CONFRONTING ARTEFACTUAL TEMPOR(E)ALITIES: RADICAL MEDIA ARCHAEOLOGY

[Related to paper for conference *Insuetude: Conversations in Technological Discard and Archaeological Recuperation*, Columbia University, New York, April 28-29, 2016]

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Archaeologizing the present: Digital compression and micro-processor ageing

[Conference draft December 22, 2015: "Insuetude is a quality of not being in use and also an 'unaccustomedness' - which evokes the state we find ourselves in today with obsolete electro-technical devices. [...] put *archaeologists in dialogue with media archaeology* in "approaches to investigating and manipulating materiality. [...] How might archaeological insights into the experimental reproduction of past technologies <...> offer insights for current interests in technological recuperation or in critical making."]

With digital communication culture, what used to be the technological present for generations, like radio and television

as independent media systems, "recedes into a contemporary past that already feels distant" or even antique <conference draft>. This discontinuation of the "analogue" does not happen naturally, but happens in two forms of techno-logical *archaeologization* of the present.

a) The core operation of translating signals from the anlogue world for computational use is digital sampling. Even if, according to the Sampling Theoreme in communication theory, nothing is lost when the "continuous" signal becomes quantized into sequences of bits, audiovisual "big data" need to be compressed for storage and transmission. This leads to a different kind of signal "discard" and "residual media"[1]. To focus attention of this digital sacrifice, research artist Ryan Maguirre applied a kind of acoustic "garbage archaology" (Ratje) by re-collecting the sonic rubbish[2] left by the compression of "musical" data.

[http://theghostinthemp3.com/theghostinthemp3.html = The Ghost in the MP3: Example 3: Sine Tone Chords - Uncompressed (audio file, plus Spectrogram)
Example 4: Sine Tone Chords - 320kbps MP3; Example 5: Sine Tone Chords - 320kbps MP3 "Ghost"
Kommentar: "low-frequency sine tones sound quite good as an MP3 encoded at 320kbps MP3.

The MP3 codec implements a lossy compression algorithm based on a perceptual model of human hearing which determined which sounds were perceptually non-important and could therefore be erased.

What does such rejected data sound like? Patrick Maguirre has developed techniques to recover such lost sounds.

[Listen and see examples 3 and 4 in: Maguirre, Sine Tone Chords - Un / compressed, from: http://theghostinthemp3.com; accessed February 2015]

The material left behind by MP3 data compression is worth listening itself. "White, pink, and brown noise, when compressed to the lowest possible MP3 bit rate, sounds very different from the original random signal" (Patrick Maguirre).[3]

Maguirre has produced an audio "[...] comprised of lost mp3 compression material from the song *Tom's Diner* which had been used

1 See Charles Acland (ed.), Residual Media (University of Minnesota Press) 2007. See further Caleb Kelly, Cracked Media: the sound of malfunction; MIT Press 2009, on artistic abuses and extensions of media technology
2 On the re-cycling of cultural value, see Michael Thompson, Rubbish Theory, xxx
3 See the video: Ryan Patrick Maguirre, moDernisT, created by salvaging the sounds and images lost to compression via the MP3 and MP4 codecs, from: http://theghostinthemp3.com; accessed January 4th, 2016

as one of the controls in listening tests to develop the MP3 encoding algorithm:

"Here we find the form of the song intact, but the details are just remnants of the original. The video is the MP4 ghost of a corresponding video [...]. Thus, both audio and video are the 'ghosts' of their respective compression codecs."[4]

While audio-visual attention to "the ghost" of MP3 files appears somewhat metaphysical, the laws of media applied here are rooted in techno-mathematical precision.[5] Probably the phantasm of "haunted media" (Geoffrey Sconce) applies to analog, that is: signal-based media recordings only, not to digital data processing any more.[6]

b) Next there is a second form of *archaeologizing* the present. Not only for obsolete analog electronic hardware but for digital media as well, there is a premature, actively enforced ageing for economic or other stratetic reasons: the planned "insuetude" of micro-processors by *online* attacks. Software for aggressive fast ageing of microchips such as MAGIC (Malicious Ageing in Circuits, experimentally developed at New York University) causes negative-bias temperature instability.[7]

[For a comment in German on such computational *Progerie* see http://www.zeit.de/digital/internet/2015-10/geplante-obsoleszenz-magic-software-laesst-hardware-altern (22. October 2015)]

All of the sudden, while entropy is the Shannon measure of "binary information units" itself, we are reminded of the physical entropy of computation: Symbolical machines are always *incorporated* in real matter.

[The (time-)critical momentum in digital media is what Norbert Wiener on occasion of the New York Macy conferences on cybernetics once called "the time of non-reality" between "on" to "off" in binary switching.]

