the Vox House building in Berlin. My meager arithmetic skills tell me that in the time between 1998 and today, that is, in a good fourteen years, the time span between seventy-five years of radio and one hundred years of radio cannot already have passed—unless media time itself generates, in terms of Minkowski and Einstein, a spatial and temporal dilation. The media-archeological view virtually lurks, waiting for such moments of uncertainty in order to formulate them as opportunities for venturing other means of perception, for blazing other memory trails, as an alternative to the media-historical viewpoint.

At first glance, we seem to be experiencing an anniversary in media history: one century of radio. But is radio, when playing, ever in a historical state? Is it not in fact always in a present state? The medium only appears to conform to the logic of historical epochal concepts; in actuality, it undermines this logic and sets a different temporal economy. For example, an original recording resonating today from an old tube radio, provided it can still run on 220 volts, hardly makes history audible. A tube radio thus practices *compressed* time with respect to our sensory perception, as long as this is not overlaid with "historical meaning," which corresponds not to the actual media workings of radio but rather to the logic of inscribed historiography.

Let us now examine the question of the temporality of electronic media. What about the being and time of radio? Seemingly historical media objects are purely of the present time as soon as they function. Martin Heidegger already asked in 1927: "How far is such equipment historical, when it is *not yet* past? . . . Or do these 'Things' have 'in themselves' 'something past,' even though they are still present-at-hand today?" What is past—even after one hundred years of radio—is "nothing else than that *world* within which they belonged to a context of equipment and were encountered as ready-to-hand and used by a concerned Dasein who was-in-the-world. . . . But what was

formerly within-the-world with respect to that world is still present-at-hand."² The within-the-world existence of radio one hundred years ago—in keeping with this timing—pinpoints a media-epistemological artifact at the heart of radio, namely, the (at that time new) electron tube, an electrotechnical artifact in the interspace of radio, its soul.

In 1906, the year Lee de Forest patented his triode tube, radio was above all still an epistemological entity for generating knowledge on the essence of electromagnetic waves themselves. During the same year, the Viennese telephone factory owner Robert von Lieben registered a patent for an amplifier tube in the form of a cathode-ray relay. His invention was referenced by Albert Einstein in a Berlin speech he gave on August 22, 1930, at the opening of the 7th Great German Radio and Audio Show, aptly addressed to "Honored Listeners, Present and Absent" (to which we can still listen as a message from the depths of the relativistically enmeshed space-time): "Think especially of Lieben, who invented an unprecedented measuring instrument for electric pulses, the electric valve tube. It was also an ideal and simple instrument to generate electric waves."

The inventors von Lieben and de Forest proceeded to copy each other back and forth, helping to spur each other on. In 1907, de Forest applied for a further patent, for he had discovered that the radio tube could not only be employed as an amplifier but could also perform the same work as a crystal detector. Here the semantic message, the modulated speech (that is, the audible, low-frequency portion), was separated from the high frequency as the actual transmission medium. The essence of the tube-based "Audion circuit" of the receiver was no longer purely electrical but rather cybernetic: feedback. The radio waves, having passed through the Audion, were once again fed back into the input circuit in order to influence it in a way that was favorable for reception. In 1913, Meißner improved on the perfected feedback circuit: the electrical current oscillating in the anode circuit exerted an effect on the grid circuit, and the feedback built up until the entire anode current pulsated in the rhythm of the incoming waves. The Audion's anode and grid circuits thus ended up resonating—producing "music" even before any acoustic application for human ears. Ever since then, the radio tube has been able not only to improve reception but also to send its own waves out into the ether (sit venia verbo).

Von Lieben's patent first applied functionally only to telephony; in actuality, broadcasting before radio was in fact not wireless—radio as a current of electrical sparks—but rather telephonic, like the Telefon Hírmondó wire radio system in Budapest invented in 1893 by Theodor Puskas as a "talking newspaper," in the words of Oskar Blumtritt. De Forest's tube circuit—with its threefold function of attenuation equalization of the oscillating circuit, demodulation of the high-frequency signal, and amplification of the resulting low-frequency signal—served the purpose of making speech more understandable, thereby favoring radio in the sense of a mass medium. The name chosen by de Forest for his patent, Audion, itself indicates that his triode vacuum tube was genuinely meant for the broadcast of sonic articulation. In 1910 the system was used to broadcast a performance by the singer Caruso from the Metropolitan Opera House in New York; in 1912, de Forest used the electron tube as an oscillator for oscillation generation, thus perfecting wireless telephony.⁵ The von Lieben tube, in contrast, served primarily to minimize the distortions in telephone lines, so it literally had a different technological connection; it acted as a relay fortifying the rapidly weakening, electrically converted signals in telephone lines. This made it possible to communicate over distances of up to one thousand kilometers; the electron stream was controlled from outside using a magnetic field (the improved von Lieben tube was the first to be equipped with a control grid). Previously, Valdemar Poulsen had already developed a process to electromagnetically record telephone conversations through induction onto an uncoiling wire. In the Telegraphone, electric voice transmission has found its congenial storage medium, forming, so to speak, a continuum of both processes in the electromagnetic field. Hence is explained the miracle that in principle we can still today with electricity hear the language entrusted to this field (whether telephone or radio), as articulated one hundred years ago, in its own medium (namely, electromagnetism).

Let us listen once again to Einstein's Berlin speech, in which he admonishes us: "Everybody should be ashamed who uses the wonders of science and engineering without thinking and having mentally realized not more of it than a cow realizes of the botany of the plants which it eats with pleasure." Therefore, let us not only consider the role played by the tube in radio but also look into the tube itself, embracing one hundred years of radio as one hundred years of electron tubes. Although when we treat radio not as a mass

medium and broadcast format but instead examine the perspective of its concrete epistemological entity, the electron tube, connections emerge to a media temporality at odds with "radio history." A media theory of the electron tube attempts to contribute to pluralism—the tube as a basis medium, which transversally unites various media complexes (radio, oscilloscope, television, computer). Media-epistemological entities are at odds with those histories that further differentiate media only as the process of such technologies developing into mass media.

The Early Phase of Radio: Not (Merely) the Prehistory but the Alternative to the Mass Medium of Radio

The media-archeological early phase of radio represents not merely the prehistory but also the alternative to the mass medium of radio. When Heinrich Hertz discovered that electromagnetic waves propagate by means of highfrequency excitation of an open oscillating circuit, it was the result of a research query. Radio meant at first specifically not language and music but rather radio waves for wireless telegraphy, particularly radio telegraphy in marine radio after 1900. The word radio was accordingly meant literally, used to emphasize the specific properties of electromagnetic fields, namely, the radial effect of the waves, broadcasting on the physical plane. It is therefore not enough to characterize radio simply as a device for receiving radio broadcasts, referring primarily to their content. Based on radius, that is, ray, the message is above all the medium: electromagnetic waves and high-frequency electrical signals, transmission, and sound.⁶ This is the message that radio underhandedly, thus latently, enunciates to our senses over and over again, notwithstanding all manifest programming significance. The radio of the twentieth century was an ongoing massage⁷ for the perception of sound prevailing in occidental culture. The electrotechnical transformation of speech into signals, of signals into waves, into recording and radiation, has impressed the collective consciousness with the fact that linguistic meaning in the media always turns into sound, sound into signal, signal into noise; even the voices of leaders and dictators were thus, in the words of Paul DeMarinis, "nothing more than a wave in the air."8

However, wherever academic endowments and grants failed to provide funding for these types of purely inquisitive experiments (for example, the

Prussian professorial system), great minds like Thomas Alva Edison were forced to finance their research themselves through marketing. This was likewise the strategy pursued by Guglielmo Marconi, who took up Popov's St. Petersburg experiments with coherer as thunderstorm detector and combined it with the idea of a transmitting antenna, with man himself replacing the natural lightning as transmitter. Like Edison, Marconi was also impelled to finance his invention as a business; he practiced wireless telegraphy. In 1901, communication bridged the Atlantic "using electromagnetic waves for the transport of informative signals," as Hagen Pfau says. 9 But wireless has not always been synonymous with radio. The patent registered in 1904 by Marconi's engineer, John Ambrose Fleming, further developed an effect detected by Edison in light bulbs by which electricity can flow from filaments to an additional enclosed electrode, even if no direct contact exists. In his patent manuscript of 1884, A Manifestation of the Edison Lamp, Edison explicitly describes electricity flowing through the vacuum "without wires"—literally "wireless," inside the evacuated, etherless tube itself.

The media-epistemological break is even starker when we speculate on the birth date of radio. As Pfau points out: "In order to return to the beginnings of wireless transmission of speech and music, we must separate ourselves from the spark gap transmitters of the first broadcasters. They generated only attenuated, pulse-shaped waves" —meaning signals, not signs, hardly in a position to transport sounds and tones to the recipient—which also solves the riddle of why Heinrich Hertz had not already considered radio content in his experiments.

Early radio was closer to Morse code than to what we know as radio today—or, to put it differently, it was literally digital before it became, through speech and music modulation, an analog medium. The digital managed its reentry only through pulse code modulation—with which radio, in fact, finds its way back to its original potential as a broadcast medium. This being the case, we may reflect on the year 1906, when the International Wireless Conference in Berlin regulated the handling of wireless communication, though it was only with the introduction of tube technology that the human voice or music lastingly replaced Morse code. Radio is the function of a technological escalation: the tube. The opposite of such electronics based on low-voltage current was the Telefunken high-frequency machine transmitter of

1912 with a frequency of 10 kHz, which could be transformed up to 170 kHz, making telephony attempts from Königs Wusterhausen to Vienna possible in 1913. The mechanical limits of this wave generation virtually forced the paradigm change to the field of nearly inertialess electronics, the realm of the modulatable electron stream in a vacuum—and thus to the electron tube transmitter. As we know, speech is emitted in a frequency range that lies beneath those higher frequencies radiated by electric transmitters in free space. Speech must therefore be inscribed as signal flow onto the highfrequency ranges by causing a low frequency generated by speech to modulate an emittable high-frequency oscillation. The modulation of electrons is actually the definition of *electronics* as opposed to sheer electricity. The triode invented by de Forest, followed forthwith by von Lieben's further development of the *modulatable* thermionic tube, allowed for just such generation of high-frequency oscillations and the amplification of modulated currents enabling amplitude modulation. Henceforth, "funken ohne Funken" (to telegraph wirelessly without sparks) was possible, as Ferdinand Braun noted in his Nobel Prize acceptance speech in 1909. Allow me here a moment of frequency ontology: the waves emitted by a tube in combination with an antenna are of an entirely different nature than those of the spark gap transmitter, for only the tube—as an Audion circuit—can emit truly evenly and continuously, thus making it a medium (and not only a machine). Electromagnetic sparks are no longer transmitted as encoded information (Morse code); instead they themselves constitute a high-frequency medium through which low-frequency signals (speech, music) can then be sent—an escalation of epistemological dimensions.

In the United States, the tube rapidly gave rise to the mass medium of radio, while in Old Europe it long remained primarily an entity of knowledge—an entity of and for research. When Hertz proved with his experimental setup that electromagnetic waves produced by sparks moving through a gap behave in principle as do light waves, it was not the beginning of radio as a mass medium but rather the endpoint of inquiry into a question of applied media theory—Aristotelian media theory—the question of what happens in between (to metaxy). In a narrower sense, Hertz's experiment was designed as a media-technological verification, namely, as the empirical proof, on its part, of an idea couched in theory: Maxwell's mathematical

calculation of the electromagnetic field discovered by Michael Faraday. This was prompted by an incident in which, on an experimentation table during a lecture by Oested, the surrealistic proximity of a magnetic needle while an electron stream was being conducted through a wire, accidentally as well as necessarily, caused the needle to deflect—the laboratory as media theater. In fact, Faraday with his neologism of an electromagnetic "field" (with which he came to grips, at least semantically, with the induction effect he had discovered experimentally), in effect placed the concept of medium on an epistemologically exciting new basis. From this perspective, the electron tube of 1906 is much more of an endpoint to one hundred years of electromagnetic phenomena analysis. Only then does it switch tracks to herald the birth of a further, different one hundred years of radio as broadcast, which today, in the age of Internet radio, is gradually drawing to a close, while the radio as actual wireless medium in the media-archeological sense is surreptitiously back at work in the form of radio-frequency identification (RFID) of goods in our supermarkets, without either speech or music.

One Hundred Years of Radio (Tubes)

A media archeology of one hundred years of radio (tubes) makes our uncertainty as to the question of where radio history begins productive as knowledge. It proves impossible to write an organized or even chronological history of the development of the tube, because the tube has no linear discursive history but instead, especially in the beginning, followed more of a zigzag course of experimental groping in the dark. For technological archeology, the defect is the true index of the real. The tube is thus a dispositive, compared to which its concrete realizations and differentiations (radio, television, computer) are more representative of deviations.

The von Lieben tube as a monument to amplification technology is not necessarily coupled with the radio idea. Media-archaeologically, *medium* means primarily measurement. Already before 1906, namely in 1898, Ferdinand Braun discovered the cathode-ray tube as a measuring instrument for time-dependent electrical quantities by way of depicting electrical signals on a fluorescent screen, the media-archeological archetype of the television picture tube. ¹² The history of Braun's tube anticipates the history of the tube we know so well from radio. As deployed by Braun, the new medium was at

first itself the message: about making visible the oscillations of the new alternating current generator at the Strasbourg electricity works in February 1897. Although the radio tube has largely disappeared, replaced by transistors, the picture tube prevails today as the television picture tube and as the computer monitor, as Franz Pichler writes.¹³ It should not be taken for granted in information technology that a device will stay around, retaining its principal, physical mode of functioning over a period of one hundred years. But this epoch is now rapidly, even abruptly, coming to an end, as cathode-ray tubes are replaced by flat screens for computers and televisions—with consequences for their graphic ontology (raster display). On the level of the display, this last stronghold of the analog, the culture of electronics, is now also being replaced by the (digital) aesthetic of information. This was already suggested by the alternative use of the cathode-ray tube: although in television the picture tube generates pictures as representations of analog values, its application as a computer monitor enables digital display; here every pixel has the function of a binary-code word. One and the same (basically analog) electron tube is now an analogizing, now a digitizing, entity.

For a Culture of Noise

This is the point at which I lapse into a nostalgic, melancholy tone as a token of bidding farewell. Discernable at the IFA Consumer Electronics Trade Show 2006 in Berlin, the trend toward digitization of shortwave radio (digital radio mondial, or DRM)—the latest rumors indicating a potential shutdown of analog shortwave reception in the United States—gives us occasion to speculate about the media-epistemological sacrifice associated with this digitization. When broadcasts are transmitted over a digitized medium-wave frequency, we may not hear anything with an analog receiver, but neither do we hear much more than noise; digitally encoded signals cannot be calculated for our ears by the analog receiver.

Digital reception is touted as advantageous due to its elimination of noise; compared to the existing analog AM radio, this means, according to a trade publication: "With DRM... strong noise and fading in reception are of the past." But it is not classical radio that is finding its way back to its original potential here but rather radio transformed into information. Though electromagnetic waves may still be wafting through the ether, atop them now ride

digitized signals in their capacity as information. Decoding them is an act of mathematics—or mathematical machines, meaning computers—an act that can no longer be mastered by the classical tube radio by means of classic demodulation of high-frequency waves to low-frequency speech and music. Instead, without a decoder, all that can be heard is digital noise, a strange return of noise to the otherwise noise-free space of digital transmission.

Exactly this noise and flickering of electrons in the vacuum tube were what inspired Albert Einstein and Norbert Wiener to equate them with the familiar phenomenon of Brownian molecular movement (for example, that of pollen) and with thermodynamics (that of gas particles) in order to deal with this disorderliness and randomness not only electromagnetically and cybernetically but, above all, mathematically. At this point we may commemorate a different "hundred years": Ludwig Boltzmann, founder of statistical physics, voluntarily took his own life in September 1906. Boltzmann's entropy formula $(S = k * \log W)$, which built the first stable bridge between classic physics and nuclear and quantum physics, is chiseled into his gravestone at Vienna's Central Cemetery—time's arrow is relentless. If we throw a tumblerful of water into the sea, we cannot get the same tumblerful out again, noted James Clerk Maxwell, anticipating the concept of the irreversibility of molecular or atomic movements. The same applies to the emission and stream of electrons in the vacuum tube. In the mid-1920s, Wiener's attention was drawn to the aptly named shot effect in electronic amplification. Einstein had theorized that thermal agitation of electrons in a conductor would generate random fluctuations, and in 1918 Walter Schottky developed the model of this effect further. The so-called tube noise was too slight, however, for then-available measuring instruments to pick up; the theoretically proposed shot effect could not be demonstrated experimentally until 1927.¹⁵ When Wiener, like Einstein, discovered the analogy between this shot effect and the Brownian movement of organic substances, he interpreted it by applying a basically similar mathematical analysis as the "result of the discreteness of the universe."16 The electron tube therewith virtually became a macromonad. Although Leibniz in his monadology believed neither in vacuums nor in remote effects, he nonetheless asserted the perceptual capability of remote monads; with a measure of imagination, Wiener therefore saw "an analogy between this mirroring activity of the monad . . . and the modern

view in which the chief activity of the electrons consists in radiating to one another."¹⁷ Xenakis's stochastic music conveys the same to our ears in the form of sound clouds.

Radio as Calculation and Computing

It is true that the amplitude modulation of analog radio is already sheer encoding, and speech and music can be heard only when they are demodulated that is, decoded. Digital transmission works the same way, but this encoding is of a different epistemological and practical nature. What is today entering into the medium of radio is this kind of operational mathematics: computing. Now that the hundred-year-old tube has vanished from radio, we can celebrate it anew in connection with computing, depending on one's point of view, as a centennial, as a semicentennial, or as a "Babylonian" sixty years. The decisive escalation of the amplifier tube was, as mentioned, attributable to the fact that it was capable of feedback. Not only did this make radio possible for the masses, feedback also entails a special case that would divergently yield unforeseeable consequences: electron tubes were negentropically taught to no longer merely amplify their incoming signals in an analog manner but also to output them digitally, hence making them calculable. The tube itself cannot count or detect whether it is transmitting analog or digital signals, but by heterodyning analog oscillations, digital signals can be generated (as Fourier's analysis already demonstrated).

Formerly a transit medium for electron and radio streams, the tube can suddenly, when switched as a twin in an Eccles—Jordan circuit, itself serve as a medium for a binary position. ¹⁸ The combination of two electronic tubes as relays is in effect a flip-flop, an electronic trigger switch. The electron tube is a media-epistemological entity insofar as it is simultaneously concrete (in its materiality and electrotechnics) and paradigmatic. What was still concrete in the days of Edison (the light bulb) appeared by de Forest's time no longer as an iconic object but as a technical drawing, as a switch—crossing over to the symbolic realm. The electron tube was thus able to survive its own demise, for the transistor remains a semiconductor with a "tubelike relay effect," albeit thermally less susceptible—medium cool. The process familiar from radio was thus echoed in the computer but with a phase shift: first the electromechanical relays in Konrad Zuse's Z1, then the tube-driven computer

(ENIAC), and finally, in 1958, Heinz Zemanek built in Austria the Mailüfter (May Breeze), a transistor computer.

One hundred years? More like ninety: Schottky's tetrode of 1916 already implemented a form of the integrated circuit; this likewise applied to the Loewe threefold tube 3NF of 1926, codeveloped by Manfred von Ardenne, the central component of the legendary Loewe local receiver (OE 333), which helped leverage private radio due to its low price—so it is actually eighty years of radio. The 3NF encased the assembly of three tube systems in *one* glass (vacuum) space, with four resistors and two capacitors fused in, and was declared to be, in terms of radio history, "the world's first integrated circuit"; the media-epistemological cross-reference for this tube was in actuality more to the computer. As an integrated resistor-coupling circuit, the tube transcended itself here, except that in the form of the 3NF it was not a logical (digital) but rather analog electron-stream control element. The actual integrated circuit of the computer (a 1959 concept) was characterized by the fact that the wiring was flattened from three-dimensional space in favor of the two-dimensional lithographic procedure.

The tube was thus—depending on its use—an analog or digital hybrid. Tube and psyche: von Lieben's electron tube not only had a link with Wien (Vienna), but with Norbert Wiener, the founder of the discourse on cybernetics, a mathematical discipline. Vacuum tubes appeared to Wiener to be the ideal instrumental equivalents to nerve circuits and nervous systems. For the electron tube (unlike electromagnetic relays) is the only example of where, as at neuronal synapses, the voltage increases until, upon reaching a specific voltage level, it flips, functioning as a digital switch. None other than the great heir to Sigmund Freud, Jacques Lacan, once correlated the function of the unconscious with a series of discrete states, explicitly taking recourse to electronics: "All those who have dealt with a radio know it—a triode tube." ¹⁹ In Lacan's psychoanalysis, the modulatable electron tube stands paradigmatically for the imaginary function of the ego. In this way, what Freud still called a "psychic apparatus" became a tube-based electron calculator. It is thus the electron tube of all things—that media-epistemological entity, serving both as analog amplifier and as digital switch without becoming something else that enables the return to Wien, to the Vienna of Freud and von Lieben, and to Wiener's technomathematics.

As soon as the tube was no longer used for radio purposes alone but instead as a digital switching element in computers, it changed its status of being without modifying one bit of its technical nature as providing inertialess modulation of a current. Tube as radio versus tube as digital switch: the electron tube thus spanned two epochs and media systems ahistorically in its pure media-archeological activation. The tube functioned as a medium for electromathematical calculations exactly (the) half(-life) of that epoch of "one hundred years of radio," which (apparently) is drawing to a close only with today's digitized, wireless communications media. The analog electron tube of radio technology comprises both a beginning and an end with regard to the realm of the digital: to the discrete medium of telegraphy and to the beginning of the digital computer. Here history turns back on itself like a Möbius strip, and that means that the present is shadowed by the inverse omens of its past.

When we approach the question of one hundred years of radio not only from the standpoint of mass-media history but also mathematically, it suddenly looks different. Digital radio does not denote the end of the analog. In the early nineteenth century Jean Fourier demonstrated in his *Analytical Theory of Heat* that even discontinuous signals, which include digital impulses, can be interpreted approximately as the sum of individual analog oscillations; consequently, the so-called digital can be described within the bounds of the analog. And the sampling theorem enables the digital reproduction of analog signals in such a way that not only do they appear original (in high fidelity) to our human senses with the limited speed of their nerve stimuli, but their complete information content is also effectively maintained (including quantization noise). Digital radio has long since been able to simulate the aesthetic feel of analog radio—*Kunstradio* (art radio).

