"RADICAL LOGO-TECHNICAL ANALYSIS: MEDIA SCIENCE, AND MEDIA ARCHAEOLOGY"

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*Towards a Media Science:*

(MIS-)UNDERSTANDING MEDIA WITH MCLUHAN

**Message, massage: McLuhan's difference to Communication Studies**

Although Marshall McLuhan is currently being re-discovered as a thinker of "social media" *avant la lettre* within the Internet community, the main lesson to take from McLuhan is still to look behind the computer screens, for a not content-orientated, but hidden message-orientated analysis. This requires - with and beyond McLuhan - a structural analysis of the techno-mathematical conditions of current media practices, to bring out the epistemological layers of such practices.

The message beyond McLuhan's grave is a critical awareness for media-induced phenomena acting upon humans in implicit ways. McLuhan has inspired neurological studies into mass media perception, that is: the awareness of subliminal processes induced by technical (mechanical and electronic) media such as later experimented by Herbert E. Krugmann's "Brain Wave Measures of Media Involvement"[1]. McLuhans seminal book *Understanding Media* originally did not result out of interest in media-epistemological theory right away, but originated more traditionally in communication studies. *Understanding Media* had been commissioned as an educational report to analyze the impact of watching television on school

1 Published in: Journal of Advertising Research vol. 2, no 1 (February) 1971, 3-9

children. It was "absolutely McLuhan" to turn this study upside down, resulting in a most original analysis of the deep impact of media on human perception on the subliminal level. Understanding media is not about content, but the *message* and *massage* of the medium: the affective, neurological level, analogous to the figure/ground separation as developed in *Gestalt* psychology.

## Expressing media theory: McLuhan the "man of letters"

McLuhan has been a man of the letter; as such, his legacy is an archive now. Once intellectual expression is coded into the symbolic regime of writing for transmission (publications) and storage (its libraries), it survives the author even *post mortem*. It is the marvellous quality of the archive as a time channel that it suspends wiriting from entropy. Is is still possible to derive fresh impulses from his thinking for contemporary media theory - as long as this reading is strictly analytic. McLuhan has been inspirative for generations of artists, but that does not turn him into an artist himself.

The message of McLuhan's publications, even if their aesthetic content is typographically experimental, is still the alphabetic regime which is symbols, not signals. In that world, an encounter with his writings is not simply historical but refreshing. In its very consequence this asks for a radically archival reading and archivographical writing of such intellectual heritage - which is today The Herbert Marshall McLuhan Fonds, held in the Library and Archives of Canada (LAC) in Ottawa, signature MG 31, D 156. As such, "McLuhan" has never become post-literate, but stays "M-C-L-U-H-A-N". His two bodies, the mortal and the intellectual one, have resulted in a grave and in an archive. Only in the latter he has, in principle, become timeless, as long as is alphabetic letters can be identified and copied without loss.

Showing McLuhan's audio and video recordings, results in a delusion, the realm of signal recording where is no voice or face at all: McLuhan's second existence in the electromagnetic sphere which he himself called "acoustic space". Portraits of McLuhan nowadays are mostly images which have been digitally refreshed (even regenerated) through algorithmic image processing. After algorithmic analysis, what looks like McLuhan only superficially results in an image for the sake of the phenomenal perspective of the human visual sense, but in fact it is a computational object, a function of two-dimensional coordinates (x, y) within a discrete matrix. Signal convolution (*Faltung*) in digital image processing turns iconic content into information. Such a convolutive turn is required for refreshing McLuhan.

## Refreshing McLuhan: "Media ecology"

Cultural knowledge has resulted in technologies which develop into autonomous systems. Apparently, Marshall McLuhan has been anticipating the current issue of "media ecology" not in the sense of environmental damage but in its cybernetic sense, with his diagnosis of the electic sphere becoming a second nature, a "noosphere" (a neologism adopted from Teilhard de Chardin which links to the current discourse on the "anthropocene" in the epistemological sense). In McLuhan's media ecology, "the medium is the

message" as well: "Any understanding of social and cultural change is impossible without the knowledge of the way media work as environments".[2] McLuhan's focus, though, is on "the phenomenology of media broadly defined through perception"[3], while the approach by radical media archaeology is distinct from such anthropocentric perspective with its focus on the inverse ecology of technical media, on micro-infracstructures, *invironment*. Media archaeology (in its "Berlin school" version) carries McLuhan beyond McLuhan who once demanded that "[t]he hidden aspects of the media are the things which should be taught" indeed, since "they have an irresistible force when invisible."[4] But while being brilliant in the diagnosis of macro media infrastructures, McLuhan failed in investigating its micro-infrastructural mirror, the electronic circuitry and its symbolic coding which now is the seven layers signal traffic as and in the Internet. "When Sputnik went around the planet, nature disappeared [...] enclosed in a man-made environment."[5]
So far McLuhan's diagnosis. The Sputnik choque in fact triggered the US-American counter-strategy of de-centralized communication structure resulting in the ARPA net indeed, prefiguring the Internet of today.

While the pervasiveness of electronic communication (from telephone over radio and finally television) has been McLuhan's contemporary concern, simply refreshing it for analysis of current media culture almost becomes a hindrance. McLuhan has not been that providential when it comes to the computational universe. Even if communicational media today are still wholehartedly electronic, their essence has ontologically changed into the algorithmic, which is an objectification of the mind in a different way which McLuhan hardly addressed. At this point, we are asked to dis-continue his media theoretical heritage rather than simply to up-date it.

With his solid background in humanities, McLuhan has always remained a man of letters. He never really cared about the technical details of the electronic media he addressed as content of his analysis. The message of his experimental approach to typography of all kind (as displayed on exhibition here) is the Gutenberg galaxis. But typography has returned conceptually within the turingmachine itself and physically within silicon chips, and requires a different kind of artistic research: hard- and software-hacking.

**McLuhan's impact (on occasion of the 50th anniversary of UM)**

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2 Marshall McLuhan, the Medium is the Massage, New York / London (Penguin Books) 1967, 26

3 Michael Durroch / Janine Marchessault, Media as Extension and Environment, publication on occasion of the project *Feedback #1: Marshall McLuhan and the Arts*, Den Haag (West) 2017

4 Marshall McLuhan in a post-lecture Q & A session recorded by ABC Radio National Network on 27 June 1979 in Australia, from: youtu.be/a11DEFmoWCw?t=4m30s (as quoted in Gottlieb 2017)

5 Marshall McLuhan, The Planet as Art Form. Interview with David Frost, The American Broadcasting Corportation, 1972; marshallmcluhanspeaks.com/interview/1972-the-planet-as-art-form, quoted after Gottlieb 2017

It is an indicator of discourse that the proper term "media" appeared in a non-technical book title at a time when the cultural impact of electronic media like radio and esp. television became evident - resulting in McLuhan's book *Understanding Media*. Is is only that escalation of electronic media (as opposed to printing and film before) that the notion of "media studies" found its proper discoursive place. Electronic media are signal-based, as opposed to cinematography with rather still relates to the mechanical age and the Gutenberg galaxy, as identified by McLuhan). From there results an additional, not humanities-centered media theory: Shannon's mathematical theory of communication.[6]

By naming media in his book title *Understanding Media* in a sense not restricted to the term medium in physics (air, liquids, gases), McLuhan made clear that cultural engineering has escalated into electronic agencies whose impact on society and economy became so strong that it deserved an academic analysis of its own. McLuhan has created a non-content-oriented, non-hermeneutic "understanding" of media, focussing on their subliminal technologically induced messages. Mistaking "understanding" for sense-making itself would be a mis-understanding of media; therefore such analysis abolishes story-telling of media-(in-)"history". McLuhan's operative definition of media as signal events resonates with the media-archaeological approach today. Has McLuhan been a true media archaeologist *avant la lettre*? At one point, he compared his method with the one of archaeologists, but he never really took care in a close reading of the precise technological artefacts and their circuit diagrams. Media archaeology is "cold" in its non-hermeneutic gaze, but "hot" in focussing on technical details.

In consequence of McLuhan's initial remark that the real impact of any technology is the change of pace that it introduces into human affairs, the focus on media tempor(e)alities differs from the well-known "historical" ones. At that point, the reference to McLuhan's classic transcends it at the same time, across the historograpical border line which still limits *Understanding Media* - even if in his posthumous *Laws of Media* McLuhan experiments with a non-historical description of media time. McLuhan himself devoted chapter 15 to the impact of the mechanical, escapement-driven clock, linking it to typography and cinematograpic movement as opposed to the ephemeral fluidity of electricity. Electronic media which are the core of McLuhan's analysis are signal-based and incorporate a completely different chrono-poetics.

## Mis-Understanding Media: McLuhan's critique of Shannon

McLuhan's insistence on the ground / figure difference can be interpreted as the difference between the media-archaeological layering of media against their phenomenological (mass) media appearance on the level of interfaces and other surfaces.[7] This can be extended into the temporal domain, where

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6 On the genealogy of terms like "communication" and Communication Studies see John Durham Peters, Speaking into the Air. A History of the Idea of Communicaiton, Chicago / London (Univ. of Chicago Pr.) 1999

7 Interfaces, though, may be treated different from traditional surfaces, since they represent a technical coupling.

frequency is the mathematical reversal of physical oscillations. High frequency carriers channels in tele-communication are being modulated by the varying low frequency articulations known to human perception as sound, music or speech, figuring or in-forming the basically *temporal* ground of transmission. Media archaeology is not only about spatial and topological grounds, but as well about the floating groundings: "Ground cannot be dealt with conceptually or abstractly: it is ceaselessly changing, dynamic, discontinous and heterogeneous, a mosaic of intervals and contours."[8]

Applying this to audio media, especially to short wave AM radio, the apparant dichotomy between medium as content and as technologtical message turns out to be rather interlaced. When listening to a broadcast from Radio Kuwait in the early evening, the noise and the phase shifting are an articulation of the ionospheric channel of transmission (i. e. the "medium" in Shannon's sense) itself; the medium here is part of the message which, though, only becomes perceptible when being part of a successful reception of content.

McLuhan's focus on the message of the medium *as perceived by human senses*, though, lacks an essential understanding of the inner processes in telecommunication technologies for the second half of the 20th century and since, which is based upon the technomathematical theory of information as developed by Claude Shannon 1948 in his "Mathematical Theory of Communication". McLuhan's critical, almost satirical reading of the Shannon diagram as a simple linear sender/reveiver-relation reveals his essential ignorance of the mathematical resoning involved in digital communication engineering; this makes all the difference between an analysis of the impact of mass media on audiences on the one side, and media archaeology on the other.

McLuhans critical comment on Shannon's communication diagram is a desastrous simplification of its mathematical understanding. In his 1978 essay "The Brain and the Media. The 'Western' Hemisphere", McLuhan attributes the Shannon-Weaver model of communication to the predominantly left-hemispheric Gutenberg galaxy.[9] "The Shannon-Weaver model of communication [...] typifies left-brain lineal bias. It is a kind of pipeline model of a hardware container for software content. It [...] assumes that communication is a kind of literal *matching* rather than resonant *making*"[10] - which reveals McLuhan's kind of "analogue thinking" from the electronic media age (thus being closer to the analogue computer indeed). As has been expressed by a follower of McLuhan, the radio scholar Tony Schwartz: "Electronic media have been viewed merely as extensions of print, and therefore subject to the same grammar [...]. The patterned auditory and visual information on television or radio is not 'content'. Content is a print term [...] As stimuli, electronically

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8 Marshall McLuhan / Eric McLuhan, Laws of media. The new science, Toronto (University of Toronto Press) 1988, 63

9 As quoted in: Peter Bexte, Cadillac und Gebetmatte. McLuhans TV-Gemälde, in: Derrick de Kerckhove / Martina Leeker / Kerstin Schmidt (eds), McLuhan neu lesen. Kritische Analysen zu Medien und Kultur im 21. Jahrhundert, Bielefeld (transcript) 2008, 323-337 (335)

10 Marshall McLuhan / Eric McLuhan 1988: 86

mediated communication cannot be analyzed in the same way as print 'content'."[11]

Can such an interpretation of electronic mass media still be applied to an analysis of the algorithms which rule digital communication media and scholarly research in times of Digital Humanities? McLuhan's brother in mind Schwartz continues: "The function of a communicator is to achieve a state of resonance with the person receiving visual and auditory stimuli from television, radio, records, etc. Decoding symbolic forms such as [...] written words is no longer our most significant problem. They extract meaning from perception in a manner prescribed by the structure of the language, code this meaning symbolically, and store it in the brain. But the brain does not store everything in this way. Many of our experiences with electronic media are recorded and stored in the same way that they are perceived. [...] since the experience is not stored in a symbolic form, it cannot be retrieved by symbolic cues."[12]

But it is an almost Hegelean irony of technological reason in the history of cultural engineering, that what looks like non-symbolic (and rather signal-based) audiovisual media, in the epoque of digital communication re-turns in an even more rigid symbolic order. The implicit message of the meta-medium computer is that all former media (especially the signal-based ones) are symbolically transformed from distinct hardware to software, thus: software formats.[13]

A first step in symbolic coding had been spoken language, then writing (especially the phonetic alphabet); these cultural technologies have since been more or less immediate to the human processor. Nowadays though, the alphanumeric programs remain hidden to most users.

## McLuhan's unease with media arts

Both media theories and media arts develop in parallel (if not incommensurable) ways. A common method, though, which joins a certain kind of academic and artistic particed-based media research, is media archaeology[14] which derives epistemogenic sparks (aesthetic or discursive knowledge) *from within* technologies.

Marshall McLuhan has not only been highly influential on New Media Art, but once declared artists being the radar antennas to the changes induced by new

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11 Tony Schwartz, The responsive chord, Garden City, New York (Anchor books) 1974, 19

12 Schwartz 1974: 24

13 See Stefan Heidenreich, FlipFlop. Digitale Datenströme und die Kultur des 21. Jahrhunderts, Munich / Vienna (Hanser) 2004

14 See Erkki Huhtamo / Jussi Parikka (eds.), Media Archaeology. Approaches, Applications, and Implications, Berkeley / Los Angeles / London (University of California Press) 2011, and Siegfried Zielinski, Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means. Cambridge (MIT Press) 2008

technologies himself.[15] Early 20th century artistic avantguardes, like cubism, have been triggered by media technologies such as chronophotography indeed. But McLuhan's own experience in the recording studio for producing the experimental record *The Medium is the Massage* apparently left him intellectually untouched.[16] The philospher of "acoustic space" as electrotechnical condition of media culture himself did not feel at home in the media arts. Even with Cera's triptych painting of a psychedelic TV at the front wall, art and science did not meet in the coach house of the Toronto University campus. McLuhan performed not as an artist, but as a true academic, with its predominant code of verbal and literary expression.



## Medium end(s)

Media theoretical analysis starts with the very term *medium* itself. By definition, Greek *metaxy* (as defined by Aritotle in his *Physics*, book IV) and its Latin translation *medium* is the material channel of transmission, and technically located inbetween sender and receiver, data input and output. The act of analog signal transmission is temporally ephemeral, almost "memoryless", while the data processing unit in computing already anticipates the output. In syllogistic reasoning, it is the "medium" term itself which has a functional existence, to vanish after the logical operation.

The familiar plurality of media itself has already started to converge into one dominant meta-medium, the interconnected computer. Books and newspapers, film, radio and television cease to exist as technically independent media; they rather return in a ghostly shape, as mere formats, within the computational frame in so-called "digital culture". Is the very term "media" itself doomed to be exhausted by universal computing?[17]

## German "media theory" *avant la lettre*

In his *Grundlagen einer Philosophie der Technik* (1877), Ernst Kapp introduced the term "Organprojection"[18] - a remarkable anticipation of McLuhan's

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15 See Baruch Gottlieb, Towards a Reasonable Ecology among the Media themselves, Royal Academy of Art, The Hague, September 2017, Den Haag (West) 2017

16 As remembered by his son Eric McLuhan, quoted by Michael Vazquez in the booklet accompanying the re-issue of the record, FDW7711-LP (orig. 1968 Columbia LP CS 9501)

17 Friedrich Kittler, Grammophon - Film - Typewriter, Berlin (Brinkmann & Bose) 1986, engl. transl. Stanford UP 1999, Preface

18 Ernst Kapp, Grundlinien einer Philosophie der Technik. Zur Entstehungsgeschichte der Cultur aus neuen Gesichtspunkten, Braunschweig (Westermann) 1877; transl. into English: Elements of a Philosophy of Technology. On the Evolutionary History of Culture, University of Minnesota Press, 2018, and Marshall McLuhan, Understanding Media. The Extensions of Man, New York (McGraw / Hill) 1964

prosthesis-theory of media when finally comparing telegraphy networks to the human nervous system itself. Sigmund Freud's notion of the Unconscious (the "psychischer Apparat") somewhat anticipates the French Apparatus approach (Baudry on the cinematic *dispositif*). Furthermore, Walter Benjamin sees human perception shaped by the variant historic media conditions. Close to what Marshall McLuhan later termed "the medium is the message" he interprets film not in its content but rather as a setting like a physiological experimental laboratory: "Das Publikum fühlt sich in den Darsteller nur ein, indem es sich in den Apparat einfühlt. Es übernimmt also dessen Haltung: es testet." The dramaturgy of "choque" accommodates the audience on the perceptual level to the speed of modernity and time-critical moments. This phenomenon has been investigated further by Paul Virilio's "dromology" which (like Heinrich Heine in his famous thesis of the annihilation of time by the new transport vehicle railway around 1840) swallows spatial distance in favour of the temporal trajectory (tele-presence).

This diagnosis has been shared by Martin Heidegger's notion of annihilation of distance ("Ent/fernung") by radio and television. Heidegger's philosophy of technology is an epistemolgical rather than engineering view ("Das Wesen des Technischen ist nichts Technisches"). Heidegger, after his post-war prohibition of teaching at university, still lingered as a ghost in the gang-ways of Freiburg university, inspiring a young generation of Friedrich Kittler, Norbert Bolz et al., while they were, at the same time, inspired by the neighbouring French (post--structuralists (Lacan, Foucault, Derrida).