[Traditional philosophy of history and archaeological research is much about physical decay of cultural artifacts. This refers to entropy in the sense of the second law of thermodynamics, assuring the irreversibility of the physical time arrow. But in an epistemologically dramatic turn, entropy has become a measure in information theory where neither matter nor energy counts (Wiener). Instead of "material literacy", there is informational

4 http://theghostinthemp3.com; accessed 4 Jan. 2016
5 See Jonathan Sterne (2012); MP3: The Meaning of A Format; Duke University Press
6 A thesis expressed by media historian John Durham Peters; see xxx
7 Announced in: ACM Transactions on Architecture and Code Optimization

code knowledge. The current nostalgia and concern for the physical (discharge) and energetic (ecology) aspects of technologies are phenomena of a "post-digital" aesthetics, by-passing the challenge of techno-mathematical theory of communication and "Shannon entropy". Re-socializing, "re-worlding" and re-anthropologizing technology as an act of reconciliation of existential human experience of being in the physical world with the technological challenge follows the wrong track of the archaeological question: a dead end, as opposed to "radical" media-√ology.]

Media-archaeological analysis reveals what goes on in the ground of computing, that is: with*in* microchips.[8] Media archaeology therefore is less about beginnings and "old" media, but about their *processual* contemporalities - "virtual temporality"[9] in the precise sense of calculated realities.

In between materiality and logical diagram: Paper machines[10]

There are methodological and philosophical overlaps between the two disciplines of cultural and media archaeology indeed. But in a complementary sense, let us recognize the gaps between those two practices as well. The archaeological focus on materiality may be adequate for traditional cultural artefacts but is not for techno-mathematical devices.

"Media archaeologists favor objects like punch cards" <conference draft>. But such punches in an antique computer card are not absent matter but information. The punch card indeed is an object inbetween cultural materiality and mathematical logic.

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8 For a reverse perspective, see Christine A. Finn, Artifacts. An Archaeologist's Year in Silicon Valley, xxx 2000

9 A term coined by Ignacio Infante, After Translation. The Transfer and Circulation of Modern Poetics across the Atlantic, New York (Fordham University Press) 2013, 170: "[...] any point in time can be retraced and accessed instantaneouly". Matthew G. Kirschenbaum, Track Changes. A Literary History of Word Processing, Cambridge, Mass. / London (The Belknap Press of Harvard University Press) 2016, 320, note 61, comments on this archival capability: "Not incidentally [...] Apple's current backup sytem for its computers is named Time Machine."

10 "Paper Machine" is the name given to a publication of Jacques Derrida on the current state of computer-based writing: Jacques Derrida, Paper Machine, transl. Rachel Bowlby, Stanford, CA (Stanford University Press) 1995. Derrida remarkably misses the point that "paper machine" is an expression in Alan Turing's seminal paper on discrete computing itself (1936), while treating this machine rather like black box which remains an enigma for philosophers. Maybe philosphers might become computer-literate in the media-archaeologically sense which reveals its techno-logical *alethéia*.

"Post-digital" nostalgia for archaeological materiality?

Recently the so-called "post-digital" has emerged as a new term in media-cultural and media-artistic discourse, indicating a nostalgia for the haptic, the material and the tangible which has disappeared in algorithmic computing.

At first glance this is good news for classical archaeology. But the analogy between archaeology as such and media archaeology in its focus on material culture and artefactual hardware is just one side of the coin. The other refers to the second component of the term "technology" itself: the *logos*, the mathematical, logical, algorithmic aspect of contemporary culture. Media archaeo*logy* refers to the sublime mechanisms and temporalities of data processing, and is "radical" rather in the sense of the mathematical symbol for numerical root ratios than as search for temporal origins.

"Radical" (square root) media archaeology is less about the application of algorithms that build up classification or seriation (Flinders Petrie) of material artifacts in archaeological research but rather a techno-mathematical anlysis, of such algorithms themselves, an un-revealing of their operational diagram and their electro-physical embeddedness in "hardware".

B. Jaulin, though, has articulated an early critique of such "anarchaeological" methods in Digital Humanities *avant la lettre*:

"[W]e are [...] concerned with some practices that we now meet in archaeology, namely the use of algorithms that build up classifications of artifacts on the basis of their description. The lack of justification in the anarchic use of such procedures is manifest at different stages. Our main purpose is the study of hypothesis related to the measure of differences in the `similarities´ between objects."[11]

What kind of *archéologie*?

Radical media archaeology is no historicist recurrence to "dead media" but investigates the fundamental techno-logical configurations of the present as continuous past. As a method, it is less a narrative move toward artefactual *histories* but an effort to reveal the non-disursive *archive* of the techno-logical present.

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11 B. Jaulin, Mesure de la Ressemblance en Anarchéologie, in: J.-C. Gardin (ed.), Archéologie et Calculateurs, Paris (CNRS) 1970, 343- (343)

Present digital devices, even if minimised to the max, are still continuing the von-Neumann-architecture of storage-programmable computing. Therefore they rather trigger the archaeologists' interest in the contemporariness of relics from past that the historicity of bygone times.

