

["ON MEDIA ARCHAEOLOGY"]

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CULTURAL TECHNIQUES AND / OR RADICAL MEDIA ARCHAEOLOGY

"Cultural techniques" vs. techno-mathematical operations

- beyond the nature/culture binary divide, a technical medium based on cultural knowledge, but still of a physical nature because there are electro- or even quantum-physical laws at work that are not solely dependent on the respective cultural discourse; media implement knowledge of physical and mathematical laws that transcend human culture; technology thus emerges *from* culture as an autonomous entity *beyond*

- "Mathematical symbols <...> have a particularity: they reveal structures"¹, in fact: they become media-archaeological operators themselves (*poiesis*)

- very term "technology" consists of two parameters. Athanasius Kircher, *Phonurgia Nova*, New York 1966 (Reprint edition Kempten 1673; German transl.: Hall- und Thon-Kunst, xxx; lat. *medium* there transl. with "Mittel" bzw. "Behülf"; difference between instrument and techno-logical medium. Kircher p. 12: "Duplex hoc loco medium considerandum est, Physicum, & Mathematicum. Physicum medium est spatium illud aereum, per quod vox propagatur, diversaeque qualitatis & constrictio est. Mathematicum medium est magnitudo, vel parvitas intervalli propagatae vocis durationem mentis [...]."² A second-order *medium* is knowledge-appropriated physics; the media condition for such appropriation is the construction of arbitrary, exact measuring device, such as tubes to measure acoustic reverberations: the interlacing of nature and culture, literate techno-logy

- term *cultural techniques* might be applied to virtually any technique that establishes such a distinction: "Humans *as such* do not exist independently of cultural techniques of hominization, time *as such* does not exist independently of cultural techniques of time measurement, and space *as such* does not exist independently of cultural techniques of spatial control."³ The concept of "cultural techniques" thus provided a way for German media theorists to move away from the anti-humanist tendencies in Kittler's work and to focus instead on cultural practices: "The culture-technical approach offers a viable alternative or escape route. To speak of operations and connections allows those inspired by the Kittler effect to speak of practices without saying society; to readmit human actors allows them to speak of agency without saying subjects."⁴ Kittler's anti-hermeneutic stance thus transformed "into a less intransigent post-hermeneutic approach involving certain notions of praxis and limited human agency

¹ Max Born, *Symbol and Reality*, in: *Objectivité et réalité dans les différentes sciences*, Archives de l'Institut International des Sciences Théoriques, Brüssel 1966, 151f. See Charles Alunni, Gustave Juvet (1896-1936). *Un Pionnier Oublié des Études Cliffordiennes*, in: *Advances in Applied Clifford Algebras*, Basel (Birkhäuser) 2009, 14-38 (26)

² Ambivalences in Kircher's use of both categories is discussed in Hoffmann 2002: 66 ff.

³ Siegert, "Cultural Techniques," 57

⁴ Winthrop-Young, "Cultural Techniques," 14.

that Kittler was prone to eschew."⁵

- concept of cultural techniques rooted in agricultural practices like alphabetic writing *boustrophedon*

- not simply progressive recursions of cultural techniques as Hegelean dialectics but technological escalations; rather delegation to the techno-logical (*auto-)*poiesis: pulling the Pythagorean string experimentally = direct human-instrument-coupling, while with VCO (voltage controlled oscillators) in electro-acoustic synthesizers a technological world inbetween unfolds. The media-epistemological focus is on what unfolds *within* that bracket / *epoché* (which escapes phenomenological, anthropocentric "media" 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 und listeners - because he wanted to be able to leave the recipient out of the mathematical theory altogether" = 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.) True *media*-understanding gets epistemologically attuned to the technological inbetween / *metaxy*, different from the media-phenomenological focus on human media experience

- cultural techniques *performative*, body-related action, vs. media-technological *operations*

- Hertzian Karlsruhe lecture room experiment with electro-magnetic waves / resonators: an inbetween acts, genuine media-event. Non-linear media-"historic" short cuts: Media Studies do not start with Pythagorean monochord, but with electric spark (Aitken), generating oscillations

- *realtime* actually n o t temporal fidelity (indexicality) but a *temporeal*. Norbert Wiener's "time on non-reality" for the binary switch; escalation of technologies from cultural techniques into the time-critical regime, the qualitative transformation from "performative" (body-and-cognition related) to "operative" (van Treeck)

Answers of Media Archaeology to Cultural Techniques Studies

- A counter-reading of the "hands on"-approach, accentuating the suspension of man from the "handy" relation to the world by technical

⁵ Ibid., 15.

machines, apparatuses and automata, beyond *Kulturtechniken*. Media archaeology keeps an ascetic analytic distance against the anthropological and discursive focus of Society and Technology Studies, concentrating rather on the non-discursive constellations which define the human-machine relation - at the expense of the "human technology which exists before a material technology" (Deleuze 34), the diagrammatical prefigurations of technologies by the diagrams of cultural engineering.