## The Berlin model: *Kulturwissenschaft* and Media Studies in critical alliance

Parallel to the emergence of "Medienwissenschaft" (written in singular) as a proper academic discipline in German universities, "Kulturwissenschaft" arose as a field of research inspired by Aby Warburg et al.; especially with the re-organization of Humboldt University after the opening of the Berlin Wall in the beginning of the 1990s, "Kulturwissenschaft" as a discipline (written in the singular) developed a sharp methodological edge, orientated rather towards "Kulturtechniken" (cultural engineering) with projects like "Bild - Schrift - Zahl" and "Das technische Bild" (the technical image), both research projects at the interdiscipinary "Helmholtz Zentrum für Kulturtechnik".

Among the protagonists of "Kulturwissenschaft", Hartmut Böhme once defined the disciplinary matrix of "Kulturwissenschaft" in a way which claims to include (or absorbe) "Medienwissenschaft", arguing for a "interdisziplinäre Kulturwissenschaft mit offenen Augen für die Geschichte der technischen Welt"[19]. Wolfgang Frühwald rephrased this with a significant shift of emphasis (which has become the *credo* of the GfM in the meantime): a "*kulturwissenschaftlich orientierte Medienwissenschaft*"[20]. This perspective is critical. While cultural studies (including research on the technological impact) tend to reduce media to its discoursive effects rather than knowing media as

19 Böhme 1989: 30

20 Wolfgang Frühwald, Geisteswissenschaften heute. Eine Denkschrift, Frankfurt/M. (Suhrkamp) 1991, 156

technologies themselves (except a few scholars like Christian Kassung and others), media studies proper require a sound techno-mathematical and media-archaeological (-historical and -theoretical) knowledge and exercises how to develop epistemological questions out of that close knowledge.

## The Different Meaning of "Communication" in Media Theory

Media archaeology rather relates to Claude Shannon's *Mathematical Theory of Communication* (1948) which does not confuse technical communication with mutual human understanding.

For conventional print and broadcast "mass" media studies, communication logocentrically referred to the distribution of the spoken word. In terms of what appears on interfaces, communication media, ranging from radio over television to second-order "radio" (smart phones), consist almost exclusively of human faces, voices and writing, addressed to other human eyes and ears. The actual media event, its signal engineering, is completely instrumentalized for anthropocentric semiotic exchange. But technical media are non interesting only as tools for intersubjective or collective human communication, but as agents of communication in themselves. Media archaeology is a temporary, epochal suspension from technological anthropocentrism, as a condition to epistemologically focus on the class of knowledge which implicitly results (partly non-intentionally) during the coming-into-being of such technologies.

Media Theory is characterized by its combination of close analysis of media technology with its deep philosophical reasoning. It rather stays close to the signal than to cultural and communicative semiotics. This peculiar mix of fascination with engineering together with epistemological reflection leads to a radical shift of focus of attention to communication not only between humans and machines but within machines themselves. 99 % of "media events" occur *within* technologies, unnoticed by humans in their interfacial use of "social" communication devices - more than ever in times of mobile media.

Norbert Wiener's 1942 typescript (classified as secret knowledge) has been a techno-mathematical analysis. Analog and digital communication, based on continuous signals or discrete symbols like telephone talks and telegraphic ("mobile media") messages can be mathematically correlated: "This is the study of messages, and their transmission, whether these messages be sequences of dots and dashes as in the Morse code or the teletypewriter, or sound-wave patterns as in the telephone or phonograph, or patterns representing visual images as in telephoto service and television. In all communication engineering [...] the message to be transmitted is represented as some sort of array of measurable quantities distributed in time. [...] by coding, or the use of the voice, or scanning, the message to be transmitted is developed into a time series."[21]

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21 Norbert Wiener, 1942, The Extrapolation, Interpolation und Smoothing of Stationary Time Series with Engineering Application, typeskript dated February 1st, 1942, 3, in: National Archives and Records Administration, Record Group 227 (Office of Scientific Research and Development), College Park, Maryland (USA), MFR, DIV.7-313.1-M2 (Division 7 Report to the Services

Shannon's *Mathematical Theory of Communication* (1948), as well as McLuhan's *Understanding Media* (1964), turned conventional communication studies upside down into emerging media studies proper by shifting attention from verbal, auditive or visual content to the techno-aesthetical message of media. The take-off of new German media theory, with Kittler's *Grammophon - Film - Typewriter* as an initial manifesto (1985), has been a radical technological grounding of French (post-)structuralism in the analysis of actual technologies, ranging from Lacan to "Foucault, the last historian or first archeologist"[22]. Such a grounding is by no means a simple extension of Lacan's psychoanalytical triple of the Real, the Symbolical, and the Imaginary to engineering, but actually reveals its different nature. While for machines, there is no "imaginary" at all, the "symbolic" becomes time-discrete signal processing (the numerical coding of the Real), and the somewhat undefinable psychic "real" is identified with mateReal noise. Instead of the psycho-logically unrepresentable, the mateReal and the tempoReal can be approached by techno-mathematical analysis (and subsequent synthesis) indeed. As remarked by the founder of the modern world-image (as analytic geometry) René Descartes, there is no soul in the machine , even if it mimicks the human - unless such performative simulation turn into operative, *lógos*-driven emulation. By-passing the human-centered approach, genuine techno-analysis starts from here.

Whereas communication studies are mostly concerned with the mass media transmission of cultural and political events, media archaeology poses the question of the "origin" of operative media on a deeper level, which is both the technical and the mathematical one - in the sense of the square root which is the symbolic expression of the verbal notion of *arché*.

The focus of media archaeology is on what unfolds *within* the technological channel which is usually bracketed by phenomenological, anthropocentric communication studies: "It was with good reason that Shannon's information theory [...] categorically distinguishes between the receiver and the recipient of the information, that is, the radio set and listeners - because he wanted to be able to leave the recipient out of the mathematical theory altogether."[23] True *media* understanding gets epistemologically attuned to the technological *between* which has transsubstantiated from Aristotle's *to metaxy* as physical channel of communication (water, air) to technologically adopted electro-physicality, different from the media-phenomenological focus on interfaces as human media experience.

Such kind of media analysis (even media "science") emerged has rather diverse epistemological roots, like Ernst Kapp's *Philosophie der Technik* 1877, Fritz Heider's "Ding und Medium" (1926), Walter Benjamin's approach to "The Work of Art in the Age of its Technical Reproduction" (1936), and Martin Heidegger's "turn" in rethinking technique, while at the same time being

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No. 19. MIT Research Project No. DIC-6037; OSRD No. 370, Massachusetts Institute of Technology); print version 1949 (M.I.T. Press); 3rd ed. 1964

22 Kittler 1999: 5

23 Friedrich Kittler, Observations on Public Reception, in: Radio Rethink. Art, Sound and Transmission, ed. by Daine Augaitis / Dan Lander, Banff (Walter Phillips Gallery) 1994, 75-85 (75 f.)

heavily influenced by theories of computation and media engineering (Alan Turing 1937, Claude Shannon 1948), Jacques Lacan's equation of the human subconscious with the machine, and Michel Foucault's rigid discourse analysis.

New German media theory has emerged from the necessity to answer technological questions rarely posed by communication studies. The speculative nature of media epistemology rather links it to object-oriented ontology than to manifest content research, asking "What It's Like to Be a Thing?"[24]. Such an approach starts from a different concept of communication, understood not in the sociological but engineering sense, with "information" being a mathematical ratio (*lógos*) rather than a semiotic negotiation. The very term "communication" is the point of bifurcation between media science and communication studies. In communication engineering, "[t]he concept of information applies not to the individual messages (as the concept of meaning would), but rather to the situation as a whole"[25]. Mathematical calculation measures the temperature of communication, its entropy, that is: the amount of freedom of choice in selecting a message.

## The *Lógos* of Technical Communication

Marshall McLuhan (1964) rather analysed the media technological message than its discursive "content" which he even dismissed as diverting critical attention. Economist Harold Innis focused on the *bias* of communication; its underlying orientation towards conquering either time (alias tradition) or space (alias telecommunication) is no metaphysical or social construction, but a function of its material or logistical techniques. But it is only with electronic media that communication transcends body-related cultural techniques to autonomous technologies.

Bertolt Brecht's "radio theory", around 1930, clearly underlined that it takes technical intervention to prevent the radio from becoming a passive consumer device. By activating the feedback channel, radio can be turned into a literal "communication device". Audio communication, as communication science, is focused on the physical and technical preconditions of communicative *lógos*.

By techno-logical necessity, Theodor W. Adorno's analysis of music in radio culture *Current of Music*, which stays close to the signal, once became incompatible with the rather sociological studies of the "Princeton Radio Research Project" directed by Lazarsfeld. The electromagnetic spectrum is made up of many kinds of waves most of which do not concern mass communication media. In "analog days", the limited of "radio" frequencies which can be squeezed in to a frequency band seemed to limit the expansion of communication media.[26] So-called *cognitive radio* (time hopping, frequency hopping, once developed by Hedy Lamarr and George Antheil against interception of radio communication based on punched tapes known from

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24 Subtitle of Bogost 2012

25 Weaver 1949 / 1963: 9

26 D. Q. Innis, A Note on Communication and Electromagnetic Resources, in: Harold A. Innis, The Bias of Communication, Toronto / Buffalo / London (Univ. of Toronto Press) 1995, Appendix I, 199-202 (201f)

music automata) has been the answer, as well as asynchronous transfer. Digitisation radically multiplied channels for transmission, which implies a radical transformation in the ontology of communication: its mathematisation and algorithmisation.

Paul Baran and Donald Watts, in 1963, developed *packet switching* as disentangled, in fact: literal de-construction of syntactically coherent communication; Bob Kahn's and Vinton Cerf's Transmission Control Protocol (TCP), later accompanied by Internet Protocol (IP), radicalize the postal epoque of address orientation; mighty compression and even predictive algorithms transform time-consuming into an almost immediate transmission. What looks like the return of face-to-face communication on the phenomenal surface for humans (technically true for time-continuous "live" transmission in analog electronic telecommunication), in fact is more non-linear (time-discretely temporalized) by nano-temporal calculation intervals than ever.

Especially with fiber optical cables for financial high frequency trading, networked locations can be addressed with the speed of electricity; digital immediacy replaces the still energetically biased notion of "mobile" transfer.

The essential message of von-Neumann architecture in current computing is algorithmic thinking and the stored program. To learn from the McLuhan method is to resist the temptation of submerging the analysis of current media culture to the media-sociological approach which looks at the figurative *Medienwirkung* (the social phenomena) first; media-archaeological analysis instead identifies the deep impact of a current media system which McLuhan call it, according to the *Gestalt* approach in psychology, the "ground". The ground of electronic communication has been "acoustic space" (McLuhan) not in its manifeste, but epistemic sense. The classic "analog" model of mediated communication which has been channel-based transmission (tele-communication in the spatial sense, tradition in the temporal sense) is currently undertunneled by mathematically sophisticated data compression, calculating "real time" effects by means of statistical anticipation of immediately future events. The techno-logics of Internet communication replaces the cultural time-biased formation called "tradition" (in its fixation on the temporal channel) into a dynamic archive, with its primacy of techno-mathematical coding. Emphatic transmission (across spatial distance) by a channel is undone (or counter-matched) by pre-emptive mathematical calculation on the one hand, and re-placed by a thick net of micro-transmissions within processors.

Media archaeology tries to precisely locate the technological momentum where communiation actually takes place: its material agencies. In the binary code of earely electric computing, e. g., the thermionic tube (triode) functions in the discrete mode, different from linear amplification in telephone lines technology.

This different bridging of distances by binary quantities results in a new quality: "The network became machine. No longer was the network a passive device, for repeater amplifiers actively added energy along the route. This change decoupled the wave that represented the conversation from its physical embodiment in the cable. [...] Electricity in the wires was now merely a carrier, separate from the message or signals it carried [...]. Now voices becomes

signals [...]. The message was no longer the medium; now it was a signal that could be understood and manipulated on its own terms, detached from its physical embodiment."[27] Already Siemens' *regenerative repetitor* in electric telegraphy (the 19th century Indo-European Telegraph Line) did not amplify with signals as well the noise, but clearly differentiates binary *digits*.

"Digital" information replaces the energetically continuous time-signal in favour of time-discrete pulses. Thereby the US-American Bell System which started with telephony "became not merely a set of voice channels but a generalized system capable of carrying any signal as a new currency: information"[28], transcending "communication" in the narrow human sense.

## The *lógos* of the Machine: Non-Human Communication

Communication is about signal circulation in coupled systems, be it man-man, man-machine, or machine-machine(s). The use of the term "communication" in Claude Shannons "Mathematical Theory of Communication" from 1948[29], relieves the notion from all semantic aspects. In that sense, a transmitter of radio waves "communicates" with the radio receiver, or computers communicate with each other in the Internet. Not the quality of information counts, but its quantitative measure, in the statistical sense. In information engineering, the word *communication* includes all kinds of procedures by which one human, or artificial, "mind" may affect another. This involves all kinds of human behaviour, for which Weaver lists written and oral speech, also music, the pictorial arts, the theatre, even the ballet. But "[i]n some connections it may be desirable to use a still broader definition of communication, namely, one which would include the procedures by means of which one mechanism (say automatic equipment to track an airplane and compute its probable future positions) affects another mechanism (say a guided missile chasing this airplane)."[30] Even without any human being involved, communication takes place.

## Communication in Real-Time

If communication is understood in the cybernetic sense, it is not restricted to bridging space as telecommunication, but opens up a temporal horizon as well. Predictive algorithms, once implemented in electronic computing machines, allow for the anticipation of the future, in friendly or hostile communication with an addressee: "The receiver's reaction can actually be observed (and thus

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27 David A. Mindell, Between Humans and Machine. Feedback, Control, and Computing before Cybernetics, Baltimore / London (Johns Hopkins University Press) 2004, 112

28 Mindell 2004: 107

29 Claude E. Shannon, The Mathematical Theory of Communication, in: Bell System Technical Journal 27, Juli/Oktober 1948, 379-423 / 623-656

30 Warren Weaver, Introductory Note on the General Setting of the Analytical Communication Studies, in: Claude Shannon / same author, The Mathematical Theory of Communication [1949], Urbana (University of Illinois Press) 1963, 3-28 (1)

cause corrections with the sender) or it can be anticipated. For the latter case of influence on the signal production by the sender's assumptions about potential effects the term *feedforward* has also been suggested."[31] Its media archaeological primary scene has been the anti-aircraft prediction for ballistic weapons in Second World War and the Anti-Missile program in the Cold War, as developed in parallel lines by Norbert Wiener with Bigelow as applied time series analysis, and by Claude Shannon.[32] Shannon developed a model of techno-mathematical enemy aircraft movement anticipation, where the human factor (the pilot's intentional manoeuvers) is superseded and limited (corrupted) by the mechanical behaviour of the airplane and other physical parameters. In this model the real position of the enemy airplane at the temporal moment *t* is considered the "message", whereas registered deviations represent "noise".[33] Even miscommunication may turn out as productive from the perspective of technical communication engineering.

## Between *lógos* and *techné*: Software Communication

Media archaeology as "critique" does not focus on cultural media content, but identifies the kind of knowledge which inherently unfolds from within hard- and software. Finding it impossible to separate between the cultural and the technical level in computing, media theorist Lev Manovich has created what he calls "cultural analytics", as a compromise between content-orientated mass media studies and hard core media archaeology. Critical software studies (Matthew Fuller et al.) look at the algorithms and their embeddedness in hardware structures themselves, while not neglecting its social and economic aspects.

Hardware- and code-focused knowledge of computing becomes "ubiquitous" with embedded computing, mobile media communication, and the operative temporality of the World Wide Web, like the time-critical "ping" signal, and its UNIX time concept. The debate about the US-American PRISM data surveillance system reminded of the necessity for "time-critical" media studies in both senses: in the sense of political analysis, and in the most precise sense of media archaeological hard- and software analysis. Obviously, PRISM roots in the fiber glass cables which link Continental European to British and US-American data transfer. "Big data traffic", as expression, has replaced "mass media communication". Such a cable can be "read" in terms of symbolical (binary) data processing.

## The Insistence of "Humanities" in the "Digital"

To what degree do Media Studies still belong to the academic Humanities department? In the late Medieval kernel of what later became the academic

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31 Winfried Nöth, Handbook of Semiotics, Stuttgart 1990, 178

32 As described in Axel Roch, Claude E. Shannon. Spielzeug, Leben und die geheime Geschichte seiner Theorie der Information, Berlin (gegenstalt Verlag) 2009

33 P. R. Masani, Norbert Wiener 1894-1964, Basel / Boston / Berlin (Birkhäuser) 1990, 186

university, the four "scientific arts", have been music, arithmetic, geometry and astronomy (the Quadrivium). Scientific *lógos* separated from human reasoning; the remaining three arts (the Trivium) constituted the "humanities" – grammar, logic, and rhetoric. In the Renaissance, the old Trivium became *Studia humanitatis*. With Digital Humanities, "science" and "humanities" fuse (or at least fold) into one, again. Humanist disciplines traditionally study subject matters to which the experimental method does not apply - "and instead mainly use the comparative method"[34]. With computational humanites, though, comparative research itself becomes *algorithmically experimental*.

"As humans and data machines become equal partners in cultural practice, social experience, and humanistic research, the humanities may no longer look like 'the humanities.'"[35] Digital post-Humanism is no more *Geisteswissenschaft* in Dilthey's sense. Still, Digital Humanities actually re-invents the informational aesthetics of cybernetics (Moles, Bense) - which is rather an up-dating than an exorcism of *Geisteswissenschaft*. In media theory there is a rather humanistic awareness (*Geistesgegenwart*) of algorithmic knowledge. It is not simply the quantitative increase of big data processing due to available computer storage and processing capacities (Moore's Law) which escalate in so-called digital culture, but its combination with a different quality of data processing: algorithmic programming as techno-logical, rather mathematical "intellectualising" in the double technical and philosophical sense of computational *intelligence*.