The accumulating material traces of the recent technological past ask for re-defining archaeological practice. It is true, the very notion of media "archaeology" has been stimulated by Michel Foucault's seminal *Archaeology of Knowledge* (1969/1972). But Foucault is not to blaim for reducing the term "archaeology" to a metaphor; Foucault has rather been frequently misinterpreted by archaeologists and cultural historians. Foucault on several occasions distanced himself from a literal interpretation of *archèologie* as digging metaphor or as reference to geological layers; he rather reactivated the need for a "philosophical archaeology" (as once expressed by Immanuel Kant) which means an inquiry into conditions of possibility for cognition (the *a priori*). Blending such archaeology with the archive, rather than searching for "origins", Foucault's *archivology* discovers "the system that governs the appearance of statements as unique events" (AK). For years, though, the rather abstract *a priori* in Foucault's archaeology of knowledge still lacked a more material grounding - which materialist media studies in its insistence on hardware analysis have borrowed from classical archaeology. Today is the technological laws which govern what can be multi-medially expressed, communicated, stored and transmitted. The computational coupling of hardware and logics resulted in the kind of "general archival system" aimed at by Foucault's discourse analysis which in the digital present we call *online* acess to the Internet of communication and things.

Toward a re-definition of the "material artefact"

In electrified digital times, cultural traces (texts or objects) are not simply material any longer; the notion of the artefact itself rather needs to be re-defined. Errors in digital image processing are called "artefacts", with their sonic equivalent being "glitches". The artefact is both physical and logical. Media-archaeological criticism therefore refers to techno*logics* which is algorithms implemented in physical matter, the marriage of matter and mathematics. Media-archaeological observation focuses on the spatial and time-critical moments of contact (even the quantum energetical interference) between physical matter and logical coding.

Media *archivology*: Kittler's case

The driving mind who radicalized Foucault's archaeology into media

theory, late Friedrich Kittler, has become a memory address himself, with his written papers, self-designed electronical toys and experimental software source code now being located at the German Literature Archive in Marbach. To answer the question in which way computing once shaped Kittler's research in the 1990, media archivology is required. A specially designed search engine called Indexer, after having copied the hard drive and storage discs of Kittler's computer in sector images, allows for the sub-hermeneutical, chronologically simplest and statistically most reliable search option of looking for modification times of his digital files - a dynamic parameter rather than the historicist focus on straightforward origins (creation time). Even if the Indexer offers a search option for creation times, these are not historically reliable as they rather depend on the inner time (*eigenzeit*) of the storage devices themselves.[12]

Media *archivology*, in an analytical sense, refers to the archive of computing itself - with *l'archive*, once more in Foucault's sense, naming less the institution for record memory which in French would always be expressed in the plural: *les archives*. *L'archive des médias* rather refers to the material and logical conditions of possibility for any kind of technical articulation. Methodologically, the approach *from within* technology expresses the media-archaeological, that is: non-human point of view, distant from the cognitive or bodily perception of "media" which humans experience from interfaces like the computer screen. For such an investigation, media archaeology necessarily departs from the familiar historical research. Radical media archaeology is not simply another variance of historiography but an alternative way of dealing with temporal evidence resulting from times past; it is rather radical historicism. A term like "historical media archaeology" (as coined by Kittler) therefore is an undecided *oxymoron*.

Insight or blindness? The focus on materiality and Object-oriented programming

The discipline of archaeology which studies how objects mediate our relationship to the past offers a lot to media archaeology, especially by investigating the role of materiality across both disciplines. But the nature of "objects" itself has changed. Since the development of the computing language SIMULA in Norway, the notion of the material object has changed. Object-oriented programming does not write lists of code lines any more which sequentially operate routines and sub-routines but rather manipulates objects which simulate the real world as instanciations of classes. While a class or type in Object-

12 See Susanne Holl, Friedrich Kittler and the Digital Humanities: Forerunner, Godfather, Object of Research. An Indexer Model Research, in: Digital Humanities Quarterly (2016), note 2

oriented programming rather looks like a Platonic idea[13], instances are particular algorithmic individuals. "*Instances exist in time and space.*"[14] Object-oriented programming resulted in the computational neo-logism of an "abstract materiality"[15].

Focus on operativity rather than matter

Archaeological practice as "virtual reality" is not about materiality any more but deals with meta-realities. Computers and algorithms themselves here become active agencies of media archaeology,

such as in Patrick Feaster's literally audio-visual computational retrieval of pre-Edison "first sound" recordings with image-to-sound software, and the "restauration" of the first electro-mechanical television recordings (John Logie Baird's *phonovision*) by Donald McLean.