The veritably "radio-active" half-life of one hundred years of radio tubes is inevitably fifty years of tube-based computer music as well, because fifty years ago Lejaren Hiller at the University of Illinois first programmed a computer to compose a piece of music, resulting in the *Illiac Suite* for string quartet. Likewise, fifty years ago Max Mathews realized at Bell Labs the first synthetic sounds using digital technology.²⁰ The moment of the first use of the electron tube in this computer application was in fact a moment at which the interplay of materiality and encoding recalled the occidental connection

between music and mathematics. Electron tubes, once brought into oscillation, not only bring sound to radio as transmitter or receiver; they were also employable for the mathematical synchronization of data cycles, as a technological form of musical *harmonía*. As soon as we artificially or artistically sonify the cycling units of early tube computers of the ENIAC type, that is, acoustically reveal them through deceleration (with the program SuperCollider), the units audibly accelerate to create a rhythmic tone—ENIAC as Techno.²¹

9 Toward a Media Archaeology of Sonic Articulations

A new kind of historical knowledge has emerged: the research into past sonospheres and ways of listening to past times. So far historiography has privileged the visible and readable archival records (with *The Gutenberg Galaxy* dominated by visual knowledge). But since Edison's phonograph sound, noise and voices can be technically recorded and thus memorized, resulting self-expressively in extended possibilities of sonic heritage and inducing the question of whether soundscapes for the time before Edison can be reconstructed. But history as a cognitive notion of organizing past data will never be audible but only readable in complex textual argumentation; the historical method will certainly be extended to sonic articulation as well—and even be pushed to its margins.

Historical versus Media-Archaeological Reconstruction of Sonospheres

"Hearing modern history" already sounds like a methodological provocation. When soundscapes of the past ("auditory cultures") are reconstructed by historical research, they become an extension of the historical method. Hence a new "auxiliary science" for the historian emerges. Soundscapes of the past are thus integrated into (if not to say subjected to) the historical discourse and historiographic writing—the "history" of sensory perception as already claimed by Karl Marx and Walter Benjamin.

But history as a cognitive dimension is bound to narrative acts (be it literary writing, oral poetry, or visual stories). Auditive evidence (as achieved in the past), though, asks for an alternative approach: media-archaeological reenactment, leading to a different temporal regime of auditory memory. Media archaeology, which is media studies as exact science, analyzes media-induced phenomena on the level of their actual appearance, that is, enunciations in Michel Foucault's terms. In our context these are physically real (in the sense of indexical) traces of past articulation, sonic signals that differ from the indirect, arbitrary evidence symbolically expressed in literature and musical notation.

Dilthey's definition of the humanities means a transformation of Helmholtz's threshold of perception into an architectural and institutional threshold between faculties. But because operating below the differential thresholds of sensual physiology is one of the conditions of possibility of technical media—of film, that is—the historical a priori of the humanities is at the same time the physiological a priori of technical media. The empire of media is the blind spot of the humanities. Inaccessible to experience and thereby to understanding in history is, according to Dilthey, the real or what only media can register or what exists only in writing but not in narration: what Bernhard Siegert refers to as the "noise of the battles, the formation of the enemy armies, the effects of their artillery, the terrain's influence on the victory."

In his novel dating from 1880, *L'Eve future*, Vielliers de l'Isle-Adam lets the inventor of the phonograph, Thomas Alva Edison, lament the loss of sonic information, which was lost in world history as long as cultural memory was indeed reduced to what could historiographically be written down by the alphabet alone: "A phrase coined approximately seventy-two centuries ago (and which, besides, according to the immemorial tradition—perhaps invented, perhaps not—could never have been picked up by any recording machine)."

The phonograph (Emil Berliner's gramophone) registers the whole range of acoustic events. Whereas in musical notation (developed by the Greeks in analogy to the alphabet and later differently by Guido of Arezzo) a symbolic recording takes place, the phonograph registers the physically real frequency. The alphabetic symbolism reduces acoustic events to the "musical" (harmonical order), whereas the register of the real encompasses the sonic (including

noise, arhythmical temporal phase shifting, the "swing," differing amplitudes and frequencies)—an *anarchive* of sound in technological storage as opposed to the archival order of musical notation.

But the phonograph reaches its limits when it comes to record the purely physical noise of times previous to technical recording media: "For example, I would have complained that while the phonograph was reproducing sounds, it was unable to represent the sound, say, of the fall of the Roman Empire. It can't record an eloquent silence, or the sound of rumors, noise." Such noise becomes musical, that is, imaginary expression in Steve Reich's minimalistic composition *Different Trains* (1988): acoustic memories of train journeys in the past, train speed sounds as sonic commentary of different tempor(e) alities, rivaling the mixed-in voices of train porters as oral testimonies.

Reich notably collected recordings of trains from the 1930s and 1940s not only from America but from Europe as well: "There they sound completely different, they have another whistle, really violent." Here minute sonic differences account for the historical discontinuity. But this mode of experiencing the past probably is not historical at all, because it cannot be expressed historiographically (that is, in symbolic writing). It is rather sonography of the real in cultural time: "The real train sounds, that is all." 5

Technical Recording versus Symbolic Transcription

According to the classicist Barry Powell, an early Greek adaptor added symbols for vowels to the known Phoenician alphabet for the explicit purpose of making stand out not only the rough linguistic content but the very sonic musicality of oral poetry. In fact, this made Homer's epics recordable.⁶

But even this advanced, Muse-inspired notation is still symbolic, like the musical transcription that Béla Bartók provided for Milman Parry's recordings of Serbian epic songs on aluminium disc around 1950. Listen now to such a recording, the performance of the master singer Avdo Međedović. What the gramophone medium was able to record, though, was not only the poetic performance but an informative surplus: the nonmusical articulations, noise in the background. Even Međedović's coughing can be closely analyzed.

Thus media archaeology uncovers a *mémoire involontaire* of past acoustic, not intended for tradition: a noisy memory, inaccessible to the alphabetic or

other symbolic recording, added by the channel of transmission—the proverbial "medium" in Claude Shannon's *Theory of Communication*.⁷

Different from notational transcription into musical scores, technical signal recording of cultural articulation allows for the electrophysical measuring of recorded events and for digital analysis done by sampling. This exposes the cultural event to experimentation, thus enabling a nonhermeneutic analysis of cultural articulation on the subphilological, even subalphabetic, level.

Although not just oral poetry is being recorded but its noise as well, the conventional transcriptions into musical notation treat the sonic event as "oral literature" (as the Harvard Collection actually calls itself), thus keeping the analysis within the disciplinary discourse of trained philologists.

A Measuring Medium and Its Sonic Message: The Monochord

Technical repeatability leads to the option of an almost ahistorical functional reenactment; the experience of high-tech media time is closer to experimenting in natural sciences than to the historicist idea of empathetic history. The technological reproduction of a sequence of sound succeeds in exactly the same way as the original, even if it successively uses modern formats. In most cases, the performance is as good as the original, exactly because technologics are technically operative and not culturally performative.

At the same time, auditory evidence splits into physical and historical. The experimental approach to the reconstruction of auditory perception in the past is a method familiar from the sciences: to *actually reenact* the sound-generating setting. When we pull the string on a monochord, in its subsequent intervals we actually experience the technical dispositive, which has been the basis for musing about music and mathematics in the past—invariant toward entropic, historical time. In fact, the vibration of the string short-circuits us with that past, undercutting the "historical" divide in between. As M. L. West writes, Pythagoras, since Greek antiquity itself,

is credited with having personally discovered the numerical basis of the concords. He is alleged to have heard them in hammer blows coming from a smithy, and on investigation to have found that the weights of the hammers stood in the ratios 4:4, 3:2, and 2:1. He is then supposed to have reproduced

the concords by putting equal strings under tension from a similarly graded set of weights. It has been pointed out ever since the seventeenth century that neither part of the story is in accord with the laws of physics.⁹

The ideology and aesthetics of harmonic ratios based on integer numbers—that is, the tuning of the ancient Greek ears—can thus be reexperienced exactly from the *difference* to the physical acoustic event. Greeks preferred the musical theory even if it deviated from the physical experience as an actual media event.

Cultural tradition, or the so-called collective memory, does not lead to a reconstruction of the actual sonic eventality; we have to switch our attention to the laws of technological media in order to be in a position to reenact past sound experience. A more plausible account has the early Pythagorean Hippasus of Metapontum discovering the concords with bronze discs of equal diameter but different thickness: "These really would give the required results," writes West. Suddenly, we are in a position to reexperience the ancient Greek acoustic setting, even if our ears are epistemologically tuned in different ways. All the difference lies in an idealistic, aesthetic, even ideological (cosmic-order) idea of sound as opposed to its physical and physiological "mediatic" experience (aisthesis); "Theophrast's fragment 89 contrasts those who give a mathematical account of intervals with the harmonikoi and those who judge by 'sense-perceptions." 11

But the human auditory sensation of harmonic ratios in music is not completely arbitrary as a function of culturally variant (and thus "historical") formations but as well *positioned*¹² by physiological and physical (the media of experimentation, such as the string chord) laws.¹³ We are dealing with two interlaced levels here: *the sonic* (partly determined by cultural engineering) and *the acoustic* (which adheres to physical and technical laws). Short-circuiting the apparent temporal distance (as declared by historical consciousness), we can actually reenact the original Pythagorean acoustic experience, looking and listening at the monochord.

For sure, when we pull the string, we are certainly not in the same historical situation as Pythagoras, because our circumstances, even our ways of listening and the psychophysical tuning of our ears, are different. But still the monochord is a time machine in a different sense: it lets us share and participate in the original discovery of musicological knowledge, because—in an almost

Derridean sense (as expressed in his *Grammatology*)—the original experience is repeatable; the actual experiment allows for (com)munication across the temporal gap.

Once human senses are coupled with technological settings, man is in an autopoietic temporal field, a chrono-regime of its own dynamics (or mathematics, when data are registered digitally). Such couplings create moments of exception: man is taken out of the man-made cultural world (Giambattista Vico's definition of "history") and confronts naked physics.

Musical instruments can also take such a technoarchaeological role. If musical instruments from the past are not just objects in the historical museum but are being reused to perform ancient music, they change their essence from historical to processual hardware, thus truly becoming media (again). Being replayed, they are transformed from historical to media-archaeological objects; they embody the physics of past soundscapes. For sound as related to media, not historicist empathy ("understanding"), leads to acoustic "understanding" of the past, but the media technology has to be reengineered.

Indirect versus Transitive Transmission of Sound (the Vocal Alphabet and the Phonograph)

In short, there is a memory of auditory culture in the past that is not historical but media archival. The evidence of ancient Greek musical articulation has been chronotechnically preserved in the metric verses and musical notations that embody the temporal measures, the actual rhythms of poetic articulation. Aristotle's disciple Aristoxenus defined *chronoi* as the smallest time units of musical rhythm. ¹⁴ There in an intricate relation between the rhythms (time measures) in the prosodic articulation of syllable-based Indo-European languages, early notation of vocal music, and dance. From this interrelation the archaeologist of cultural articulation deduces information on the very nature of time-based movement from poetic verse: according to West, an indication of tempo "can be drawn from the relation of music to movement. We do not know how to match notes to dance-steps." ¹⁵

But soon the limits of the alphabetic notation of sonic expression have been experienced. Audiovisual recording by nonsymbolic media is cultural engineering in a specific way, able to register sonic expression in a way that even the most elaborate symbolic writing systems (with the notable exception of current computer programs) cannot achieve. ¹⁶

In terms of an archaeology of acoustics, let us differentiate sharply between the cultural respectively "collective" (Halbwachs) memory of sonic events (auditory memory) and the media recording of sonic articulations from the past. For an archaeology of the acoustic, the human auditory sense does not suffice. Let us therefore track the sonic trace with genuine tools of media studies. One way to conduct "acoustic archaeology" is to play a musical partition on historic instruments. But the real archaeologists in media archaeology are the media themselves—not mass media, but measuring media that are able to decipher physically real signals technoanalogically, representing them in graphic forms alternative to alphabetic writing, requiring moving diagrams (because sound inevitably is articulation in time): oscilloscopes.

Sonic Reentry of the Sirens

The technical siren had been developed by Charles Cargniard La Tour in 1819 and was improved by Hermann von Helmholtz, linking discrete sound production (the siren or the alphabet) to the mathematics of the Fourier series, which led to auditory perception as a machinic process. The composer Edgard Varèse, in his piece *Ionisation* (1929–31), performed what Ana Ofak and Philipp von Hilgers refer to as the "corporification de l'intelligence qui est dans le sons" (embodiment of intelligence that is in the sound) musically—like a reentry (or "recursion")¹⁷ of the Muses within the Sirens.

With the introduction of the optical film soundtrack in the end 1920s, as Hugh Davies writes,

The sound is photoelectrically recorded on a narrow track beside the visual images, and the fact that it is visible means that it can even be monitored and analysed. Most of the photoelectric organs and organ-like instruments from the late 1920s and the 1930s were based on the mechanism of a rotating disc that interrupted the passage of a beam of light between its source and a photocell... thus avoiding the wear and tear of direct contact with the surface of recording. Many of these systems used a principle derived from that of the siren, interrupting the light-beam by a rotating opaque disc in which holes or slits had been cut.¹⁸

Synthesizers take over.

When Hermann von Helmholtz developed his double siren made of brass as a media-archaeological instrument to measure the frequencies of sound, this was not a continuation of ancient Greek knowledge as allegorized by the Homeric Siren motif but rather a radical epistemological rupture. If the Sirens resonate here, it is not for poetic reasons but for acoustic knowledge.¹⁹

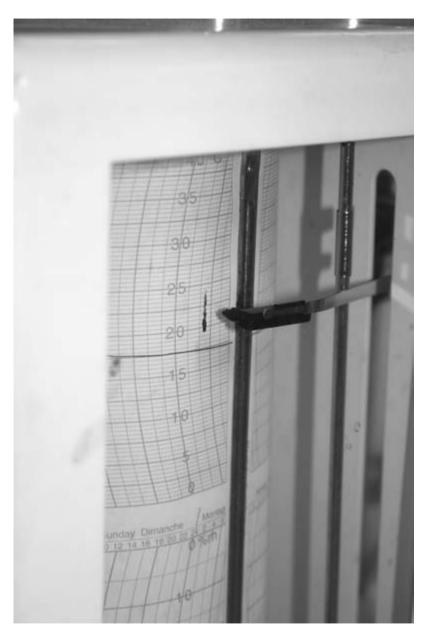
Acoustic records have been, since 1877, closer to cinematography (1895) than to historical (that is, symbolically or historiographically inscribed) records, because only technical media able to register physically real signals can deal with time-based events like sonic articulation and movement.

There is a kind of knowledge that exclusively emerges with delicate signal-sensitive media; the neologism acoustic knowledge belongs there. According to Jonathan Sterne, "The techniques of listening that became widespread with the diffusion of the telephone . . . early in the twentieth century were themselves transposed and elaborated from techniques of listening developed elsewhere" namely, in the experimental laboratories of linguistic phonetics.

Technical phonography undermines the phonetic alphabet—in which the beginning in both senses (the first letter in the alphabetic: *alpha*) in a way already consequently anticipates its end (*omega*)—from oral culture to phono media.

Léon Scott's Phonoautographe was indeed a kind of "natural stenography"²¹—a kind of writing emancipated from the vocal alphabet to such a degree that by optical scanning it can now be reconstructed as sound information again, with the digital processing the true nonhuman archaeologist of an auditory event in the past (*audiovision* not as aesthetic phenomenon but as technomathematical synaesthesia). The original phonoautographic curves along the rotating cylinder (the *kymograph*) register the "actual" (that is, temporally authentic) acoustic event and are thus closer to operative Fourier analysis of sound than to cultural articulation.

The indexical relation between writing and vocal sound that the phonetic alphabet had aimed at in vain (because symbolic notation cannot transcend discrete inscription) could be achieved only when writing became technical instead of symbolic, as a direct (analog) function of the acoustic signal as characterized by vibrations and waves—two-dimensional events in time, almost mathematically authentic²² and close (ana) to speech (logos) indeed.



A close-up of the kymograph device. From the Media Archaeological Fundus. Photograph courtesy of Sebastian Döring and the Institute for Musicology and Media Studies, Humboldt University, Berlin.

When the pick-up of the gramophone was finally based on electromagnetic induction, this acoustic information could even be amplified, with no human coding of the signal anymore, as in alphabetic or other symbolic notation, but its immediate translation from acoustic energy into the electric (or electronic when the vacuum tube entered this technoauditory scene). Suddenly, the human voice could be "electrically re-created" like in Bell's telephone transmission.²³

Music, in cultural tradition, has since long ago (Greek notation, early Renaissance notational lines) been recorded symbolically; the recording of the acoustic event (signal) succeeded only with Thomas Alva Edisons's phonograph. In digital sound processing, the symbolical returns, but on a dynamical, time-based level, thus essentially close to the nature of sonic events themselves, which evolve only in time, rivalling history.

Sonic Arts or Acoustic Archaeology

Media-active archaeology can be applied to past sound, generating a different kind of audio archive.

Let us listen to an "ancient" music-ethnological recording dating back to 1907, in fact from an Edison wax cylinder in the Berlin Phonogram Archive, restored with technomathematical software as digital archaeologist of sound. ²⁴ Today optodigital reading of early Edison cylinders allows us to listen again to otherwise inaccessible sound recordings; the optodigital *close reading* of sound as image, though, dissolves any meaningful unit into discrete blocks that are accessible for human analysis only by operative technomathematical diagrams. ²⁵ This is an analytic, media-archaeological deciphering. A question arises, once posed by Michel Foucault in a slightly different context: "Message or noise?" ²⁶ There is something like the "media-archaeological ear" that listens to the sound of material tradition, in fact the technically mediated *sonic* processuality of what is otherwise called history, an alternative to the cultural emphasis on listening to musical semantics.

In the age of history, sound has been evasive, in itself unrecordable and transferable beyond the bodily range. In the age of technical media (different from phonetic writing, which "freezes" the human voice by reducing it to a range of a very limited symbolic code), we are able to defreeze recorded voices in all their frequencies (that is, the Lacanian "real" of the voice) by identical

replay. The uniqueness of an acoustic articulation that coincides with the narrative notion of an "event" can be identically repeated and thus subjected to systematic measuring. Although the context of the recording technology is completely historical in its technological and discursive context, the mechanism itself is able to sustain an island of nonhistorical eventuality—like the Second Law of Thermodynamics, which scientifically defines the arrow of time as being relativized by recent insight into local areas of negentropic behavior.²⁷ The author Arthur Schnitzler knew this when speaking into a phonograph on March 19, 1907, thus admitting that, confronted with the phonograph, literature had lost its unique privilege to transmit the memory of human language.²⁸

There is a voice document of a classical protagonist in history, Emperor Franz Joseph I (1830–1916) of Austria–Hungary, written into the deep relief of an Edison wax cylinder (recording Bad Ischl, August 2, 1903), prepared for and preserved in the Vienna Phonogram Archive. Imagine listening to this phonographic recording of Emperor Franz Joseph's voice. I am sure that whatever we think the timbre of his voice was, we will acoustically hallucinate as well the scratching, the noise of the recording apparatus. True media archaeology starts here: the phonograph as media artifact preserves not only the memory of cultural semantics but past *technical* knowledge as well, a kind of frozen media knowledge embodied in engineering and waiting to be revealed by media-archaeological consciousness.

After that brief imaginary experiment, let us quote Emperor Franz Joseph's statement. Significantly, this statement—which is preserved in one of the first voice recordings—subjects the emperor to the pure message of the medium, proving that at the moment when a new technical medium emerges, humans are very aware of its technicality (which afterward, when the medium becomes a mass medium, tends to be forgotten in favor of so-called content). The emperor expresses his joy to "incorporate" his voice into the phonoarchival collection, literally.²⁹ Strangely enough, we are able, today, to listen to human voices that terminated a hundred years ago by reading the wax cylinders using lasers, which do not destroy their source in the act of replay. What we hear is both the message (the emperor) and the noise (the scratch of the recording medium). The record stores the noise of the wax cylinder itself as well—which is not discursive but media-archaeological information

(about the physically real event). Let us listen to this carefully and not exclude it hermeneutically as in the proverbial cocktail-party effect of auditory communication between humans.

In the microphysical *close reading* and *close hearing* of sound, the materiality of the recording medium itself becomes poetical.³⁰ Instead of philological hermeneutics, the media-archaeological ear (or microphone) is required here. The media archaeologist, without passion, does not hallucinate life when he listens to recorded voices, as does the notorious dog Nipper when listening to "His Master's Voice" on a phonograph. The media-archaeological exercise is to be aware of the fact that at each technologically given moment we are dealing with media not humans, that we are not speaking with the dead but dealing with dead media that operate.

10 Experimenting with Media Temporality

Pythagoras, Hertz, Turing

All such mass media as the phonograph, kinematograph, radio, and electronic television were first developed for experimental research. Media are measuring devices, and as such they are scientific, analytical apparatuses. To put it roughly, any listening to music on records or to radio programs is essentially experimental, a kind of reverse experimentation. The well-known television tube was developed out of a measuring device, Ferdinand Braun's electronic oscilloscope, just as the Edison phonograph was preceded by Léon Scott's Phonautograph, created to register the frequencies of the human voice for analytic purposes. Tuning an analog radio is experimenting with radio waves and their electromagnetic resonances. The public-use "synthetic" mass media represent a step from such measuring devices to worlds of mass media, as we often approach them, but we are able to also analytically approach the *reverse experience*: to go back to the scientific experimentality of such machines.

The subject of "experimentality as event" touches a crucial figure of contemporary epistemology, especially when we take epistemology in its processual, time-based sense as defined by cybernetics. This comes from its self-definition and the insight into "circular causal and feedback mechanisms in biological and social systems." Heinz von Foerster is explicit when he states that epistemology is not meant as a static theory of knowledge. In analytic philosophy (as represented by Alfred North Whitehead), the "event" represents an ontological being that is not a static object but a process. Such a processual ontology is close to the essence of media technologies itself

(because only when in operation is a medium in its medium state). Media archaeology uncovers not artifacts but events, which is where it differs from the traditional archaeological discipline.

So let us investigate the processuality and event nature of media-enhanced experimentation. One level of temporality is the microtemporal behavior of the object in question (that is, "under experiment"); the second is what it does to (or with) the "temporal sense" of the human experimenter. An ambivalent experience of experimental time takes place in three exemplary scenarios: first, the insights into the mathematical beauty of cosmic relations that Pythagoras experienced when he pulled the string of his monochord in early Greek antiquity; second, the microtemporal nature of electromagnetic oscillations (Heinrich Hertz's "radio" experiment); and third, Alan Turing's notion of a computing mechanism that strictly exists in discrete "states." On the one hand, such experimental settings clearly belong to what we call and describe as cultural history (or the "history of knowledge," in more Latourean terms), but on the other hand (from the point of view of the media themselves, and hence the media-archaeological perspective), there is something at work (at the level of both the artifact and the epistemological *dispositif*) that is indifferent to the historical. This I call the "time-invariant event."