While transitive hand-machine relations might be subsumed under the field of studies called "cultural techniques" (German: "Kulturtechniken")⁶ and remain somewhat anthropocentric, media archaeology with its focus on the non-discursive human-machine constellations keeps a more ascetic distance to the human agency in favor of the techno-mathematical field itself. For the purposes of such an analysis, the socio-cultural discourses that envelop technological processes must be momentarily suspended.

- hermeneutically distant look and "cold gaze" for media archaeology is para-human in terms of Walter Benjamin's comparison of the camera man (brilliantly expressed by Dziga Vertov's film *Man with a Camera*) with the operative gaze of the surgeon.⁷

- human culture does not loose, but win by non-semantic challenge, when suspended from subject-centered interpretations for a moment. Media archaeology exposes technicality of media not reducing culture to technology but revealing the techno-epistemological momentum in cultural artefacts itself

- Deleuzian concept of the machine as "organless body": "simultaneously and inseparably a machinic assemblage and an assemblage of enunciation" = Gilles Deleuze / Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi, Minneapolis 1987, 504 / "a site at which a discursive formation intersects with material practices" = Jonathan Crary, *Techniques of the Observer: on vision and modernity in the nineteenth century*, 2nd printing, 1991, Massachusetts Institute of Technology 1990, 31

⁶ See Theory, Culture & Society, vol. 30, no. 6 (November 2013), Special Issue *Cultural Techniques*, edited by Jussi Parikka / Geoffrey Winthrop-Young

⁷ See Walter Benjamin, *Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit* [1936], Zweite Fassung, in: ders., *Gesammelte Schriften*, hg. v. Hermann Schweppenhäuser / xxx Tiedmann, Frankfurt/M. xxx, Bd. xxx, 474- (496)

- all the difference between hand-writing and type-writing (Heidegger)

- phonetic alphabet (cultural technique) vs. phonograph (the actual acoustic signal) vs. spectral voice analysis / synthesis (re-entry of symbolic code, implemented and thereby temporalized in electro-physics)

- technical signal recording is not a cultural technique any more but physical event. The recording of the acoustically or optically "real" physical signal is opposed to symbolic notation by the alphabet not only in a technical but also in an epistemological way: the difference between physical signal as indexical and the arbitrary cultural symbol. With computing, dialectic opposition becomes synthesized; Digital Signal Processing (notably sampling of audio events) a function of discrete symbolization, a re-entry of the "alphabet" in numerical and logical form

- ancient Greek vowel alphabet, distinct to other writing systems, "invented" not only to write down Homer, but engendered operative mathematics, "thus, to science as such"; Kittler's critique of Foucault, Heidegger, and Derrida, for not including mathematics in their merely historiographical approaches. Today, this very vowel alphabet of the Greeks has be/come (again) closer to new media than most of the other languages, such as roman scripts, since letters in the vowel alphabet could also be numbers and the codes of new media is now alpha-numeric, embodied in binary digits = Axel Roch, Hegel is Dead: Miscellanea on Friedrich A. Kittler (1943-2011), in: Telepolis (November 17, 2011); <http://www.heise.de/tp/artikel/35/35887/1.html> (accessed June 26, 2017)

- according to Walter Ong, electronic revolution in mass media communication devices like radio and television resulted in "secondary orality", communication based on the symbolic machine (computing) has led to a (hidden) secondary alphabetic revolution, with bits and bytes inheriting the typeset, but different from the printing culture in a dynamic way. The voice turns silent and still articulates - in implicit mathematical sonicity which is the ultimate shock to occidental logocentrism

- a resonance circuit (the electronic basis of oscillators for electronic music synthesizers) is not a cultural technique but a physical event of second (culturally intelligent) order

- beyond the reach of "cultural techniques": When the inscribed phonographic traces on wax cylinders from Edison's days are opto-

digitally retraced, inaccessible sound recording becomes audible again.⁸ Frozen voices, once confined to analogue and techno-archivally secluded storage media, wait for their (digital) unfreezing. In that media-archaeological analysis, "media are the new capital-s subjects of media archaeology [...]"⁹