Media archaeology reveals the material and logical, therefore: techno-logical principles (ancient Greek *archai*) that drive signal transduction and data processing in the architectural hardware and archival textural software of computing. This necessarily includes analysis of its operativity, that is: truly processual media-archaeology, revealing temporal and time-critical patterns of the medium - just like contemporary archaeology as such nowadays shifts the focus of analysis from the distant past to the "production of presence" (Gumbrecht, Shanks): The past *is* present *in* its traces and is *made* present *through* reenacting its traces indeed.

[The archaeologist Michael Shanks at Stanford University is co-editor of a volume on performantive arts: *Archaeology of Presence*]

But past media can be "re-presenced"[16] not by shere materiality; they reather require operative re-enactment, operative presence (which is the ratio for assembling techno-epistemological "toys" in the Media Archaeological Fundus and the Signal Laboratory at Humboldt University).

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13 See Casey Alt, xxx, in: Huhtamo / Parikka (eds.) xxx

14 James M. Fielding / Dirk Marwede, The Anatomy of the Image: Towards an Applied Onto-Psychiatry, demnächst in: Philosophy Psychiatry and Psychology, xxx

15 Matthew Fuller / Andrew Goffey, Die obskuren Objekte der Objektorientierung, in: Zeitschrift für Medienwissenschaft 6, Heft 1/2012, 206-221 (221)

16 See Vivian Sobchack, Afterword. Media Archaeology and Re-presencing the Past, in: Erkki Huhtamo / Jussi Parikka (eds), Media Archaeology. Approaches, Applications, and Implications, Berkeley / Los Angeles / London (University of California Press) 2011, 323-333

Anatomy of Kittler's modular sound synthesizer

The circuit design of a radio set is not a "text" any more but an operative diagram when set in media function.

[Charles Sanders Peirce's concept of "diagramatic reasoning" is close to the archaeological method in its epistemological sense.[17]]

Both archaeologists and media theorists alike are therefore being challenged: To what degree can textual and hermeneutic metaphors which have been familiar to humanities be applied to elctro-material culture?

In the years around 1980 late Friedrich Kittler had engineered a modular sound synthesizer which nowadays endures as strange artefacts in the midst of his collected papers. Therefore research artist Jan-Peter E.R. Sonntag has directed an "anatomy" of this three-dimensional circuitry architecture, to answer the question if there is something like an idiosyncratic style or even authorship in Kittler's handling of actual electronics. This is hardware-oriented media hermeneutics in the tradition of what the archaeologist Eduard Gerhard in 19th century once called *monumental philology*.

Fig.: "Anatomy" of Friedrich Kittler's modular sound synthesizer, directed by Jan-Peter E.R. Sonntag [= Anatomie-Synthesizer-Sonntag-2]

Rethinking computing with Heidegger

As has been identified by Vivian Sobchack, the archetypal *emplotment* of media archaeology is not simply an antiquarian love for the ancient artefact, but as well the romantic desire to revive it "through a transhistorical *operative practice*"[18] which correlates with Martin Heidegger's reading of ancient Greek *techné*: "a 'revealing' that not only 'brings forth' but also *makes present*"[19]. In the philosopher's own words:

"No matter how sharply we just *look* at the 'outward appearance' of Things in whatever form this takes, we cannot discover anything ready-to-hand. If we look at Things just 'theoretically', we can get along without understanding readiness-to-hand. But when we deal with them by using them and manipulating them, this activity is not a blind one; it has its own kind of sight, by which our

17 See M. I. Doran, Archaeological reasoning and machine reasoning, in: J.-C. Gardin (ed.), Archéologie et Calculateurs, Paris (Éditions du CNRS) 1970, 57-67
18 Sobchack, Afterword, in: Huhtamo / Parikka (eds.), xxx, 324
19 Quoted ibid.

manipulation is guided and from which it acquires its spefific Thingly character."[20]

Technology is not primarily a way of making or doing things, but rather itself an archeological action: "a way of revealing things that precedes the making"[21]. The essence of *Technik* is by no means simply techological; it is rather *Gestell*: a framework, like a mill. "Mill" accidentally was the term Charles Babbage used to described the central processing unit of his nineteenth-century full-mechanical proto-computer, his Analytical Engine).

Mathematical thinking precedes both the materiality and the coding of computing technologies. Thereby it once led to mathematizing material machines like Babbage's Engines and later to mechanizing mathematics itself: Turing's 1936 conceptual computer.

Arché* and *logos

Let us look at the very term archeology itself: *arché* and *lógos*. An *arché* is never simply a beginning; it is a massive rupture, a leap forth, "implicitly anticipating whaterver springs from it [...]"[22].

With a lot of recently familiar technological devices abruptly getting out of use, "the present recedes into a contemporary past that already feels distant" <conference draft>; a new "antiquity" emerges as pre-history or even: pre-historical archaeology of the "contemporary now" (the Benjaminean *Jetztvergangenheit*).

Still, antique electronic circuit diagrams remain readable, in equiprimordial, even ahistorical invariance towards temporal change - just like a geometric drawing on an ancient Egyptian papyrus can still be deciphered as a mathematical argument.