"Experiment as event" can be reformulated as "experiencing the event." The media-archaeological view considers the question of how media temporality, and especially its proper temporal figure of time-critical and microtemporal processes, is experienced through the experiment. In contrast to empirical experience of the observation of primary nature, media-experimental settings perform "culturalized" experiences of a secondary nature—with measuring media the crucial observers. A media-experimental setting is an artificial configuration based on cultural knowledge—but it is still of a physical nature because there are electro- or even quantum-physical laws at work that are not solely dependent on the respective cultural discourse. The media-experimental event cannot be reduced to discursive effects. There is always the imminent "veto" that comes from physics.

Listening to the Monochord (Pythagoras versus Mersenne)

If we reenact today the procedure by which Pythagoras experimented with the monochord in the sixth century BC, pulling such a string, we actually reenact the technophysical insight of the relation between integer numbers and harmonic musical intervals that once led Greek philosophers to muse about the mathematical beauty of cosmic order in general.³ We are certainly not in the same historical situation as Pythagoras, because our circumstances, even our ways of listening and the psychophysical tuning of our ears, are different. But still the monochord is a time machine in a different sense: it lets us share, participate in, the original discovery of musicological knowledge because—in an almost Derridean sense (expressed in his *Grammatology*) the repeatable is the original. On the one hand, in phenomenology the event is a singular and instant act that cannot be subsumed under general terms. On the other hand, in Martin Heidegger's late philosophical work, the fundamental notions of being (Sein) and time (Zeit) converged in the notion of the event (*Ereignis*).⁵ In this double sense, the experiment allows a unique experience for communication across the temporal gap. It bridges a temporal distance. In the processual moment of the reenacted experiment, we share the same temporal field as the past time (a notion that implicitly refers to the episteme of electromagnetic induction).

So far experimentation has been applied to the analysis of microtemporal events. Can experimentation be extended to the macrotemporal event as well? At first glance, experimentation does not give access to historic knowledge because past events cannot be experimentally reenacted except perhaps in experimental archaeology. This is the argument historians usually applied to differentiate their hermeneutic discipline from the natural sciences.⁶

But media-archaeological experimentation (as opposed to historiographical historicism) gives access to the invariants of knowledge in time. One could in this way talk about "experiments with history" that extend practices of simulation to history. Such techniques are able to tunnel new connections through history, and this is where media archaeology finds its own ground as reenacting historical time objects, as Martin Carlé shows.⁷ Such tunneling brings us back to Pythagoras's monochord and ancient music.

Radio and Light Waves (Heinrich Hertz)

The media-electronic equivalent to the vibrations of the monochord string is, of course, the electromagnetic wave. Sound and vision as experienced by television have their media-archaeological roots in early experiments on the

nature of communication by electricity.⁸ Radio waves, on the microtemporal level (that is, before becoming part of a mass medium called radio), have a sense of ending. Michael Faraday and Heinrich Hertz discovered that the relation between electricity and magnetism is not static but dynamic—which transformed the philosophical question of its essence into its perception as event:

- 1. Electric charges make electric fields.
- 2. Moving electric charges make magnetic fields.
- 3. A changing electric field makes a magnetic field.
- 4. A changing magnetic field makes an electric field.

We are faced here with microevents. A moving magnetic field induces a current in a conductor; reversed, a current generates a magnetic field. It was this finality, which is the temporality implicit in the event named induction, that led to a rupture with Newton's mechanistic notion of *actio in distans* and to early speculations on the common nature of light-wave propagation and electromagnetic oscillation. The theory of visible light as a specific part of the electromagnetic wave spectrum was synthesized by James Maxwell. Maxwell symbolically analyzed the event nature of electric and magnetic fields as inductively found by Faraday's experiments.

Maxwell composed four mathematical formulas summarizing these phenomena, finally combining them into one that had the same form as the equation all waves obey. Thus he demonstrated that it was the electric and magnetic fields that were oscillating in light. The speed of these oscillations (the proverbial "speed of light") was predicted by Maxwell's work.

In 1887 Heinrich Hertz produced ultrafrequent electromagnetic waves and detected them at the other end of his experimental setting in his extended lab (in fact, a university auditorium). The Kantian notion of space itself here became critical: successively, experimentation has not taken place exclusively in macro-Newtonian space but has explored "electromagnetic space." The measuring media, though, still belong to the macrophysical word.

Through his experimental setting, in 1886 Hertz demonstrated that sparks are in fact ultrafrequent oscillations of electricity and transmit electromagnetic waves that behave as light. Such sparks have been known since the

discovery that rubbing pieces of amber together led to the emission of sparks (this is why electricity has been named after the Greek *elektron* since Thales of Miletus).

These sparks already behaved like "radio," but there was a detector missing, both mentally (humans) and technically (there was no "detector" until Édouard Branly's "coherer," invented in 1890 as a laboratory device in the Parisian Salpêtrière and further developed by Oliver Lodge). Radio thus was unconsciously invented in the laboratory (and only later put together by entrepreneurs like Guglielmo Marconi, who combined the Hertzean apparatus with Branly's device and Popov's antenna to make a functional tool for transmitting wireless Morse code). The experimental system "knew" it already. With a slight variation of an expression coined by Douglas Kahn, we might say that radio discovered itself before it was invented. This alreadyness is the index of a nonhistorical temporality that is equally original each time in experimentation.

Experimenting with electromagnetic wave propagation has not merely been the prehistory of the mass medium called radio but is the alternative approach to it. When Hertz discovered that electromagnetic waves propagate by means of the high-frequency excitation of an open oscillating circuit, it was the result of an experimental query.

In 1901, communication bridged the Atlantic using electromagnetic waves for the transport of informative signals. But "wireless" has not always been synonymous with "radio" as a medium of communication. The patent registered in 1904 by John Ambrose Fleming developed an effect detected by Edison in experimenting with lightbulbs by which electricity can flow from filaments to an additional enclosed electrode even if there is no direct contact. In his patent manuscript of 1884, "A Manifestation of the Edison Lamp," Edison explicitly describes electricity flowing through the vacuum "without wires," literally wireless: radio inside the evacuated, etherless tube itself.

Let us thus solve the riddle of why Heinrich Hertz had not already considered the implied radio content of his experiments. Early radio was closer to Morse code than to what we know as radio today, or, to put it differently, it was literally digital before it became, through speech and music modulation, an analog medium. The digital managed its reentry only through pulse

code modulation, through which radio, in fact, finds its way back to its original potential as a telegraphic medium.

Computing as Experimentation (Turing)

Pulse and counting bring us to an alternative kind of experimental time, which is an extreme of what the vibrating media have been considered before: discreet microevents called "digital." Alan Turing's notion of a computing mechanism, which started as a thought experiment, was based on the unconditional assumption that this machine could exist only in discrete "states." Experimental media eventuality changed from the continuous (the electromagnetic radio paradigm) to the discrete. The Turing machine experimented with the eventuality of mathematics. And yet computing extends to both analog and digital.

James Clerk Maxwell's differential equations have been the symbolical tools used to master the phenomenon of what Michael Faraday called the "field," that is, the sphere of electromagnetic interaction and induction. Thus mathematics itself is the simulation of a physical event with symbolical means (operators). Experimentation by computing is usually associated with the digital computer, in which the mathematical algorithm is a model of the physical event to be simulated. However, simulation by analog computers performs mathematical simulation by (electro-)physical means itself; the setting and configuration comprise a "physical experiment" in themselves.¹¹

In analog computing, material elements that embody certain mathematical structures such as integration and multiplication are coupled according to a mathematical model analogous to the simulated object. Analog machinery is not a metaphysical, intransitive abstraction from the world (a "language") but part of physics itself. In analog computing, mathematics becomes experimentation itself. Analog computing is experimentation, which means in this context doing mathematics in the engineering way. Thus the analog computer is less a mathematical machine than "a model for experimentation" whose virtue is real-time performance and thus providing an intuitive interface, a temporal sense of the objects under analysis.

This analogization is not exclusively based on a construction of cultural knowledge but rather on an implicit knowledge in nature itself. Again and again scientists have been amazed by the analogous behavior of a swinging

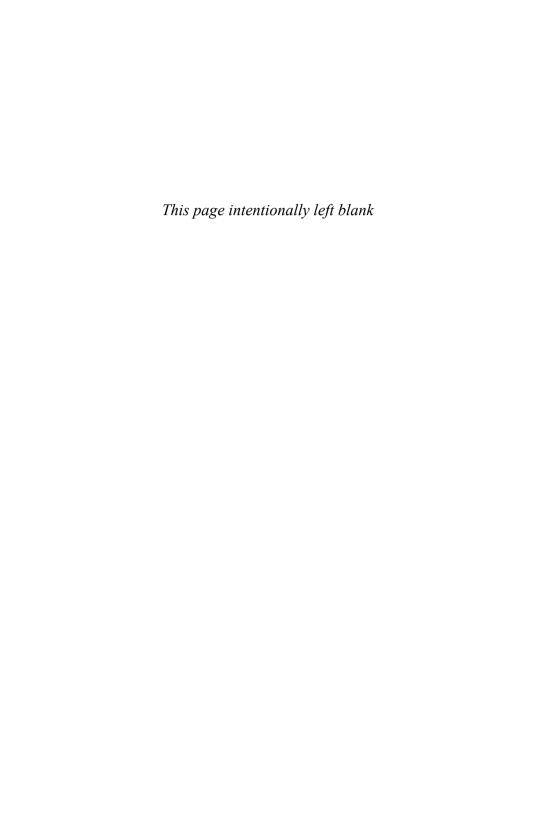


The Bulle Electric Pendulum Clock, one form that exemplifies the intertwining of time and technology. From the Media Archaeological Fundus. Photograph courtesy of Sebastian Döring and the Institute for Musicology and Media Studies, Humboldt University, Berlin.

pendulum (a mass, suspended at a lever), an electronic short-circuiting of induction (coil) and capacity (condensers). The syllogistic medium of both mechanical and electrical operations is a mathematical differential equation common to both. According to an operating manual for one analog computer, "One of the most powerful applications of analog computers is simulation in which physical properties, not easily varied, are represented by voltages which are easily varied." Simulation generally means performing experiments on a model in order to gain insights into the physically real, modeled system; such modeling by computers step-by-step replaces the traditional physical experiment. The analog computer can even be functionally integrated into the analyzed system (such as the simulation of a nuclear reactor by analog computing); there is no longer the problem of the distance of the observer but rather there is immersive experimentation.

Experimentation by numbers (digital computing) differs from analog by introducing virtual, that is, mathematized, counted time, experimenting with virtualities in simulation. This virtuality also refers to time-axis manipulation, which cannot be done with physical means, thus engendering knowledge, 16 chronomorphing experimental events or even creating "events" that otherwise have not been perceptible to human senses. The implication is that the digital simulation of experiments can lead to the creation of a new type of events: artificial events, "artifactual events," revealing not physical but mathematical moments of the real. As Eric Winsberg writes: "All discretization techniques present the possibility of roundoff errors or instabilities creating undetected artifacts in results."

Numerical experiments are simulations performed by the digital computer, in other words, operative diagrams. In between the physical laboratory experiment on the one hand and theoretical physics on the other, such simulations realize a true media theory, that is, theoretical reasoning is being algorithmically implemented in the real world (as the computer has been born out of a theoretical mathematics, the *Entscheidungsproblem*, articulated by Alan Turing in 1936). Being in the world, that is, being in time and thus happening as events, complex models can result in phenomena that have not been envisioned by the author of the program, thus generating unexpected phenomena. Such phenomena are information in the true sense of mathematically informed communication theory.¹⁸



APPFNDIX

Archive Rumblings

An Interview with Wolfgang Ernst Geert Lovink

German media theorist Wolfgang Ernst (born 1959) is a member of the Berlin circle inspired by Friedrich Kittler and founder of the Seminar for Media Studies at Humboldt University. He is contributing to the media archaeology school in which new media are traced back to earlier concepts. Following this methodology, one reads traces of digital technologies into history, not the other way around. The idea is that there is no teleology in which media unfold themselves in time. Against the usual chronological reading of media, from photography and radio to television and the Internet, Ernst uses the Foucauldian "archaeological" approach that aims to unveil active power relationships. But whereas Foucault looked into social formations, today's media archaeologists are primarily interested in the (hidden) programs of storage media. Following McLuhan, Ernst poses that "cyberspace is not about content, but rather a transversive performance of communication. Without the permanent re-cycling of information, there is no need for emphatic memory."

In his 2002 book *Das Rumoren der Archive* (Archive rumblings), Wolfgang Ernst points out that archives are no longer forgotten, dusty places.¹ The archive as a concept has gained universal attention and reached metaphorical status. In this era of storage mania, everything is on record. Repositories are no longer final destinations but have turned into frequently accessed, vital sites. For instance, East German secret police archives, opened after 1989

and frequently visited, show how contested data collections can become. Ernst signals a shift from the political-military (secret) meaning of (national) archives toward a broader cultural understanding in which the archive stands for collective memory. Ernst believes that archives are defined by their "holes" and "silent" documents. His annals look like crashing operating systems that should not be taken at face value. In short, archives are cybernetic entities. These days everyone is painfully aware that archiving equals careful selection. Chronicles are anything but neutral collections. Instead they reflect the priorities and blind spots of the archivists and the zeitgeist in which they operate. By now that is common sense. What can we expect from twentyfirst-century archive theory, beyond digitization and database architectures? Will the elites establish safeguarded "islands in the Net" where essential knowledge is stored, leaving the wired billions floating in their own data trash? Do tactical silence and the aesthetics of forgetfulness have to be all-tooobvious responses to storage mania? These are some of the issues I addressed in an e-mail interview with Ernst in February 2003.

GEERT LOVINK: One would associate the theoretical interest in archives with Foucault, Derrida, and other French authors. You make many references to them. Is that the destiny of our generation, to get stuck in the postmodern canon? Or is there another, more personal, reason for your interest in archives and the "French" approach? Do you keep an archive yourself, and which archive is your favorite one?

wolfgang ernst: When Peter Gente and Heidi Paris from the Berlinbased Merve publishing house asked me to write an essay on archives with special regard to French theories, I took the opportunity because it gave me a chance to work through my own intellectual past. Having been extremely affected by French poststructuralist theories in the 1980s and actually trying to deconstruct the notion of text-based history myself, my research year at the German Historical Institute in Rome then made me a convert, not to Catholicism but to the acknowledgment of real archives. I then discovered that no place can be more deconstructive than archives themselves, with their relational but not coherent topology of documents that wait to be reconfigured, again and again. The archival subject is thus a way out of the one-way postmodern aesthetics of arbitrary anything goes—without having to return to authoritarian hermeneutics (a point made as well by the "new historicists" in literary studies, for example, Stephen Greenblatt). The simple fact is that archives exist not only in metaphorical ways, as described by Foucault and Derrida, but as part of a very real, very material network of power over memory.

Do I keep an archive myself? In fact, I keep nothing but an archive at home: no bookshelves, no library, but a modular system of textual, pictorial, and even auditory information in movable boxes—that is, among others, fragments of books distributed according to diverse subjects—liberated from the restrictive book covers.

GL: How would you describe the methodology of media archaeologists? Is it useful to speak of a school in this context? Media archaeologists can be found in places such as Cologne (KHM, the Academy of Media Arts), Berlin (Humboldt University), and Paris. Then there is, for instance, Lev Manovich, who "reads" film history as an episode in the coming-into-being of a new media story. How do you look at the field, and what interesting approaches have you come across lately?

WE: I owe the term to Siegfried Zielinski, who—as the former director of the Academy of Media Arts in Cologne—once hired me for a research and teaching job called Theory and Archaeology of Media in the Context of the Arts (a worldwide premiere as an academic field?). Zielinski himself, of course, owes the term to Michel Foucault's *Archaeology of Knowledge* but has given it a technological turn in cultural analysis with his brilliant work on the video recorder (orig. 1985).² In his most recent work, literally called *Media Archaeology* (2002), Zielinski advocates an anarchival history of forgotten or neglected media approaches.³ Different from that libertarian approach, my version of media archaeology tries to carry further Foucault's approach.⁴ My media archaeology is an archaeology of the technological conditions of the sayable and thinkable in culture, an excavation of evidence of how techniques direct human or nonhuman utterances—without reducing techniques to mere apparatuses (encompassing, for example, the ancient rules of rhetoric as well).

Media archaeology is a critique of media history in the narrative mode. When Lev Manovich (whose writings I appreciate a lot) reads film history as an episode in the coming into being of the new media story, his approach already is trapped by the linear approach of media history. Having been trained as a historian, a classicist (and partly even as a "real" classical archaeologist in the disciplinary sense), I have always felt uneasy with the predominance of narrative as the unimedium of processing our knowledge of the past. It takes a new infrastructure of communicating realities—the impact of digital media itself—to put this critique of historical discourse into media-archaeological terms and practice. But I have to confess, even when I claim to perform media-archaeological analysis, I sometimes slip back into telling media stories. The cultural burden of giving sense to data through narrative structures is not easy to overcome.

The archaeology of knowledge, as we have learned from Foucault, deals with discontinuities, gaps and absences, silence and ruptures, in opposition to historical discourse, which privileges the notion of continuity in order to reaffirm the possibility of subjectivity. As Sven Spieker said, "Archives are less concerned with memory than with the necessity to discard, erase, eliminate." Whereas historiography is founded on teleology and narrative closure, the archive is discontinuous, ruptured. Like all kinds of data banks, it forms relationships not on the basis of causes and effects but through networks; the archive—according to Jacques Lacan—leads to an encounter with the real of script-directed culture.

Media archaeology describes the nondiscursive practices specified in the elements of the technocultural archive. Media archaeology is confronted with Cartesian objects, which are mathematizable things, and let us not forget that Alan Turing conceived the computer in 1936–37 basically as a paper machine (the most classical archival carrier). Media archaeology is driven by a certain "Berlin school of media studies" obsession with approaching media in terms of their logical structure (informatics) on the one hand and their hardware (physics) on the other—and thus is different from British and U.S. cultural studies, which analyze the subjective and social effects of media.

The real multimedia archive is the *arché* of its source codes; multimedia archaeology is storage and rereading and rewriting of such programs.

Media history is not the appropriate medium to confront such an archive. Consider, for example, two examples in current media research: The Renaissance Computer, edited by Neil Rhodes and Jonathan Sawday. The Renaissance Computer expressly draws a parallel between the media revolution from manuscripts to printing in Europe enabled by Johann Gutenberg in 1455 and by Martin Luther's use of printed text for the distribution of Protestant messages (theses) in 1517 and the actual digital technology era. The symbolic machines of the sixteenth-century "methodizer" Peter Ramus are presented as a pendant to the computer of today. This claim still thinks media from the vantage point of alphabetical texts, but audiovisual data banks make all the difference. Against such analogies, media archaeology insists on differences. Computing is not about imagination and texts but rather about the alliance of engineering and mathematics. The coupling of machine and mathematics that enables computers occurs as a mathematization of machine, not as machinization of mathematics. Although the book has, for half a millennium, been the dominant medium of storing and transmitting knowledge, the computer is able, for the first time, to process data as well. In 1999, Frankfurt Literaturhaus organized a conference on "book machines." On this occasion, Friedrich Kittler argued that analog broadcast media, which are linear sequential and base their storage on the principle of the tape, will be swallowed by the Internet. Books, however, according to Kittler, share with the computer the deep quality of being discrete media. That is why "Internet archaeology" is necessary, according to Denis Scheck. But who is responsible for this kind of documentation? Classical archives and libraries do this kind of documentation only exceptionally; the new kind of memory might be caught not by institutions but rather by rhizomes within the Net itself.

GL: Michel Foucault made a distinction between archaeology and genealogy. Is that also useful within the media-theory context? I have never heard about media genealogy. Do you have any idea what it could be? Would it be a useful term?

WE: It indeed makes sense to differentiate media archaeology and genealogy of media. Referring back to Friedrich Nietzsche's *Genealogy of Morals*,

Michel Foucault used the term "genealogy" to describe a cultural countermemory unfolding a different index, a different rhythm of temporality—it could be called mediated timing (the time of "time-based media"). Instead of looking for origins, genealogy looks for events in unexpected places and in unexpected moments without supposing individual agencies, teleology, or finality. But the exact relation between genealogy and archaeology in Foucault's work has been the source of much dispute or even confusion. With regard to media theory, let us put it this way: media archaeology is not a method of analysis separate from genealogy but rather complementary to it. Genealogy examines process, whereas archaeology examines the moment, however temporally extended that moment might be (reflecting "analog" versus "digital" analysis). Genealogy offers us a processual perspective on the web of discourse, in contrast to an archaeological approach that provides us with a snapshot, a slice through the discursive nexus (as Phil Bevis, Michèle Cohen, and Gavin Kendall once expressed it).

GL: There is the often-heard criticism that media archaeology, in its obsessive search for the Laws of Media, ends up as cynical, technical determinism that glorifies scientists and the military while explicitly fading out economical, political, and cultural aspects. How do you respond to such remarks? Do you see a debate here?

WE: You hit exactly on a recent, ongoing dispute within the Berlin school of media studies itself. When we sat down to analyze the "branding" of our group, we realized that we are, from an outward perspective, being reduced to hardware-maniac, assembler-devoted, and anti-interface ascetics, fixed to a (military) history of media without regard to the present media culture (which is a "software culture," as described by Lev Manovich, and is moving from the computer to the Net, as expressed by Wolfgang Hagen). In my chair in media theory at Humboldt University, I want to be concerned with a reentry of economical, political, and cultural aspects into this media-archaeological field—without giving up to cultural studies, though, which has overly neglected a precise analysis of technologies. In a couple of evenings, for example, some of our academics in media studies (like Stefan Heidenreich) went to an experimental media lab (Bootlab in Berlin)

to discuss with nonuniversity people who practice media theory (like Pit Schultz) topics such as surfaces or interfaces, the aesthetics of programming, economics, ownership and copyright issues, and computer games. The next cooperative event might address media definitions and media terms themselves.

GL: The popular management discourse of "knowledge management" has no explicit references to archives. Instead, according to certain business gurus, knowledge is stored in people, in organizations, ever transforming networks in, let's say, "living" entities rather than "dead" documents. In this hegemonic ideology, knowledge exists only if it is up-to-date and can operate strategically, not hidden somewhere in a database. Only then can it be segmented as intellectual property rights. How do you read this tendency?