- physical and electromagnetic laws known to the designers of a *Volksempfänger* from pre-war Germany are still in operation in today's enduring AM radio infrastructure. "Mathematically encoded laws of nature, then, occupy the place once held by the place of the music of the spheres."¹⁰

- inductive rather than meta-discursive argumentation: media archaeology is radically rooted in the actual techno-logical event

- cultural techniques (such as writing and counting) as pre-condition for technological escalations; an escalation, though, is not simply an extension, but a new quality. Cultural techniques are related to the arbitrariness of the human hand / body / action, while technological implementation into electro-physics enables a techno-sphere below human "historical" (Vico) culture

- conceptually, cultural techniques remains within the time-field of cultural history: Vico's man-made temporality, while media archaeology claims that media, when in operation (instead of being simply material things), constitute their *Eigenzeit*.

- according to Giambattista Vico, history = temporality which humans understand for what their culture has produced itself, different from natural evolution. Autopoietic techno-mathematical time is an interlacing of both temporal regimes. Even if technologies are products of human culture, they generate non-historical figures of temporality (standardized clocking time) which irritate humans accustomed to / by the narrative discourse of time-telling

- concept of cultural techniques is to *Kulturwissenschaft* what radical media archaeology is to *Medienwissenschaft* (both disciplines written in singular)

- technology = culturally, i. e. symbolically (re-)defined real, i. e. physical nature; (electro-)physics mathematically folded upon itself

⁸ See Patrick Feaster, *Pictures of Sound. One thousand years of educed audio: 980-1980*, Atlante, GA (Dust-to-Digital) 2012

⁹ Winthrop-Young, *Siren Recursions*, in: xxx

¹⁰ Winthrop-Young, *op. cit.*

(such as so-called "cognitive radio")

Electric circuit diagrams

- only in historical discourse, retrospectively from today's omnipresence of the "flipflop" in binary computing, the "first" diagram of a digital switching circuit has been the Eccles-Jordan trigger; rather media-archaeological *ur-* (ongoing *arché*) than "original" in the historical sense: the trigger relay; cp. Bonch-Bujevich 1918 = "gleichursprünglich"

- discrete computing ultimately boils down "to signifiers of voltage differences" = Friedrich A. Kittler, *There is No Software*, in: same author, *Literature, Media, Information Systems: Essays*, ed. John Johnston, Amsterdam (G+B Arts International) 1997, 150

- circuit diagrams as mixtures of iconic signs, indexical signs and symbols; they interrelate switching and interpretation. "But [...] do you see a digital device? Do you see an analog device? Is it a matter of interpretation? A historian of electronic media would read this diagram in a way that would locate that diagram within the history of radio: After all, what we have here basically is a grid electrode which is modulated by a signal. What strikes at once is the similarity this circuit has to Edwin Armstrong's Audion amplification circuit of 1913.¹¹ Armstrong himself described in his patent abstract this apparatus in terms of two coupled circuits: the grid circuit, connecting the aerial to the grid of the triode, and the wing (anode) circuit, connecting the anode of the tube, the battery, an autotransformer T and a telephone receiver. [...] The principle is that of a relay: the feeble input signal that is applied to the grid is amplified by a feedback of the strong oscillations in the anode circuit. A highly instable device, though: If the feedback became too strong the whole apparatus turned into a oscillator, i.e. a transmitter. Armstrong himself already noticed a pathological bias of his circuitry: 'Signals that are scarcely audible with the ordinary audion connection can be amplified to a point where they are too strong for, and *'paralyze' the most stable audions*'.¹² In the Eccles-Jordan trigger this pathological bias became the one and only purpose."

- replacing the historicist quest for "beginning" by structural principles

¹¹ And Eccles and Jordan are fully aware of it: "In a well-known method of using a triode for the amplification of wireless signals an inductive coil is placed in the filament-to-anode circuit, and another coil magnetically coupled with this is introduced into the filament-to-grid circuit."

¹² Edwin Armstrong, Patentschrift 1,113,149, Patent Abstract, p. 2. Meine Hervorhebung.