[The Heideggerian term "gleichursprünglich" (equiprimordial) signifies that two constellations are neither derivable from or based on the other.[23]]

Archaeology shall therefore not be reduced to the study of beginnings. *Arché* as well expresses the lasting impact, the ongoing rules and order resulting from that origin. In Aristotle's scientific philosophy, "*arché* means, at one and the same time, beginning and control <...> origin and ordering."[24] Heidegger

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20 Martin Heidegger, Being and Time, New York (Harper and Row) 1962, 98
21 See Inwood, Heidegger Dictionary (1999), 209
22 Inwood, Heidegger Dictionary, 152
23 Inwood, Heidegger Dictionary, 152
24 Martin Heidegger, On the Essence and cncept of *Physis* in Arostotle's *Physics* B, I. In: M. H., Pathmarks, Cambridge (Cambridge UP) 1998, 189

emphasizes "the unity that oscillates between the two", in a kind of historic-archaeological double-bind: thinking structure and time. The archaeological act of revealing (*aletheia*) precedes *logos;* the very term "archeo/logy" is disrupted by that epistemic gap.

The affinity between media archaeology and pre-historical archaeology

It is by epistemologic necessity that there is a close affinity between radical media archaeology and *pre*-historical archaeology as such. It is mainly prehistorians which recently turned to an archaeology of the present or even future challenges such as nuclear waste site preservation.[25] "Knowledge of a pre-history [Ur-geschichte] is not unearthing the primitive and collecting bones" (Heidegger[26]) - *nota bene* Flinders Petrie.

[Without providing absolute chronological dates, archaeology can not really contribute to historiography. Archaeology is within a different tempor(e)alty of material things. As long as there is no such evidence, we do not know if the remains from the Hissarlik dwelling in Turkey is really the textual Troy described by Homer.[27]]

There is a clash between the anthropocentrism of academic archaeology (focusing human performance) and *media* archaeological notions of non-human agency (operativity) and technological *eigenzeit*: Here, the real protagonists are rather the machines than the people who created them.[28] Inventors should be mentioned, but their creations are controlled by some rather external machinic logic. Media can be studied without people"[29] - in *radical* versus *historical* media archaeology.

The alliance of "processual" archaeologies

<see Robert W. Preucel (Hg.), Processual and Postprocessual Archaeologies. Multiple Ways of Knowing the Past, Carbondale 1991>

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25 E-mail Cornelius Holtorf (Archaeology, Department of Cultural Sciences, Linnaeus University, Kalmar, Sweden; see http://web.comhem.se/cornelius), 7th January, 2015

26 = IM, 119/131; quoted after Inwood?

27 Donald F. Easton, Schliemanns Ausgrabungen in Troja, in: Justus Cobet / Barbara Patzek (eds.), Archäologie und historische Erinnerung (1992), 69

28 Friedrich Kittler, Optical Media: Berlin Lectures 1999, trans. Anthony Enns, Cambridge (Polity Press) 2010

29 John Durham Peters, Introduction: Friedrich Kittler's Light Shows, in: Kittler, Optical Media, 5

There is a close affiliation between media archaeology and so-called processual archaeology. Inbetween hermeneutics and cultural semiotics, both are less concerned with the human behind the artefact, but rather with the system embracing both[30],

<see Ian Hodder / Scott Hutson, Reading the Past. Current Approaches to Interpretation in Archaeology, Cambridge, 3rd ed. 2003>

oscillating between agency and structure in "post"-structural analysis. As soon as the operative context of an artefact is known, it is no longer silent.[31]

Is it mandatory to defend the "monumental" approach *versus* making it speak as "document"? Technologies do not "speak", though, but they act.

[Let us decipher the term techno/logy in this sense. *Lógos* and *techné*, words and material things, "are not documents to be read, but `monuments´"[32] - mapped on the technological mediascape. It is for this reason that Foucault did not label his inquiry "historical" but "archaeological".]

Radical media archaeology instead of "dead media" research

Only to traditional archaeologists and historians the emergent research field of media archaeology looks like devoted to the curious or forgotten paths in the history of technology. Siegfried Zielinski's approach takes care of such a "variantology" indeed.[33] Radical media archaeology, on the contrary, avoids the attractive and seductive, but tranquillizing metaphor of resurrecting "dead media". Thereby both the kinship and the difference between "conventional" archaeology and media archaeology may become clear.