WE: Intellectual property rights were in fact developed within the context of archives—libraries, to be exact; the legal notion of copyright was an effect of the need to protect authors and publishers against plagiarism around 1800. As to knowledge management, a current trend is the so-called warehouse approach, which takes for granted that implicit knowledge is always already there in humans and in systems—just waiting to be excavated, triggered, extracted by agencies. I have a lot of sympathy for the transarchival notion of "organizational" instant memory. But leaving the neurological metaphors aside, this approach dissimulates the existence of material memory agencies—both hardware and institutions—which still govern the power of what can be stored legally and technically, and what will be forgotten. Let us, memory-politically, not underestimate the ongoing impact of traditional paper archives or present audiovisual archives; the quest for access to such archives makes us feel immediately that they are still real. With digital archives, though, there is—in principle—no more delay between memory and the present than the technical option of immediate feedback, turning every present datum into an archival entry and vice versa. The economy of timing becomes a short-circuit.

GL: Over the past few years you have worked on a research project on the history of Russian computing. Could you tell us something about the

"mystery" of Soviet cybernetics? It is well known that the strength of the Eastern Bloc computer industry, military secrecy, also led to its demise. I suppose it is wrong to state that this is a history of losers—but to some extent it is. There is some irony involved. How did the project deal with this? Did you stumble into interesting differences compared to U.S.-led computer development?

WE: The genealogy of the computer and computing sciences as associated with names such as Charles Babbage, Alan Turing, Norbert Wiener, Heinz von Foerster, Claude Shannon, and John von Neumann has been the object of an impressive number of publications in the German-speaking and Anglo-American areas, but this media archaeology is reductive to the Western Hemisphere. In general the historiography of computing is—even a decennium after the fall of the Iron Curtain—still blind in respect to Eastern Europe. The art of computing in the former Soviet Union, immediately after World War II, developed some remarkable alternatives to Western machines that are attractive even today.

The alternative computing culture in the former Soviet Union has been stimulated by a weird and ever-changing reconfiguration between inventive improvisations on the engineering side and ingenious mathematics on the other, for example, Viktor Glushkov's idea of the language-based development of computers alongside Sergey Lebedev's more electronic approach. The activity in these directions was shared between the Kiev Institute of Cybernetics and the Institute of Precise Mechanics and Computer Engineering in Moscow. As a scientist, Sergey Lebedev was a professional and (maybe even more important) a born electronic engineer, while Viktor Glushkov was primarily a mathematician more interested in cybernetic problems.

The paradox is that, in a communist country, the material deficiencies in hardware and software due to the very absence of standardized mass production created highly original and mostly individual technical solutions. This flourishing pluralistic technoculture, though, tragically came to an end when Moscow decided in 1972 to copy the IBM production line in order to get cheap software running. Promising efforts to combine Russian computing with German Siemens computing and the British ICL

(International Computers Limited) by means of a joint European venture collapsed because Walter Ulbricht had already decided on IBM standards in the GDR (German Democratic Republic) and convinced Brezhnev in Moscow to follow suit. With these decisions in the early 1970s, not only did the option for an independent European computer standard die, but I would call this as well the beginning of the Decline and Fall of the Russian Empire in favor of what we today call the Microsoft global player.

One of the heroes of computing in the former Soviet Union, professor Zinovy Rabinovich, told us during the recent Transmediale media arts festival in Berlin about the construction of the first "European" electronic computer in Kiev more than half a century ago (1948–50). This computer architecture was developed independent of the von Neumann model, putting emphasis on parallel rather than sequential computing. Engineers and mathematicians in the former Soviet Union came together in ways different from the Western context—exactly because the mass economic uses of computing were limited to almost zero, so they were concentrating less on universal than on special-purpose computers. At the age of eightyfour, Rabinovich fervently argued that they rethink the options of a European computer to fill the gaps left by the American model. Thus Rabinovich proved to be an "old European" (to quote Donald Rumsfeld) in the best sense. As an alternative to software versus hardware, he proposed his engineering philosophy under the name of "middleware" (though this sounded familiar to Western ears; we know it as microprogramming).

GL: The American cyber conservative George Gilder is a "store-width" guru who has been promising for decades infinite computer storage and unlimited bandwidth and computational power. For economic reasons Moore's law (stating that the number of transistors one is able to fit on one chip doubles every two years) may be out of order for a while due to the implications of the "techwreck." Yet by and large, capacity has indeed risen incredibly. Ours is a society that cannot implement its own technological progress. What does that tell you, as a theorist who deals with archives?

WE: When the talk is about maximized computer memory capacities, the discourse continues an old occidental obsession that culture depends on

storage (historic architectures, libraries, museums). My media analysis tells me that the future cultural emphasis will be rather on permanent transfer, not storage (without undoing storage, though). There is already an implosion of storage mania into processual data flows, a different economy of the archive as dynamic agency "online." The notion of immediate data feedback replaces the data separation that makes all the archival difference.

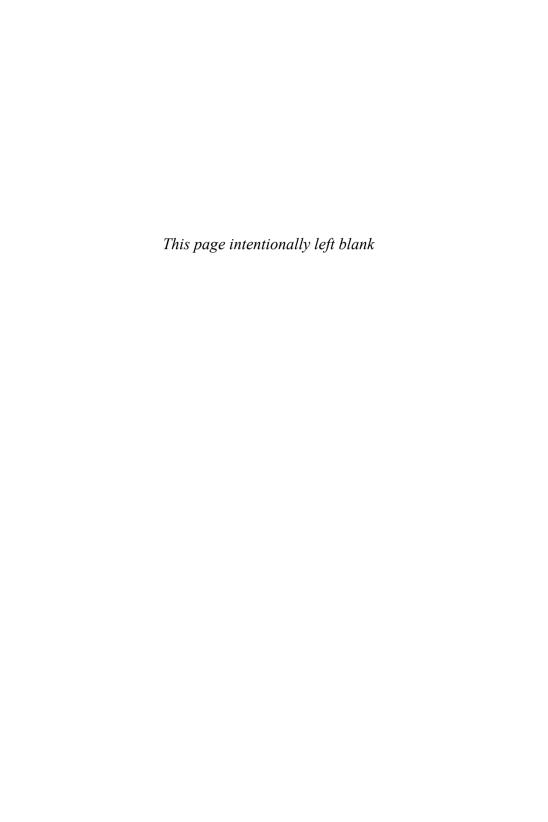
GL: German history, throughout the twentieth century, always occurs to me as incredibly well documented, which forms the basis for books, TV documentaries, exhibitions, and museums. Despite war and destruction, there is so much left that is still waiting to be classified and analyzed. Orderly file keeping has resulted in an overwhelming practice of detailed historical research. The Nazi period and the Holocaust are of course well-known examples. Communist East Germany has produced food for historians for many decades to come. One could also say that this is a guilt-driven industry. Hendryk Broder once said, "There is no business like Shoah business." How do you look at the present storage-driven memory cult? This whole industry is obviously based on archives and continuously creates new archives.

WE: My thesis is that the rhythm of historical memory is directed and triggered by the opening of formerly inaccessible archives and the waves of documents that are then disseminated, feeding the endless production of new texts and books. The Prussian system of state archives (which became a kind of model for both the former Soviet Union and the American state archives) has provided for a perfectly organized memory of official records in politics and culture. In the twentieth century, a unique constellation hit the German archives: although normally state-related documents stay classified for a long period of time, the collapse of the Nazi regime in 1945 led to the immediate opening of the German state archives (for the Nuremberg trials, for instance)—presenting a unique opportunity for historians and the public to know the archives almost in real time, without the usual delay. At least two successive generations of Germans were then permanently confronted with this open archival evidence of war crimes, the Nazi involvement of parents, and so on. A similar thing happened when the

Berlin Wall came down in 1989: suddenly, the most secret archives of the former GDR State Security was open to the public, revealing the state's system of observation to the subjects immediately.

With Holocaust memory in Germany, the case is different. A lot of what happened during this genocide is not only documented in files but also firmly fixed in the memory of the victims—or remains undocumented at all (for the victims who died). At present, we are observing the transition of living memory (survivors) to mediated memory, which is fixed by paper or audiovisual records in order to transmit it to the future.

One more word on future archives in Germany: postwar Germany (after 1945) had a discontinuous relation to the past history of Germany; I myself, having grown up in West Germany, remember that German history before 1945 was something alien to me. Instead the historical consciousness of the postwar generation in Germany that grew up with radio and television now coincides with its media archives—public broadcast archives that are no longer paper based but exist in audiovisual form. The present and future problem is: how can we get access to these new kinds of archives in a nonproprietary mode? Although the state was always concerned about public education, as manifested by the public library network and memory agencies like the state archives, the audiovisual memory of postwar Germany remains with companies that might sell these media archives to private investors. Memory will be commodified; let us be political on this. There is a glimmer of hope, though: with the retroconversion of analog magnetic tapes (radio, TV) to digital storage for preservation reasons, there will be different ways to hack into these digital memories because the digital archives, once online, will not be separated from the "present" anymore. In a way, of course, this will mean the disappearance of the emphatic notion of the archive; it will dissolve into electronic circuits and data flow.



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—J. P.

NOTES

Archival Media Theory

- 1. Geoffrey Winthrop-Young, *Kittler and the Media* (Cambridge, England: Polity 2011), 143–46). See also Axel Roch's recent article written in the wake of Kittler's funeral: Roch, "Hegel Is Dead," *Telepolis*, November 17, 2011, http://www.heise.de/tp/artikel/35/35887/1.html.
- 2. Wolfgang Ernst, Im Namen von Geschichte: Sammeln–Speichern–(Er)Zählen; Infrastrukturelle Konfigurationen des deutschen Gedächtnisses (Munich: Fink, 2003).
- 3. Bernhard Siegert, "Cacophony or Communication? Cultural Techniques in German Media Studies," trans. Geoffrey Winthrop-Young, *Grey Room* 29 (Winter 2008): 28.
- 4. Wolfgang Ernst, "Between Real Time and Memory on Demand: Reflections on/of Television," South Atlantic Quarterly 101, no. 3 (Summer 2002): 625–37; "Telling versus Counting? A Media Archaeological Point of View," Intermédialités 2 (Autumn 2003): 31–44; "Let There Be Irony: Cultural History and Media Archaeology in Parallel Lines," Art History 28, no. 5 (November 2005); "Dis/continuities: Does the Archive Become Metaphorical in Multi-Media Space?," in New Media, Old Media: A History and Theory Reader, ed. Wendy Hui Kyong Chun and Thomas Keenan (New York and London: Routledge, 2006), 105–23; "Media Archaeology: Method and Machine versus History and Narrative of Media," in Media Archaeology: Approaches, Applications, and Implications, ed. Erkki Huhtamo and Jussi Parikka (Berkeley: University of California Press, 2011), 239–55; and Sorlet från arkiven: Ordning ur oordning, trans. Tommy Andersson (Göteborg: Glänta, 2008).

- 5. Friedrich Kittler, "Towards an Ontology of Media," *Theory, Culture, and Society* 26, nos. 2–3 (2009): 23–31.
- 6. Geoffrey Winthrop-Young, *Kittler and the Media* (Cambridge, England: Polity, 2011).
- 7. See Siegfried Zielinski, Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means, trans. Gloria Custance (Cambridge, Mass.: MIT Press, 2006).
- 8. Wolfgang Hagen, Das Radio: Zur Geschichte und Theorie des Hörfunks—Deutschland/USA (Munich: Fink, 2005).
 - 9. Ernst, "Let There Be Irony," 591.
 - 10. Quoted from chapter 9 of this book.
- 11. Cornelia Vismann, *Files: Law and Media Technology,* trans. Geoffrey Winthrop-Young (Stanford, Calif.: Stanford University Press, 2008).
 - 12. Ibid., 592.
 - 13. Ernst, quoted in ibid.
- 14. Ernst, "Medienwissen(schaft) zeitkritisch: Ein Programm aus der Sophienstrasse," inaugural lecture, Humboldt University, Berlin, October 21, 2003, 6.
 - 15. Ibid., 11.
 - 16. Ibid.
 - 17. Ernst, "Let There Be Irony," 597.
- 18. See, for instance, on entanglement, Karen Barad, Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning (Durham, N.C.: Duke University Press, 2007).
- 19. Helmut Lethen, Cool Conduct: The Culture of Distance in Weimar Germany (Berkeley: University of California Press, 2002). Thank you to Geoffrey Winthrop-Young for the heads-up on this context.
- 20. Lisa Gitelman, Always Already New: Media, History, and the Data of Culture (Cambridge, Mass.: MIT Press, 2006).
 - 21. Ernst, "Media Archaeography," 243.
- 22. See Huhtamo and Parikka, eds., *Media Archaeology*. See also Jussi Parikka, *What Is Media Archaeology*? (Cambridge, England: Polity Press, 2012).
- 23. Erkki Huhtamo, "Dismantling the Fairy Engine: Media Archaeology as Topos Study," in *Media Archaeology*, ed. Huhtamo and Parikka, 27–47; Siegfried Zielinski, *Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means*, trans. Gloria Custance (Cambridge, Mass.: MIT Press, 2006); Thomas Elsaesser, "The New Film History as Media Archaeology," *CINÉMAS* 14, nos. 2–3 (2004): 71–117; Lev Manovich, *The Language of New Media* (Cambridge, Mass.: MIT Press,

- 2001); Wendy Hui Kyong Chun, *Programmed Visions: Software and Memory* (Cambridge, Mass.: MIT Press, 2011).
- 24. John Armitage, "From Discourse Networks to Cultural Mathematics: An Interview with Friedrich A. Kittler," *Theory, Culture, and Society* 23, nos. 7–8 (2006): 32–33.
 - 25. Ernst, "Media Archaeography," 239.
 - 26. Ibid., 243.
- 27. Chapter 2 of this volume. For information, see http://www.youtube.com/user/HUMediaStudies and the Fundus wiki: http://www.medientheorien.hu-berlin.de/foswiki/bin/view (both in German).
 - 28. Ibid., 240.
- 29. Cf. Garnet Hertz and Jussi Parikka, "Zombie Media: Circuit Bending Media Archaeology into an Art Method," *Leonardo Journal* 45, no. 5 (2012).
- 30. "Wozu Medientheorie? Wolfgang Ernst und Till Nikolaus von Heiseler im Gespräch," in *Medientheater: Inszenierte Medientheorie*, ed. Till Nikolaus von Heiseler (Berlin: Kadmos, 2008), 33.
 - 31. Ibid., 43.
- 32. On multiplicity of times and mathematical-technical notions of time as well, see Ana Ofak and Philipp von Hilgers, "Einleitung," in *Rekursionen: Von Faltungen des Wissens*, ed. Philipp von Hilgers and Ana Ofak (Munich: Fink, 2010), 7–21.
- 33. See Friedrich Kittler, "The History of Communication Media," *Ctheory*, July 30, 1996, http://www.ctheory.net.
- 34. Wolfgang Ernst, *Chronopoetik und* Gleichursprünglichkeit (Berlin: Kadmos, forthcoming).
- 35. Wendy Hui-Kyong Chun, "The Enduring Ephemeral; or, The Future Is a Memory," in *Media Archaeology*, ed. Huhtamo and Parikka, 184–203.
- 36. Wolfgang Ernst, "Cultural Archive versus Technomathematical Storage," in *The Archive in Motion*, ed. Eivind Røssaak (Oslo: Novus Press, 2010), 53–73.
 - 37. Ibid., 56.
- 38. Matthew G. Kirschenbaum, Richard Ovenden, and Gabriela Redwine, *Digital Forensics and Born-Digital Content in Cultural Heritage Collections*, Council on Library and Information Resources (CLIR) publication 149 (2010), http://www.clir.org Washington.
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- 40. Wolfgang Ernst, ". . . Else Loop Forever': The Untimeliness of Media," talk given at the Il Senso della Fine conference, Centro Internazionale di Semiotica e Linguistica, Universitá degli Studi di Urbino, Urbino, Italy, September 10–12, 2009.

- 41. Ernst, "Cultural Archive versus Technomathematical Storage."
- 42. Ernst, "Between Real Time and Memory on Demand," 634.
- 43. Ernst, "… Else Loop Forever:" See also Claus Pias, "The Game Player's Duty: The User as the Gestalt of the Ports," in *Media Archaeology*, ed. Huhtamo and Parikka, 164–83.
 - 44. Chun, Programmed Visions, 156.
- 45. Ernst, "Between Real Time and Memory on Demand," 627–28. Italics in original.
- 46. Cf. the hyphenated concepts of Félix Guattari with regard to thinking across the classical philosophical epistemes such as ethico-aesthetic. Guattari, *Chaosmosis: An Ethico-aesthetic Paradigm,* trans. Paul Bains and Julian Pefanis (Bloomington: Indiana University Press, 1995).
- 47. Friedrich Kittler, *Optical Media*, trans. Anthony Enns (Cambridge, England: Polity, 2010); Siegert, "Cacography or Communication? Cultural Techniques in German Media Studies."
- 48. Siegert, "Cacography or Communication?," 40. Siegert summarizes the link between aesthetics and technical, physics-based communication media: "Like physics, aesthetics is a science whose primary object is signals, the physical materiality of signs."
 - 49. Ernst, Medienwissen(schaft) zeitkritisch, 20.
 - 50. "Wozu Medientheorie?," 22.
- 51. See Eva Horn, "Editor's Introduction: There Are No Media," *Grey Room* 29 (Winter 2008): 6–13.
- 52. Friedrich Kittler, "There Is No Software," *Ctheory,* October 18, 1995, http://www.ctheory.net.
 - 53. Winthrop-Young, *Kittler and the Media*, 2−3.
 - 54. Ibid., 144.
- 55. Zielinski, Deep Time of the Media; Vismann, Files; Bernhard Siegert, Relays: Literature as an Epoch of the Postal System (Stanford, Calif.: Stanford University Press, 1999); Vilém Flusser, Does Writing Have a Future?, trans. Nancy Ann Roth (Minneapolis: University of Minnesota Press, 2011); Flusser, Into the Universe of Technical Images, trans. Nancy Ann Roth (Minneapolis: University of Minnesota Press, 2011). Earlier translations of Flusser include The Shape of Things: A Philosophy of Design, trans. Anthony Mathews (London: Reaktion, 1999). Further translations of, for instance, Siegert's work are forthcoming, and such publications as "New German Media Theory," ed. Eva Horn, a special issue of Grey Room no. 29 (Winter 2008), has offered important glimpses of a range of theorists. See also Claus Pias, "The Game Player's Duty."

- 56. Eva Horn, "Editor's Introduction: There Are No Media," in "New German Media Theory," 7–8.
- 57. Thank you to Geoffrey Wintrop-Young for pointing out this important differentiation. A special issue of *Theory, Culture, and Society* is also forthcoming on "cultural techniques," featuring various translations of important German authors.
- 58. Claus Pias, "Was Waren Medien-Wissenschaften? Stichworte zu einer Standortbestimmung," in *Was Waren Medien*, ed. Claus Pias (Zürich: Diaphanes, 2011), 14–15.
- 59. See also Siegfried Zielinski's partly personal reflections on the trajectory of media theory in Germany during the past sixty years in Zielinski, *Nach den Medien* (Berlin: Merve, 2011).
- 60. On Kittler's reception in Anglophone academia, see Geoffrey Winthrop-Young, "Krautrock, Heidegger, Bogeyman: Kittler in the Anglosphere," *Thesis Eleven* 107, no. 1 (2011): 16–27.
 - 61. Winthrop-Young, Kittler and the Media, 16-27.

Media Archaeology as a Transatlantic Bridge

- 1. As expressed in Wendy Hui Kyong Chun's introduction, "Did Someone Say New Media?," in *New Media, Old Media: A History and Theory Reader,* ed. Wendy Hui Kyong Chun and Thomas Keenan (New York: Routledge, 2006), 4.
- 2. Kjetil Jakobsen, "Anarchival Society," in *The Archive in Motion: New Conceptions of the Archive in Contemporary Thought and New Media Practices*, ed. Eivind Røssaak (Oslo: Novus, 2010), 141.
 - 3. Heraclit's fragment B8 defines the harmonic juncture of the different.
- 4. The archive "governs the appearance of statements as unique events," whereas archaeology "questions the already-said at the level of its existence [...] and the general archive system to which it belongs." Michel Foucault, *The Archaeology of Knowledge* (New York: Tavistock, 1972), 129 and 131.
- 5. Mark B. N. Hansen, *New Philosophy of New Media* (Cambridge, Mass.: MIT Press, 2004), 13. See Henri Bergson, *Matter and Memory* (New York: Zone Books, 1988), 35–36.
- 6. Geoffrey Winthrop-Young, "Cultural Studies and German Media Theory," in *New Cultural Studies*, ed. Gary Hall and Clare Birchall (Edinburgh: Edinburgh University Press, 2006), 100.
- 7. In their introduction to *Critical Terms for Media Studies* (Chicago: University of Chicago Press, 2010), the editors, W. J. T. Mitchell and Mark B. N. Hansen, take the title of Marshall McLuhan's seminal *Understanding Media* (1964) at face value: understanding current culture from the perspective of media.