Once the harvesting of "big data" turns into epistemogenic operations, quantities of digitised cultural sources become qualitative *humanities*. "DH" methods require both critical and epistemological reflection as has been traditionally cultivated within old-fashioned humanities. But when in the field of the human-machine interface, human-centered design aims at "usability" in the visual aesthetics of screen design, this is a rather weak version of "Humanities of the Digital", even a misconception. "Humanities of the digital"[36] is not about re-humanising the digital world; on the contrary: "In order to reach true 'humanities of the digital', we - by a second-order observation – need to figure into our inquiries the human misconception of the digital itself and reduce it out of the equation"[37], rediscovering the rigour and the tools from what was once the humanities in order to "get to the core of the digital itself, its 'Being' in the Heideggerian sense, its procedures, its time-critical operations that leave what was once called the human behind" (idem). German

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34 Entries "Liberal arts (education)" and "Humanities" in https://en.wikipedia.org/wiki, accessed August 7, 2017

35 Anne Burdick / Johanna Drucker / Peter Lunenfeld / Todd Presner / Jeffrey Schnapp, Digital_Humanities, Cambridge, MA (MIT Press) 2012, 105

36 As proposed, e. g., in the draft for the 13th International Conference on New Directions in the Humanities, 2015 special focus: From the Digital Humanities to a Humanities of the Digital, 17-19 June, 2015, University of British Columbia, Vancouver

37 Jan Claas van Treeck (Department of Media Studies, Humboldt University, Berlin), Humanities of the Digital – exorcizing Ghosts, typescript July 2018, https://www.musikundmedien.hu-berlin.de/de/medienwissenschaft/medientheorien/hausarbeiten_essays/pdfs/jcvt-humanitiesofthedigital2018.pdf

*Geisteswissenschaften* are what roughly translates into "Humanities", but German "Geist", as *lógos*, gets another meaning when understood by technology: "It can also denote a ghost" (van Treeck). What culture perceives as human-minded agency (the Hegelean *Geist*) "could be just the ghosts of the machines, the technical media we use" (van Treeck). Humanities of the digital are not philosophical analysis of subjective consciousness, but techno-mathematical *analytics* turned into true *sciences* of the spirit. Computing machinery, instead of being non-human, is rather discovered *within* the human: "While other species have technology, only humans, so far, compute. Thus digital technologies [...], can be brought under humanist modes of study."[38]

## Tracing Techno*lógos*

The core drama which is enacted within the technological world, are the entanglements of logical reason with the material real. Analog and digital media as technologies oscillate between logified matter and mechanised mind. "Radical" media archaeology is an adequate method of investigating concrete scenarios *in*, and *as* the media theatre.

Beyond the "question concerning technique" (Martin Heidegger), technology (deciphered in its composite sense) is more than simply a specification of what cultural engineering is in general: a negentropic, explicitly unnatural regime of symbolic manipulation impressed upon physical bodies and material (ranging from articulated language to traffic signs as "discourse" regulation). Once condensed in actual technologies, and understood as an "experimental epistemology" (Warren McCulloch), this encounter becomes a model of experiencing the physical world itself, whose implicit Eigenknowledge deserves to be uncovered and articulated explicitly by the media archaeo*lógos*.

The encounters of technical reason (*lógos*) with informatisable matter occur in two ways: one being method, the other being actual realisations. Academic media science, with media archaeology as its method, "grounds" the investigation of technical things in actual matter and discovers its principal sources of action (*archai*). How close can such analytic *lógos* get to what unfolds within the technical (mate-)real? On the other hand, since mathematical computation has resulted in actual computing, *lógos* has become a technical *arché* itself, as the implementation of symbolic reason into real matter.

The relation between mind and body or matter, and the embodiment of *lógos* in actual flesh, have concerned philosophy, and religion for centuries. The focus of Media Science, though, is on techno*lógos*. Its investigation is not the human performative, body-related, but the technological, therefore: operative aspect of this fundamental theme. The daring hypothesis is anthropic: The physical world needed human culture to become aware of its implicit knowledge by techno-experimental technology. Instead of inserting the question concerning technology into social history or history of science (Science and Technology

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38 Blog post "Toward a Humanities of the Digital" by Grant Simpson on September 13, 2010, accessed March 28, 2018: https://www.hastac.org/blogs/grantls/2010/09/13/toward-humanities-digital

Studies), media archaeology radically cuts short this horizon, and focuses on the disruptive new qualities arising from the tight coupling of matter and *lógos* in electro-physics and techno-mathematics. While cognitive neuroscience has developed the concept of the "embedded mind", operative reason (*lógos*), is understood as media in its strict techno-logical sense: as modulation and mastering of matter and energy by symbolically coded communication and control.

The question concerning technology deals with epistemic insights which can be created from close, non-discursive technological analysis. With digital computing, media matter has radically become logified in the techno-mathematical sense; from there results a privileged affinity between mathematical (computational) reasoning and rigid media archaeological analysis. Precise technological analysis, in times of "cloud" and "embedded" computing, and within the discourses on the "Anthropocene", media ecology, "soft" (algorithmic) "thought" and "Deep" Learning, is at risk of being lost to speculative metaphysics. Radical Media Archaeology, on the contrary, insists on a critical rooting of such discourses in what actually happens within the techno-logical micro media theatre.Going *medias in res*, media archaeology aims at identifying, and archaeographically describing, the varying encounters of *lógos* and matter as the central event in media-technological culture, in exemplary, metonymic scenes, as first attempts towards a more comprehensive ontology of techno*lógos*.

Concerning technology, the varying media constellations between *lógos* and matter do not simply result in final relativism. Such encounters rather asks for a more radical, non-dichotomic, archaeological understanding of media as technology. Mind and matter, in the case of technological things, are not clearly separate entities a priori, but co-originary intertwined. While "analog" technologies represent primarily logified matter, digital machinery rather tends towards logo-technification, as "objectivisation of the mind" (in Hegel's terms). Recent alternative approaches to computing, allow for a material arché-lógos, unfolding a symbolical regime from within the physically real itself. While in the mathematical model of algorithmic procedures, reasoning has been logocentristically defined as (turing)"machine", a different kind of machinery emerges where the relation between *lógos* and the matter it acts upon is no longer intransitive, but interacts with its materiality. "Machine learning", based on artificial neural nets, is still oriented at data. But what if *lógos* finally unfolds from operative matter itself?

## TRANS- AND POST-URBAN COMMUNICATION

### Telematic and / or urban space

Telephony from within buildings has long ago transcended the limits of intra-architectural communication, while not changing the architectural matter itself. Just ornamentally, a telephone may have been carved into the facade like in the Cincinnati and Suburban Telephone Company Building (Harry Hake, 1931).[39]

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39 Reproduced in the "call for papers" to the *Building Communcation* conference, Toronto, as cited

In both cases, in urban spaces and other territories, as well as in universal computing, architectures have sometimes been "rerouted" according to signal flows - even if what has affected theory and design, rarely evolved in practically new architectural territories. Architecture has been been relocated by media technologies more conceptually than factually. "The representation of the contemporary city is [...] no longer determined by a ceremonial opening of gates, by a ritual of processions and parades, nor by a succession of streets and avenues. From now on, urban architecture must deal with the advent of a 'technological space-time'. The access protocol of telematics replaces that of the doorway. The revolving door is succeeded by 'data banks', by new rites of passage of a technical culture masked by the immateriality of its components: its networks, highway systems and diverse reticulations whose threads are no longer woven into the space of a constructed fabric but into the sequences of an imperceptible planning of time in which the interface man / machine replaces the façades of buildings and the surfaces of ground on which they stand."[40] But doors and gates return from within such technologies itself, as media infrastructures.

## Not to be confused: Material transport and signal transmission

Different from the "deep history" of cities dating back to medieval times or even antiquity, most modern cities have a rather compressed genealogy of transformations in its infrastructures. More radically, this might rather be discribed as an archaeography of disruptions. Even the opening of borders and the subsequent passage of humans and vehicles through gates can be understood in more technological terms like signal transmission.

While in urban and social politics, migration remains a matter of moving real people, data migration is of a different kind - unless both actions are short circuited and the gap between bodily and data migration closes, with forensic voice recognition algorithms applied to localize and identify refugees at another country's border - from location to addressability.[41] Such automated production of evidence is based on the spectrographic hard- and software tools which have previously been developed for scientific linguistic, phono-archival or ethno-musicological research.

To what degree do transport and passages of matter or bodies in urban space differ from coded or uncoded energy transmission? There is traffic passing through urban gates: moving bodies, bikes, automobiles. But there is a fundamental difference between physical transportation and the logistics of thermodynamic vehicles and material infrastructures such as streets, railway

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40 Paul Virilio, Une ville surexposée, in: Change International no. 1 (December 1983), 19-22; transl. "The Overexposed City", in: Zone 1-2, New York (Urzone) 1986, 540-550 (545)

41 As presented in the talk by PhD candidate Michelle Pfeifer, Your Voice is (not) Your Passport: Voice Forensics and Asylum, at the conference *Transsubstantiating Transmission: Walls become Ports become Channels*, NYU (New York University) Berlin Global Research Initiative institute, October 12 / 13, 2018

roads, architectural and urban gates, on the one hand, and transmission of signals according to the logics and protocols of data processing. Urban infrastructures might not be confused with the integrated circuitry of electronics (microchips) itself. Data compression by coding is even undoing delay of transfer with mathematical intelligence[42]; here it is rather information which is passing through gates, while the mobile device travel with their users. "Protocols", rather than material hindrance, "are the immaterial groundwork of material infrastructures"[43].

## "Locative media" vs. "urban space"

The modern metropolis has become adapted and wholly absorbed into global mobile communication standards, losing its specifiCITY; geophysical location (grounding) has been overshadowed (if not replaced, since real user bodies are still subject to physical being-there) by "locative media", which is: an address structure of global telecommunication sytems like UMTS. Urban space has become a momentary point of receiving and sending data from myriads of individual mobile devices, be it tourists or native citizens. Location is not fixed to a unique place any more, but becomes mobile itself. "[A]dresses guarantee the correlation of devices and positions, while at the same time assuring that devices can move from one place to the other without losing connectivity."[44] "The traditional division between the social and the techical becomes obsolete"[45]; "social media" converge with the media-archaeological *a priori* which is the technology of triangulation, developed for this purpose since the 1950s at Bell Labs and Motorola. Movement of the device through the space of the network assures its localization. Always already being part of a communication network, the devices can be monitored. "The distance of a device is constantly measured in relation to at least three radio towers"[46] - which means, beyond the imminent death of traditional analog radio, there is more "radio" than ever in communication media. Location-based services are offered by Google's Android and Apple's iOS, based upon the datasets of woldwide wifi networks. Thereby, the notion of "citizenship" is de-located.

## On transmission as "bridging"

The conceptual difference, in media theory, between cultural techniques and technologies corresponds with the difference between material bridge constructions on the one hand, and transmission by electro-magnetic waves on the other. In Bertolt Brecht's *Lindberghflug*, as true media theatre in 1929, the

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42 See Bernhard Siegert, Relays. Literature as an Epoch of the Postal System, Stanford (Stanfort UP) 1999

43 Entry "Protocols", chapter "Concepts", in: Brett Neilson / Ned Rossiter (eds.), Logistical Worlds. Infrastructure, Software, Labour, No. 2, Kolkata (Low Latencies) 2017, 104

44 Florian Sprenger, Modes of Address and Ontologies of Disconnetion: Towards a Media Archaeology of Mobile Networks, in: Media Theory vol. 2, no. 1 (2018), 155-163 (157)

45 Sprenger 2018: 158

46 Sprenger 2018: 159

airplane is an instanciation of material transportation, whereas radio wave transmission (the subject of Brecht's "Radio theory"[47]) has been "bridging" the distance between Europe and North America at the speed of light. While the material bridge is stable, electro-magnetic bridging is vibrating itself in terms of high frequency resonance circuits, a repetitive temporal process. Material transportation implies delay in transmission (the actual transportation time), while immaterial radio transmission allows for "live" presence or the "mediated present" indeed.

## Opening / Closing "Gates": Case Berlin

The opening of the Berlin wall on November 9, 1989, has been "historically" figurative. But the (back-)"ground", in McLuhan's terms, has been a deep media-epistemic transformation: the shift of emphasis from matter & energy (material "wall", physical hindrance) to "information", as identified by Wiener 1948.

In the present media-cultural condition, a decisive difference endures between performative cultural techniques like passages of bodies and vehicles through gates, and operative technologies like signal flow between machines. "Code that runs on a machine is performative in a much stronger sense than that attributed to language. When language is said to be performative, the kinds of actions it 'performs' happen in the minds of humans, as when someone says 'I declare this legislative session open'" - or "open that wall", like US president Reagan during his Berlin visit in an address to Soviet Union president Gorbatchov. Even if such changes in minds might reach in behavioral effects, "the performative force of language is nonetheless tied to the external changes through complex chains of mediation. By contrast, code running in a digital computer causes changes in machine behavior and, through networked ports and other interfaces, may initiate other changes, all implemented through transmission and execution of code."[48] Only as a superficial phenomenon, the urban "Berlin experience" still escapes such codings.

While the opening of the Brandenburg Gate of Berlin in 1989 has become an anecdotic allegory of the end of the East / West Cold War divide, there had been a different opening and closing of logical gates operative within digital technology for decades.

In 1948, at the outbreak of the "cold war" between East and West - a period which ended with the opening of the Berlin wall in 1989 indeed[49] -, Norbert Wiener defined a transsubstantiation in communication engineering: "Information is information, not matter or energy. No materialism which does

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47 See Bertolt Brecht, Der Rundfunk als Kommunikationsapparat, in: idem, Gesammelte Schriften, vol. 18, Frankfurt / M. (Suhrkamp) 1967, 127-134

48 N. Katherine Hayles, in: My Mother Was a Computer: Digital Subjects and Literary Texts, Chicago (University of Chicago Press) 2005, 50

49 For a transgressive reading of Berlin terrains and borders during Cold War in terms of electromagnetic radio spheres, see Alfredo Thiermann, Radio as Architecture: Notes toward the Redefintion of the Berlin Walls, in: gta papers 2 (2019) [ETH Zurich], 69-83

not admit this can survive at the present day."[50] Socialist countries collapsed since their economy, for ideological reasons, anachronistically insisted on the priority of matter and energy.[51]

The technological infrastructure had already transcended or rather undermined the political or ideological divide of the cold war military "blocks": The Soviet empire implicitely collapsed with its economic decision for computing hardware to become compatible to IBM software standards in early 1970s.[52]

The Berlin wall has become a seductive but misleading metaphor for interrupted passage from the pre-information age. The new wall is the "firewall" for streaming data. The transition has not been that smooth as suggested in the *Transubstantiating Transmission: Walls become Ports become Channels*[53], but rather a disruption, an originary bifurcation of two different regimes: the urban one and the micro-technological. Walls do not "become" ports but have been a precondition of binary computing (switching "gates") already.

Urban space is no "channel" of communication ("medium", in Shannon's terms), rather a sphere where channels in the more precise sense are being logically embedded  and physically implemented. Sociological terminology might not be confused with the analysis of communication media condition; the "wall" metaphor might rather be addressed in cybernetic terms like "hindrance" (Shannon), logical "gates", and the binary "door" which allows for electric communication to flow exactly when it is closed (Lacan's definition of the "cybernetic door"[54]), contrary to the intuition of opening or closing the passage by check points at the Berlin wall.

*Media-Archaeology as Method:*

MEDIA ARCHAEOGRAPHY

**Different from the Narrative Organisation of Data Events: Archaeography**

The digitisation of paper-based archives from the past not only affects textual criticism and philological research by new "Digital Humanities" options of accessablity and addressability of "big data" strings and by intelligent search algorithms. Even image and sound collections, where the video recording and

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50 Norbert Wiener, Computing Machines and the Nervous System, in: idem, Cybernetics or control and communication in the animal and the machine, Cambridge, Mass. (MIT Press), 2nd ed. 1962 [*1948], 116-132 (132)
51 See W. E., Licht im Palast. Eine postmortale Erinnerung an den Code der DDR, in: Tumult (Vierteljahreszeitschrift), Nr. 1 (Frühjahr 2013), 54-56
52 A core thesis in Nitussov et al. (eds.) 2001
53 Workshop title at NYU Berlin, October 12-13, 2018, organized by the Department of Media, Culture and Communication (MCC) at New York University and NYU-Berlin
54 See Kittler, Hardware, das unbekannte Wesen, in: Lab. Jahrbuch 1996/97 für Künste und Apparate, ed. by Kunsthochschule für Medien Köln, Cologne (Walther König) 1997, 348-363

phonographic signals have escaped verbal taxonomies so far, become "logified" by digitization. Born-digital objects belong to the symbolical regime of computation right from their moment of coming into being. Media archaeological analysis focuses on the micro-temporality in operative data processing, and reformulates the macro-time of what has been known as cultural history in different terms. The literal quantisation of time signals, just like Fourier Analysis of wave forms before, replaces the time domain by numerical frequencies.[55] Archaeography practices an alternative form of minimal, serial time-writing (or rather registering), closer to the programming of computers itself. Computers practically transform narrative aesthetics into non-discursive, algorithmic configuration of events. Current culture begins to acknowledge this different kind of chrono-*lógos*.

## Writing Technology: Media Archaeography

Next to media-archaeological analysis, remains the challenge to develop a language to appropriately describe the electronic circuitry and the algorithms which are active within media (art): media archaeography. Media archaeography practices alternative models of writing the being of technologies in time: their governing principles, their archaic essentials, their variabilities and invariances.