Since Bruce Sterling first used the term "dead media" in a speech delivered at a symposium on Electronic Art in 1995 to address lost, marginalized or obsolete media[34], the resulting project ("part archive, part nostalgia, part requiem"[35]) itself almost

30 Kent V. Flannery, Culture, History vs. Cultural process: A Debate in American Archaeology, in: Mark P. Leone (ed.), Contemporary Archaeology. A Guide to Theory and Contributions, Carbondale 1972, 105

31 Hodder / Hutson 2003, 5

32 xxx, in: History and Theory XX (3/1981, 253, unter Bezug auf: The Archaeology of Knowledge, transl. by A. M. Sheridan Smith, N. Y. 1976, 7, 106-117, 138-139

33 Siegfried Zielinski / xxx (eds.), Variantology, xxx

34 Bruce Sterling, The life and death of media, speech at Sixth International Symposium on Electronic Art ISEA ’95, Montreal, (19 September)

35 Tara Brabazon, Dead media: Obsolescence and redundancy in media

disappeared and "became obsolete" <ibid.>. The thematic mailing list itself died. Even if the Dead Media Project still holds a URL[36] and has a 'holding' Web site in place with (a) few functional links, "[t]ragically, all the links capturing the research and comments [...] are disabled or broken. Instead, media artist Garnet Hertz revived such projects in his research.[37] The cultural phantasm of the "undead" needs to be re-defined in technical terms.

For sure, current academic research on the "social web", cloud computing and mobile media, has displaces the original "technical a priori" focus on material computer platforms and source code. But

[On the other hand, media ecology in Jussi Parikka's sense points to the rare earths trade as the very material core of "mobile media"). See Jussi Parikka, Media Geology, xxx 2014]

different from such communication studies, material media studies insists on "the media artefact at the centre of analysis with theory as an amplifier"[38].

"E. T." as topic of computer (game) archaeology

Like advanced cultural archaeology, media archaeology is not an abstract theory but primarily an applied research method; its character is both object-oriented and operational, esp. when the focus is on computing. While the Turing Machine has been an operative diagram for computing numbers on paper, computers as we know them nowadays actually take place in physical hardware and individualized computer architectures.[39]

What separates computers from previous technologies is its double-bind of being *both* material hardware and symbolic software. "Obsolescence" in computing can not be reduced to the naive understanding of digging out its residual materialities.

An archaeology of digital culture can never be reduced to the

history, in: First Monday, Volume 18, Number 7 (July 2013), at http://firstmonday.org/ojs/index.php/fm/article/view/4466/3701 doi:10.5210/fm.v18i7.4466; accessed November 20, 2015

36 http://www.deadmedia.org

37 See Garnet Hertz, A collection of many problems, Los Angeles (Telharmonium Press) 2009, at http://www.conceptlab.com/problems

38 Rezension von Ernst, Digital Memory and the Archive (2012), in: Media, Culture & Society, Bd. 37, Heft 4 (2015), 658-660 (659)

39 An argument by Stefan Höltgen in his presentation "It's more fun to compute!" Theoretische und operative Begriffsbestimmung von "Computerarchäologie", July 9th, 2014, at the research colloquy *Medien, die wir meinen*, Humboldt University Berlin, Media Studies

material, "stones and bones" artefactual interpretation; it has to confront that its technologies come into media-being only processually. Media hardware, like skeletons or architectural walls, tends to remain; but its flesh is software which, like electrons themselves, is volatile.

The archaeological metaphor for digital media has been triggered by the spectacular digging out of *E. T. - The Extraterrestrial* computer game cartridges a few years ago. The commercial failure of the computer game *E. T.* (designed for Atari in 1982) once led to its literal "dumping" in the sand of New Mexico in 1983 - until its spectacular archaeological rediscovery in 2013.

[But the real media-archaeological issue is "core dump"; see Hex-Dump representation of storage content]

This computer game has since become subject of a soft and a hard way of practicing media archaeology. Ironically, the soft archaeological version concerns hardware, and the hard media archaeological version concerns software.

Different from materialist archaeology, media archaeology of computer games involves the symbol manipulation level of source code as well. Precisely this requires *disassembling* a given Atari game module microchip, which leads to a new meaning of the very term archaeo-logy: revealing the computer *logos*, different from simply opening the electronic circuitry in analog media.

Only disassembling brings into symbolically readable form what is physically buried as memory in a computer game.[40] Binary data stored in physical memory cells, once being detected, can be re-translated into the symbolical mnemonics of Assembly language. The special operation of disassembling means that the raw machine language of the program is read and understood in its own terms. But other parts of the coding process still requires hermeneutic interpretation in the effort of making sense of an obsolete programming text again - such as the commentaries in Assembly code written by humans, which are not being stored in machine language.

[*Writing the archive* is equivalent to "assembling" in computer programming: Reading back the coherent narrative text into the archival ingredients of the memory machine. This epistemologic filter isolates and monumentalizes the relevant parts of the document.]

Archaeological insights into the experimental reproduction of past technologies can "offer insights for the current interest in critical making" indeed <conference draft>. A genuine "archaeology" of past computing practice is its re-enactment by emulators.

While electro-physical intusion in opening actual hardware might

40 Höltgen 2015: 130, note 18

destroy this symbolic machine, mnemonics and hexadecimal values represent the op-codes of machine language and the binary values symbolically and thereby allow for non-invasive reading. Once the hardware of an archaic computer game like E.T. has been emulated, in real-time debugging its software can be analyzed and manipulated in single-step mode.