- 8. Siegfried Zielinski, *Deep Time of the Media: Towards an Archaeology of Hearing and Seeing by Technical Means,* trans. Gloria Custance (Cambridge, Mass.: MIT Press, 2006), and the book series *Variantology* edited by Zielinski, starting with volume 1 (coedited with Silvia M. Wagnermaier): *Variantology: On Deep Time Relations of Arts, Sciences, and Technologies* (Cologne: Walther König, 2005).
 - 9. See Axel Volmar, ed., Zeitkritische Medien (Berlin: Kadmos, 2009).
- 10. See Erkki Huhtamo and Jussi Parikka, "An Archaeology of Media Archaeology," in *Media Archaeology: Approaches, Applications, and Implications,* ed. Huhtamo and Parikka (Berkeley: University of California Press, 2011).
- 11. See Jay David Bolter and Richard Grusin, Remediation: Understanding New Media (Cambridge, Mass., 1999), and Lisa Gitelman, Always Already New: Media, History, and the Data of Culture (Cambridge, Mass.: MIT Press, 2006).
- 12. Friedrich Kittler passed away in October 2011, aged 68. Hopefully this discontinuity will not serve as another pretext to historicize his impact on media studies, that is, his decisively technological analysis of how culture is being engineered. Media still determine our situation, as stated in the incipit of Friedrich Kittler, *Gramophone, Film, Typewriter*, trans. Geoffrey Winthrop-Young and Michael Wutz (Palo Alto, Calif.: Stanford University Press, 1999). Probably the English translation blurs the subtle overtones of Kittler's statement in its German original (Berlin 1986): "Medien bestimmen unsere Lage." *Lage* is the technical term for the military analysis in the operational room, and *bestimmen* resonates with the notion of frequencies.
- 13. On the oscillating clock and its progressive detachment from its original locus in the monasteries of medieval Europe, see Wolfgang Ernst, "Beating Clock, Oscillating String: Vibrating Time-Sense between Religion and Machine," in *Deus in Machina: Essays on Religion and Technology in Historical and Cross-Cultural Perspective*, ed. Jeremy Stolow (New York: Fordham University Press, forthcoming).
- 14. As an example of a sharpened view, see Friedrich Kittler, *Optical Media: Berlin Lectures 1999*, trans. Anthony Enns (Cambridge, England: Polity Press, 2010).
- 15. On "media studies without people" (referring to Kittler before his re/turn to the human factor of knowledge in ancient Greece), see John Durham Peters, "Introduction: Friedrich Kittler's Light Shows," in Kittler, *Optical Media*, 5.
- 16. See Ferdinand Bucholtz, ed., *Der Gefährliche Augenblick: Eine Sammlung von Bildern und Berichten,* with an introduction by Ernst Jünger (Berlin: Junker und Dünnhaupt, 1931).
- 17. "The avant-garde strategy of collage reemerged as a 'cut and paste' command, the most basic operation one can perform on digital data." Lev Manovich, "What Is Digital Cinema?," http://www.manovich.net/TEXT/digital-cinema.html (accessed

- January 2011). See Manovich, *Engineering Vision: From Constructivism to the Computer* (Austin: University of Texas Press, forthcoming).
- 18. Lev Manovich, *The Language of New Media* (Cambridge, Mass.: MIT Press, 2001).
- 19. For a case study in the discourse-orientated approach to past media, see Carolyn Marvin, When Old Technologies Were New: Thinking about Electric Communication in the Late Nineteenth Century (New York: Oxford University Press, 1988). A productive in-between position of media analysis is seen in Erkki Huhtamo's new book Illusions in Motion: A Media Archaeology of the Moving Panorama and Related Spectacles (Cambridge, Mass.: MIT Press, forthcoming).
- 20. See the editors' introduction in *New Cultural Studies*, ed. Hall and Birchall, 1–28, and Caroline Bassett, "Cultural Studies and New Media," in ibid., 220–37.
- 21. As an exemplary study from the German side, see Cornelius Borck, *Hirnströme: Eine Kulturgeschichte der Elektroenzephalographie* (Göttingen: Wallstein, 2005), and Borck, "Electricity as a Medium of Psychic Life: Electrotechnical Adventures into Psychodiagnosis in Weimar Germany," *Science in Context* 14 (2001): 565–90.
- 22. See Matthew Fuller, ed., Software Studies: A Lexicon (Cambridge, Mass.: MIT Press, 2008), and Jussi Parikka, Digital Contagions: A Media Archaeology of Computer Viruses (New York: Peter Lang, 2007).
- 23. See Matthew G. Kirschenbaum, *Mechanisms: New Media and the Forensic Imagination* (Cambridge, Mass.: MIT Press, 2008).
- 24. With an early interest in material archaeology and textual philology, the author once studied ancient history, classical archaeology, and Latin at the universities of Cologne, London, and Bochum.
- 25. Notably during a research year at the German Historical Institute in Rome, 1991–92.
- 26. Mitchell and Hansen, in *Critical Terms for Media Studies*, take "memory" as a key term in current media studies.
- 27. An explicit argument in Jean-François Lyotard, *The Postmodern Condition:* A Report on Knowledge, trans. Geoff Bennington and Brian Massumi (Manchester, England: Manchester University Press, 1984).
- 28. See Frederik Stjernfelt, Diagrammatology: An Investigation on the Borderlines of Phenomenology, Ontology, and Semiotics (Dordrecht: Springer, 2007).
- 29. In an exemplary way, the cover of Friedrich Knilli's analysis of the radio play has been illustrated not by allegories of communication but by technical drawings: psychoacoustic parameters and diagrams. *Das Hörspiel: Mittel und Möglichkeiten eines totalen Schallspiels* (Stuttgart: Kohlhammer, 1961).

- 30. See Wolfgang Ernst, "Media Archaeography: Method and Machine versus History and Narrative of Media," in *Media Archaeology*, ed. Huhtamo and Parikka, 239–55. The term "archaeography" is meant to indicate alternative models of thinking the being of media in (emphatic) time, thus an alternative to narrative historiography.
- 31. Jonathan Sterne, "The MP3 as Cultural Artefact," New Media and Society 5 (2006): 825-42.
- 32. Although an analog signal might be digitized and reproduced without a loss according to the sampling theorem (Nyquist–Shannon) in respect to the human ear, computational intelligence itself still knows the difference, which becomes crucial in time-critical situations of signal processing. See Jonathan Sterne and Tara Rodgers, "The Poetics of Signal Processing," in "The Sense of Sound," special issue, *Differences: Journal of Feminist Cultural Studies* 22, nos. 2–3 (November 2011).
- 33. With the museum as both material and immaterial architecture in the material and visual representation of history, the author discovered his first "medium," resulting in the published Ph.D. thesis *Historismus im Verzug: Museale Antike(n)rezeption im britischen Neoklassizismus (und jenseits)* (Hagen, Germany: Margit Rottmann Medienverlag, 1992). Parallel to his turning into a media archaeologist in its proper sense during his assistantship at the Cologne Academy of Media Arts (1995–99), the author's habilitation thesis aimed at uncovering the hidden agencies and nondiscursive mechanisms (the technological infrastructure) of constructing collective memory (archives, libraries, museums, inventories, source editions, and data banks): *Im Namen von Geschichte: Sammeln–Speichern–(Er)Zählen; Infrastrukturelle Konfigurationen des deutschen Gedächtnisses* (Munich: Fink, 2003).
- 34. For Michel Foucault, the term *archaeology* explicitly "does not relate analysis to a geological excavation." Foucault, *The Archaeology of Knowledge*, 129.
 - 35. Kittler, Gramophone, Film, Typewriter, 5.
- 36. "Postisms," which dominated the intellectual avant-garde in the 1980s, have left their stamp on the present collection of essays, be it postmodernism (Lyotard), post-histoire (Baudrillard), or poststructuralism (Lacan). For a media archaeologist whose primary concern is to understand computer culture, it is just one step from Jacques Derrida's *Grammatology* to diagrammatics.
- 37. Vilém Flusser, as cited in Strohl's introduction to Vilém Flusser, *Writings* (Minneapolis: University of Minnesota Press, 2002), xxxiii.
- 38. Hayden White, *Metahistory: The Historical Imagination in Nineteenth-Century Europe* (Baltimore: Johns Hopkins University Press, 1973).
- 39. Hayden White, "The Value of Narrativity in the Representation of Reality," *Critical Inquiry* 7, no. 1 (Autumn 1980): 5–27.

- 40. On the neuroprocessual time frame ("window of simultaneity") that counts as the human experience of "presence," see Francisco Varela, "The Specious Present: A Neurophenomenology of Time Consciousness," in *Naturalizing Phenomenology: Issues in Contemporary Phenomenology and Cognitive Science,* ed. Jean Petitot, Francisco J. Varela, Bernard Pachoud, and Jean-Michel (Stanford, Calif.: Stanford University Press, 1999), esp. 272–73 and 276–77.
 - 41. See Hansen, New Philosophy for New Media, chap. 7, 235-68.
- 42. As paraphrased by Tim Lenoir in his foreword to Hansen, New Philosophy for New Media, xxvi.
- 43. See Bill Viola, "The Sound of One Line Scanning," in *Sound by Artists*, ed. Dan Lander and Micah Lexier (Toronto: Art Metropole and Walter Phillips Gallery, 1990), 39–54. While entries such as "time," "temporality," and "vision" figure prominently in the index of Hansen's book, "acoustic," "sonic," and "music as time-based art" are missing.
- 44. As expressed by Shintaro Miyazaki in his Ph.D. thesis, "Algorhythmisiert: [Trans]sonische Archäologien digitaler Gefüge," Faculty of Philosophy III, Humboldt University, Berlin, 2011.

I. The Media-Archaeological Method

- 1. Bernhard Siegert, "Cacophony or Communication? Cultural Techniques in German Media Studies," trans. Geoffrey Winthrop-Young, *Grey Room* 29 (Winter 2008): 28.
 - 2. Michel Foucault, "Message ou bruit?," in Dits et Écrits I (Paris: Gallimard, 1994).

1. Let There Be Irony

- 1. Stephen Bann, "'Views of the Past': Reflections on the Treatment of Historical Objects and Museums of History," in *The Inventions of History* (New York: Manchester University Press, 1990), 122.
- 2. See Vanessa R. Schwartz, Spectacular Realities: Early Mass Culture in Fin-desiècle Paris (Berkeley: University of California Press), 1998.
- 3. Abigail Solomon-Godeau, review of Stephen Bann's *Parallel Lines, Visual Resources* 18 (2002): 220.
- 4. Letter dated September 15, 1837, Collection of Miss Rosalie Gandy, quoted in Brian Lukacher, "Phantasmagoria and Emanation: Lighting Effects in the Architectural Fantasies of Joseph Michael Gandy," *Files of the Architectural Association* 4 (1984): 47.
 - 5. "Die technische Organisation der Weltöffentlichkeit durch den Rundfunk . . .

ist die eigentliche Herrschaftsform des Historismus." Martin Heidegger, "Der Spruch des Anaximander," in *Holzwege* (Frankfurt on the Main: Klostermann, 1950), 301.

- 6. Stephen Bann, Romanticism and the Rise of History (New York: Twayne, 1995), 88.
- 7. Stephen Bann, "Historical Text and Historical Object: The Poetics of the Musée de Cluny," *History and Theory* 17, no. 3 (1978): 251.
- 8. See Wolfgang Ernst, "Not Seeing Laocoön? Lessing in the Archive of the Eighteenth Century," in *Regimes of Description: In the Archive of the Eighteenth Century*, ed. John Bender and Michael Marrinan (Stanford, Calif.: Stanford University Press, 2005), 118–34.
- 9. Stephen Bann, Parallel Lines: Printmakers, Painters, and Photographers in Nineteenth-Century France (New Haven, Conn.: Yale University Press, 2001), 58.
- 10. Stephen Bann, "Three Translators: Silhouette, Barante, Rossetti," *Twentieth-Century Studies* 11 (September 1974): 86–101.
- 11. Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Vintage Books and Random House, 1994), 387.
- 12. Walter Benjamin, "The Work of Art in the Age of Mechanical Reproduction," in *Illuminations*, ed. Hannah Arendt, trans. Harry Zohn (New York: Schocken, 1978 [1969]), 217–51.
- 13. Barbara Maria Stafford, Body Criticism: Imaging the Unseen in Enlightenment Art and Medicine (Cambridge, Mass.: MIT Press, 1993), 54–55.
 - 14. Bann, Romanticism, 130.
- 15. See Ségolène Le Men, "Printmaking as Metaphor for Translation: Philippe Burty and the Gazette des Beaux-Arts in the Second Empire," in *Art Criticism and Its Institutions*, ed. Michael Orwicz (Manchester, England: Manchester University Press, 1994), 88–108.
- 16. William M. Ivins, *Prints and Visual Communication* (Cambridge, Mass.: MIT Press, 1953); Benjamin, "The Work of Art."
- 17. Stephen Bann, "Clio in Part: On Antiquarianism and the Historical Fragment," *Perspecta: The Yale Architectural Journal* 23 (1987): 27.
- 18. André Bazin, "Ontologie de l'image photographique," in *Qu'est-ce que le cinéma?* (Paris: Cerf, 1987), 9–17.
- 19. See Susanne Holschbach, "TV-Stillgestellt: Fotografische Analysen gegenwärtiger Fernsehkultur," in *Fernsehperspektiven: Aspekte zeitgenössischer Medienkultur,* ed. Sabine Flach and Michael Grisko (Munich: Kopäd, 2000), 213–14, referring to Siegfried Kracauer's theories on photography.
 - 20. As explained in Bann, Romanticism, xiii.

- 21. See also H. D. Gower, L. Stanley Jast, and W. W. Topley, *The Camera as Historian* (London: Sampson Low, Marsten and Co., 1916).
 - 22. Bann, Romanticism, 7.
- 23. Stephen Bann, The Clothing of Clio: A Study of the Representation of History in Nineteenth-Century Britain and France (Cambridge, England: Cambridge University Press, 1984), xx.
- 24. Hayden White, *Metahistory: The Historical Imagination in the Nineteenth Century* (Baltimore: John Hopkins University Press, 1973); Lev Manovich, *The Language of New Media* (Cambridge, Mass.: MIT Press, 2001).
- 25. Hayden White, "The Value of Narrativity in the Representation of Reality," *Critical Inquiry* 7, no.1 (1980): 5–27.
- 26. Leopold von Ranke, preface to his *Geschichten der romanischen und germanischen Völker von 1494 bis 1535* (Berlin: Georg Reimer, 1824), vi. Both the translatability and the implications of this phrase are discussed in Bann, *The Clothing of Clio*, 8ff.
- 27. "Ranke ist ein Grobes okular" (Ranke is an ocular Historian), letter from Paul Yorck von Wartenburg to Wilhelm Dilthey, July 6, 1886, quoted in Martin Heidegger, Sein und Zeit (Tübingen: Niemeyer, 1980), 400.
- 28. Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: University of Chicago Press, 1983).
- 29. Stephen Bann, *Under the Sign: John Bargrave as Collector, Traveler, and Witness* (Ann Arbor: University of Michigan Press, 1994), 15–16.
- 30. See Konrad Repgen, "Über Rankes Diktum von 1824: Bloss sagen, wie es eigentlich gewesen," Historisches Jahrbuch 102 (1982): 440.
- 31. Marshall McLuhan, *The Gutenberg Galaxy: The Making of Typographic Man* (Toronto: University of Toronto Press, 1962), and *Understanding Media: The Extensions of Man* (London: Routledge, 1964).
- 32. Roland Barthes, *Die helle Kammer: Bemerkungen zur Photographie* (Frankfurt am Main: Suhkamp, 1985), 90; *La Chambre Claire: Note sure la photographie* (Paris: Gallimard, 1980).
- 33. See Richard Hobbs, "Boltanski's Visual Archives," History of the Human Sciences 11, no. 4 (1998), 126.
 - 34. McLuhan, Understanding Media and Gutenberg Galaxy.
 - 35. Bann, Romanticism, 125. Italics in original.
- 36. Michel Foucault, *Archaeology of Knowledge* (New York: Pantheon, 1999), introduction.
 - 37. Bann, Romanticism, 127.
 - 38. Bann, The Clothing of Clio, 88.

- 39. Ibid., 133.
- 40. Visuality before and beyond the Renaissance, ed. Robert S. Nelson (Cambridge, England: Cambridge University Press, 2000), quoting Daguerre, Bann, and Fox Talbot.
- 41. See Hubertus von Amelunxen, Die aufgehobene Zeit: Die Erfindung der Photographie durch William Henry Fox Talbot (Berlin: Nishen, 1988), quoting Bann.
 - 42. See ibid.
 - 43. McLuhan, Understanding Media, 89ff.
- 44. See Matthias Bickenbach, "Geschwindigkeit ist Hexerei: Be- und Entschleunigung in der Kunst der Gegenwart," in *Fast forward: Essays zu Zeit und Beschleunigung*, ed. Hartmut Rosa (Hamburg: Edition Körber-Stiftung, 2004), 133–44.
- 45. Morse is discussed in Beaumont Newhall, *Geschichte der Photographie* (Munich: Schirmer and Mosel, 1998), 16.
- 46. This title refers to Hilaire Belloc, *First and Last*, 3rd ed. (London: Methuen, 1924), 48–52.
 - 47. Quoted in Bann, Romanticism, 150.
 - 48. Bann, Inventions, 137.
- 49. See Stephen Bann, "Das ironische Museum," in *Geschichte sehen: Beiträge zur Ästhetik historischer Museen*, ed. Jörg Rüsen, Wolfgang Ernst, and Heinrich Theodor Grütter (Pfaffenweiler: Centaurus, 1988), 63–68.
 - 50. Bann, Inventions, 215.
- 51. Hayden White, *Tropics of Discourse: Essays in Cultural Criticism* (Baltimore: Johns Hopkins University Press, 1978), 4.
 - 52. Bann, Inventions, 142.
- 53. An obvious reference to Douglas Crimp, On the Museum's Ruins (Cambridge, Mass.: MIT Press, 1993), 55ff.
- 54. From the second volume of John Sell Cotman, Architectural Antiquities of Normandy (London: J. A. Arch, 1819–22); Bann, Romanticism, 117.
 - 55. Bann, Romanticism, 150.

2. Media Archaeography

- 1. See Walter Benjamin, "Excavation and Memory," in *Selected Writings*, vol. 2, 1927–1934 (Cambridge, Mass.: Harvard University Press, 1999), 576. Benjamin compares "authentic memory" with "a good archaeological report."
- 2. An exemplary study is Claus Pias, *Computer Spiel Welten* (Vienna: Sonderzahl, 2002).
- 3. Martin Heidegger, Überlieferte Sprache und technische Sprache [lecture, 1962] (St. Gallen, Switzerland: Erker, 1989), 19.

- 4. Quoted in Erkki Huhtamo, "From Kaleidoscomaniac to Cybernerd: Notes toward an Archeology of the Media," *Leonardo* 30, no. 3 (1997): 221.
- 5. See Charles Süsskind, "Hertz and the Technological Significance of Electromagnetic Waves," in *Philosophers and Machines*, ed. Otto Mayr (New York: Science History Publications, 1976), 193.
- 6. Martin Heidegger, Sein und Zeit (Tübingen: Max Niemeyer, 1986), 380. "Inwiefern ist dieses Zeug geschichtlich, wo es doch noch nicht vergangen ist? . . . Was ist 'vergangen'? . . . Die Welt ist nicht mehr. Das vormals Innerweltliche jener Welt aber ist noch vorhanden. . . . Welt ist nur in der Weise des existierenden Daseins, das als Inder-Welt-sein faktisch ist." Italics in original.
- 7. See, e.g., the spectrogram of a reconstructed recording of Wedda chants in Ceylon in 1907 on the SpuBiTo Web page, http://www.gfai.de/projekte/spubito/index.htm (accessed December 11, 2008).
- 8. See Karl Sierek, "Die weiße Leinwand," in Aus der Bildhaft: Filmanalyse als Kinoästhetik (Vienna: Sonderzahl, 1993), 122. The passage refers to Umberto Eco, Einführung in die Semiotik (Munich: Wilhelm Fink [UTB 105], 1972), 263–64.
- 9. See the reports contained in a file on early experimental use of the "Magnetophon" in the AEG-Telefunken-Archives, located at the Berlin Museum of Technology. Electronic recording of sound practically starts with Valdemar Poulsen's wire recorder, the Telegraphon (1898).
- 10. See Webster-Chicago Corporation, "A Photofact Standard Notation Schematic of Webster Wire Recorder Model 80–1," 1948, http://www.webster-chicago.com/80sch.jpg (accessed February 19, 2009).
- 11. Walter Benjamin, "Der Erzähler," in *Gesammelte Schriften*, vol. 2.2 (Frankfurt am Main: Suhrkamp, 1972), 439.
- 12. Barry Powell, *Writing and the Origins of Greek Literature* (Cambridge, England: Cambridge University Press, 2002), 6.
- 13. Denise Schmandt-Besserat, *Before Writing*, vol. 1, *From Counting to Cuneiform* (Austin: University of Texas Press, 1992).
- 14. See Wolfgang Hagen, *Das Radio: Zur Geschichte und Theorie des Hörfunks* (Munich: Wilhelm Fink, 2005), 1–111.
 - 15. Powell, Writing and the Origins, 7.
- 16. See Wolfgang Ernst and Friedrich Kittler, eds., Die Geburt des Vokalalphabets aus dem Geist der Poesie: Schrift, Ton und Zahl im Medienverbund (Munich: Wilhelm Fink, 2006).
- 17. See Wolfgang Ernst, "Dis/continuities: Does the Archive Become Metaphorical in Multi-media Space?" in New Media, Old Media: A History and Theory Reader,

- ed. Wendy Hui Kyong Chun and Thomas Keenan (New York: Routledge, 2006), 105–23.
- 18. See Das Berliner Phonogramm-Archiv, 1900–2000: Sammlungen der traditionellen Musik der Welt, ed. Artur Simon (Berlin: VWB, 2000), 209–15.
- 19. To see one of these early recordings, go to Thomas Weynants's Web site "Early Visual Media," 2003, http://users.telenet.be/thomasweynants/television.html.
- 20. Don McLean, "The World's Earliest Television Recordings," May 2007, http://www.tvdawn.com.
- 21. Heinz Richter, Fernsehen für Alle: Eine leichtverständliche Einführung in die Fernseh-, Sende- und Empfangstechnik (Stuttgart: Franckh, 1962), 222.
- 22. Siegfried Zielinski, "Supervision und Subversion: Für eine Anarchäologie des technischen Visionierens," in *Konturen des Unentschiedenen: Interventionen*, ed. Jörg Huber and Martin Heller (Basel: Stroemfeld, 1997), 186.
- 23. James Cameron, foreword to Joel Avirom and Jason Snyder, *James Cameron's Titanic* (New York: Harper Perennial), xii.
 - 24. Ibid.
 - 25. Michel Foucault, Archaeology of Knowledge (New York: Pantheon, 1999), 16.
- 26. The term "digital retroaction" is taken from the title of a conference organized by William Warner at the University of California–Santa Barbara: Digital Retroaction: A Research Symposium, September 17–19, 2004.
- 27. Paul Virilio, "Technik und Fragmentierung," in Aisthesis: Wahrnehmung heute, ed. Karlheinz Barck et al. (Leipzig: Reclam, 1990), 71. See Dieter Thomä, "Zeit, Erzählung, Neue Medien," in Zeit–Medien–Wahrnehmung, ed. Mike Sandbothe and Walther Ch. Zimmerli (Darmstadt, Germany: Wiss. Buchges, 1994), 89–110.
 - 28. See also chapter 8, where these points are elaborated.
- 29. "Alles Wunderbare . . . , das wir gerade an den Naturgesetzen anstaunen, . . . liegt gerade und ganz allein nur in der mathematischen Strenge und Unverbrüchlichkeit der Zeit- und Raum-Vorstellungen." Friedrich Nietzsche, "Ueber Wahrheit und Lüge im aussermoralischen Sinne" [1873], in *Friedrich Nietzsche, Kritische Studienausgabe*, vol. 1, ed. Giorgio Colli and Mazzino Montinari (Munich: Deutscher Taschenbuch, 1988), 885–86.
- 30. Martin Stingelin, "Das Netzwerk von Gilles Deleuze oder Der nichtlineare Begriff des Begriffs," *Kunstforum International* 155 (2001): 166.
- 31. "Die Natur wird daraufhin gestellt, sich in einer berechenbaren Gegenständlichkeit zu zeigen (Kant)." Heidegger, Überlieferte Sprache, 17.
- 32. The Greek notion derives from the linguistic root w(e)id = to see, to know—as in "video"—a derivation contested by Edwin D. Floyd, "The Sources of Greek (H)Istor—'Judge, Witness," Glotta 68 (1990): 157–66.