Media archaeology addresses the field of new media art suspended from the (art) historiographical narratives which immediately place such works in its discursive contexts, in favour of other temporal constellations and short-cuts between the present and the past. It is on the operative level that media archaeology differs from the discourse of history: "Unlike contextualism, media archaeology's aim is to set these objects as potentially *transhistorical* - that is, not necessarily context dependent."[56]

Media archaeology does not narrate, because machines do not tell stories, they transduce and count signals. Algorithmics precedes narration. Jean-Luc Godard chose to change his medium from textual writing to video editing when creating his *Histoire(s) du Cinema* as an artistic attempt of media archaeography. Not just another method to conceive the history of technology, media archaeology faces the vibrant chronopoetics of media as an alternative to the discourse of history itself. Media historiography and media archaeology, to a certain extent, are incompatible in the most productive way; they are fundamentally different approaches to the temporal layers of technological media and their human condition. As retrospective archaeography of current media culture, "[a] robot historian would write a different history than would its human counterpart"[57]. It is essential to media archaeology as method to take (or simulate) the techno-mathematical point of view of the media themselves. Media archaeology as academic method is performed by humans; but there are cases where the media themselves all of the sudden actively become the

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55 See Friedrich Kittler, Draculas Vermächtnis. Technische Schriften, Leipzig 1993, 200

56 Sobchack 2011: 329

57 Manuel de Landa, War in the Age of Intelligent Machines, New York (Zone Books) 1991, 3

archeologists of past signals and data, be it numerical, texts, acoustic or optical. When Samuel Beckett's one-act drama *Krapp's Last Tape* was performed in 1959 on the theatre stage, the main protagonist was a magnetic tape machine, confronting the human actor with his own voice from years ago - veritable "media theatre". In media-acoustic research, the human voice itself turns out as a technical function.

While conventional media historiography as symbolic organisation of cultural time tends to privilege linear evolutions of the type "from abacus to computer", media archaeology diagrammatically imagines non-linearities and anachronistic re/turns. The so-called "digital" does not simply emerge after analogue, that is: signal recording media like the phonograph or wireless radio but has been there already: in telegraphy with dots and dashes, and above all, with alphabetic writing. And analogue computing is not just a dead end in the history of calculating machines, but the method of "thinking anlogue" remains a genuin alternative to algorithmic numerical data processing. Dutch music composer Hans Kulk demonstrates how to generate music on an analogue computer, thus reminding of the sisterhood of analog computer and musical synthesizer, such as his composition *North-West* (December 2002).

## Non-Historical Media Temporalities

In media culture, there is an increasing uneasiness with the dominant historiographical model of organising knowledge about past times, in favour of recognising non-linear temporal interrelations: the "temporal fold" (Deleuze referring to Leibniz) "recursions" (Kittler); "resonance" (McLuhan). Entropy as the physical law of one-directional time (the temporal arrow) came into existence not by emphatic philosophy of history (such as G. W. F. Hegel's) but by Hegel's contemporary Carnot who theorised about the minimal energy loss in machine work. In the information age, Shannon's mathematical definition of digital information for communication engineering has since replaced the thermodynamic meaning of entropy.

# TECHNICAL MEDIA MATERIALISM

## What kind of *archéologie*? Media Materialism

Just occasionally, media archaeology is a hunting for "dead media" discoveries and reverse engineering such as Semen Karsakof's 1832 design for an "intellectual machine"[58]. Media archaeology describes moments when media themselves, not exclusively humans any more, become "archeologists" of epistemic objects, like practiced in so-called "content-based" image and sound retrieval in media-archival data banks. Somewhat beyond Marshall McLuhan, media are not just extensions of men any more but have become autonomous, beyond body-related cultural techniqes such as religious rituals or hand-writing practices in a broader sense. Media are not just objects of media-archaeological

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58 Wladimir Velminski / W. E., Semen Karsakov: Ideenmaschine. Von der Homöopathie zum Computer, Berlin (Kulturverlag Kadmos) 2007

analysis, but as well active "archaeologists" of a different kind of knowledge themselves (understood here in Bruno Latour's sense of "non-human agencies).

While sharing with the classical archaeologicst the attention of the material artefact ("hardware"), the essence of media archaeology comprises the *operative*, processual mode of technological media as well. 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 an effort to reveal the non-disursive *archive* of the techno-logical present.

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 media archaeologists' interest in the contemporariness of relics from past that the historicity of bygone times.

The accumulation of material traces of the recent technological past asks for redefining media-archaeological practice. The very notion of media "archaeology" has been stimulated by Michel Foucault’s seminal *Archaeology of Knowledge*. 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. For years, though, the rather abstract *a priori* in Foucault's archaeology of knowledge still lacked a more material grounding, while materialist media studies insist on hardware analysis. 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 is *online* access to the Internet of communication and things.

*Archaeology*, in Michel Foucault's notorious definition, questions the already-said at the level of its existence: the enunciative function that operates within it, the discursive formation, and the general archive system to which it belongs. This general archive can be specified, media-archaeologically, to the techno-logical condition: "The archive is first the law of what can be said, the system that governs the appearance of statements as unique events."[59] Archaeology in its traditional sense refers to the material or substance of which cultural artefacts consist. For Foucault, archaeology is aware rather of the enunciative level of what happens; an enunciation is what is *not* immediately visible, rather

59 Michel Foucault, The Archaeology of Knowledge [FO 1969], transl. A. M. Sheridan Smith [1972], London / New York (Routledge Classics) 2002, 145

geno- than phenotextual.[60] It is not a relation between surface and deep ground, but rather a Moebius-loop-like dynamics of back and forth.

When the Foucauldean term is applied to the genealogy of media, thus performing a *media archaeology*, his somewhat vague notion of the "discursive formation" suddenly can be addressed in positive and precise technomathematical terms. Media archaeology performs a technological micro-epistemology, that is: disovering, analysing and describing the epistemological sparks which spring from the most concrete level of technology itself, such as the delicate circuitry of the electronic saw-tooth signal generator which creates the jumps of single cathode ray lines within a television set in order to achive the impression of a cohrent image for (lagged) human perception at all.[61]

What predominantly counts in information processing media is not its material support; therefore no more archaeology in the classical sense is required but rather cybernetic archaeo*logistics*.

While multi-media aesthetics is a surface effect, digital signal processing is its media-archaeological generative law. The techno-mathematical essence of computing is its electric fluidity and switching circuits.

Such is the media *archive* in Foucault's sense (who uses this word in French in the singular mode, not to be confused with the classical state archive which in French is *plurale tantum*, notably *archives*). As opposed to structural laws, the media-archaeological *archive* is dynamic: all the difference between an algorithm as a symbolical mathematical notation and its implementation as running program in real hardware.

What is the relation between the phenomenological surface of media and their concealed technological condition? Whatever appears on the computer screen is a direct expression of its algorithms and codes (though disguised under audiovisual metamorphosis). It is the emphasis on *semiosis* which differentiates Charles Sanders Pierce's semiotics from straightforward structural linguistic semiotics, that is: the processual relation between signifier, signified and the "interpretant". One catches this on the tactile level of computer interfaces: Whenever an alphanumeric symbol on the keyboard is pressed as part of a string (a word, a sentence, a text, a formula, a graphic notation), the "sign" (the single letter) transforms into a electro-physical signal.[62] A transformation (or even "transsubstantiation" in the theological sense) takes place. When this passage of symbol into signal takes place, it looses all its semantical referentiality and becomes a coded element within a (physically) real word - loosing "meaning" while gaining "indexicality".

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60 See Walter Falk, Vom Strukturalismus zum Potentialismus. Ein Versuch zur Geschichts- und Literaturtheorie, Freiburg i. Br. / Mnchen (Alber) 1976, 310 f.

61 See A. J. Klopow, Grundlagen der Fernsehtechnik, bers. und ergänzt v. P. Neidhardt, mit e. Geleitwort von Manfred v. Ardenne, Berlin (VEB Verlag Technik) 1956, chapter 5 (50-99)

62 As emphasiced in: http://www.agis.informatik.uni-bremen.de/ARCHIV/Publikationen/BegegnungenImZeichen.pdf

## Media Archaeology in Alliance with Prehistorical and Processual Archaeologies

It is by epistemic necessity that there is a close affinity between radical media archaeology and *pre*historical archaeology as such - understood as the investigation of material culture in the absence of textually coded *lógos*. Knowledge of media pre-history is not unearthing the primitive, but rather an archaeology of the present techno-logical condition. It is mainly prehistorians which recently turned to an archaeology of the present or even future challenges, such as nuclear waste site preservation.[63]

Media archaeology operates with a different tempor(e)alty of material things. Still, 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.[64] Inventors should be mentioned, but their creations are controlled by some rather external machinic logic. Media can be studied without people"[65] - in *radical* versus *historical* media archaeology.

In affinity to so-called processual archaeology, between hermeneutics and cultural semiotics, media archaeology as well is less concerned with the human behind the artistic or technical artefact, but rather with the techno-logical system embracing both[66], oscillating between agency and structure in analysing operative *lógos*. As soon as the operative quality of an artefact is known, it is no longer silent.[67]

Is it mandatory to defend the "monumental" approach of archaeology *versus* making it speak as "document" for something else in the hermeneutic sense. What "speaks" in technological action, is its *lógos*. The very term technology can be deciphered in this sense. *Lógos* and *techné*, words and material things, in Foucault's sense are not documents to be read, but monuments[68] - mapped on the technological mediascape. It is for this reason that Foucault did not label his inquiry "historical" but "archaeological".

## Media materialism: Cultural technologies and Nietzsche's typewriter

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

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

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

66 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

67 Ian Hodder / Scott Hutson, Reading the Past. Current Approaches to Interpretation in Archaeology, Cambridge, 3rd ed. 2003, 5

68 The Archaeology of Knowledge, transl. by A. M. Sheridan Smith, N. Y. 1976, 7, 106-117, 138-139

Conceptual media archaeology is neither about re-discovering the losers in media history for a kind of Messianic redemption, but rather an effort for in-depth insight into the principles of technological events. Therefore, media archaeology reminds of the hardware material or software logical substance of which media is made or consist. Digital archaeology operates below sight and sound, and is therefore not immediately accessible to human senses. The very term "digital" refers to the archaeological meaning of computing, its hardware relays, signal processing by electric fluidity and swichting boards.

Inbetween stands Lev Manovich's notion of "cultural software". Manovich separates between the cultural and the technical level in computing; the term "cultural engineering" (German *Kulturtechniken*) links both.

Media archaeology focuses its cultural analysis to techno-cultural engineering, which differentiates it from the more discourse-oriented Cultural Studies. At this point media archaeology exposes the technicality of media not in order to reduce culture to technology, but applying what is known in textual studies as "close reading" to the analysis of mediated and mediating processes, in order to reveal the epistemological momentum in technology. The aesthetics of "loops" in popular music or video art, for example, are a product of the technology itself, resulting in a specific sense of repetitive temporeality in contemporary media culture.[69] A technical notion like "real time", on a discursive level, is commonly confused with synchronicity and "live" transmission like in radio and TV, but is rather a simulated presence: the time-critical processing of an complex event in digital space for what the human perception still conceives as "present".

Media archaeology takes as its actual model and point of departure the digital condition of contemporary culture, by opening the horizon ranging from the elementary ancient Greek vocal alphabet across Raimundus Lullus´ combinatorial "memoria artificialis" which operates with the idea of the discrete, stochastic "alphabet" of terms[70], up to the operative algorithms of digital computing.

Marshall McLuhan underlines that the "archaeological" analysis of scientific research is itself a by-product of the Gutenberg era of printed, discrete letters; analysis in fact operates by de-composing a text into single elements (*elementa*, or even *stoicheia*, the Greek expression for both single alphabetic letters and atomic units in nature). It has been a crucial moment - rather archaeological than historical, since not immediately reflected in cultural terms - when the invention(s) of the discrete alphabet (as opposed to ideographic writing systems like the Egyptian hieroglyphs) cut down the human language into smallest elements which are meaningless in themselves, from house (*beth*) to "B", so to say. At this moment the machines take over, since only machines can perform symbolic operations without any semantic referentiality (which hinders effective data processing) at all, purely syntactically.

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69 See Tilman Baumgärtel, Schleifen. Geschichte und Ästhetik des Loops, demnächst Berlin (Kulturverlag Kadmos), 2015

70 Sybille Krämer, Symbolische Maschinen: die Idee der Formalisierung in geschichtlichem Abriß. Darmstadt 1988, 88

The discrete alphabet materially refers to a prominent media-archaeological artefact. A small exhibition at Weimar 2002 grounded so-called Weimar culture as rupture between classicism (Goethe) and modernism (Nietzsche) in two media-archaeological artefacts: Goethes mechanical pencil and Nietzsche´s typewriter. Different kind of content has been produced by such different devices, as explicitely expressed by Nietzsche: "The writing instrument co-produces our thoughts." Media technologies are not simply functions of historical and cultural discourses. On the contrary, the French *Apparatus* theory, notably Marcelin Pleynet, took account of the ideological *a priori* (in the Kantean sense) of the technical apparatus: "[...] l'existence non significante d'un appareil producteur d'images, qu'on peut indifférement utiliser à ceci ou à cela, à droite ou à gauche. [...] les cinéastes auraient intérêt à s'interroger sur l'idéologie que produit l´appareil (la caméra) qui détermine le cinéma"[71], for instance "une caméra productrice d´un code perspectif directement hérité, construit sur le modèle de la perspective scientifique du quattrocento" (ibid.).

For an analysis of the hardware of Nietzsche's typewriter itself (housed in the Weimar Classic Collection), an operative analysis could not be accomplished by textual hermeneutics of the resulting typescripts exclusively, reading the texts which Nietzsche produced. It is the mechanism and symbolic order of his typrewriter itself which produced his co-called "nonsense-poems", proving that Shannon was right when in his theory of information he declared that semantic aspects do not matter to techno-mathematical engineering.

## The Antiquarian Impulse in Media Archaeology

Different from an archaeology of "dead media" from the past, radical media archaeology focuses on actual mathematics, on the operative diagram embedded in hardware, on signal processing transcending pre-technological cultural techniques.

Media archaeology, in its epistemologic understanding, only occasionally is about digging out obsolete media from the past or to remember alternatives to existing technologies. Media Archaeology defends the "antiquarian" approach to machines and automata indeed, as way of very haptic reexperiencing technological materialities from the past, even if antiquarianism in nineteenth und 20th century came to be considered antiquated itself and has been replaced by philosophies of cultural history as background discourse for research into past materialities. Antiquarians once practice(d) what the archaeologist Eduard Gerhard once successfully termed "monumental philolology", which became "forensic analysis" in terms of Matthew Kirschenbaum. The new art of such closest reading is media philology.

Bruce Sterling's "Dead Media Handbook Project" (initiated 1995, conceived for the Internet, nowadays non-functional itself) cared for the redemption of otherwise forgotten technologies. Sometimes scholars take the term "media archaeology" at face value, almost metaphorically referring to the "digging out" of forgotten machine visions of the past, of antique or baroque media design

71 "Éconimique, idéologie, formel ...", in: Cinéthique no. 3 (1969), 10

which was never materialized, which has remained a singular effort, or which are simply forgotten today. But even if "[...] media archaeology [...] in a pragmatic perspective means to dig out secret paths in history"[72], this is not meant as historicist musealization, but turns towards "prospective archaeology"[73].

With the *Telharmonium Press* in Hollywood, California, Garnet Hertz in 2009 published a book in the spirit of Sterling's *The Dead Media Handbook*, entitled itself in an "antiquarian" fashion of an 18th century book: *A Collection of many Problems Extracted out of the Ancient and Modern Philosphers: As, Secrets and Experiments in Informatics, Geometry*, Cosmography, Horologiography, Astronomy, Navigation, Musick, Opticks, Architecture, Statick, Mechanicks, Chymistry, Water-Work, Fire-Works, etc., Wherennto is added, Dead Media. Choosing by chance (that is: by random access) any of these items, one finds, e. g., the switch-board of an early computer installation in an office. The book is supplemented by scraps of indented paper stripes which apparently is Morse code. What is declared as "dead media" here, in this case can principally be reenenacted (thus: deciphered, read, sonified). That is the difference to ancient sculptures or other traditional archaeological artefacts. Melancholy is the expression of nostalgia for something we long for but can not reach any more, since it is irreversibly gone. The media-archaeological approach is non-melancholic though, since past media are not dead, but un-dead, principally to be re-activated and thus in a radically present state of latency. Such media-archaeological artefacts are embedded in another temporal logic which defies historical discourse: They remain in latency just like a voice recorded on magnetic tape; at any moment, though, they can be re-activated, signals as a function of time. Different from a more historical media archaeology, which is familiar to cultural studies by bringing "dead media" knowledge back to consciousness in contemporary digital media culture, radical media archaeology rather experiments with writing media time in non-historiographical terms.

## There is no "dead" media

Far from simply "excavating" material knowledge of technologies past, media archaeology can not be reduced to unearthing "dead media" as once described by Bruce Sterling - although this impetus is one of its driving components. Among *A Collection of many PROBLEMS. Extracted out of the Ancient and Modern Philosophers: As, SECRETS and EXPERIMENTS in Informaticks, Geometry, [...] Whereunto is added, DEAD MEDIA*, edited by Garnet Hertz[74] is a segment of metal "recording wire" which once was used for electromagnetic sound recording, a kind of mnemonic hair once wound around a reel. But the media-archaeological point is not in the artefact itself but in its operative coupling with the "field" it needs to be literally embedded in. A stripe of

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72 Siegfried Zielinski, Media Archaeology, published November 7, 1996, in the journal CTHEORY, http://www.ctheory.net/articles.aspx?id=42 (accessed May 2, 2019)

73 Siegfried Zielinski, Prospektive Archäologie, in: Hiller / Höltgen (eds.) 2019: 47-62

74 Edition Two, Telharmonium Press, California, 2010

punched Morse code (which I found inserted in a previous edition of this *Collection*) might now actually be re-inserted into a reading mechanism which can decipher the latent message. The piece of wire most probably magnetically stores a voice or piece of music recorded decades ago; when inserted into a working Wire Recorder (re-activated, maybe, from a technical museum), one might all of the sudden perceive voices from bodies which probably have passed away already. This experience is not about dead media, but about media as being undead - a latency wainting to be processually activated. There is an untimeliness of media which is incorporated here.