This is an alternative kind of archaeology: no digging in the desert for cartridges but within the source code (the binaries) of the cardridges themselves.[41] Thereby, media archaeology does not play with the computer game but with its code.[42]

Even if such retro-computing at first sight appears like nostalgia for "dead media", its epistemological value is critical media philology of new kinds of archival records from the past. Contrary to the romantic image of buried computer game modules in the desert, the non-material code of *E. T.* has been present all the time and has been "kept alive". Processual analysis of ancient game code layers by debugging leads to an operative definition of computer archaeology which does not reconstruct historical material but operates within a different temporal regime of equi-primordiality between past and present computing.

In a similar kind of experiment, the Aperture Labs managed to read out the raw bits preserved in electro-magnetic remanence on Read Only Memory chips.[43] These were put through a disassembler and become re-readable as code again.

The distinction between hard- and software for computer culture does not suffice; it must be supplemented by an analysis of the operational machine behaviour (for which Babbage once developed his "symbolic notation").[44] This is a new form of *processual archaeology* for technological items. The monumental record (be it hardware of source code) must be set "in motion" in order to become a media-archival document at all.[45]

But there remains some kind of an uncertainty relation in such media archaeological observation of technical devices: One gets either as close as possible to their electro-phyiscal materiality, or close to their temporal dynamics which is algorithmic

41 See David Richardson, Fixing E.T. The Extra-Terrestrial for the Atari 2600: www.neocomputer.org/projects/et (2013)

42 Stefan Höltgen, *It's more fun to compute!* Retro-Games als Wissensobjekte, in: Ann-Marie Letourneur / Michael Mosel / Tim Raupach (eds.), Retro-Games und Retro-Gaming. Nostalgie als Phänomen einer performativen Ästhetik von Computer- und Videospielkulturen (Verl. Werner Hülsbusch) Glückstadt 2015, 49-66

43 See http://adamsblog.aperturelabs.com/2013/01/fun-with-masked-roms.html; accessed July 10, 2014

44 See as well Franz von Reuleaux, Theoretische Kinematik, xxx 1875

45 See Eivind Rossaak (ed.), *The Archive in Motion*, Oslo 2010

operativity. Let us sustain the undecidability of the literally techno-archaeo-logical question: Where does symbolic op-code end, and where does material machine language start?[46]

[Media-archaeological insight: the Janus-faced interface (Fry's *deconstructulator*)]

Ben Fry's *Deconstructulator* - created as part of his "Visually Deconstructing Code" series shown in the Ars Electronica 2003 CODE Exhibition -

"[...] is a deconstructed Nintendo emulator that shows how sprites and sprite memory are handled while a game is being played. The intent is to show insight for how software and hardware work, given the relatively simple example of a minimal architecture from an old game console system."[47] Fry's *Deconstructulator* modified source code of the NESCafe emulator written by David de Niese which Fry hacked up literally "a bit" (bit-wise) "to dynamically show aspects of how the machine works" <ibid.>.

Fig.: PAC-MAN-Sprite-Hoeltgen

[Really "forensic" media archivology: Reading a ROM]

What is kept apart in the introduction of Foucault's *Archaeology of Knowledge* is dialectically synthesized in the digital computer: it encompasses both "document" (source code) and "monument" (its physical hardware architecture).

Hardware without code, and in reverse software without material embodiment, would be "the computer" in theory, but not real computers as operative media. This asks for different excavation practices.

The chrono-poetic equivalent to the archaeologically hidden object is the techno-real moment of *temporal* gap.[48]

<siehe § "Computerspiel-Sprünge: Pac-Man (Höltgen)", in COMPSPIEL>

How "material" is software?

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46 See Semen Karsakov, Ideenmaschine [1832], Berlin (Kulturverlag Kadmos) 2xxx

47 http://benfry.com/deconstructulator (last up-dated: November 2003; accessed April 21, 2016)

48 See Stefan Höltgen, JUMPs durch exotische Zonen. Portale, Hyperräume und Teleportation in Computern und Computerspielen, in: Thomas Hensel / Britta Neitzel / Rolf F. Nohr (eds.), "This cake is a lie!" Polyperspektivische Betrachtungen des Computerspiels am Beispiel von "Portal", Münster et al. (LIT Verl.) 2015, 107-134

<begin copy MEDARC-CCA-WITHIN>

"[...] trying to do something like reset a fuse to allow reading/writing of protected areas or probe a data track to observe data being processed by the chip" is material criticism: materially de-constructing computer chips by reverse engineering it's construction. Such software hacking is dangerous on the level of the symbolical order of computing, while tinkering with circuits that are directly connected to mains is dangerous in an electric sense.