- 33. On the shift from tool to machine technology, see Bernhard Dotzler, *Papiermaschinen: Versuch über Communication und Control in Literatur und Technik* (Berlin: Akademie, 1996).
- 34. Martin Kusch, "Discursive Formations and Possible Worlds: A Reconstruction of Foucault's Archeology," *Science Studies* 1 (1989): 17.
- 35. George David Birkhoff, "Quelques éléments mathématiques de l'art," 1950, reprinted in *George David Birkhoff: The Collected Mathematical Papers*, vol. 3 (New York: Dover Publications, 1968), 288–306.
- 36. When Cybernetics Meets Aesthetics was the title of a conference organized by the Ludwig Boltzmann-Institute for Media.Art.Research in Linz, Austria, August 31, 2006, on the occasion of the Ars Electronica festival of media arts.
- 37. Gregory Benford, "Time Shards," in *Universe 9*, ed. Terry Carr (New York: Fawcett Popular Library, 1979), 88–98.
- 38. Wolfgang M. Heckl, "Fossil Voices," in *Durability and Change: The Science, Responsibility, and Cost of Sustaining Cultural Heritage*, ed. W. E. Krumbein et al. (New York: John Wiley, 1994), 292–98.

II. Temporality and the Multimedial Archive

1. See Norbert Bolz, Am Ende der Gutenberg-galaxis: Die neuen Kommunikationsverhältnisse (Munich: Wilhelm Fink, 1995).

3. Underway to the Dual System

- 1. http://www.europeana.eu/portal (accessed August 6, 2012).
- 2. See the chapters by Gunther Reisinger and Robert Sakrowski in the collection *Netpioneers 1.o: Contextualizing Early Net-Based Art,* ed. Dieter Daniels and Gunther Reisinger (Berlin: Sternberg Press, 2009).
- 3. See *Permanence through Change: The Variable Media Approach*, ed. Alain Depocas, Jon Ippolito, and Caitlin Jones (New York: Guggenheim Museum, 2003). http://www.variablemedia.net/e/preserving/html/var_pub_index.html.
- 4. See Georges Didi-Huberman and Knut Ebeling, *Das Archiv brennt* (Berlin: Kulturverlag Kadmos, 2007).
- 5. Warren Weaver, "Recent Contributions to the Mathematical Theory of Communication," in Warren Weaver and Claude Shannon, *The Mathematical Theory of Communication* (Urbana: University of Illinois Press, 1963), 8. Italics in original.
- 6. Netpioneers 1.0: Archiving, Contextualising and Re-presenting Netbased Art, staged online. See the chapters by Robert Sakrowski, Dieter Daniels, and Gunther Reisinger in Netpioneers 1.0: Contextualizing Early Net-Based Art.

- 7. Moritz Baßler talks of "archive-immanent structuralism." See his *Die kultur-poetische Funktion und das Archiv: Eine literaturwissenschaftliche Text-Kontext-Theorie* (Tübingen: Francke, 2005).
- 8. HILUS was hosted by THE THING Vienna. The early Net-art framework THE THING Vienna will be restored and put to art-historical scrutiny in the context of the LBI research project Netpioneers 1.0. See http://www.thing.at.
- 9. See Alexander Galloway, *Protocol: How Control Exits after Decentralization* (Cambridge, Mass.: MIT, 2004).
- 10. Arlette Farge, "Le travail en archives oblige forcément à des opérations de tri, de séparation des documents," in *Le Goût de l'archive*, trans. "JP" (Paris: Seuil, 1989), 87.
- 11. Brewster Kahle, "Preserving the Internet," *Scientific American* 276, no. 3 (1997): 83.
- 12. See "Ein erster Schritt auf dem Wege zum Hifi-Fernsehen," Funk-Technik 39, no. 1 (1984): 15.
 - 13. Peter Krapp, e-mail to the author, January 24, 1997.
- 14. John Battelle, Die Suche: Geschäftsleben und Kultur im Banne von Google & Co. (Kulmbach: Börsenmedien AG, 2006), 89.
- 15. Trudy H. Peterson, "Machine Readable Records as Archival Material," *Archivum* 35 (1989): 88.
- 16. Boris Groys, *Unter Verdacht: Eine Phänomenologie der Medien* (Munich: Hanser, 2000), 21.
- 17. On the connection of art and media theory, see Günther Reisinger, "Digital Source Criticism: Net Art as a Methodological Case Study," in *Netpioneers 1.0,* 123–42. See also Dieter Daniels, *Kunst als Sendung: Von der Telegrafie zum Internet* (Munich: Beck, 2002).
- 18. Marshall McLuhan, Die magischen Kanäle: "Understanding Media" (Düsseldorf: Econ, 1968), 24.
- 19. Wulf Herzogenrath, "Der Fernseher als Objekt: Videokunst und Videoskulptur in vier Jahrzehnten," in *TV-Kultur: Das Fernsehen in der Kunst seit 1879,* ed. Wulf Herzogenrath, Thomas W. Gaehtgens, Sven Thomas, and Peter Hoenisch (Amsterdam: Kunst, 1997), 113.
- 20. Volker Kahl, "Interrelation und Disparität: Probleme eines Archivs der Künste," in Archivistica docet: Beiträge zur Archivwissenschaft und ihres interdisziplinären Umfelds, ed. Friedrich Beck (Potsdam, Germany: Verlag für Berlin-Brandenburg, 1999), 254.
- 21. Jens Schröter, "Einige Bemerkungen über löschbare Bilder," in the catalogue *Videokunstfest Bochum 2000*, 116.

- 22. See Stefan Heidenreich, FlipFlop: Digitale Datenströme und die Kultur des 21. Jahrhunderts (Munich: Hanser, 2004).
- 23. Ray Edmondson, "AV Archiving Philosophy: The Technical Dimension," *Papers of the IAMI-IASA Joint Annual Conference, Perugia, 1996,* no. 8 (November 1996), 28–35; quote on 29.
 - 24. Version 1.0 downloadable at http://mmk.f4.fhtw-berlin.de.
- 25. George R. Stibitz, "Digital Computation for A. A. Directors," typescript memo of a conference on electronic antiaircraft fire control, quoted in a lecture by Robert Dennhardt, "Die Flipflop-Legende und das Digitale," given at the congress Kulturtechniken der Synchronisation: Adressieren Speichern Takten, Helmholtz-Zentrum für Kulturtechnik der Humboldt-Universität Berlin, February 1–3, 2007.
 - 26. Freely formulated after Renate Flagmeier (Werbund-Archiv Berlin).
- 27. Michael Wettengel, "Technische Infrastruktur für die Archivierung von digitalen Datenbeständen: Anforderungen und Verfahrensweisen," Europäische Archivnachrichten INSAR, Supplement 2 (1997): 190–98.
- 28. Bernard Stiegler, *Technics and Time 2: Disorientation,* trans. Stephen Barker (Stanford, Calif.: Stanford University Press, 2009), 126. Translation modified.
- 29. Doron Swade, "Collecting Software: Preserving Information in an Object-Centred Culture," *History and Computing* 4, no. 3 (1992): 206–10.

4. Archives in Transition

- 1. See also Wendy Hui Kyong Chun, *Programmed Visions: Software and Memory* (Cambridge, Mass.: MIT Press, 2011).
- 2. See DIN 44300 (Deutsches Institute für Normung), Informationsverarbeitung: Begriffe, March 1982.
- 3. Mark S. Ackerman and Christine A. Halverson, "Reexamining Organizational Memory," *Communications of the ACM* 43, no. 1 (January 2000): 63. See as well Niklas Luhmann, "Zeit und Gedächtnis," *Soziale Systeme: Zeitschrift für soziologische Theorie* 2 (1996): 307–30.
- 4. "Glossary," in Edward B. Magrab and Donald S. Blomquist, *The Measurement of Time-Varying Phenomena* (New York: Wiley, 1971), 314.
- 5. See Kilian Hirt, "Das Übertragungsproblem in der elektrischen Nachrichtentechnik," master's thesis, Humboldt University, Berlin, June 2007, 6.
- 6. Sigmund Freud, letter to Fließ, December 6, 1896, in *The Standard Edition of the Complete Works of Sigmund Freud,* vol. 1 (1886–1899), ed. James Strachey (London: Hogarth, 1966), 233–39.

5. Between Real Time and Memory on Demand

- 1. Hans-Magnus Enzensberger, Baukasten zu einer Theorie der Medien: Kritische Diskurse zur Pressefreiheit, ed. Peter Glotz (Munich: Fischer, 1997), 150 and 168.
- 2. Walter Benjamin, "Vorstufen zum Erzähler-Essay," in *Gesammelte Schriften*, vol. 2, pt. 3 (Frankfurt: Suhrkamp, 1991), 1282: "Man kann all diese Dinge als ewig ansehen (Erzählen z. B.), man kann sie aber auch als durchaus zeitbedingt und problematisch, bedenklich ansehen. Ewiges im Erzählen. Aber wahrscheinlich ganz neue Formen. Fernsehen, Grammophon etc. machen all diese Dinge bedenklich. Quintessenz: So genau wollen wir's ja garnicht wissen. Warum nicht? Weil wir Furcht haben, begründete: daß das alles desavouiert wird: die Schilderung durch den Fernseher, die Worte des Helden durchs Grammophon, die Moral von der Geschichte durch die nächste Statistik, die Person des Erzählers durch alles, was man von ihr erfahrt. . . . *Tant mieux*. Nicht weinen. Der Unsinn der kritischen Prognosen. Film statt Erzählung." Italics in original. See also Jochen Hörisch, *Ende der Vorstellung: Die Poesie der Medien* (Frankfurt: Suhrkamp, 1999), 258–59.
 - 3. Knut Hickethier, Film- und Fernsehanalyse (Stuttgart: Metzler, 1993), 434–35.
 - 4. Ibid., 156, using Vienna by Univox (MTV, 1992) as an example.
 - 5. Ibid., 158.
- 6. Cf. also Stefan Heidenreich, "Bilderströme: Lineare und nichtlineare Relationen zwischen Bildern," *Kunstforum International* 155 (June–July 2001): 243–48.
- 7. "Kunde von Dingen geben," a term obviously taken from Herodotus's Historia. Cf. Fritz Heider, "Ding und Medium" [1926], in Kursbuch Medienkultur: Die maßgeblichen Theorien von Brecht his Baudrillard, ed. Claus Pias, Joseph Vogl, and Lorenz Engell (Stuttgart: Deutsche Verlags-Anstalt, 1999), 329; translated as Fritz Heider, "Thing and Medium," Psychological Issues 1, no. 3 (1959): 1–31.
- 8. James Monaco, *How to Read a Film: The World of Movies, Media, and Multimedia: Language, History, Theory, 4th ed.* (New York: Oxford University Press, 2009), 170.
- 9. Michael Thompson, Rubbish Theory: The Creation and Destruction of Value (New York: Oxford University Press, 1979).
 - 10. Hickethier, Film- und Fernsehanalyse, 434.
- 11. Samuel M. Weber, "Television: Set and Screen," in *Mass Mediauras* (Stanford, Calif.: Stanford University Press, 1996), 108.
 - 12. Ibid., 115 n. 5.
- 13. Siegfried Zielinski, *Video: Apparat/Medium, Kunst, Kultur* (Frankfurt am Main: Peter Lang, 1992), 9.
- 14. Cf. Georg Trogemann's experiments with uncompressed video streaming at his Laboratory for Mixed Realities, Academy of Media Arts, Cologne: "Einrichten im

- Dazwischen," in Medienwissenschaften und Wissenschaft: Strukturen-Profile-Positionen, ed. Friedrich Reimers and Gabriele Mehling (Munich: UVK, 2001), 102–14.
- 15. Samuel Weber, "Virtualität der Medien," in Konfigurationen: Zwischen Kunst und Medien, ed. Sigrid Schade and Georg Christoph Tholen (Munich: Fink, 1999), 47, referring to books 2 and 3 of Aristotle's Peri Psyches. Italics in original.
- 16. Richard Dienst, *Still Life in Real Time: Theory after Television* (Durham, N.C.: Duke University Press, 1994), 20.
- 17. Akademie der Künste, Berlin, November 19, 1999, as heard on the radio show *Vinyl Coda III*, Deutschlandfunk, April 14, 2000.
- 18. See Birgit Richard's interview with Friedrich Kittler, "Zeitsprünge," *Kunstforum International* 151 (July–September 2000): 104.
- 19. Christopher Fynsk, "The Claims of History," *Diacritics* 22 (Fall/Winter 1992), 118.
- 20. Kay Kirchmann, as quoted by Richard Kämmerlings, "Ein Störfall möglicherweise," Frankfurter Allgemeine Zeitung, May 14, 1999, 46. See Mary Ann Doane, "Information, Crisis, Catastrophe," in Logics of Television: Essays in Cultural Criticism, ed. Patricia Mellencamp (Bloomington: Indiana University Press, 1990), 222–39.
 - 21. Weber, "Television: Set and Screen," 127.
- 22. Jeanette Goddar, "Offenem Kanal droht die Abschaffung: 500 Stunden Fernseh-Demokratie monatlich," *Zittv Berlin*, June 2000, 58.
- 23. C. Talley, "The Army's Amateur," *Radio News* 12 (April 1931): 892-94, 925, and 931.
 - 24. Max Egly, Eintritt Frei ins Fernsehen (Lausanne: Editions Rencontre, 1963), 7.
- 25. Terry Winograd, Understanding Computers and Cognition (Norwood, N.J.: Ablex, 1986).
- 26. The other extreme—the opposite of experiment in real time with living beings in containers—is the documentary film *Berlin—Ecke Bundesplatz* by Detlef Gumm and Hans-Georg Ullrich, abbreviated for TV in six sequels of ninety minutes each; broadcast June 28, 2000, West III, Germany.
- 27. "Weil sich das breitbandige Fernsehsignal nicht wie ein Telefongespräch durch einen dünnen Draht über tausende von Kilometern hinweg transportieren läßt" (Karl Tetzner and Gerhard Eckert, Fernsehen ohne Geheimnisse [Munich: Franzis, 1954], 103 and 60).
- 28. Karin Wenz, "Fernsehen-Online: Ein Riesenschritt ins nachste Jahrtausend?," in Fernsehperspektiven: Aspekte zeitgenossischer Medienkultur, ed. Sabine Flach and Michael Grisko (Munich: KoPäd, 2000), 269.
 - 29. Tetzner and Eckert, Fernsehen ohne Geheimnisse, 105.

- 30. Albert Abramson, "Video Recording: 1922 to 1959," in Zielinski, Video, 38.
- 31. Knut Hickethier, "Fernsehen, Modernisierung und kultureller Wandel," in Flach and Grisko, *Fernsehperspektiven*, 32.
 - 32. Weber, "Television: Set and Screen," 121. Italics in original.
- 33. Samuel Weber, interviewed by Cassi Plate in "Deux ex Media," in Weber, *Mass Mediauras*, 160.
- 34. Cf. Piero Steinle, "Das tagliche Welttheater—die Fernsehnachrichten," in *News: Eine Videoinstallation von Julian Rosefeld und Piero Steinle,* exhibition catalog (Heidelberg: Kehrer, 1998), 75–76.
 - 35. Weber, interviewed by Plate in "Deux ex Media," 165.
- 36. A leaflet from the Museum of Television and Radio warns, "So many television programs were performed live and are now thought to be lost forever" (Nick at Nite Classic TV and MTV Networks, New York, 1997).
 - 37. http://www.paleycenter.org/lost-programs-television (accessed June 8, 2012).
 - 38. Dienst, Still Life in Real Time, 20-21.
- 39. Peter Hoff, "Schwierigkeiten, Fernsehgeschichte zu schreiben," in Fernsehperspektiven, ed. Flach and Grisko, 41.
- 40. Samuel Weber, "Mass Mediauras, or: Art, Aura and Media in the Work of Walter Benjamin," in *Mass Mediauras*, 87 and 107. Italics in original.

6. Discontinuities

For coauthoring this chapter, thanks to Stefan Heidenreich and Peter Geimer (both in Berlin).

- 1. Michel Foucault, *L'Archéologie du savoir* (Paris: Gallimard, 1969). Hayden White, *Metahistory* (Baltimore: Johns Hopkins University Press, 1973).
- 2. Sven Spieker, "Archive Fever: Storage, Memory, Media," draft proposal for a research project, 2000, n.p. See also Spieker, *The Big Archive: Art from Bureaucracy* (Cambridge, Mass.: MIT Press, 2008).
 - 3. Ibid.
- 4. On media hardware in Germany, see Deutsches Technikmuseum Berlin, http://www.dtmb.de/Rundgang/indexJS.html and Heinz-Nixdorf-Museum http://www.hnf.de/museum/comp4all.html (both accessed June 9, 2012). In a more global context, see Apple History, http://www.apple-history.com and the rubric "Classic Computing," http://listings.ebay.de/aw/listings/list/category8086/index.html (both accessed June 9, 2012).
- 5. News reported by Detlef Borcher in his column "Online," in *Die Zeit*, October 19, 2000, 46; on related subjects, see Bruce Sterling's "Dead Media Project," http://www.alamut.com/subj/artiface/deadMedia/dM Manifesto.html.

- 6. In a media-genealogical sense, there are no proper media, but rather there is a constant coming-into-being of media; see Joseph Vogl, "Medien-Werden: Galileis Fernrohr," in *Archiv für Mediengeschichte*, vol. 1 (Weimar: Universitätsverlag, 2001), 115–23, esp. 120.
- 7. On a proposed "museum" of software programs, see Wolfgang Hagen, "The Style of Sources: Remarks on the Theory and History of Programming Languages," trans. Peter Krapp, in *New Media, Old Media: A History and Theory Reader*, ed. Wendy Hui Kyong Chun and Thomas Keenan (New York: Routledge, 2006), 157–75.
- 8. See Friedrich Kittler, *Eine Kulturgeschichte der Kulturwissenschaft* (Munich: Fink, 2000), 12th lecture, 228–49; see further, Richard Dienst, *Still Life in Real Time: Theory after Television* (Durham, N.C.: Duke University Press, 1994).
 - 9. 8-bit Nirvana Web site, http://www.zock.com (accessed November 2011).
- 10. Konrad Lischka, "Verlassene Kunst: Softwarepiraten retten das digitale Erbe," Die Zeit, January 18, 2001, 34, referring to the (up to then) only exhibition of computer game archaeology, in the Maryland Science Museum, organized by the group Electronic Conservancy (http://www.videotopia.com).
- 11. Neil Rhodes and Jonathan Sawday, "Introduction: Paperworlds; Imagining the Renaissance Computer," in *The Renaissance Computer: Knowledge Technology in the First Age of Print*, ed. Neil Rhodes and Jonathan Sawday (New York: Routledge, 2000), 10 and 12.
 - 12. Ibid., 13.
- 13. Sebastian Domsch, "Diskretion ist Maschinensache," in *Frankfurter Allgemeine Zeitung* 7, no. 259 (November 2000): 52.
- 14. See Rolf Sachsse, "Das Gehirn der Welt: 1912; Die Organisation der Organisatoren durch die Brücke; Ein vergessenes Kapitel Mediengeschichte," in *Mitteilungen der Wilhelm-Ostwald-Gesellschaft zu Großbothen e.V.* 1, 5. Jg. (2000): 38–57; the text—in the best tradition of Ostwald's "global brain" project—can be addressed on the Internet, as subject and object of this theme: http://www.heise.de/tp/artikel/2/2481/1.html. He calls it multimediatic because it encompasses visual cultural artifacts of communication as well.
- 15. Jonathan Sawday, "Towards the Renaissance Computer," in *The Renaissance Computer*, 35.
- 16. "Freud a fait des énoncés verbaux des malades, consideérés jusque 'là comme bruit, quelque chose qui devait être traité comme un message." Michel Foucault, "Message ou bruit?," in *Dits et Écrits I* (Paris: Gallimard, 1994): 559. [Translation JP]
 - 17. Lacan, quoted by Spieker in "Archive Fever," n. p.

- 18. Volker Kahl, "Interrelation und Disparität: Probleme eines Archivs der Künste," in *Archivistica docet: Beiträge zur Archivwissenschaft und ihres interdisziplinären Umfelds*, ed. Friedrich Beck (Potsdam: Verlag für Berlin-Brandenburg, 1999), 252.
- 19. See Friedrich Kittler, "Von der Letter zum Bit," in *Gutenberg und die Neue Welt,* ed. Horst Wenzel (Munich: Fink, 1994), 105–17.
- The computing part of the computer, however, is not for storage but for dynamic calculation.
- 21. [Ernst refers here to the research project "Hypertext: Theorie und Geschichte," University of Kassel, Kassel, Germany. Unfortunately the original link to the project is not operational anymore. Ed.]
- 22. Theodor H. Nelson, "As We Will Think," in *From Memex to Hypertext: Vannevar Bush and the Mind's Machine*, ed. James M. Nyce and Paul Kahn (San Diego: Academic Press, 1991), 259, 243, and 253.
- 23. Though somewhat reducing this claim back to history is the very sequential unfolding of arguments following the format of the book.
- 24. Book jacket text on Cornelia Vismann, Akten: Medientechnik und Recht (Frankfurt am Main: Fischer, 2000), translated as Cornelia Vismann, Files: Law and Media Technology, trans. Geoffrey-Winthrop Young (Stanford, Calif.: Stanford University Press, 2008). Italics in original.
- 25. "Our candidate for replacing the desktop is called 'Lifestreams." David Gelernter, *Machine Beauty: Elegance and the Heart of Technology* (New York: Basic Books, 1997), 106.
- 26. Bertolt Brecht, "Der Rundfunk als Kommunikationsapparat: Rede über die Funktion des Radios (1932)," in *Ausgewählte Werke*, vol. 6 (Frankfurt am Main: Suhrkamp, 1997), 146–51.
- 27. Rhodes and Sawday, *The Renaissance Computer*, 12, referring to Vincent Gillespie, "Medieval Hypertext: Image and Text from York Minste," in *Of the Making of Books: Medieval Manuscripts, Their Scribes and Readers; Essays Presented to M. B. Parkes*, ed. P. R. Robinson and Rivkah Zim (Aldershot, England: Scholar Press, 1997), 208f.
- 28. We are familiar with this from the technical options of the rewritable magnetooptical disc.
- 29. "Informationen, die nicht im externen oder internen Speicher einer Datenverarbeitungsanlage abgelegt sind, können überhaupt nicht als Daten verwendet werden. Der Grad der Öffentlichkeit ergibt sich dann aus den Zugriffsmöglichkeiten auf den Speicher." Michael Giesecke, "Als die alten Medien neu waren: Medienrevolutionen in der Geschichte," in *Information ohne Kommunikation? Die Loslösung der Sprache vom Sprecher*, ed. Rüdiger Weingarten (Frankfurt am Main: Fischer, 1990), 86.