("archi-tectural") *arché* which is operational timings rather than chronological origin; "if we take care to identify the digital as a condition that is made possible by the conceptual foundations of digital media and not necessarily by digital media itself, the boundaries of the digital moment—when it began and under what circumstances—become less clear" = announcement of book launch of Andrew Goodhouse (ed.), *When is the Digital in Architecture?*, at: Spike, Berlin, 15 June, 2017 = media archaeology in the Kantian / Foucauldian sense (*a priori* / *l'archive*); the pre-"digital media" conditions of "the digital" = rather cultural techniques of counting and discrete numerical / measuring operations

Cultural techniques vs. technological idio-chrony

- rivalling with the concept of *Kulturtechnik* (cultural engineering), term "technicity" as defined by the Gilbert Simondon, to trace the force, effectivity and performativity of cultural transformation *intrinsic* and *prior* to tools, apparatuses, media technologies and other technical assemblages.¹³

- technological media not simply subjected to an all-embracing cultural history, but tend to develop a temporality of their own. They are not just historical techniques but as well material "logic" which escapes historicization; when we nowadays re-enact the Pythagorean monochord, the medium itself sets us in a equi-primordial temporal position to his time-invariant argument. There is an implicit operative knowledge within media themselves waiting to be discovered by humans (different from the performative "tacit knowledge" as defined by Polanyi)

- different from historical hermeneutics (and within humanities as *Geisteswissenschaft*), replica of a material experiment in the past allows for its understanding by re-enactment even if the replica is not the original materiality but a functional equivalent - which is different from the limits of understanding for knowledge coded in written documents; technological object is an operative "source" of past knowledge¹⁴

¹³ See Andrea Bardin and Giovanni Menegalle, Introduction to Simondon, in: *Radical Philosophy* 189 (Jan/Feb) (2015): 15; Aud Sissel Hoel / Iris Tuin, The Ontological Force of Technicity: Reading Cassirer and Simondon Diffractively, in: *Philosophy & Technology* 26, no. 2 (2012), 187-202

¹⁴ See Christian Sichau, Die Replikationsmethode: Zur Rekonstruktion historischer Experimente, in: P. Heering / F. Rieß / C. Sichau (eds.), *Im*

- technological media part of cultural history and culture can be read as a function of technical operations (the concept of 'cultural techniques')

- "media archaeology has been critiqued for being overly dramatic and focused on technological developments."¹⁵ It insistively continues to address digital culture in terms of its *technological* media-specificity indeed: concrete platforms, constituting apparatuses, assemblages and protocols such as Internet infrastructures (cables and codes), rather than getting lost in more liberal terms of media ecology (or the "anthropocene") considering them in its "subjectivities, and atmospheres"¹⁶

- technological "determinism" in media archaeology? rather its anachronistic identification of con-temporary pre-defining states such as the technological infrastructure (which, in the case of AM radio, for instance, endured for almost the whole 20th century, notwithstanding its political and cultural catastrophes).

- media innovations are culturally co-determined - a premise culminating in the *new historicist* view that affirms both the technicity of history and the historicity of technologies; chiasitic model calls for a supplement: the assumption of an inner logic of media development that literally introduces a third element to the Promethean dichotomy of culture and nature

- almost anything associated with the term "media" or "technique" can be absorbed by discursive framework of cultural history. That inclusion, however, would jeopardize the accuracy of a term. Michel Serres distinguishes between techniques and technologies; distinction applies to the difference between cultural techniques and media technologies, between energetic / material machines and informational electronics / computing; Norbert Wiener contrasts the "hard" machinery of the Industrial Revolution, functioning on the basis of thermodynamics, with

Labor der Physikgeschichte. Zur Untersuchung historischer Experimentalpraxis, Oldenburg (Bibliotheks- und Informationsystem der Universität Oldenburg) 2000, 10-23 (10, note 3)

¹⁵ Report on *The Terms of Media II: Actions* conference, October 8 - 10, 2015;

<https://www.brown.edu/academics/humanities/events/conferences-and-symposia/terms-media-ii-actions> (accessed June 26, 2017)

¹⁶ <https://www.leuphana.de/en/research-centers/cdc/news/single-view/date/2015/07/07/terms-of-media-conference-a-review.html>, accessed 26 June, 2017): "Terms of Media Conference: A Review"

the “soft” negentropy of information technology - just like the difference between a steam engine and a thermionic tube: “I therefore reserve the term ‘technology’ for those types of artefacts that negotiate signs - and thus the logos - and contrast them with ‘techniques’, whose energetic scope is 10^{16} times higher”¹⁷, just like German engineering since Heinrich Barkhausen (as pointed out by Norbert Wiener) differentiates “Starkstromtechnik” (current used as energy, like heating) from “Schwachstromtechnik” (low current) where subtle amount of electricity is used for communicational rather than energetic purpose - which equals the difference between electricity and electronics. The thermionic tube (triode) allows for technological intelligence. No more transitive cultural technique but “second machine” age (Gotthard Günther)

- concerning the frequent confusion between the stroboscope and the afterimage effect in the transmission of visual perception, Bernhard Siegert stresses “how fundamentally the media-theoretical discourse is in need of a media-historical framework of analysis to match media’s inherently high physical and mathematical standards.”¹⁸ And, indeed, the history of knowledge and technology serves as a necessary test for all media theories. But media archaeology does not merely reconstruct historical media practices; it also reflects on their time-building, chronopoetic processes - thereby raising a challenge to history.