[Is it possible to get literal "insight" into the computer not only a a posthumous archaeological device which can be "excavated" by opening it physically, but while it runs? Whatever we see on a computer monitor is a direct function (and therefore indeed "indexical") of its data storage allocations. In times of the so-called Williams Tube the cathode ray tube did not primarily serve as a computer-to-human interface but as an intermediary RAM itself.]

One specific media-archaeological (or media-archival) target is the program code that is stored in a masked Read Only Memory (ROM) chip. As long as the chip itself is using a known architecture and assembly language, reverse engineering is able to recover the actual instructions stored in the ROM; "data" is clearly discernible.

A second-order observation paradox in media archaeology arises. Computer software - even if it is able to archivize all other previous forms of cultural memory - can not itself be displayed from within.[49]

Therefore museums of computer architecture are necessary to store hardware architectures and software solutions - "so precisely as to preserve at least the validity of mathematical algorithms" <Kittler ibid.>. But this has to be done as executable programs instead of passive reading - which makes all the difference to the Gutenberg Galaxy, beyond the *stasis* of traditional textual archives.[50]

Fig.: Identifying Assembler code as charged elements in a SRAM [= RAM-APERTURELABS-3]

The term "interpretation" of source code is problematic already: Before a human reader can make sense of such a text, it must first

49 An argument made by Kittler 1996: 78

50 See Doron Swade, Collecting Software: Preserving Information in an Object-Centred Culture, in: History and Computing, vol. 4, no. 3 (1992), 206-210; furthermore: same author, Virtual Objects - Threat or Salvation?, in: S. Lindquist / M. Hedin / U. Larsson (ed.), Museums of Modern Science, Canton, Mass. (Science History Publications) 2000, 139-147

be logically be "interpreted" by a compiler or "interpreter".

Archaeology (like critical philology) always insists on the close examination of the material artefact instead of simply relying upon its edited publication. There are always features of the (analog) original which are not (digitally) reproducible.[51]

[This changes when the physical laboratory in experimental science is replaced by computer simulation itself.]

Archaeology as such and media archaeology are both confronted with fragmented artefacts. A digital file "is not a document in its own right - it merely describes a document that comes into existence when the file in interpreted by the program that produced it"[52]. A digital image is not coherently framed any more in space like the cinematic shot but is being regenerated dynamically in time.

["Digital humanities" *avant la lettre*? "New Archaeology" and Peirce's archaeological semiotics]

It is not by coincidence but by epistemological necessity that archaeology has been among the first disciplines within the humanities to employ computing and statistical techniques ("Digital Humanities" *avant la lettre*), but:

"Even the beneficial contribution of such 'hard' science such as radio carbon determinations of date or ground penetrating radar to archaeological interpretation, rely on operators having a close empathy with archaeological material, the context of discovery and the role of post-depositional processes"[53]

- "computational" humanities. The techno-mathematical application of stochastic analysis is not simply a special method in classical archaeology (as expressed in journals like the Italian *Archeologia e calcolatori*), but can be identified upside down as the *archaeological* element in mathematics itself

- just as Foucault's *Archaeology of Knowledge*, should not be taken metaqphorically, but at its implicit mathematical face value, which is the propositional logic of enunciations.[54]

Hodder close to Charles S. Peirce, not reducing semiotics to (de)coding, but semiosis as agency

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51 See Dymond 1974: 55
52 Rothenberg 1995: 44
53 E-mail Peter Rauxloh (Information Strategy Manager, Museum of London), July 2002
54 See Martin Kusch, xxx

Hodder / Hutson 2003, 169: the past can be "read" exactly because material culture is not text: text is just a metaphor, not an analogy for material culture.

Manuscripts, for Peirce, are not immediately "documents", esp. as long as they are not yet deciphered. For ancient history, even manuscripts are first of all: monuments.[55]

Peirce started from the assumption of the materiality of any sign.

In *Minutiöse Logik* (1902), chap. "Über Methodenprobleme der Klassifikation"[56], Peirce refers explicitely to Flinders Petrie, founder of pre-historical archaeology of Egypt: his system of sequential chronology as quantitative archaeology (genealogy of ceramics); as entries in lists they constitue series. On paper stripes entries of pre-dynastic ceramics, numbers: relative seriation.[57]

This coincides with Egyptian mathematics itself which did not apply a calculus but lists: results were listed, esp. complex ratios.[58]

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55 Charles S. Peirce, in his unpublished *A History of Science*, chap. "The Logic of Drawing History from Ancient Documents, especially from Testimonies" (1901), 146

56 In: Charles S. Peirce, Semiotische Schriften, Bd. 1

57 See Franziska Lang, Klassische Archäologie, Tübingen / Basel 2002, 139

58 James Ritter, Jedem seine Wahrheit. Die Mathematiken in Ägypten und Mesopotamien, in: Michel Serres (ed.), Elemente einer Geschichte der wisenschaften, Frankfurt/M. 1995, 89