- 30. Mark U. Edwards Jr., *Printing, Propaganda, and Martin Luther* (Berkeley: University of California Press, 1994), 163; see also Rhodes and Sawday, "Introduction," 12.
 - 31. Rhodes and Sawday, "Introduction," 11.
 - 32. Ibid.
- 33. See Derrick de Kerckhove, *Die atomare Kommunikation Schriftgeburten: Vom Alphabet zum Computer* (Munich: Fink, 1995), 143–58.
 - 34. See Rhodes and Sawday, The Renaissance Computer, 7.
- 35. Heinz Schlaffer, "Introduction to Jack Goody/Ian Watt/Kathleen Gough," in *Enstehung und Folgen der Schriftkultur,* trans. Friedhelm Herbeborth (Frankfurt am Main: Suhrkamp, 1991), 7.
 - 36. Samuel Weber, e-mail to the author, October 14, 1998.
- 37. Leah S. Marcus, "The Silence of the Archive and the Noise of Cyberspace," in *The Renaissance Computer*, ed. Rhodes and Sawday, 18.
 - 38. Milton, quoted in ibid., 24.
 - 39. Ibid., 25.
- 40. For example, Erich Moritz von Hornbostel's music-ethnological Berlin *Phonogramm-Archiv* after 1900; see Sebastian Klotz, ed., "Vom tönenden Wirbel menschlichen Tuns": Erich M. von Hornbostel als Gestaltpsychologe, Archivar und Musikwissenschaftler (Berlin: Schibri, 1998).
- 41. Jules Michelet, quoted in Stephen A. Kippur, *Jules Michelet: A Study of Mind and Sensibility* (Albany: State University of New York Press, 1981), 50. "Dans les galeries solitaires des Archives où j'errai vingt années, dans ce profond silence, des murmures cependant venaient à mon oreille." Jules Michelet, "Histoire de France: Preface of 1869," in *Oeuvres complètes*, vol. 4, ed. Paul Viallaneix (Paris: Flammarion, 1974), 24.
 - 42. Marcus, "The Silence of the Archive and the Noise of Cyberspace," 27-28.
- 43. Christoph Keller, Encyclopaedia Cinematografica, exhibition at Kunstbank, Berlin, May 2000.
- 44. Jonathan Crary, *Techniques of the Observer* (Cambridge, Mass.: MIT Press, 1990), 2.
 - 45. Sigmund Freud, *Die Traumdeutung* (Leipzig: F. Deuticke, 1900).
- 46. See Wolfgang Ernst, "Hornbostels Klangarchiv: Gedächtnis als Funktion von Dokumentationstechnik," in *Vom tönenden Wirbel*, ed. Klotz, 116–31. See also Catalogue VI (Wissen) of Exhibition 7 Hügel Bilderund Zeichen des 21. Jahrhunderts, Martin Gropius Bau, Berlin 2000 (esp. on the installation *Musikweltkarte*). In addition, see *A Century of Sound Archiving*, Proceedings of the Annual Conference of the International Association of Sound and Audiovisual Archives (IASA), Vienna, September 18–23, 1999.

- 47. See Sabine Lenk, "Die Autochrone- und Filmsammlung des Albert Kahn," in Früher Film in Deutschland, Jahrbuch zur Erforschung des frühen Films (Basel: Stroemfeld/Roter Stern, 1992), 120–22; Paula Amad, Counter-Archive: Film, the Everyday, and Albert Kahn's "Archives de la Planète" (New York: Columbia University Press, 2010). Carl Stumpf actually deplored the absence of optical memory in the Berlin Phonogram Archive; see Otto Abraham and Erich Moritz von Hornbostel, "Über die Bedeutung des Phonographen für vergleichende Musikwissenschaft," Zeitschrift für Ethnologie 36 (1904): 222–36.
- 48. Susanne Ziegler, "Das ehemalige Berliner Phonogrammarchiv," in *Studien zur Musikgeschichte: Eine Festschrift für Ludwig Finscher*, ed. Annegrit Laubenthal (Kassel, Germany: Bärenreiter, 1995), 771.
- 49. On phonographic metaphors of writing in medieval times avant la lettre, see Horst Wenzel, "Die 'fließende' Rede und der 'gefrorene' Text: Metaphern der Medialität," in Poststrukturalismus: Herausforderung an die Literaturwissenschaft, ed. Gerhard Neumann (Stuttgart: Metzler, 1997).
- 50. See Das Berliner Phonogramm-Archiv 1900–2000: Sammlungen der traditionellen Musik der Welt, ed. Artur Simon (Berlin: VWB, 2000), 209–15.
- 51. Quoted from Max Wertheimer, "Musik der Wedda," Sammelbände der Internationalen Musikgesellschaft 11, no. 2 (January–March 1910): 300.
- 52. See the Gesellschaft zur Förderung angewandter Informatik e.V. Web site, http://www.gfai.de/projekte/spubito/ (accessed October 2011).
- 53. See the spectrogram of a reconstructed recording of Wedda chants from 1907 on the www.gfai.de Web page.
 - 54. Spieker, "Archive Fever," n.p.
- 55. For the German case, see Heinz Hoffmann, Behördliche Schriftgutverwaltung: Ein Handbuch für das Ordnen, Registrieren, Aussondern und Archivieren von Akten der Behörden, 2nd ed. (Munich: Oldenbourg, 2000).
- 56. See the article by C. Thomalla, "Ein medizinisches Filmarchiv" (A medical film archive), in *Berliner Klinische Wochenschrift* 44 (1918).
- 57. Christoph Keller, "Lost/Unfound: Archives as Objects as Monuments," in *ars viva oo/o1—Kunst und Wissenschaft,* catalogue for the exhibition by prizewinning artists of Kulturkreis der deutschen Wirtschaft im Bundesverband der Deutschen Industrie e.V. (Berlin: M8 Labor für Gestaltung, 2000), n.p.
- 58. Stefan Heidenreich, "Die Wirklichkeit mag keine Bilder, über die Ausstellungder *Encyclopedia Cinematographica* des Medienkünstlers Christoph Keller in der Kunstbank Berlin, Mai/Juni 1999," *Frankfurter Allgemeine Zeitung* (Berlin ed.), May 31, 2000, BS8.

- 59. See the medfilm Web site, http://www.medfilm.de. [The Web site appears to be for sale, which, perhaps in an ironic twist, actually might add to Ernst's analysis concerning online "archives." Ed.]
- 60. "Unterschenkelamputation," http://www.khm.de/~chrk/medfilm/o3.unters.html (accessed October 2011).
- 61. Not only did Michel Foucault write about the birth of the clinic as "an archaeology of the medical gaze," but he himself deferred, by making it a subject of research, his (dis)continuity with the three-generation-long tradition of the Foucault family as surgeons.
- 62. Thanks to Thomas Elsaesser for this precise look at the Quick-Time movie. See as well Keller, "Lost/Unfound," on the 1900 movie.
 - 63. Keller, Encyclopaedia Cinematografica exhibition.
- 64. For comparison, see the records on the film-based so-called Institute for Cultural Research (Institut für Kulturforschung/Kulturfilm-Institut) dating from June 2, 1933, through July 4, 1935, in the Archive for the History of the Max-Planck-Institute, Berlin-Dahlem, I. Abteilung: Kaiser-Wilhelm-Gesellschaft, Repositur 1A: Generalverwaltung der KWG, no. 1041.
- 65. Thanks to Lisa Parks (University of California–Santa Barbara) for reminding me of this corresponding scene.
- 66. Friedrich Kittler, "Computeranalphabetismus," in *Literatur im Informations- zeitalter* (Frankfurt am Main: Campus, 1996), 239.
- 67. "Je näher man ein Wort ansieht, desto ferner sieht es zurück." Karl Kraus, *Pro domo et mundo* (Munich: Langen, 1912), 164.
- 68. Such is the installation *BLOW_UP T.V.* of Angela Bulloch in the gallery Schipper & Krome, Berlin, September–November 2000.
- 69. Andreas Menn, textual supplement (Cologne, July 2000) to his digital video *Workout* (1999).
 - 70. Ibid.
- 71. Claudia Reiche, "Pixel: Erfahrungen mit den Bildelementen," in *Frauen in der Literaturwissenschaft*, Rundbrief 48 (August 1996): 59.
- 72. On technical images and the notion of the technoimaginary, see Vilém Flusser, *Kommunikologie*, ed. Stefan Bollmann and Edith Flusser (Frankfurt am Main: Fischer, 1998).
- 73. See Hans Ulrich Reck, "Metamorphosen der Archive/Probleme digitaler Erinnerung," in *Metamorphosen: Gedächtnismedien im Computerzeitalter*, ed. Götz-Lothar Darsow (Stuttgart-Bad Cannstatt: Frommann-Holzboog, 2000), 223.

- 74. Hartmut Winkler, "Theorie und Geschichte der Schrift," abstract for a lecture at the University of Paderborn, winter term 2000–2001.
 - 75. Knut Hickethier, Film- und Fernsehanalyse (Stuttgart: Metzler, 1993), 158.
- 76. Rhodes and Sawday, "Introduction," 13, referring to Michel de Montaigne, Oeuvres complètes, ed. Albert Thibudet and Maurice Rat (Paris: Gallimard, 1962), 1047, and to N. Katherine Hayles, The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century (Ithaca, N.Y.: Cornell University Press, 1984).
- 77. Claire Preston, "In the Wilderness of Forms: Ideas and Things in Thomas Browne's Cabinets of Curiosity," in *The Renaissance Computer*, ed. Rhodes and Sawday, 170.
 - 78. Ibid., 174-75. Italics in original.
- 79. Stefan Heidenreich, "Image retrieval und visuelles Wissen," lecture at the EVA (Electronic Imaging and the Visual Arts) conference in Berlin, November 13, 1997.
- 80. William Vaughan (Birkbeck College, University of London), "Automated Picture Referencing: A Further Look at 'Morelli," *Computers and the History of Art* 2 (1992): 7–18, quote on 7.
 - 81. Ibid., 8.
 - 82. Ibid., 9.
- 83. Ircam Web site, http://www.ircam.fr/produits/techno/multi-media/Cuidad/mpeg7_info.html. [The link is dead. Ed.]
- 84. [Ernst speaks here still of "time-based" media, whereas his emphasis has turned to time-critical media as differentiated from the concept of time-based media. In short, time criticality refers to the also internally time-differentiating aspects of, for instance, computable media. Ed.]
- 85. Spieker, "Archive Fever," n.p., referring to Jacques Derrida, *Archive Fever: A Freudian Impression* (Chicago: University of Chicago Press, 1998).
 - 86. Christoph Drösser, "Ein verhängnisvolles Erbe," Die Zeit, June 23, 1995, 66.
- 87. Harriet Bradley, "The Seductions of the Archive: Voices Lost and Found," *History of the Human Sciences* 12, no. 2 (1999): 113.
- 88. Howard Caygill, "Meno and the Internet: Between Memory and the Archive," *History of the Human Sciences* 12, no. 2 (1999): 10.
 - 89. Ibid., 2.
- 90. Paula Findlen, "The Museum: Its Classical Etymology and Renaissance Geneaology," *Journal of the History of Collections* 1, no. 1 (1989): 59–78.
- 91. See, though, the Open Archives movement and the Internet Archive Web site, http://www.archive.org.
 - 92. Arlette Farge, Le goût de l'archive (Paris: Seuil, 1989), 87.
 - 93. See, for example, Adaweb, http://adaweb.walkerart.org.

- 94. Thanks once more to Tilman Baumgärtel for these somewhat autopoetic links on the Internet: http://www.o100101110101101.ORG; http://www.dejavu.org, announcing, "Experience the history of the web! Go to the emulator to re-live an era in the history of the web! Or go to the timeline to read about the old times!"; and see also http://www.w3history.org.
- 95. "The Internet: Bringing Order from Chaos," editorial, *Scientific American* 276, no. 3 (March 1997): 49.
- 96. Steven G. Jones, "Understanding Community in the Information Age," in *Cybersociety: Computer-Mediated Communication and Community*, ed. Steven G. Jones (Thousand Oaks, Calif.: 1995), 28.
 - 97. Rhodes and Sawday, "Introduction," 12.
- 98. See Thomas Hoeren, "Urheberrecht in der Informationsgesellschaft," *GRUR* 12 (1997). On the technical regulations of cyberspace beyond legalism, see Lawrence Lessig, *Code and Other Laws of Cyberspace* (New York: Basic Books, 1999).
- 99. Sebastian Handke, "Die neue Flüchtigkeit: Wer archiviert das Internet? Archivwissenschaftler und Medienarchäologen diskutierten in der Mikrolounge des WMF über die Zukunft der Erinnerung," *taz*, October 7, 2000, 26.
- 100. For links to recycling, see the Redundant Technology Initiative Web site, http://www.lowtech.org, and Mark Napier's Web site, http://www.potatoland.org. On the term anarchaeology, see Siegfried Zielinski, Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means, trans. Gloria Custance (Cambridge, Mass.: MIT Press, 2006).

III. Microtemporal Media

- 1. Axel Volmar, ed., Zeitkritische Medien (Berlin: Kadmos, 2009).
- 2. Thomas Macho, "Zeit und Zahl: Kalender- und Zeitrechnung als Kulturtechniken," in *Bild–Schrift–Zahl*, ed. Sybille Krämer and Horst Bredekamp (Munich: Fink 2003), 179–92.
- 3. Vivian Sobchak, "Afterword: Media Archaeology and Re-presencing the Past," in *Media Archaeology: Approaches, Applications, and Implications* (Berkeley: University of California Press, 2011), 323–33.
- 4. Wolfgang Hagen, Das Radio: Zur Geschichte und Theorie des Hörfunks-Deutschland/USA (Munich: Fink, 2005).

7. Telling versus Counting

- 1. See Barry B. Powell, *Homer and the Origin of the Greek Alphabet* (Cambridge, England: Cambridge University Press, 1991).
 - 2. See Joachim Latacz, Troia und Homer (Munich: Koehler & Amelang, 2001).

- 3. Encarta® World English Dictionary, North American ed., Microsoft Corporation, 2001, http://www.microsoft.com/uk/encarta/ (accessed November 2011). [The Online Dictionary has now been discontinued. Ed.]
- 4. See William J. Brandt, *The Shape of Medieval History* (New Haven, Conn.: Yale University Press, 1966), 86.
- 5. Don P. Fowler, "Narrate and Describe: The Problem of *Ekphrasis,*" in *Journal of Roman Studies* 81 (1991): 25.
- 6. Or is it indeed "much more likely that the Catalogue began as it ended, as poetry"? Richard Hope Simpson and John F. Lazenby, *The Catalogue of the Ships in Homer's "Iliad"* (Oxford, England: Clarendon, 1970), 160.
- 7. Christoph Albrecht, "Listen von Macht und Begehren," *Frankfurter Allgemeine Zeitung*, June 25, 2002, 49.
- 8. See Hayden White, *Metahistory: Historical Imagination in Nineteenth-Century Europe* (Baltimore: Johns Hopkins University Press, 1973).
- 9. Arno Borst, *Computus: Zeit und Zahl in der Geschichte Europas* (Berlin: Wagenbach, 1990), 29–116, esp. 77.
- 10. Quoted in Borst, *Computus*, 41, referring to *Annales Fuldenses* (by an anonymous medieval author), anno 884, in *Monumenta Germaniae Historica*, series *Scriptores rerum Germanicarum*, vol. 7 (Hannover: Hahn, 1891), 112.
- 11. Wolfgang Pfeifer, ed., Etymologisches Wörterbuch des Deutschen (Berlin: Akademie, 1993), 298 (my translation). Italics in original. "[E]rzählen, ahd. irzellen (8. Jh.), mhd. erzel(le)n steht zunächst (ähnlich wie ahd.zellen, mhd. zeln, s. zählen) für zählen, (der Reihe nach) aufzählen, auch bei der Darstellung von Ereignissen und Taten, daher (im Rechtswesen) 'öffentlich hersagen und verkünden' und allgemein 'mündlich mitteilen, berichten.' Die letztere Bedeutung ist dann allein auf erzählen übergegangen, während nhd. zählen aufden rechnerischen Bereich eingeschränkt wird; doch hält sich die alte Bedeutung 'aufzählen' gelegentlich bis ins 18. Jh."
- 12. George Kubler, *The Shape of Time: Remarks on the History of Things* (New Haven, Conn.: Yale University Press), 1963.
- 13. Hans Dieter Huber and Angela Bulloch, *Die Matrix des Sehens*, handout available at the exhibition of Angela Bulloch's *Pixel Works* at the art gallery Schipper & Krome, Berlin, June–July 2002.
- 14. "Chante (imagine), ma Muse, le Rien: ne méprise pas la tâche / Car Rien est une gemme, Rien est de l'or précieux." Jean Passerat, *Carmen De Nihilo*, in Marten Schoock, *Tractatus Philosophicus de nihilo* (Groningen: Typis Viduae Edzardi Agricole, 1661), 125. See Victor I. Stoichita, *L'instauration du tableau: Métapeinture à l'aube des Temps Modernes* (Paris: Méridiens Klincksieck, 1993), 300. The English translation

- is by Leofranc Holford-Strevens and is from the appendix to Samuel Johnson, *The Lives of Poets: A Selection* (Oxford: Oxford University Press, 2009), 462.
- 15. Matthew Schlesinger, "Production of Utterance and Language Acquisition," in *The Ontogenesis of Grammar*, ed. Dan Isaac Slobin (New York: Academic Press, 1971), 63–101.
- 16. Hayden White, *The Content of the Form: Narrative Discourse and Historical Representation* (Baltimore: Johns Hopkins University Press, 1987), 42.
- 17. Ernst H. Kantorowicz, "The Problem of Medieval World Unity," *Annual Report of the American Historical Association for 1942* 3 (1944): 33.
- 18. Julian Richards and Nick Ryan, eds., *Data Processing in Archaeology* (Cambridge, England: Cambridge University Press, 1985), 1.
- 19. See Pierre Chaunu, *Histoire quantitative, histoire sérielle* (Paris: Armand Colin, 1978).
- 20. François Furet, "Quantitative History," in *Historical Studies Today*, ed. Felix Gilbert and Stephen R. Graubard (New York: Norton, 1972), 47.
- 21. Johann Martin Chladenius, Einleitung zur richtigen Auslegung vernünftiger Reden und Schriften (Leipzig, 1742; rpt. Düsseldorf: Stern, 1969), 185–89.
- 22. Gisela Bock, "Machiavelli als Geschichtsschreiber," in Quellen und Forschungen aus italienischen Archiven und Bibliotheken, vol. 66 (Tübingen: Niemeyer, 1986), 175.
- 23. Barthold G. Niebuhr, "Ueber den Unterschied zwischen Annalen und Historie," in *Kleine historische und philologische Schriften*, vol. 2 (Bonn 1828; rpt. Osnabrück: Zeller, 1969), 229.
- 24. See Max Ettlinger, *Leibniz als Geschichtsphilosoph* (Munich: Koesel & Puslet, 1921), with an edition of Leibniz's fragment *Apokatastasis panton* [1715], 27–34. See also Hans Blumenberg, *Die Lesbarkeit der Welt*, 3rd ed. (Frankfurt am Main: Suhrkamp, 1993), 128.
- 25. Jerome Bruner, "The Narrative Construction of Reality," *Critical Inquiry* 18 (Autumn 1991): 19.
- 26. Siegfried Kracauer, Geschichte: Vor den letzten Dingen, trans. Karsten Witte (Frankfurt am Main: Suhrkamp, 1971 [1969]), 177.
- 27. See Gérard Genette, *Narrative Discourse*, trans. Jane E. Lewin (Oxford, England: Blackwell, 1980).
- 28. Robert F. Berkhofer Jr., *Beyond the Great Story: History as Text and Discourse* (Cambridge, Mass.: Belknap Press of Harvard University Press, 1995), 117.
- 29. Gotthold Ephraim Lessing, Laocoön: An Essay on the Limits of Painting and Poetry, trans. Edward Allen McCormick (Baltimore: John Hopkins University Press, 1984 [1766]), 91.

- 30. Diskin Clay, "The Archaeology of the Temple to Juno in Carthage (*Aen.* 1.446–93)," *Classical Philology* 83 (January 1988): 200.
- 31. In French, the original passages are as follows: "Plus un corps est composé, plus il est nécessaire de décrire les détails de son organisation, pour en exposer le jeu & la mécanique"; in geometry, "l'action de tracer une ligne, une surface, etc."; and in literature, "Une description est l'énumération des attributs d'une chose, dont plusieurs sont accidentelles Une description au premier coup d'oeil a l'air d'une définition; elle est même convertible avec la chose décrite, mais elle ne la fait pas connoître à fond, parce qu'elle n'en renferme pas ou n'en expose pas les attributs essentiels." Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers, vol. 4, (Paris, 1754), 878. Italics in original. The translations are from the online The Encyclopedia of Diderot & D'Alembert—Collaborative Translation Project, http://quod.lib.umich.edu/d/did/ (accessed November 2011).
- 32. Walter Hagenbüchle, Narrative Strukturen in Literatur und Film: Schilten ein Roman von Hermann Burger (Bern: Lang, 1990), 93.
- 33. See Manfredo Tafuri, "The Dialectics of the Avantgarde: Piranesi and Eisenstein," Oppositions: A Journal for Ideas and Criticism in Architecture 11 (Winter 1977): 72–110. See also Sergei Eisenstein, "Piranesi, or the Fluidity of Forms," in The Sphere and the Labyrinth, Avant-Gardes and Architecture from Piranesi to the 1970s, ed. Manfredo Tafuri (Cambridge, Mass.: MIT Press, 1990).
- 34. Joachim Paech, *Passion oder die Einbildungen des Jean-Luc Godard* (Frankfurt am Main: Deutsches Filmmuseum, 1989), 41. See also, by the same author, "Eine Szene machen: Zur räumlichen Konstruktion filmischen Erzählens," in *Onscreen/Offscreen: Grenzen, Übergänge und Wandel des filmischen Raumes*, ed. Hans Beller et al. (Stuttgart: Hatje Cantz, 2000), 93–121.
- 35. Rudolf Arnheim, "A New Laocoön: Artistic Composites and the Talking Film," in *Film as Art* (Berkeley: University of California Press, 1957), 199–230.
- 36. Ulrich Kuder, *Der Teppich von Bayeux oder: Wer hatte die Fäden in der Hand?* (Frankfurt on the Main: Fischer, 1994), 23; see also Anatole Jakovsky, "Encore quelques mots en marge de la Tapisserie de Bayeux," *L'Âge Nouveau* 21 (1947): 24–27, which compares the tapestry with early Russian films.
- 37. Thomas Y. Levin, "You Never Know the Whole Story: Ute Friederike Jürß und die Ästhetik des heterochronen Bildes," in *Ute Friederike Jürß*, "You Never Know the Whole Story," ed. Götz Adriani, exhibition catalogue (Ostfildern-Ruit, Germany: Hatje Cantz, 2000), 57.
 - 38. Levin, "You Never Know the Whole Story," 61.
- 39. Thomas Elsaesser, "Introduction: Harun Farocki," *Senses of Cinema* 21 (2002), http://www.sensesofcinema.com/2002/21/farocki_intro/ (accessed November 2011).