When simply exhibited in a museum, an old Edison phonograph is dead matter indeed, a cultural artefact but not a medium. Once an Edison cylinder is played on it, Enrico Caruso's voice might be heard, however noisy. Only when in operation a technical device is really in its medium state, a "medium in being", and then something radically present takes place. Media-immediacy is ahistorical by its signal processing (and human perceptional) nature. Watching an old analog video from Nam June Paik's days still grants the phenomenologically experience radical presence - which is the affective power of such media.

## Media-active archaeology

Analytic technologies can be considered media-active "archaeologists" themselves, once they reveal epistemic structures and aesthetic processes which had been rather unknown to human-centered cultural investigation before.

Media archaeology is a form of generating knowledge with the media themselves as active agents respectively archaeologists, like digital signal processing which restored early "phonographic" records of John Logie Baird's experimental electro-mechanical television. It is a gesture of "open source" (de-constructing hardware) not only in the sense of public usage of source codes in programming, but as well in the sense of dis-mantling media from their designed enframing, like "platform studies" perform it.

## Archaeological media materialism

Siegfried Zielinski argues for a "philology of material things"[75] - a reminder of the term "monumental philology", once coined by Eduard Gerhard for the method of classical archaeology in the 19th century. To analyse a material technical artefact in its own terms (as *monument* in terms of Foucault) differs from deriving this evidence from the accompanying texts - unless reading circuitry diagrams. As a partial off-spring of the literatures department, media archaeology practices techno-material and techno-mathematical philology, material *aisthesis*.

An approach close to the materiality of media is akin to Classical Archaeology which deals with the material remains of a culture (as opposed to textual

75 In his book (Berlin 2012) *Jenseits der Medien* ("beyond media")

hermeneutics). But the archaeological metaphor can be seductive. Admittedly, a certain nostalgia for so-called "dead media" (Bruce Sterling) and "the analogue" is a driving bias, but this melancholy should be kept private. Media archaeology is n o t about beginnings, about origins in the temporal sense, but rather about the *arché*, the laws governing media in action. These principles are rather structural than temporal, though it happens that at its emergence a medium most openly reveals its structures before it becomes dissimulated by interfaces.

## Media Archaeology vs. Media Phenomenology

Media archaeology and -archivology is a techno-deterministic, that is: machine- and code-centered form of media studies indeed[76], rooted as much in Foucault's definitions[77] as it is connected with Marshall McLuhan's non-contentist media analysis. The field of (new) media theory seems split between two very different approaches: While media archaeologists "describe the non-discursive practices of the techno-cultural archive", media phenomenologists "analyze how phenomena in various media appear to the human cognitive apparatus, that is, to the mind and senses"[78]. In the discussion of, e. g., what is an "image" in the age of new (that is, electronic and digital) media, phenomenology, in an explicit Bergsonean tradition, insists on the coming-into-being of the mediated image in the "enframing" acts of the human bodily cognition.[79] Radical media archaeology as a form of "posthuman cultural studies"[80], rather takes the point of view (*theoría*) of the machine itself.[81] Non-discursive media archaeology (recently re-phrased as "variantology"[82]) is going

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76 As expressed in Wendy Hui Kyong Chun, Introduction. Did Someone Say New Media?, in: New Media, Old Media. A History and Theory Reader, eds. Wendy Hui Kyong Chun / Thomas Keenan, New York / London (Routledge) 2006, 1-10 (4)

77 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

78 Kjetil Jakobsen, Anarchival Society, in: Eivind Røssaak (ed.), The Archive in Motion. New Conceptions of the Archive in Contemporary Thought and New Media Practices, Oslo (Novus) 2010, 127-154 (141)

79 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 f.

80 Geoffrey Winthrop-Young, Cultural Studies and German Media Theory, in: Gary Hall / Clare Birchall (eds), New Cultural Studies, Edinburgh (Edinburgh University Press) 2006, 88-104 (100)

81 In their introduction to *Critical Terms for Media Studies* (Chicago 2010), the editors W. J. T. Mitchell and Mark B. N. Hansen take the title of Marshall McLuhans seminal *Understanding Media* (1964) at face value: understanding current culture from the perspective of media.

82 Siegfried Zielinski's book series on *Variantology*, starting with volume I (co-edited with Silvia M. Wagnermaier), Variantology. On Deep Time Relations of Arts, Sciences and Technologies, Cologne (Walther König), 2005

"back" to the roots (Greek *arché*) in two ways: to the archive (in order to open the time-critical *momentum*[83] and its temporal horizons), and in the sense of the mathematical square root "√" as a constitutive force in algorithmic, techno-mathematical media.

## "Back" to the roots: identifying the techno-logical core

Media archaeological analysis (both academic and artistic) departs from the concrete "technical" (Simondon[84]) or "epistemic" (Rheinberger) object, such as the discovery of the enigmatic phenomenon of electro-magnetic waves. When evaluating such evidence, a methodic bifurcation takes place; a "Y" diagram of techno-temporal analysis is therefore proposed. "Cultural" studies, discourse analysis and humanities immediately then tend to (re-)locate such objects in historical contexts (such as, in the case of radio, vibrant spiritism and the "ether" fiction), thereby performing a historicist turn, oscillating between technical, cultural, and discursive aspects. Media archaeological analysis, on the contrary, rather remains *within* the technical configuration, going even deeper into the non-human, non-anthropocentric and non-societal signal event, radicalizing the epistemological inquiry into the techno-knowledge inherent in technology. When, e. g., Ali Grami's *Introduction to Digital Communications* reminds of interference occuring in every act of signal transfer ("No communication channel is ideal, and thus a message signal undergoes various forms of degradation. [...] a paramount goal in the design of a communication system is to overcome the effects of such impairments."[85]), techno-cultural analysis identifies, to what degree human-related notions of impairment or other "disabilities" may have derived directly from notions like "noise" or "signal distortion" in communication engineering.[86] Radical media archaeological analysis, in an ever closer reading of technical descriptions, relates this *momentum* to the implementation of the symbolic (code) into the (materially) real in technological media analysis, to the dynamic object of signal transmission in the media channel. It is here that "noise" emanates from without and within the physical, time-varying signal which channel coding seeks to counteract with mathematical intelligence.

While engineers aim to reduce technical noise by negative feedback correction, media-archaeological artist - which investigate media close to the signal - actually amplify it, in order to critically reveal the techno-logical drama which unfolds in the encounter of the symbolical with the real. Disruptive moments break the logocentric cultural desire of code-controlled nature. Once designed electronic circuitry or written source code is embodied in technical matter, an infinite possibility of electro-physical frictions arises. Even if there are no "errors" from the techno-logical point of view[87], all kind of glitches and noise occur. In "post-digital" aethetics and so called "aesthetic of failure" as proposed

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83 See Axel Volmar (ed.), Zeitkritische Medien, Berlin (Kulturverlag Kadmos) 2009

84 Gilbert Simondon, Du Mode d'Existence des Objets Techniques, Paris (Aubier) 1958

85 Amsterdam et al. (Elsevier) 2016, 6 (italics W. E.)

86 See Mara Mills, On the Phone. Hearing Loss and Communication Engineering (forthcoming)

by sound designer and media artist Kim Cascone, it is "precisely these infractions that give code its real aesthetic value"[88]. The strictly computational approach even celebrates incompleteness arisen from algorithmic theory itself, trying to "convince mathematicians that randomness not only occurs in nonlienar dynamics and quantum machanics, but that it even happens in rather elementary branches of number theory"[89]. Very techno-logically, for both mathematics and science, in a nonlinear system "the change of the output is not proportional to the change of the input"[90].

## CLOSE TO THE SIGNAL. "Radical" Media *Aisthesis*

This text will discuss the meaning and necessity for a more "radical" media archaeology (RaMA) for critical media (art) analysis. In hard- and software archaeology, a media materialistic approach requires to be combined with a media-philological micro-analysis of code. As a form or description, its archaeography is (at least temporarly) suspended from the chronological narratives which prematurely contextualise media articulation in social histories of technology. Against its prevalent associations with "dead media" research, "radical" media archaeology has a privileged affinity to techno-mathematics, with a critical focus on computing in its current transitions from classical to unconventional architectures.

### *I: Towards a More Radical Archaeological Approach to Media Technology*

The field of media archaeology, even if its definitions and methods are rather multiple than coherent, in terms of academic research, and artistic practice, still seems to be sufficiently united in its concerns with media materiality from the past which deserves to be remembered, and experimented, in rather non-historical ways, as it has been defined by Vivian Sobchack as scholarly or artistic ways of "re-presencing". With its focus on technological ways of re-generating and re-storing time signals, media archaeology is concerned with the conditions under which the technological past, which extends to both "deep" and prospective media time (Zielinski, Parikka), can "have 'presence' in

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87 See Timothy Barker / Maria Korolkova (eds.), Misunderstanding, London (Bloomsbury), forthcoming

88 Parisi / Portanova, referring to Kim Cascone, The Aesthetics of Failure. "Post-Digital" Tendencies in Contemporary Computer Music, in: Computer Music Journal 24 (2002)

89 Gregory J. Chaitin, An Algrebraic Equation for the Halting Probability, in: Rolf Herken (ed.), The Universal Turing Machine. A Half-Century Survey [*1988], 2nd ed. Vienna / New York (Springer) 1994, 255-259 (258); see idem, Information, Randomness and Incompleteness, Singapore (World Scientific) 1987

90 Wikipedia entry "Nonlinear System", https://en.wikipedia.org/wiki/Nonlinear_system, accessed April 1st, 2019

the present".[91] At the same time, it escapes the nostalgic orientation "via the insistence on a rigorous attention to matter and machines"[92].

This text will not attempt secondary scholarly readings of primary works of media-archaeologically informed art, but rather propose "radical" media archaeology (RaMA) as an inspiration for both media-archaeological research, and artistic practice. RaMA whole-heartedly feels at home with this kind of approach[93], but it is more than simply its escalation. Being inspired by media-archaeological research and related artistic practice, RaMA rather dares to by-pass the burden of cultural historicism at all, in favour of a radically media-epistemic understanding of technologies.

**What is "radical" in RMA?**

There is a certain historicism, even romanticism, which has become dominant in the discourse of media archaeology. The historicism refers to obsolete, even forgotten media from the past, and the romanticism refers to the materiality of such relics, in opposition to the apparent immateriality of software-based contemporary digital culture. "Radical" media archaeology, on the other hand, is "archaeology" in the sense of a non-historical, and therefore as well non-narrative, approach to media as structures, as *l'archive* in the Foucaultean sense. Its archive is a present condition, which deserves transparency against the metaphors of interfaces and narratives. And it requires resistance against a melancholic reduction of media to matter. RMA rather shifts the attention to the encounters of the symbolic order with physical matter, which is the media-epistemological drama which unfold today. Archaeologically informed media art is a close analysis of technological hard- and software conditions, in order to demystify, e. g., the metaphysics of a so-called intelligence which emerges from artifical neural nets, and to demetaphorise the hermeneutics which is suggested by terms like "deep" machine learning, where the apparent depth is nothing but a topological configuration of signal-processing "layers" which are neither geological nor archaeological in the sense of an excavation, but mathematical models. Immanuel Kant's definition of the *apriori* of time and space as condition for sensation has been, more positively, extended by Michel Foucault to the discursive *apriori*, before Kittler's materialist turn transformed it upside down into an analysis of the technical *apriori*. Even if this approach, nowadays, already tends to be "historicised" within media studies itself. But

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91 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 (323)

92 Michael Goddard, Opening up the black boxes: Media archaeology, 'anarchaeology' and media materiality, published 28 April 2014 in: New Media & Society, p. 13 http://nms.sagepub.com/content/early/2014/04/27/1461444814532193

93 As it has been outlined in the "call for papers" for the conference Media Matter: Media-Archaeological Research and Artistic Practice, 27 - 29 November 2019, Stockholm University, https://www.su.se/ike/english/about-us/events/media-archaeological-research-and-artistic-practice-1.433412, accessed July 25, 2019

any media analysis which loses contact with its techological ground will dissolve into a subset of other, more traditionally hermeneutic humanities. A more "radical" media archaeology is concerned with techno-epistemological insights which are derived immediately *from within* technology.

"Radically" archaeology-informed media artistic practice is not primarily focused upon so-called "dead media", but uncovers the material *arché*, and the technical *lógos*, in fact: the techno*lógos* of the conditions insofar as this past (still) defines the present media culture. Its temporal mode is not the past, but the present past, the *Present - Continuous - Past(s)* in terms of Dan Graham's notorious video installation from 1974, where the spectator, in the gallery, was confronted with his own image in an eight minute video tape time delay. The temporality, and its writing, of this media condition, is not historiography, but archaeography, where the source code which drives computing, and its epistemic reflection, are written in the same editor. Adrian Mackenzie calls such *in situ* analysis, in the field of machine learning, an "auto-archaeology"[94].

**[Against "Analogue Media" Romanticism: "Radical" Media Archaeology's Affinity to Mathematics]**

Notwithstanding the adequacy of material analysis for analogue technologies, "radical" media archaeology, as a method of media scientific research, is close to mathematical analysis as well, therefore necessarily extending to computational media culture.

Media, when taken as physical channels of signal communication and as technical artefacts which are operated by symbolic codes and streaming data, require analysis which is different from text hermeneutics or works of art aesthetics. Media archaeological theory is a distanced way of looking at media objects: enumerative rather than narrative, descriptive rather than discursive, infra-structural rather than sociological, taking algorithms (literally) "into account".

A core target in the mathematical analysis and technical modelling of physical and biological processing is the signal *momentum* and direction. The calculation of vectors is an alternative way of expressing what is symbolically expressed as "event", "(hi)story", or "evolution".

The natural way of rendering Foucault's remarks on archaeology intelligible (like his affinity to serial, notably Barraqué's, music) is to take the notion of enunciative function at its mathematical face value.[95] This is the context when Kittler as well proposes an explicitly "archaeological" research into the moment when counting with integers has been replaced by a system or real numbers.[96] The "digital" not only means the countable, but mechanically computable; media archaeology is its radically mathematical mode of material investigation.

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94 Mackenzie 2017: xi

95 Martin Kusch, Discursive formations and possible worlds. A reconstruction of Foucault's archeology, in: Science Studies 1 / 1989, 17-25 (17)

96 Friedrich A. Kittler, Die Maschinen und die Schuld, interview by Gerburg Treusch-Dieter in: Freitag No. 52/1, December 24, 1993

## "Radicalising" Media Archaeology

Radical media archaeology as research method rather and media-scientific approach relates to techno-epistemological reasoning and insights from within technological events as techno-materially interiorized *lógos*. While the social, cultural, political and historical impact *on* and *of* technologies is taken care of by Science and Technology Studies "or science, technology and society studies (both abbreviated STS)"[97], the media archaeologial approach assumes that for an "alien phenomenology" (Ian Bogost), that is, for an understanding of media technologies from within, the analytic mind needs the freedom to be suspended from paying immediate or premature regard to the social, economic, ecologic or other kinds of impact. "Alien phenomenology" coincides with the media-archaeological premise in its focus on *operations* to describe how techno-logical units behave and interact among themselves.[98]

[If radical media archaeology tends to be oriented at early versions of technologies, this is not meant in the historical, but literally pre-historical sense. Media archaeology is not interested in time as such, but as an operator for the analytic understanding of technical things. In analogy to the physical concept of entropy, the time arrow is rather understood as a measure of tendency towards complexity, against which media archaeology focuses on the archaic - not in terms of origins in the evolution of technical objects, but of principles which tend to be forgotten in the phenomenology of highly differentiated media, such as the central operations in a CPU in computing.]

In radical media archaeology, the "radical" is not an avant-garde pretension (such as in explorative media arts), but rather in the structural, operative techno-mathematical sense of the "square root", for analysis close to the techno-logical complex which is both (electro-)physical *techné* and algorithmic *lógos*.

If the adverb "radical" is meant rather literally, referring to the mathematical square root, it diagrammatically insists that "going to the ground" of media, in times of ubiquitous computing, is facing its techno-mathematical precondition. If technology is understood as (electro-)physically embedded materialization ("objectification", with Hegel) of the mind, this at the same moment accepts the essential transsubstantiation taking place when the symbolic is implemented into the real. Radical media archaeology focuses on techno-epistemology rather than cultural or artistic research (which both of course remain a vital branch of media-archaeological practice), while at the same time acknowlediging such agencies of triggering new technological constellations, is short-cutting and by-passing of the collective socio-historic context and its anecdotic individual narratives, in favor of an unimpended microscopy of technologies to uncover the sparks of knowledge which can be the better derived the closer the technological analysis works.

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97 https://en.wikipedia.org/wiki/Science_and_technology_studies, accessed October 16, 2018

98 Ian Bogost, Alien Phenomenology, or What It's Like to Be a Thing, Minneapolis / London (Univ. of Minnesota Press) 2012, 25

[It is a specific quality of *media* epistemology that its analysis is firmly rooted within techno-mathematical constellations. Such technological configurations result on the one hand from condensed cultural, non-natural knowledge, while at the same time, as physically embedded knowledge, there is material self-referentiality and auto-logic at work from which inductive sparks of epistemic questions and insights either involuntarily arise or are being derived by conscious inquiry.]

A different kind of agency emerges the technological is increasingly detached from the human, such as in "machine learning", where in speech recognition, e. g., the former linguistic, "tele-phonic" approach (in the Bell Labs) has been replaced by the statistical one (the subsequent IBM approach), dealing with "big data" processing approach with the mathematical theory of communication (Hidden Markov models, and the "noisy channel" premise which takes all kind of acoustic signal input, articulated language or not, as equally human and non-human source of "information")[99] - just as has been prepared by the subsitution of the human operator in automatic telephone connection for which the numerical approach to the machine (the dial phone and the Strowger electromechanical stepping switch) have been an archetypical instance.[100]

Previous cultural techniques not simply escalate into technologies; the present situation rather enacts new kind of techno-mathematical condition. Therefore, radical media archaeology short-cuts (Occam's razor) the prehistories of technologies to its decisive moments knowledge), the becoming autonomous of the technological "spirit" (Hegel). Radical media theory therefore requires a different analytical attitude of relating to media: a non human-centered, rather ahermeneutic aesthetics of technological knowledge. Therefore a different vocabulary for analytic description is required, borrowing directly from communication engineering itself where it has been developed, but re-applying it in different from its simply functional sense, uncovering the epistemological beauty implied in terms like "logical gates" or "delay line".