- 40. Honke Rambow, "Rhythmus, Zeit, Stille," *Kunstforum International* 151 (July–September 2000): 179–84.
- 41. Lev Manovich, "Global Algorithm 1.3: The Aesthetics of Virtual Worlds; Report From Los Angeles," *Ctheory*, May 22, 1996, http://www.ctheory.net (accessed December 2011). Italics in original.
- 42. Michel de Certeau, *The Practice of Everyday Life*, trans. Steven Rendall (Berkeley: University of California Press, 1984), 129.
 - 43. Manovich, "Global Algorithm 1.3."

8. Distory

With thanks to Dr. habil. Renate Tobies (Technical University of Braunschweig) for casting a critical eye over my remarks.

- 1. See Raymond Williams, *Television: Technology and Cultural Form*, 2nd ed. (1975; rpt. London: Routledge, 1990).
- 2. Martin Heidegger, *Being and Time*, trans. John Macquarrie and Edward Robinson (New York: Harper Collins, 1962), 431–32. Italics in original. For the original German publication, see Martin Heidegger, *Sein und Zeit*, 16th ed. (Tübingen: Niemeyer, 1986), 380.
- 3. The translation of Einstein's speech, quoted twice in this chapter, is excerpted from the following sources: *Einstein on Politics: His Private Thoughts and Public Stands on Nationalism, Zionism, War, Peace, and the Bomb,* ed. David E. Rowe and Robert Schulmann (Princeton, N.J.: Princeton University Press, 2007), 237, and "Einstein's Speech on Occasion of the Radio Show in 1930," http://www.einstein-website.de/z_biography/speechfunkausstellung.html (accessed October 12, 2011).
- 4. Oskar Blumtritt, Nachrichtentechnik: Sender, Empfänger, Übertragung, Vermittlung, 2nd ed. (Munich: Deutsches Museum, 1997), 79.
- 5. On this type of "remote telephone system," see Franz Pichler, "Telegrafie- und Telefonsysteme des 19. Jahrhunderts," in *Vom Verschwinden der Ferne: Telekommunikation und Kunst*, ed. Edith Decker and Peter Weibel (Cologne: DuMont, 1990), 281.
- 6. This is the explanation given in the German entry under "Radio" in the online encyclopedia Wikipedia, http://de.wikipedia.org/wiki/Radio (accessed December 2006).
- 7. In the sense of Marshall McLuhan and Quentin Fiore, *The Medium Is the Massage: An Inventory of Effects* (Berkeley, Calif.: Gingko, 2005 [1967]).
- 8. Paul DeMarinis, text accompanying his installation *Tongues of Fire* at the Singuhr-Hörgalerie of the Parochial Church of Berlin-Mitte, June–August 2004.
- 9. Hagen Pfau, quoted in *Mitteldeutscher Rundfunk: Radio-Geschichten*, ed. Steffen Lieberwirth (Altenburg, Germany: Kamprad, 2000), 10.

- 10. This is emphasized by Pfau in ibid., 13.
- 11. Freely formulated after a contribution by Hartmut Petzold to the workshop Archäologie, Theorie und Künste der Elektronenröhre, Kunsthochschule für Medien, Cologne, June 4–5, 1997.
- 12. Ferdinand Braun, "Ueber ein Verfahren zur Demonstration und zum Studium des zeitlichen Verlaufes variabler Ströme," *Annalen der Physik und Chemie* 296, no. 3 (February 15, 1897): 552–59.
- 13. Franz Pichler, "100 Jahre Braunsche Röhre: Ein Jubiläum für einen Interfacebaustein," *PLUS LUCIS* 2 (1997): 14.
- 14. Thomas Riegler, DRM: Digital Radio Mondiale; Theorie und Empfangspraxis (Baden-Baden: Siebel, 2006), 13.
- 15. P. R. Masani, *Norbert Wiener 1894–1964* (Basel: Birkhäuser, 1990), 85, citing Norbert Wiener, "The Harmonic Analysis of Irregular Motion (Second Paper)," *Journal of Mathemathics and Physics* 5 (1926): § 6.
- 16. Norbert Wiener, *I Am a Mathematician: The Later Life of a Prodigy* (New York: Doubleday, 1956), 40.
- 17. Norbert Wiener, "Back to Leibniz! (Physics Reoccupies an Abandoned Position)," *Technical Review* 34 (1932): 202.
- 18. Johannes Arnold, *Abenteuer mit Flipflop* (Halle, Germany: Mitteldeutscher, 1970), 16; also, in this sense, see Bernhard Siegert, *Passage des Digitalen* (Berlin: Brinkmann & Bose, 2003), 405.
- 19. Jacques Lacan, "Das Ich in der Theorie Freuds und in der Technik der Psychoanalyse," in *Das Seminar Buch 2*, 2nd ed. (1954–55; rpt. Berlin: Quadriga, 1991), 156.
- 20. See the Computing Music VII Web site, http://www.computing-music.de (accessed October 2006).
- 21. The demiurge of this program is Martin Carlé, media scientist at Humboldt University in Berlin. See Martin Carlé, "NOMOI: Eine seynsgeschichtliche Durchführung der poetischen Weisen des ersten Computers nach Klang, Tanz und Skulptur," a research project and presentation in Berlin, July 7, 2006, http://www.inf.fu-berlin.de/inst/institutskolloquium/SSo6/huBerlin.html (accessed October 2011).

9. Toward a Media Archaeology of Sonic Articulations

1. Bernhard Siegert, "Life Does Not Count: Technological Conditions of the Bifurcation between Sciences and Humanities around 1900 (Especially Dilthey)," presentation at the Sommerakademie der Rathenau-Stiftung für Wissenschaftsgeschichte, Berlin, July 1994. See Siegert, "Das Leben zählt nicht: Natur- und Geisteswissenschaften bei Dilthey aus mediengeschichtlicher Sicht," in *Medien: Dreizehn*

Vorträge zur Medienkultur, ed. Claus Pias (Weimar: VDG, 1999), 161–82, esp. 175, referring to Wilhelm Dilthey, Die Abgrenzung der Geisteswissenschaften, 2nd ed., in Gesammelte Schriften VII, 8th ed. (Stuttgart: Vandenhoeck & Ruprecht, 1992), 311.

- 2. Villiers de L'Isle-Adam, *Tomorrow's Eve*, trans. Robert Martin Adams (Urbana: University of Illinois Press, 2001), 9. "Voici tantôt soixante-douze siècles . . . qui, d'ailleurs, à titre de précédent immémorial, controuvée ou non, eût échappé à toute phonographie." Auguste de Vielliers de l'Isle-Adam, *L'Eve future* (Lausanne: L'Aged'Homme, 1979), 34.
- 3. Villiers de L'Isle-Adam, *Tomorrow's Eve*, 10. "Ainsi, j`eusse blâmé, par exemple, le Phonographe de son impuissance à reproduire, en tant que *bruits*, le bruit . . . de la Chute de l'Empire romain." *L'Eve future*, 36. [The English translation loses the meaning of the word "bruit," referring to noise. Translation slightly modified. Ed.]
- 4. "Schrecklich" in the original quote. Steve Reich (in conversation with Gisela Gronemeyer), "ärts und zurück," *MusikTexte* 26 (1988): 11.
 - 5. Ibid.
- 6. Barry Powell, *Homer and the Origin of Writing* (Cambridge, England: Cambridge University Press, 1991).
- 7. Claude E. Shannon and Warren Weaver, *The Mathematical Theory of Communication* (Urbana: University of Illinois Press, 1949).
- 8. "Zeitinvariant sind Systeme dann, wenn sie zu unterschiedlichen Zeiten gleich reagieren, d. h. wenn eine Zeitverschiebung am Eingang ein zeitverschobenes, ansonsten aber unverändertes Signal am Ausgang produziert." Stefan Weinzierl, "Grundlagen," in *Handbuch der Audiotechnik*, ed. Stefan Weinzierl (Berlin: Springer, 2008), 15.
 - 9. M. L. West, Ancient Greek Music (Oxford: Clarendon Press, 1994), 234.
 - 10. Ibid.
 - 11. West, Ancient Greek Music, 218 n. 1.
 - 12. Alluding to the Heideggerian notion of "Gestell."
- 13. See William A. Sethares, *Tuning, Timbre, Spectrum, Scale, London* (London: Springer, 2005); see also Karsten Lichau, Viktoria Tkaczyk, and Rebecca Wolf, eds., *Resonanz: Potentiale einer akustischen Figur* (Munich: Fink, 2009).
- 14. See the introduction by Lionel Pearson to his translation of Aristoxenus, *Elementa Rhythmica: The Fragment of Book II and the Additional Evidence for Aristoxenian Rhythmic Theory* (Oxford: Clarendon, 1990), xxxiv.
 - 15. M. L. West, Ancient Greek Music (Oxford: Clarendon, 1994), 154.
- 16. Dietrich Schüller, "Von der Bewahrung des Trägers zur Bewahrung des Inhalts," in "Archive-Medien als Gedächtnis," special issue, *Medium* 4 (1994): 28.

- 17. See Ana Ofak and Philipp von Hilgers, eds., Rekursionen: Von Faltungen des Wissens (Munich: Fink, 2010).
 - 18. Hugh Davies, "The History of Sampling," Feedback Papers 40 (1994): 6, fig. 7.
- 19. See "Sirenengesang," in *Das Neue Universum*, vol. 49 (Stuttgart: Dt. Verlagsges, 1929), 401. "Bei dieser Überschrift werden unsere Leser wohl zunächst an das denken, was Homer in seiner Odyssee erzählt.... Der Physiker versteht aber unter einer Sirene und ihrem Gesang etwas akustisch besonders Einfaches und deshalb für Studien sehr Geeignetes: liefert doch die Sirene wirkliche Töne fast ohne alle Obertöne, während bei allen Musikinstrumenten den Tönen Obertöne beigemischt sind, demnach nicht Töne, sondern Klänge entstehen. Töne ohne Obertöne sind für das musikalische Ohr wie Speisen ohne Würze für die Zunge; aber akustisch einfacher sind sie als Klänge.... Das ist dann der Sirenengesang der Physik."
- 20. Jonathan Sterne, *The Audible Past: Cultural Origins of Sound Reproduction* (Durham, N.C.: Duke University Press, 2003), 90.
- 21. Jonathan Sterne, "A Machine to Hear for Them: On the Very Possibility of Sound's Reproduction," *Cultural Studies* 15, no. 2 (2001): 267.
- 22. Kilian Hirt, "Das Übertragungsproblem in der elektrischen Nachrichtentechnik," Magisterarbeit (Fach Kulturwissenschaft), Phil. Fak. III der Humboldt-Universität zu Berlin, typescript, June 2007, 90.
- 23. See Homer W. Dudley, "The Vocoder—Electrical Re-creation of Speech," *Journal of the Society of Motion Picture Engineers* 34 (1940): 272–78. Italics mine. See also Hirt, *Das Übertragungsproblem in der elektrischen Nachrichtentechnik*.
- 24. Sound file of a 1907 Wedda song from Ceylon, accessible at http://www.gfai.de/projekte/spubito/index.html (accessed June 2012).
 - 25. For a spectrogram of this reconstructed recording, see note 24.
- 26. Michel Foucault, "Message ou bruit?," in *Dits et Écrits I* (Paris: Gallimard, 1994): 557–60.
 - 27. See the studies of Ilya Prigogine.
- 28. "Lebendige Stunden? Sie leben doch nicht länger als der letzte, der sich ihrer erinnert: Es ist nicht der schlechteste Beruf, solchen Stunden Dauer zu verleihen, über ihre Zeit hinaus." Track 3 on CD hörBar, Signature Ph 536, Vienna Phonogram Archive.
- 29. Ibid. "Es hat mit sehr gefreut, auf Wunsch der Akademie der Wissenschaften meine Stimme in den Apparat hineinzusprechen und dieselbe dadurch der Sammlung einzuverleiben."
- 30. Karl Sierek, "Die weiße Leinwand," in Aus der Bildhaft: Filmanalyse als Kinoästhetik (Vienna: Sonderzahl, 1993), 122, referring to Umberto Eco, Einführung in die Semiotik (Munich: Fink, 1972), 263–64.

10. Experimenting with Media Temporality

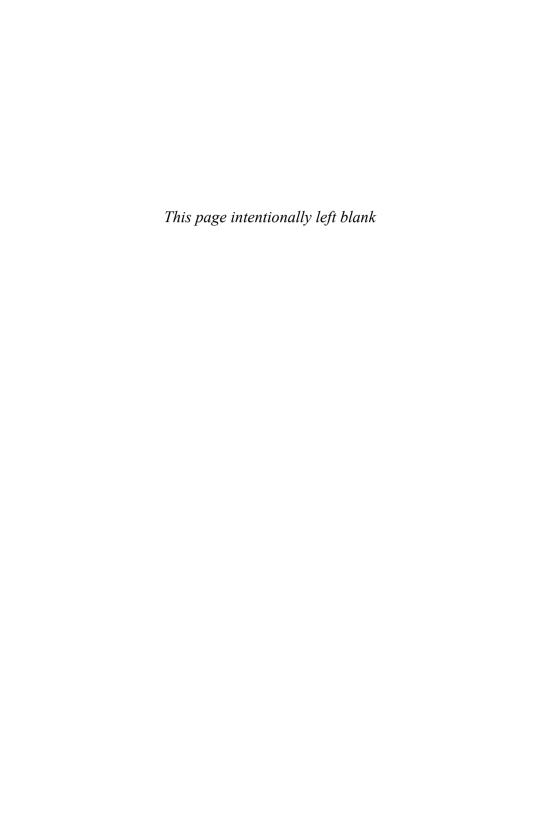
- 1. The original title of the Macy Conferences in New York, which resulted in the publication of Heinz von Foerster, ed., *Cybernetics: Transactions of the Sixth Conference* (New York: Josiah Macy Jr. Foundation, 1949), and subsequent volumes by Heinz von Foerster, Margaret Mead, and Hans Lukas Teuber (1950, 1951, 1953, 1955).
- 2. Heinz von Foerster, Sicht und Einsicht: Versuche zu einer operativen Erkenntnistheorie, autorisierte dt. Fassung v. Wolfram K. Köck (Braunschweig, Germany: Vieweg, 1985), 65 (a summary of the chapter "Kybernetik einer Erkenntnistheorie").
- 3. This includes the rejected experience and fear of deviation of this aesthetic ideology resulting in the "Pythagorean *komma*," that is, irrational number relations.
- 4. Martin Heidegger, Sein und Zeit, 17th ed. (Tübingen: Max Niemeyer, 1993), 385. "Die Wiederholung ist die ausdrückliche Überlieferung, das heißt der Rückgang in die Möglichkeiten des dagewesenen Daseins." Italics in original.
- 5. See Martin Heidegger, Beiträge zur Philosophie (Vom Ereignis), 3rd ed., Gesamtausgabe III. Abt. Unveröffentliche Abhandlungen Vorträge—Gedachtes, Band 65 (Frankfurt am Main: Klostermann, 2003).
- 6. Hermann von Helmholtz declares at the climax of historicism in Germany: "Die Beziehung auf die Geschichte der Musik wird . . . auch deshalb nötig, weil wir hier Beobachtung und Experiment zur Feststellung der von uns aufgestellten Erklärungen meist nicht anwenden können, denn wir können uns, erzogen in der modernen Musik, nicht vollständig zurückversetzen in den Zustand unserer Vorfahren, die das . . . erst zu suchen hatten." Hermann von Helmholtz, Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik (Brunswick, Germany: Vieweg 1913), 411.
- 7. Martin Carlé, "Geschenke der Musen im Streit ihrer Gehörigkeit: Die antike Musiknotation als Medium und Scheideweg der abendländischen Wissenschaft," Musiktheorie: Zeitschrift für Musikwissenschaft, vol. 4, Zur Aktualität des antiken griechischen Wissens von der Musik (2007): 313–14.
- 8. See Wolfgang Hagen, "Technische Medien und Experimente der Physik: Skizzen zu einer medialen Genealogie der Elektrizität," in *Kommunikation, Medien, Macht,* ed. Rudolf Maresch and Niels Werber (Frankfurt am Main: Suhrkamp, 1998), 133–73, available online at www.whagen.de.
- 9. See Johannes Gfeller, "Der Referenzgerätepool von AktiveArchive an der Hochschule der Künste Bern," in Schweizer Videokunst der 1970er und 1980er Jahre: Eine Rekonstruktion, ed. Irene Schubiger (Zürich: Ringier, 2009), 215.
- 10. See Douglas Kahn, "Radio Was Discovered before It Was Invented," in *RELAT-ING RADIO: Communities, Aesthetics, Access; Beiträge zur Zukunft des Radios,* ed. Golo Föllmer and Sven Thiermann (Leipzig: Spector, 2006), 24–32.

- 11. "Ein Analogrechner liegt vor, wenn man zur Lösung eines mathematischen Problems ein analoges physikalisches System aufbaut und die Lösung des Problems *durch ein physikalisches Experiment* gewinnt." E. Kettel, "Übersicht über die Technik der elektronischen Analogrechner," *Telefunken-Zeitung* 30, no. 116 (June 1957): 129. Italics mine.
- 12. Wolfgang Giloi and Rudolf Herschel, *Rechenanleitung für Analogrechner*, ed. Allgemeine Elektricitäts-Gesellschaft AEG-Telefunken, Fachbereich Anlagen Informationstechnik (Konstanz: n.p., n.d.), 13.
- 13. See, for instance, Heinrich Barkhausen, Einführung in die Schwingungslehre nebst Anwendungen auf mechanische und elektrische Schwingungen, 6th ed. (Leipzig: Hirzel, 1958), foreword.
- 14. Operational Manual for the Heath Educational Analog Computer Model EC-1 (n.p., n.d.), 3.
- 15. "Dass Computersimulationen, verstanden als die verzeitlichte Imitation von Systemverhalten durch das Medium Computer, analytisch nicht zugüngliche Phänomene wie etwa Klima behandelbar gemacht haben, rückt sie in eine Position jenseits der tradierten Kategorien von Theorie und Experiment." Claus Pias, "Klimasimulation," in 2°: Das Wetter, der Mensch und sein Klima, ed. Petra Lutz and Thomas Macho (Göttingen: Wallstein, 2009), 108–15, esp. 112.
- 16. "Der Erkenntnisvorteil von Simulationen liegt in ihren Extrapolationsmöglichkeiten für Bereiche, die zu klein oder zu groß sind, zu schnell oder langsam ablaufen." Gabriele Gramelsberger, "Im Zeichen der Wissenschaften," in Schrift: Kulturtechnik zwischen Auge, Hand und Maschine, ed. Gernot Grube, Werner Kogge, and Sybille Krämer (Munich: Fink, 2005), 448–49.
- 17. Eric Winsberg, "Simulated Experiments: Methodology for a Virtual World," *Philosophy of Science* 70 (2003): 120.
- 18. See Johannes Lenhard, "Mit dem Unerwarteten rechnen? Computersimulation und Nanowissenschaft," in *Nanotechnologien im Kontext: Philosophische, ethische und gesellschaftliche Perspektiven,* ed. Alfred Nordmann, Joachim Schummer, and Astrid Schwarz (Berlin: Akademische Verlagsgesellschaft, 2006), 151–68, esp. 159–60. In software engineering, a so-called event is meant to govern a momentary use of the computer program in nonlinear ways (often user orientation at interfaces). For example, the "interrupt" makes the mechanism wait for signal input from outside and in modeling an input leads to related "events." This is close to object-oriented programming; let us call it event orientation in the sense of an operative diagram.

Appendix

1. Wolfgang Ernst, Das Rumoren der Archive: Ordnung aus Unordnung (Berlin: Merve, 2002).

- 2. Siegfried Zielinski, *Zur Geschichte des Videorecorders,* neuausgabe (Potsdam: Polzer, 2010).
- 3. Siegfried Zielinski, *Deep Time of the Media: Towards an Archaeology of Seeing and Hearing by Technical Means*, trans. Gloria Custance (Cambridge, Mass.: MIT Press, 2006). Originally published in German as *Ärchaeologie der Medien* (2002).
- 4. See Wolfgang Ernst, M.edium F.oucault: Weimarer Vorlesungen Über Archive, Archlologie, Monumente und Medien (Weimar: VDG., 2000).
- 5. Sven Spieker, "Archive Fever: Storage, Memory, Media," draft proposal for a research project, 2000, n.p. See Spieker, *The Big Archive: Art from Bureaucracy* (Cambridge, Mass.: MIT Press, 2008).



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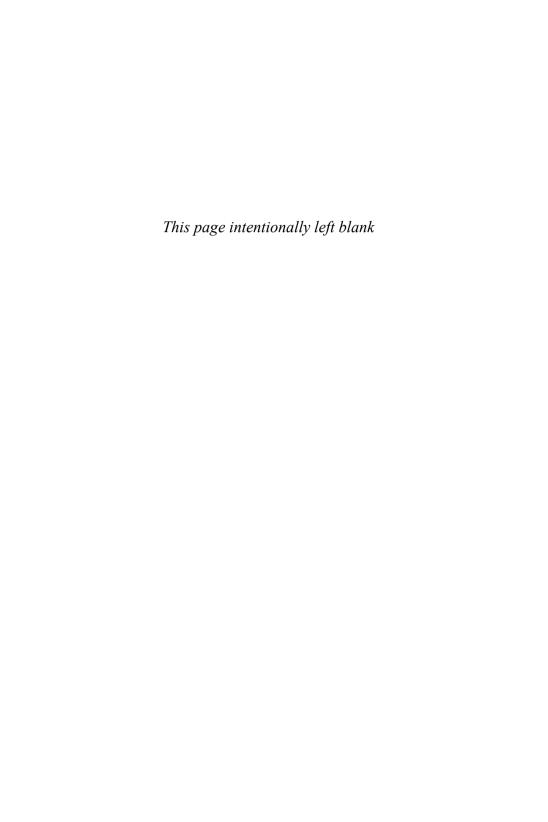
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