As defined by the curriculum at the University of Twente in the Netherlands, "[m]edium theory focuses on the medium characteristics itself [...] rather than on what it conveys or how information is received."[101] If "media" is understood as technologies in themselves rather than being reduced to their function as agencies of human communication content, they extend to mathematical logics and non-historicist tempor(e)alities as well. The media-epistemic

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99 A central argument in Xiaochang Li's talk presented at the conference at NYU Berlin *Transsubstantiating Transmission: Walls become Ports become Channels*, Berlin, October 12 / 13, 2018

100 Shari Wolk, An Undertaking: The Automation of a "girl-less, wait-less, and cuss-less" Telephone, talk presented at *Transsubstanting* conference, as cited

101 Entry "Medium theory", https://www.utwente.nl/en/bms/communication-theories/sorted-by-cluster/Mass%20Media/Medium_theory, accessed Oktober 18, 2018, referring to the writings of Harold Innis, Marshall McLuhan, and Joshua Meyrowitz, No Sense of Place. The impact of electronic media on social behavior, New York (Oxford University Press) 1985

challenge is that the symbolic, the *lógos*, here is implemented in the technically pre-conditioned material real, in order to become effectively operative in-the-world, i. e.: in time - in the very material sense of Turing's term "effectively computable": given enough paper (the inscription tape), writing matter (pens), and finite time.[102]

Media archaeology only occasionally "unearthes" obsolete media. It is rather about revealing, searching and identifying aesthetic insights which can be derived from a close analysis of technologies, by creating "sparks" of knowledge from within. Resisting the application of cultural and anthropocentric metaphors, media archaeology analyses the technological condition, the techno-mathematical constellation and dynamics of what then may become a discursive event. Investigative media-artistic archaeology detects, e. g., the presence of 13.56 MHz RFID tags used in plastic cards.[103]

In addition, media archaeology tries alternatives models of thinking the being of media in (emphatic) time, for an alternative to linear historiography of technology. Apart from narratives of media origins in the historic sense, there are other levels of media tempor(e)alities: governing principles, archaic essentials - such as the *enduring* infrastructure of radio or the recursive return of the "alphabet" in the digital age which with its alphanumerical data processing all of the sudden recalls a genealogy of mathematics which had not been central to media studies in times of analog radio and television.

Media archaeology encompasses a variety of approaches to media. Media archaeology, first of all, it is a method of media analysis, addressing the structural level of media practice (which Foucault named as the governing laws of media, such as Internet protocols or the von-Neumann-architecture of digital computers). Furthermore, it is an aesthetics: the "cold gaze" of distanced understanding but "close reading" of technological circuits. Next it is an "archivology", that is: deeply obliged to archival evidence and historical as well as technological precision (circuit diagrams as source of evidence, f. e.). Media archaeology is certainly not a nostalgia for the analog (unless this is kept private), but extends to an art form (Paul de Marinis, Carsten Nicolai) which reveals the technical basics of media as opposed to the intangible hiddenness of micro-chip based media today (reduced to the max).

Media archaeology is a form of disclosing technically implicit knowledge, with the media themselves as active agents like digital signal processing which restored early "phonographic" records back to sound, speech and music again (case *Lautarchiv* Berlin). Media archaeologiy is the gesture of "open source" and de-constructing hardware: not simply in the sense of public usage of source codes of computer programs, but in the sense of unclothing media from their designed enframing.

The media-archaeological approach is close to the materiality of media, hereby akin to Classical Archaeology which deals with the material remains of a culture (as opposed to philological hermeneutics), but equally it refers to the mathematical (square) "root" (*arché*) in techno-*logos*. There is a risk to be

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102 See Finn 2017: 23 f.
103 http://shop.marcboon.com/snifferkit.pdf

seduced by the archaeological metaphor. Media archaeology is n o t about beginnings, about origins in the temporal sense, but rather about the *arché*, the laws governing media in action. These principles are rather structural than temporal; it only happens at its emergence a medium reveals its structures before it becomes dissimulated by interfaces - like early radio sets.

"The cold gaze" is a description of the media-archaeological aesthetics indeed, somewhat close to Ernst Jünger's photographic media aesthetics. Admittedly, German pre-war engineering culture still lurks through (just like in Ernst Jünger's aesthetics of the photographic "cold gaze"), and the Heideggerian ways of fundamental rethinking of terms like technics.[104] Today, I would add to the "the cold gaze" the unpassionate ears (listening to the "sonic", that is: sound emerging from technomathematical media).

Media studies ask for a specific mixture of technological competence and epistemological reflection (if not desire). One should indeed expect for a researcher and critic of media to know exactly what is, e. g., the physics of electromagnetic induction, the mathematical equation of Fourier Analysis for time-varying signals (sonic or visual), or the TCP / IP protocol and the topological concept of "routing" in Internet communication engineering. But of course academics do *not* read German media theories primarily to gain technical knowledge, rather to rethink technology in the Heideggeran sense.[105]

There is a certain technologistic, that is: machine- and code-centered school of media studies indeed.[106] 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."[107] What is clear by this arbitrary name list already, is that the theoretical front is not one between continental European media archaeologists and media archivists on the one side and Anglo-speaking cultural critics of media practices on the other. The archaeological / archivological approach is rooted in Foucault's definition that *l'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"s[108]; it is as well connected with Marshall McLuhan's non-contentist media analysis.

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104 Martin Heidegger, The question concerning technology and other essays, New York, NY (Garland) 1977

105 An argument in Geert Lovink, Der Verbleib der deutschen Medientheorie, in: idem, Zero comments. Elemente einer kritischen Internetkultur, Bielefeld (transcript) 2008, 129-145

106 As expressed in Wendy Hui Kyong Chun, Introduction. Did Someone Say New Media?, in: New Media, Old Media. A History and Theory Reader, eds. Wendy Hui Kyong Chun / Thomas Keenan, New York / London (Routledge) 2006, 1-10 (4)

107 Kjetil Jakobsen, in chapter 6 of his text "Anarchival Society", discusses "Archaeology versus phenomenology", in: Eivind Røssaak (ed.), The Archive in Motion. New Conceptions of the Archive in Contemporary Thought and New Media Practices, Oslo (Novus) 2010, 127-154 (141)

Whereas Hansen in his discussion of what is an "image" in the age of new (that is, electronic and digital) media, in an explicit Bergsonean tradition insists on the coming-into-being of the mediated image in the "enframing" acts of the human bodily cognition only[109], "posthuman cultural studies"[110] as radical media archaeology takes the point of view of the machine itself, with "radical" to be interpreted in two ways: going to the roots (which is the archive), to the beginnings (less in the sense of historic causality but temporal originality: the opening and generation of the time-critical *momentum* and of temporal horizons), and in the techno-mathematical sense (square root) as the basic conditions of media hardware and algorithms (software).

This signal-based approach is different from the rather semiotic approach of Cultural Studies. Apart from some idiosyncasies in graphical notation, there is no principal translation barrier for logical circuit diagrams so far; the world of techno-mathematical engineering cross-culturally wires artefacts into standard operations. For both "forensic" and "formal" materialist analysis[111], the circuit design of a radio set is not a "text" any more but an operative diagram when set in media function. To what degree can textual and hermeneutic metaphors which have been familiar to humanities be applied to electro-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 applied media philology, hardware-oriented media hermeneutics in the tradition of what the archaeologist Eduard Gerhard in 19th century once called *monumental philology*. Micro-technological research on signal transduction is not strictly opposed to the media-phenomenological approach; the ways media affect human perception (in best McLuhanite tradition of analysis) is as close to neuroscience as it is to media archaeology.

With no overall consensus about its definition, methods, tools, or even its field[112], there are different ways of doing media archaeology, much of them "re-mediating" new media (theories) with previous ones recursively.[113] At the same

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108 Michel Foucault, The Archaeology of Knowledge, New York (Tavistock) 1972, 129 and 131

109 Mark B. N. Hansen, New Philosophy of New Media, Cambridge, Mass. (MIT Press) 2004, 13

110 Geoffrey Winthrop-Young, Cultural Studies and German Media Theory, in: Gary Hall / Clare Birchall (eds), New Cultural Studies, Edinburgh (Edinburgh University Press) 2006, 88-104 (100)

111 Kirschenbaum 2008: 10 f.

112 See Erkki Huhtamo and Jussi Parikka, An Archaeology of Media Archaeology, in: *Media Archaeology: Approaches, Applications and Implications*, eds. Huhtamo and Parikka, Berkeley / Los Angeles (University of California Press), 2011

113 See Jay David Bolter / Richard Grusin, Remediation. Understanding New Media, Cambridge, Mass. / London 1999; I. Gitelman, Always Already New. Media, History, and the Data of Culture, Cambridge, MA (The MIT Press) 2006

time a Foucault-driven media archaeology accentuates the discontinuities. Media archaeology is aware of discontinuities in media cultures (as opposed to the reconciliating narratives of cultural history). The German "school" that has emerged emphasizes material factors as prime movers of media history. From writing surfaces, and inscriptions on phonograph cylinders or celluloid film to machine architectures and computer code, media archaeologists trace the widening gap between the technological evolution and traditional cultural engineering.

An example for media archaeological reasoning is the approach it takes to a central artifact in occidental cultural engineering, the wheeled clock, which in fact turns out to be a formative mechanism to develop the chronotechnical sense of oscillations which later became basic for the temporal agency of technical media. Media archaeology analyses the mechanisms of time-keeping, and thereby is less concerned with the traces of ancient religious practices embedded in the history of time-keeping technologies but its continuous effect in the present. What is paramount to consider is the *dis*-continuity between the history of religious time-keeping and the evolution of time-based media. Media archaeological analysis, different from the "cultural study" of religion and technology, does not to bring them closer together, but rethink the terms on which they must remain separate: the oscillating clock and its progressive detachment from its original locus in the monasteries of medieval Europe.[114]

Another case is optical media. Their genealogy can not be reduced, by (hi)story telling, to the people who created them, exhibited them, consumed them, and fantasized about them. Its real co-agency have been the machines, with its techno-logical laws of optics and mechanics being its *archive*. Media archaeology does not simply tell "a very different story", but no story at all.[115] "Inventors do not figure as the primary agents, but their creations seem controlled by some external machinic logic rather than by human desires and needs. "So-called humans" rarely appear in Kittler's media studies.

Media archaeology does not presuppose an primordial binding of media to the social and cultural spaces they occupy.[116] The relegation between cultural and media epistemology acknowledges both the nonhuman agencies (Bruno Latour) and their discursive dependencies.[117]

Where do technological continuities derive from? Can an archaeology of the computer screen be derived from the Western tradition of screen functions as a

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114 See Jeremy Stolow (ed.), Deus in Machina: Religion, Technology, and the Things in Between, New York (Fordham University Press) 2013

115 John Durham Peters, Introduction: Friedrich Kittler's Light Shows, in: Friedrich Kittler, Optical Media: Berlin Lectures 1999, trans. Anthony Enns, Cambridge (Polity Press) 2010, 5

116 For a dicourse-orientated approach to past media, see Carolyn Marvin, When Old Technologies Were New: Thinking About Electric Communication in the Late Nineteenth Century (New York and Oxford: Oxford University Press, 1988)

117 See Cornelius Borck, Electricity as a medium of psychic life. Electrotechnical adventures into psychodiagnosis in Weimar Germany, in: Science in Context vol. 14 (2001), 565-590

window into a virtual space?[118] No technological imperative leads from digitisation to the rectangular screen as human-computer interface (HCI). Below cultural semantics (the iconology of images), "the digital image is an aggregate of quasi-autonomous, independently addressable, numerical fragments. It is not a frame and new media are not constrained by the rectangular frame. Cinematic interface may thus be seen as a cultural lag, rather than a technological imperative."[119]

The "frame" rather become replaced by the matrix as a mathematical figure, which became material technology with the rectangular magnetic core memory for storing an image in early digital computers.

Manovich interprets the possibilities of such interfaces as prefigured already by the cinematographic avantguardes of the 1920s, in their experiments with jump cuts, animation and collage. According to Manovich, the avant-garde anticipated digital aesthetics.[120] But let us have a close look at a magnetic core memory. It is *not* just aesthetic strategies which became embedded in the commands and interface metaphors of computer software. The modernist strategy of collage reemerged as a 'cut and paste' command, the most basic operation one can perform on digital data."[121] The so-called "post-cinematic image" is different from the cuts and jumps and interactivity in computer games.[122]

How does techno*lógos* translate? Radio and television emerged in different countries in almost parallel ways, on an almost identical engineering basis, derived from scientific research on the physical nature of electromagnetic wave propagation. Ideo-logical differences were rather expressed by the content of the broadcast programs. While there has been a long translation barrier for relevant texts on philosophy of technology to cross national language barriers, the world of techno-mathematical engineering, with its cross-cultural communication of diagrams and symbols, has wired artifacts into standard operations almost immediately, whereas computer viruses, by online connection between computers, cross national boundaries like memetic

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118 See Lev Manovich, Towards an Archaeology of the Computer Screen, in: Cinema Futures: Cain, Abel or Cable?, edited by Thomas Elsaesser / Kay Hoffmann, Amsterdam (Amsterdam University Press) 1998, 27-43

119 Mark B. N. Hansen, New Philosophy for New Media, Cambridge, Mass. (M. I. T. Press) 2004, as paraphrased in: Kjetel Jakobsen, Anarchival Society, in: Eivind Røssaak (ed.), The Archive in Motion. New Conceptions of the Archive in Contemporary Thought and New Media Practices, Oslo (Novus) 2010, 127-154 (146)

120 Lev Manovich, The Language of New Media, Cambridge, Mass. (The MIT Press) 2001, 78 f.

121 Lev Manovich, What is digital cinema?, http://www.manovich.net/TEXT/digital-cinema.html, accessed January 2011; see idem, Engineering Vision: from Constructivism to the Computer (The University of Texas Press), forthcoming

122 See Benjamin Bigl / Sebastian Stoppe (eds.), Playing with Virtuality. Theories and Methods of Computer Game Studies,Frankfurt/M. (Peter Lang 2013

units.[123] The "language" of so-called new media which obviously refers to electronics driven by the binary code, is not just what interfaces offer to the human user, it is its machine language on the operative level of machine programming.

## Distinctive Technical Definitions by Media Archaeology

Media archaeology is the complementary method (if not antithesis) to media phenonemology. It does not focus on media on the level of their surface effect on humans or their more sublime affective impact *via* interfaces, but rather uncovers the hidden agenda of technomathematical artefacts, or better: artefactuality, focussing on temporal and time-critical configurations.[124] Whereby to most human users media are opaque technology - "present-at-hand" (*vorhanden*) in Heidegger's vocabulary -, media archaeology tries to make technology transparent for analysis, that is: "ready-to-hand" (*zuhanden*) in Heideggerean terms. Just like the "external form" of software, as interface appearance, differs from its "inner form" as source code, and comparable to the figure / ground dichotomy which has been applied by Marshall McLuhan from Edgar Rubin's and Max Wertheimer's *Gestalttheorie* to media-theoretically[125], media archaeology separates the phenotype from the genotype of technology.

[A media archaeological uncertainty challenge arises here. One can get either get close to the micro-event on the hardware level, but misses the "image". Or one can focus on the algorithm which organises "big" data into a figurative image, but misses its material grounding. Scaling from one extrem to the other unfolds the horizon of media archaeological investigation.]

Media archaeology at first sight is about technological architectures, but it is concerned with media not only on their structural but as well on their *operative* level, thus becoming "post-structural" or "diagrammatic". This post-structural vector (a diagrammatic media theory) places it beyond semiotics and closer to the analysis of signal processing (a signal being the physical representation of a message respectively information *in time* - that is, with time as the variable of functions under analysis).

Technological media themselves have an enfolded, implicit knowledge of the physical and mathematical world which differs from human perception. Media archaeology as a doube-faced method here takes the point of view of humans and hypothetically the point of view of media as well. To exemplify it: The length of numbers in binary notation which is at least double that of numbers in the decimal system "makes the binary system impractical for human

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123 See Jussi Parikka, Digital Contagions. A Media Archaeology of Computer Viruses, New York et al. (Peter Lang) 2007

124 "Nicht [...] eine ableitende Begründung, sondern [...] aufweisende Grund-Freilegung": Martin Heidegger, Sein und Zeit, 15th ed. Tübingen (Niemeyer) 1979, 8

125 Marshall McLuhan / Bruce R. Powers, The Global Village. Transformations in World Life and Media in the 21st Century, Oxford et al. (Oxford University Press) 1989

calculators, but it does not upset computers in the least. From the computer's point of view, these sequences of 1 and 0 are convenient, for they are easily codified in electric signals; the passage of current expresses 1, its interruption 0"[126] - which perfectly corresponds with a binary switch in the real world of electronic which was available "at hand" in times of the mathematician and engineer Claude Shannon: the electromagnetic relay.

What started with the electro-mechanical relay resulted in electronic flip-flop circuits first on vacuum tube, then an transistor basis. Different from e. g. *ternary* switching, it is "easier to work in the scale of two than any other, because it is easy to produce mechanisms which have two positions of stability; the two positions may then be regarded as representing 0 and 1"[127].

Written and read carefully, there is media *archéo*logy. In ancient Greek, *arché* splits into a temporal and a functional meaning: *origin* on the one hand, and *command* on the other. Misunderstandings should be avoided here. Instead of "media archaeology", should I not rather write "prehistory of media"? The term *prehistory* implies a certain teleology that is alien to technology.[128] The prefix "pre-", though, does not just refer to a "before" in its temporal, historically lineare sense, but rather to a structural pre-condition as well. This pre-structuring "before" can happen in nonlinear modes (as described in René Thom's theory of catastrophy) just as there are electro-dynamic processes which are ultra-sensitive to slightest changes which result in a complete re-organisation of the whole system. Narrative historiography fails when it has to explain nonlinear, contingent events in the past[129], such as on 9th November 1989 when the erroneous answer by Günter Schabowski, spokesman of the GDR government in East Berlin, when asked in a press conference about the timing of the new, liberal rule for citizens to travel, without bureaucratic delay, outside the enclosed state. Schabowski's verbal answer "immediately" (German "sofort") corresponded with the electromagnetic immediacy of live transmission in radio and TV, thus turning the word into electronic flash as signal event, which immediately arrived the audiences on TV and radios. This triggered an immediate mass-migration to the intra-Berlin gates, before the military apparatus could be instructed in advance, resulting in the sudden opening of the Berlin wall. Such a contingency can not be formulated in terms of historical discourse at all, but this does not lead to agnosticism. Instead, a modelling of mathematical probabilities is the dynamic answer to that question.

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126 Denis Guedj, Numbers. The Universal Language, London (Thames & Hudson) 1998, 59

127 Alan Turing, Lecture to the Mathematical Society on 20 February 1947; printed in Vol. 10 in the Charles Babbage Institute Reprint Series for the History of Computing, A. M. Turing's ACE Report of 1946 and Other Papers, The Massachusetts Institute of Technology, 1986, 106-124 (114)

128 David A. Mindell, Between Human and Machine. Feedback, Control, and Computing before Cybernetics, Baltimore / London (Johns Hopkins University Press) 2004, 6

129 Ludolf Herbst, Komplexität und Chaos. Grundzge einer Theorie der Geschichte, Munich (C. H. Beck) 2004, 213

Media archaeology refers to the past insofar as it recognises the condition of the possibility for current media operations, which means: being (still) at work. Different from history of technology or Science and Technology Studies, the emphasis is not on discursive differences, but on transhistorical techno-logical insistance. *Techné* as revelation, in the Heideggerean sense, does not only "bring forth", but as well *makes present*.[130] The media-archaeographical description of an old Edison phonograph or an early home computer aims not at historicizing, but revealing "the deep physical and structural operations" of the device, as a material *arché* technical *lógos*. Such archaic precedence is not historical but media-epistemologically enduring. The temporal category "past" thus appears rather like a temporal function of a present process, as an unfolding of presence-in-action, in the mathematical sense of an event: Fourier Analysis (for signals) and Markov Chains (for discrete character strings).

Media archaeology is not a simplification, but an analytical reduction to techno-logical essentials and *principles* (the Latin equivalent to *arché*); when Hermann Helmholtz published his seminal *Lehre von den Tonempfindungen* in 1863, the subtitle declares a kind of sonic archeology: the "physiologische Grundlage", that is almost literally: *arché* (foundation), for the theory of music. In this sense Milton S. Kiver's book *Television simplified* (New York 1946) does not teach the appropriate use and consuming of TV programs but the precise description of its inherent electrotechnology.

Media archaeological aesthetics is an *archaic* media experience. The archaic, besides its temporal meaning ("origins"), refers to a structural element, to the dominant (*arché*), essential features of a medium system. At the same time, aesthetically it means its reduction to the essential, the elementary bits, a "rarification" of discourse in Foucault's sense. What tends to be mystified as new kind of "intelligence" in discourse on "deep" machine learning, can be made explainable again by simply programming and implementing a neuronal network associative memory pattern recognizer in fewer than 250 lines of BASIC on a Commodore 64 home computer, and identifying its core code instructions.[131]

According to the media-archaeological *credo*, technological structures become especially evident in beginnings: "It is the beginnings of invented things, which appeal to me", writes Lance Sieveking (who wrote one of the first televisoin dramas transmitted by the BBC), and explains: "For it is a their beginnings, that we may detect their true nature", that is: their epistemological essentials. Sieveking is quoted here as the *motto* of the Memoirs of John Logie Baird[132] which is a very archaeological insight into first steps of the electro-mechanical television apparatus itself. "In principle, the *televisor* is both simple and ingeniour", comments the brochure accompanying the model kit *The Televisor*, developed as teaching device by the Middlesex University.

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130 As accentuated by Sobchack 2011: 324

131 John Walker, Neural Network on a Commodore 64 [September 4, 1987], https://www.fourmilab.ch/documents/commodore/BrainSim, accessed April 29, 2019

132 Television and Me. The Memoirs of John Logie Baird, edited by Malcolm Baird, Edinburgh (mercatpress) 2004

**[Towards a Redefinition of the (Media-)"Archaeological" Artefact]**

- "Post-digital" Nostalgia for Materiality?

- Archaeologising the Present: The *Alógos* of Video Noise, and Digital Sound Compression

- *Imaging* as Object and Agency of Media Archaeology: the RestAURAtion of Early Television Recordings

- "E. T." as topic of computer (game) archaeology, and Micro-Processor Ageing

- Really "forensic" media archivology: Reading a ROM

*II: "Radical" Media Archaeology and / as Artistic Research*

**Is there a belatedness of media art?**

Technological media are not simply escalations of centuries-old cultural techniques. As noticed by McLuhan (referring to Samuel Butlers science fiction novel *Erewhon*), machines have started to emancipate in the meantime. Man lags behind; implicit media knowledge is already ahead of their current user practice. That is why the "content" of a new medium is always simply the previous medium. Günther Anders' book *Die Antiquiertheit des Menschen* carries the archaeological moment in its title: Humans are belated when compared with the possibilities and potentialities which are dormant within technological artefacts. In the age of technological reproduction, media themselves become the agency of artistic production; the human artist is just the "shepard" of his technological objects (as expressed by Anders), such as Carsten Nicolai's sonifications and visual insights into the nature of electricity by an oscilloscope. "Sonic" delay lines were developed for short-time storage in early digital computers (Turing's ACE) first, before this hybrid technology was re-discovered in Yun-Chul Kim's media art installation *Hello World!* (once presented at Ars Electronica in Linz, having been developed at the Academy of Media Arts, Cologne). And Paul de Marinis' artistic re-invention of archaic forms of phonographic sonification has been anticipated by Édouard-Léon Scott de Martinville's "Phonautograph" in the 1860s - as if the archive of media-archaeological artefacts with its therein embedded implicit knowledge is always already one step in advance of media art as anamnesis of these layers.[133]

**Media-Archaeological *Aisthesis* vs. Media-Artistic Aesthetics**

In philosophy, the category of aesthetics pushes the explainability of the appeal of works of art to its limit, media archaeology reminds of the archaic

133 See Anthony Moore, Transactional Fluctuations 2. "Reflections on Sound", in: Siegfried Zielinski / Eckhard Frülus (eds), Variantology 4. On Deep Time Relations of Arts, Sciences and Technologies in the Arabic-Islamic World and Beyond, Cologne (Walther König) 2010, 289-304 (289 f.)

Greek meaning of *aisthesis*, which refers to the channels of perception, be it in humans, or machines. Critical media *aisthesis*, in consequence, stays close to the signal - either by austere mathematical analysis (the "radical" archaeo*lógos*), or by making it accessible to human sense perception (in its ancient Greek sense of *aisthesis* indeed). Research-artistic representations of physical signal events, such as they emerge from within the Large Hadron Collider in Geneva, are creative ways to spot data patterns, and their stochastic trends, by data visualisation and sonification, thereby addressing them to human *aisthesis*. But when it comes to so-called media art, such as in the Synthgear blog which hosts a contest "to see who can make the best music out of sonified LHC data"[134], interface-oriented installations rarely lay bare and provide insight into their generative hard- and software techniques.

[Fig.: Snapshot from the St. Elisabeth installation AIS³, Berlin, from: http://www.imachination.net/ais3, accessed November 8, 2018]

Tim Otto Roth's *Astroparticle Immersive Synthesizer³* has been installed from August to September 2018 at St. Elisabeth church, Berlin. The spatial installation of 444 luminiscent spherical loudspeakers, suspended from the ceiling, and LEDS, claimed to translate the astrophysical measuring of cosmic Neutrino particles by a grid of more than 5000 electro-technical light sensors (so-called DOMs) sunk deeply into the ice of the Antarctic, at the IceCube Neutrino Observatory, into an immersive audiovisual visitor experience. While the sensors actually record the light flashes which are generated by occasional interactions of neutrinos with earth matter, the artist re-arranged the data into a musical composition consisting of colour spectra and pitches. Physical artefacts thereby become art.[135] Even if Roth's parameter mapping and data synthesizing, as an well-established tool of scientific sonification, let the measured physical events correspond to the phenomena observed by visitors of the Berlin installation, the degree of transposition, or even transformation applied by artistic manipulation remained unclear in the multimodal cloud of perception. What remained hidden, in the installation, is the chain (channel) of transformation between the physical signals and their arbitrary artistic manipulation. The aesthetic representation derives its authority from the scientific dispositive, but does not really reveal the degree of its indexical - or metaphorical - relation to it. It is the critical analytic focus on the precise momentum and location where techno*lógos* encounters physical matter, which separates media archaeological analysis from such rather arbitrary artistic data archaeology. The micro-media theatre enacts a drama which unfold within technologies themselves, which differs from the external human choreography of media events.

Analogue technological signal transduction, and digital data processing, can be uncovered as technological pre-condition of such media artistic installations indeed, such as sensors and A / D converters with their sample-and-hold mechanism. Practice-based, techno-investigative media artistic research opens this "black box" in terms of hard- and of software. "Radical" media archaeology goes back to the (square) roots of technology, not in the historical sense of

134 http://www.boingboing.net/2011/02/14/making-music-with-th.html
135 The symposium at the end of the installation had the title *Physics & Art[efact]*, September 14 / 15, 2018

origins, but in the structural sense of principles (ancient Greek *archai*): spotting the decisive moments in electronic circuitry (*techné*) and in source code (*lógos*), such as performed in Ian Bogost's and Nick Montford's study *Racing the Beam. The Atari Video Computer System*[136] when it comes to identifying the time-critical cross-over between coding an archaic computer game (the symbolic, computational regime) and the scan line television for the visual output of animated objects and sprites (electro-physics).

Research artist Ryan Maguirre has developed techniques to recover sonic articulations which got lost in data compression.[137] The MP3 standard is anthropocentrically oriented at human hearing and its limits of signal *aisthesis*. In contrast, the media archaeological ear is machine listening to the new kind of data garbage which falls victim to lossy compression algorithms. The field of analysis for such media-active archaeology is no past technologies at all, but it is "radical" in its focus on the techno-mathematical operations of the computing machinery of today, and the signals which occur unnoticed by cultural aesthetics.

### Micro(-Artistic) Research: Declothing Media

In May 2009 the *Micro Research* lab in Berlin, curated by Shintaro Miyazaki, offered a workshop on the "Epistemology of electromagnetic waves"; other workshops comprised subjects like the RFID sniffer workshop which led to the practical construction of a simple analog electronic circuit which detects the presence of 13.56 MHz RFID tags which are commonly used in plastic cards in libraries or shops.[138] In media-archaeological terms, applied epistemology is technological micro-research, down to electronic and digital media forensics. Against the mysticism of unexplainable complexity (such as in recent Artificial Intelligence discourse), media-archaeology seeks the *arché*, reducing technological complexity to its fundamental, essential operations - be it core electronic circuitry, or mathematical formula translated into source code for computing. In this way, media archaeology is an active examination and questioning of technology. "Open" soft- and hardware, in that context, can be understood literally: revealing its hidden structures and "hidden layers" (in "deep" machine learning), thus undermining the *dissimulatio artis* which is the central trope of techno-rhetorics for media in order to be successful against humans.

## OPERATIVE MEDIA (ART) PRESERVATION

### Towards a (re-en)active techno-archive

Media art becomes a more literal "archaeological" issue with the challenge of preservation. Taking for granted the definition that a technical piece is in its "media" state only when being in signal processing, the non-historicist imperative is to keep such works reenactable - either from the original, or by

136 Boston, Mass. (M.I.T. Press), 2009
137 See http://theghostinthemp3.com; accessed January 4, 2016
138 See: http://shop.marcboon.com/snifferkit.pdf

their software emulation. External documentation (by photography, or cinematic recording) does not suffice, since it does not reveal the inner engine which is driving the aesthetic techno*lógos* of works of media art. Artistic technologies here change from subjects to objects of media archaeology.

Preservation of computer-based art is not about the aesthetic content for cultural memory only, but its technological condition of possibility as a cultural value as well. Media-archaeological investigation of early computer art is not nostalgic but has a techno-epistemic cutting edge. While artistic and aesthetic phenomena arising from a piece of media art mostly dissimulate their conditional techno-mathematical processing, "forensic" investigation analyzes the critical techno-logical layers underneath and the "formal materialism", that is: the structure of its logical circuits and its data formats.[139]

A semantic gap opens when future observers do not understand the interface interaction of a piece of computer art any more. Not only that peripheral storage devices like a CD-ROM do not keep its data intact for a long time; the computing machines themselves will have become outdated and replaced by other systems in faster rhythms. Therefore both operative museums for the continuous (re-)enactment of the electronic hardware, and arctive archives not somply for the documentation of algorithms, but for executable softare, are required.

## Operative media museology

In 20th century, the familiar agency of the museum has been confronted with the challenge of electronic exhibits. In most museums of technology, for example, television sets of the late 1950 are usually exposed as a "dead" object like any other material artefact. An electronic device that is not processing signals is not in its medium state but just a piece of furniture. Most museum visitors actually look at old television and radio sets like a piece of antiquated design: they recognise the style and maybe become nostalgic about it, but do not attend to it as an operative medium. To exhibit an old TV or video set (like a musical instrument from the past) in action is a challenge for museum conservators when, for example, a couple of condensers have to be exchanged for re-activating their signal processing: Then it is not the original anymore. And when the electronic image is unfolding again, should historical footage from the period of the television be shown, or up to date content?

If the external (protective or decorative) case of a radio from the 1940s is removed in favour of insight into its technological structure, it looks nearly ahistorical. As a technological object it principally works as a radio from much later periods. The electronic tubes (or valves) have been replaced by transistors and microchips in the meantime but functionally it operates in exactly the same way, as amplitude or frequency modulated FM / AM radio. Considered this way, such electronic objects, are structurally not historical at all, they are invariant against temporal change until their infrastructure is replaced by a completely new system, in another temporal rhythm.

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139 See Matthew Kirschenbaum, Mechanisms. New Media and the Forensic Imagination, Cambridge, MA (The MIT Press) 2008

In museums of industrial science and technology, one often sees steam engines actually running. But media art which starts with electronic technology is of a different kind; they are not primarily related to energy transformation like industrial machines. What should be displayed in a museum if the object is electronic media? If the display is reduced to the surface or interface, their essence is missed, but it is difficult for visitors to have a medium opened and understand what is going on within. It is a challenge to museum education and didactics to explain what is really happening *within*, a challenge to the design-orientated, surface-orientated display.

## Materiality matters: tape-based electronic media art

Different from immobile museum objects in *stasis*, time-based technological artifacts are in their "media" (art) state only when being in dynamic operation. In order to functionally re-enact Dan Graham's video installation *Present - Continuous - Past(s)* from 1974, the analog recorder tape delay may be emulated in digital signal processing. But the media-artistic message (the irritation of "presence") can only be preserved in its spefcific materiality which once triggered the idea of delayed presence, the reel-to-reel video tape and loop. Graham's installation has been a pure function of an electronic diagram: the *feedback circuit*, creating a re-entry within the actual present, as effect of technically delayed video tape signal transduction.

In the score for Steve Reich's *Violin Phase* composition 1967, published 1979, the violinist and a sound engineer, working with a four-channel tape recorder, are given detailed directions for creating the basic tape loop that generates the performance tape used in live performance. But due to the scarcity of appropriate tape recorders, most present-day performers of Reich's composition use looping software that make it possible to dispense with many of the instructions in the score (including the engineer on stage). "[T]he decades-long ubiquity of tape has been replaced by a kind of invisibility, through which the particularities of the medium have been subsumed into more generalized notions of fixed media."[140] But the specific materialities of tape and tape machines "are not incidental to Violin Phase, but are central to its composition, performance, and reception" (ibid.). The same argument holds for the 2012 new realization of Peter Weibel's sound sculpture ("Tonskulptur") *ichmasse / masseich* (1977/78) at ZKM Karlsruhe, based on a magnetic tape loop recurring between three magnetophones repeating the workd "I" ("Ich").[141]

Synchronizing signals are recorded on a video tape itself, along with picture and sound information. This sync information enables the images to be played back in a stable fashion, oriented properly both vertically and horizontally. Changes in these synchronizing or timing signals cause time base errors that result in disturbances to the images, to be matched by the Time Base Corrector

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140 Joseph Auner, Reich on Tape: The Performance of Violin Phase, in: Twentieth-Century Music 14/1 (2017), special issue *Tape: Or, Rewinding the Phonographic Regime*, eds. Andrea F. Bohlman and Peter McMurray, 77–92 (77, abstract)

141 Romana Schuler (ed.), Peter Weibel. Bildwelten 1982-1996, xxx, 69

(TBC). Video itself takes place not simply in cultural time but is always already a technological time object itself, chrono-poetically manipulated by artists.

Video art master tape restoration means bringing it into playable condition again, which requires preservation of its signal processing state. This is technical rest*aura*tion, restoring its post-Benjaminesque "aura" by preserving its processual temp*aura*lity. Such technical reproduction of electronic signals basically preserves its processual authenticity, even when resulting in linear distortions of the signal. A media art work is "copied" when resting within the same format; moving it onto a different format (analog transfer or digital "migration") means its substantial transformation.

It has not been with photography or film, but with electronics that true "media art" as category emerged: electro-acoustic music, and video art. In 1965 Sony's Portapak enabled independent Television art. Contemporary media arts festivals like the Berlin Transmediale and the Ars Electronia in Linz started as video art festivals. The real *archié* of electronic media art is its inherent temporal sonicity, from which the "musicality" of the generic term Fluxus Art as concert-like live event happening is derived, with Nam June Paik's tape-music experiments, and John Cage et al., relating to the volatile, transient character of the acoustic / electronic signal, different from the rather typographic film frame (McLuhan 1964). Paik's legendary *Exposition of Music - Electronic Television* in the Wuppertal Galery Parnaß from 11 to 20 March, 1963 allowed for the distortion of the live television image by magnetic modulation as "participative". Fluxus art emanated from the electro-magnetic field. Such *performative* media art requires co-originary re-operation (rather than arbitrary re-enactment) of the electro-magnetic effect on functionally equivalent machines in its analog idiosyncacies, such as Paik's seminal *Participation TV*.[142]

A film documentation would not tell anything about the conditions which made such appearances possible. Only the preservation of actual electronics allows for re-enactment whose *a priori* radically depends on the analogue electronic tube (it does not work with pixel monitors). Since the electronic image, different from traditional photography, is not fixed, rather a live signal than iconic representation, the criterium for its media art preservation shifts to the oxymoron of material processuality.

Materiality in electronic media does not refer just to hardware. The question that arises is whether, in addition to their value as aesthetical information, media art from the past has an external value linked to the original form of its hardware – which is not sufficiently preserved after its transformation to a digital information carrier. It is not sufficient to migrate the artistic content without saving the original carrier - which would suggest that for an electric video image or a musical tone it is insignificant whether it is recorded on schellack disc, on Compact Disc or as computer file. Whereas for coded, that is: symbolically expressed art forms like literature the essential enunciation can be migrated via copying alphabetically, the analog signal depends on its material implementation - unless it becomes digitally sampled and thereby ingegrated into the symbolic order which literally transsubstantiates its essence. "The characteristic hiss and crackle of 78 rpm pressings, played by a stell needle,

142 http://www.youtube.com/watch?v=JHC1CdgfkVo

was a part of the listening experience" of a gramophone record.[143] If the material carrier remains transitory, only artistic content becomes the object of preservation. But McLuhan himself insisted, partly in accordance with the communication engineering model, that noise was part of the communication process, pointing at the hidden ground of the apparent technical figure. "What they [Shannon / Weaver] call "noise", I call the *medium* - that is, all the side-effects, all the unintended patterns and changes. [...] all media tend to be subliminal in their structures [...]."[144] But here McLuhan might have expressed more accurately (in comparison to Shannon): the medium *has* a (hidden) message.

Media-active archaeology is anachronistic in many ways, when it comes to the restoration, e. g., of original recordings from the dawn of television technology, made in the era of mechanically-scanned television. "Not until the computer era came on us could we study these images"[145] by means of algorithmic signal detection and filtering software. An ironic echo is the *VinylVideo* project, which Gerhard Sengmüller calls a "piece of faked media archaeology"[146].

Media archaeology does not bury technological events by contextualizing them in historical narratives but helps for media devices to let it "speak for itself". As enunciative media archaeography, it focuses on essential, knowable epistemogenic sections which normally escape human interface perception (like the "racing" of the beam in early computing games, or the "latency" image in iconoscopic television) - a plea for "material semantics" without reductive materialism. The access to the archive is no bureaucratic decision any more but requires proper technologies and algorithms for signal re-play - which makes all the difference between traditional arts and genuine electronic media art. The internal value of all electronic technology lies in its configuration and circuitry, in its interlacing of aesthetic appeal and material form of transmission. To reveal this implicit knowledge is a cultural value in itself and therefore belongs to the tasks of media art preservation in museums. Digital signal processing (DSP), with which one can simulate analogue sounds and images, up to and including interference, acoustic noise, and virtual reconstruction of the original performance space, is an example of the ambivalence between physical carrier and aesthetic content. Here, as in works of audiovisual media art, the performative (better: operative) behavior of time-based media art works becomes the decisive criterion in the analysis. For this reason, processual "re-presencing" (Vivian Sobchack) is a key operation in media-art archaeology. In the case of the video tape, the storage medium itself moves, while current flash memory in computers stands still and data movement becomes a function of programming. The obvious materiality of

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143 Ray Edmondson, AV archiving philosophy - the technical dimension, in: Proceedings of the IAMI-IASA Joint Anjual Conference, Perugia 1996, no. 8 (November 1996), 28-35

144 National Archives (Canada), H. M. McLuhan Papers, H. M. McLuhan to Jerry Agel, 26 March 1976

145 Donald McLean, http://www.tvdawn.com/index.htm; accessed 15 March, 2008

146 visomat inc., asciiVision, in: Thomas Y. Levin, Ursula Frohne / Peter Weibel (eds.), CTRL[SPACE]. Rhetorics of Surveillance from Bentham to Big Brother, Cambridge, Mass. (MIT) / Karlsruhe (ZKM) 2002, 372

electronic analog media enters the space of the calculating media by means of the simulation, for example, of a magnet tape video installation as a time event in a computer. The sampling theorem allows for the digital to recreate the analog signal.

## Preserving Signals as Data

The imperative for museological preservation of digital media art is to lay bare not only the abstract underlying algorithms, but their concrete implementation in circuitry. This techno-anatomy reveals the *arché* of the technological *l'archive* in Foucault's, not in the memory institutional sense, the "submedial space" (Boris Groys) behind the screen or other kinds of interface.

[Fig.: Media-archaeological “excavation” and subsequent re-processing of one of the earliest relics from cybernetic media art (New Tendencies, Zagreb): Vladimir Bonačić's “Dynamic Object” no. GF.E16S (1969), a random number generator (Galois Field) for light patterns. Photo: Miro Cimerman]

The Electronic Records Program at the National Archives and Records Administration in the U. S. offers a model for defining digital (art) objects on three levels: its physical embodiment (such as magnetic charges on tape), its logical existence (formats in software), and its conceptual existence which refers to the phenomenon appearing at the machine-human interface.[147] Kirschenbaum analytically separates forensic (hardware) and formal (software) materiality while admitting its increasing interlacing.[148] An EEPROM, for example, is an electrically erasable programmable read-only memory. The climax of this oxymoronic blurring is the software emulation of previous computer hardware itself.

Materiality is still the blind spot of the information age and in electronic media. Digital media provide for materiality only by means of the 3-D printer, transforming the information of the object into its material replica. But a media artistic object has more information in it than a recording or scanning would ever provide. If the "aura" appeal of a work of art is rooted in its uique quality of being here and now[149], it is dependent on its material presence which is lost in reproduction.

Ephemeral media (art), though, is process-oriented; thereby it undermines the traditional evaluation of the museum object in its principal claim for long-time endurance. There is a conscious transformation in the temporal economy of cultural value. The advantages of "new" media usage, like online access to the

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147 Kenneth Thibodeau, Overview of Technological Approaches to Digital Preservation and Challenges in the Coming Years, in: The State of Digital Preservation. An International Perspective, Concil on Library and Information Resourses, pub107 (2002), http://www.clir.org/pubs/reports/pub107/thibodeau.html

148 Matthew Kirschenbaum, Mechanisms. New Media and the Forensic Imagination, Cambridge, MA (The MIT Press) 2008 111

149 As defined in Walter Benjamin, Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit [*1936], Frankfurt / M. (Suhrkamp) 1969, 14

Internet and computer software, opens more immediacy and creative possibilities than ever but for the price of almost immediate obsolescence. Media artists since Fluxus Art times have been conscious of this time-critical contract (creative processuality vs. museal endurance); from that derives that the preservational imperative itself diminuishes into an extended present.

Analog signal recording media like phonographic, magnetophonic and video image recordings are subject to entropic ageing; they degrade over time and quality with every copy they (re-)produce, and in themselves. But once the signal has been digitized, it becomes ideally "timeless". Digital information - even if actual computing takes place in energy-absorbing, thereby temporally irriversible machine systems - is conceptually suspended from physical time in information theory. The present as temporal denominator looses its plausibility with the *binary information digit*.

The Videodisc, as the technological scene (or condition) of a couple of early media art works, in close reading looks digital, but it is analog video signals which are recorded discretely, different from the Audio Compact Disc which actually stores binary information, not the acoustic signal itself (like the phonographic record). Finally the CCD (charge-coupled device) camera, with its frame-transfer system, transforms the electronic image into data blocks.

With digital preservation of analog media art heritage, the data file becomes a complete substitute of the original image relating to the visual content. This epistemological dilemma changes when it comes to "born-digital" media art. The American Standard Code for Information Interchange (ASCII) has been based on a seven bit structure, which in early days of computing was used for transmitting photos and graphics as well by pixeling the visual information and translating it into the available 128 characters. Different art projects refer to this digital Stone Age like *ascii Vision* in the works of the *ascii-art-ensemble*.[150]

The media archaeological approach to preservation of (digital) media art preserves the conditions of possiblity of such aesthetic expressions, not primarily the surface appearance (the aesthetic "content") which is figuratively exposed. The inherent quality of a technological work of art is not addressed to human senses only. In works of ASCII art, the hidden media message ("ground", in McLuhan's sense) is expressed by the work of art itself.

There have been moments when the hidden technological ground expresses itself, like the Williams-Kilburn Cathode Ray Tube memory in early electronic computing from 1947. Each phosphor charge, on and off on the screen, not only represented but embodied a binary "zero" or "one". This is not video art but functional electronic imaging. Since the charge would decay within 0,2 seconds, a detector was placed in front of the CRT, obstructing human insight, allowing for an electronic beam again to refresh the charge just in time to keep it. In such technology, the Cathode Ray Tube was actually used as a storage device for a number of bits - thereby revealing the medium message on the "interface" itself, in an act of almost media artistic engineering. But the only

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150 visomat inc., asciiVision, in: Thomas Y. Levin, Ursula Frohne / Peter Weibel (eds.), CTRL[SPACE]. Rhetorics of Surveillance from Bentham to Big Brother, Cambridge, Mass. (MIT) / Karlsruhe (ZKM) 2002, 372

audience to observe this display was meant to be the computer.[151]

## The "two bodies" of computer-based art

For the preservation and legacy of signal-based (analog) and (computational) works of new media art, a secure storage environment for media-artistic data, in digital preservation, is achieved by generating checksums for files which are monitored by re-checking, on a regular basis, in order to identify any changes to files - be it corruption, loss of data, or unintended manipulation. "This could mean creating checksums as you export a file from the hard drive on which an artwork was received, or as soon as you have exported a file from an editing program or after digitizing a tape."[152]

Different from previous technologies, the computer as *turingmachine* is a theory-born medium. Still, a symbolical machine (equalling the algorithm, according to Turing 1936), in order to become operative in time, needs to be implemented in the physical world, i. e. in time. While its main quality is software, such code needs to be implemented in actual and active matter. A museological gap opens between material preservation and functional re-enactment, especially in preserving computer art.

Regarding his early computer graphics, Georg Nees insisted that they were *not* works of art but models for works of art. "They belonged to the domain of aesthetics, but to a different category than that of art that requires a human imperative."[153] Therefore, "computer arts" is a hybrid term. Programming differs from making a sculptural or painterly art object; code does not violently manipulate raw physical matter but cybernetically decides *re-configurable* electro-physical hardware).

When a present computer emulates a previous Commodore 64 in order to run a vintage video game, it functionally (not historically) *is* in the C64 *present* state. The concept of emulating another machine is essential for the very definition of the Universal Turing Machine: Once a mechanism has been transcribed into a discrete sequence of states, it can be initially inscribed onto the "register", that is the tape of the TM.[154] A Universal Turing Machine can emulate any other specific Turing machine, by defining its sets of program states and writing it as data symbols on the tape. "Being remarkably similar to the Von Neumann model of a computer, where both programs and data can be stored on the

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151 See David Link, There Must Be an Angel. On the Beginnings of the Arithmetics of Rays, in: Siegfried Zielinski / idem. (eds.), Variantology 2. On Deep Time Relations of Arts, Sciences and Technologies, Cologne (Walther König) 2006, 15-42

152 http://mattersinmediaart.org/sustaining-your-collection.html

153 As quoted in: Paul Brown / Charlie Gere / Nicholas Lambert / Catherine Mason (eds.), White Heat Cold Logic: British Computer Art 1960 - 1980, Cambridge, MA (MIT Press) 2009, 86

154 Alan M. Turing, On Computable Numbers, with an Application to the Entscheidungsproblem, in: Proceedings of the London Mathematical Society (2) vol. 42 (1937), chap. 6

same medium [...] it follows that a UTM could emulate itself."[155] Although the TM is construct in mathematical theory rather than a physical computer, it therefore ultimately leads to the material 3D printer.

That makes computer-generated art different from previous analog media works. At the same time, in the background the contemporary operating system is running; therefore the emulated computer is in both a historical and a trans-historical state. The timing of the present system speeds the emulation up, so that the characteristic C64 time behaviour as once coded in BASIC language has artificially to be simulated. With the temporal dimension functional emulation (the matahistorical realm of techno-mathematical logic) becomes "high fidelity" in terms of micro-temporal behaviour. So-called "Retro Computing" resembles what is known as *reverse engineering*. It liberates the primary artefact, the C64 computer, from its total historisation and musealisation, and rather identifies the time-tunneling immediacy of its operational being.

Even if most of digital computing is embedded in a body of integrated electronic circuitry, what (literally) "counts" in actual computing is not only the materiality but its algorithmicized logic. What the symbolic order of culture distinguished for a long time as *physis* can now be negotiated alphanumerically as information. The re-presentation of seminal works of digital media art in particular is enabled by functional emulation; at the moment of the configuration this concerns not a historical citation, the invocation of a chapter in digital art history, instead the new computer *is* in the state of the old. The category of the “historicity” of media art may therefore be reconsidered.

A conflict arises between preserving material hardware and preserving software, with an emphasis on the concept of "emulation" as preservation strategy. Emulation as different ontology is inherent already to the character of the Turing machine, different from electro-material-only artefacts.

## The Different Quality of Computational Media Art Preservation

G. E. Lessing's *Laocoon* theorem from 1766 once defined the medium-specificity for different art forms such as literal poetry and visual painting. For analog media art, this refers to the electronic technologies which are the pre-condition for any subsequent specific aesthetic effect. Behind the phenomenal appeal, the essential *message* of such media works derives from the conditioning hardware and circuitry which have become co-authors of the artistic production.

With computational art, though, previous media art differences are not rooted in their brute materialities any more but have become formats within the software regime. Source code on the one hand (algorithms), and the formating frameworks (operation systems, browsers et al.) are the core "engine" of New Media art. From that derives the option of "emulation" for re-creating (rather

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155 Mike DeHaan, The Universal Turing Machine is a Turing Machine Emulator; https://www.decodedscience.org/what-is-universal-turing-machine/12081 accessed February 9, 2017

than passively archiving) a work of code art even if its original software environment has become obsolete.[156] Computational art exists in "turing time" (Friedrich Kittler) which fundamentally differs from the historicist temporal order which has concerned media (art) preservation so far.

The philosophy of media art preservation therefore is symptomatic of the challenge in media-cultural heritage itself, beyond the museum works in the more limited sense.  Media art can be evaluated on the basis of its technical properties which are subject to temporal ageing. But with digital media, there is an additional logical level of techno/logies involved which is negentropic in principle.

The digital sublime (to make use of a Kant's and Burke's category for an-aesthetic sensation) has become the core experience of "virtual" space. While the binary and algorithmic features of computational art works are not what humans perceive in their interface encounter with the machine it is the more urgent to remind of the material aspect of computerized data. Technological economics is still fundamental in both the design of computer hardware and software.

The qualities of new media art are neither reducible to material nor to its software tools. Rather, new media art is process-based practice with limited duration, including artistic research. Documenting dynamic media art (be it site-specific installations or internet art) is one task; preserving and re-enacting the interactive experience another for which the "webrecorder" provided by Rhizome (New York) as free software allows. A gap opens between the phenomenal appeal and its intra-structural technical condition. Taking into account audience participation and (web-)site-specificity, it becomes clear that for processual media art works there is no such original state at any given moment from the phenomenological perspective. The technological conditions for such interactivity itself, though, on the contrary, are not allowed to change within the artwork from moment to moment, even if *in-situ* conditions mean that the installation must constantly adapt to new circumstances.

The challenge of algorithmic art preservation may be compared to the musical score. Performative media art only exists in actual operative realizations; the Berlin Computer Games Museum has developed experience in preserving such interfacial situations for interactive ludic media. Alternative to a focus on the phenomenological appearance of ephemeral media art installations is the epistemological focus on the knowledge embedded within the machines, which is revealed by a specific work of media art, as process-oriented ontology. Terms like "emulation" are not just functional in the context of media art preseration but deserve unfolding their epitsemic delicacy in terms of object-oriented ontology.

For dynamic media art preservation, the ephemeral phenomenal visitor or user experience is not the only cultural value worth to be preserved. While for the

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156 For the "logical replication" of obsolete computing machinery (case Charles Babbage's Difference Engine No. 2), see Doron Swade, Collecting Software: Preserving Information in an Object-Centred Culture, in: History and Computing, vol. 4, no. 3 (1992), 206-210

inaugural exhibition event, priority is on the affective experience and human-machine communication ("media art"), what becomes more interesting for future memory of past artistic research knowledge is the testimony of its technological ground ("medium art") as implicit knowledge for which the interfacial, phenomenal appeal has been rather a symptom. Central for the preservation of Internet art is the algorithms and microprocessing electronic units which run digital media formats and compression - the real *l'archive* as precondition of media art action in terms of Foucault's *Archéologie de Savoir* (1969). A radical museology of "new" media art reveals computing architecture from within instead of surface display. Here, the logic of enunciation in fact corresponds with machinically implemented logics, to be expressed in algebraic formulas and program code. The notion of "logical preservation" as developed in documentary science[157] therefore extends to the media-active, archaeological preservation of a continuously represencable techno-aesthetic past.

157 Hans-Joergen Marker, Data Conservation at a Traditional Data Archive, in: Edward Higgs (ed.), History and Electronic Artefacts, Oxford (Clarendon Press) 1998, 294-303 (296)