Technological media processes within/-out Cultural History

- *Kulturwissenschaft* prefers to read technologies as a function of historical processes; media archaeology takes the opposite perspective where the model of history itself appears as a function of cultural (symbolic and signal-based) operations

- cultural history emerged in the 19th century both as an academic practice and a research *dispositif*; it is vital to analyse its material and processual conditions. The postal system (transmission) and the archive (storage) became conjoined when Erich Moritz von Hornbostel ordered Edison cylinders with ethno-musical recordings from all over the world for his Berlin phonographic archive, with the scope of

¹⁷ Michel Serres, *Der Mensch ohne Fähigkeiten. Die neuen Technologien und die Ökonomie des Vergessens*, in: *Transit* 22 (Winter 2001/02), 193-206 (194f). [Transl. by GS]

¹⁸ Bernhard Siegert, *Good Vibrations. Faradays Experimente 1830/31*, in: *Kaleidoskopien* Heft 1/1996, 6-16 (8). [Transl. by GS]

developing the field of comparative ethnomusicology.¹⁹ The notion of culture that governed the projects involved in collecting knowledge around 1900, had become identical to the storage media it generated. In its materiality, culture thus reveals itself as an object of research for the study of storage and transmission techniques. Chronology, diplomacy, epigraphy, genealogy, heraldry, numismatics, palaeography, sphragistics, historical cartography: these so-called ancillary disciplines of history, which identify and analyse their objects with regard to their usability as cultural data storage devices, acquire the status of media archaeology *avant la lettre* and are intimately connected with the category of *Kulturwissenschaft*. As a result, culture becomes calculable; it is a function of mnemonic strategies and transmission techniques, as well as their respective institutions.

- difference between *Kulturwissenschaft* and *Medienwissenschaft*; the former is primarily interested in discourses, while the latter places a much stronger focus on non-discursive aspects; media archaeology (much like Gaston Bachelard's epistemology) focuses on moments of contingency²⁰

- discover the specific inner temporality [*Eigenzeit*] of technologies in a kind of reverse hermeneutical move. Writing, reading, counting, networking, and representing are symbolic techniques which generate culture as a recurring and normative formation. They transform a priori concepts of space and time into an analysis of concrete spatial and temporal systems. Media archaeology does not conduct this analysis on the level of macro-cultural production, but rather on the level of micro-technical operativity; technological media systems can be understood primarily and conclusively on the basis of their elementary, sub-semantic procedures. Material, symbolic and signal-based operators are not just escalations of classical cultural techniques; they require a theory of genuine media-temporal processes.

- traditional media history and cultural history agreeing on how 'organ projections' and the *extensions of men* (Ernst Kapp, Marshall McLuhan) have developed into culture's servomechanism

- man as codified (or even programmed) by cultural techniques and media technology. To paraphrase Günter Anders, media theory actively pursues the "antiquation" of man by distancing the subject-centred

¹⁹ See Sebastian Klotz (ed.), „Vom tönenden Wirbel menschlichen Tuns“: Erich M. von Hornbostel als Gestaltpsychologe, Archivar und Musikwissenschaftler, Berlin / Milow (Schibri) 1998, 116-131

²⁰ See also: Hans-Jörg Rheinberger, *Experimentalsysteme und epistemische Dinge*, Göttingen (Wallstein) 2001.

perspective through apparatus-based *theoría*

Media-temporal processes and their break from cultural history

[= rewriting of modules from W. E., *From Media History to Zeitkritik*, transl. Guido Schenkel, in: *Theory, Culture & Society*, vol. 30, no 6 (2013, Special Issue *Cultural Techniques*), 132-146]

- segment titled "Movement and Time" in Gustav Deutsch's film *Film ist* [Film Is] (Austria, 1998): medical X-ray footage of a speaking larynx. In this case, the medium speaks for itself, producing the same effect as the invention of the vocal alphabet in ancient Greece, which not only created the possibility to record – and thus store and transfer – oral poetry as a stream of phonetic utterances, but also allowed objects like drinking vessels and tombstones to speak to the reader in the first person via their inscriptions. The scientific observation of a speaking larynx in sets of 12 to 24 X-ray images per second is no longer conditioned by the human eye but by the eye of the camera or even that of the X-ray cathode. Only technical media are capable of manipulating, decelerating and accelerating moments such as this in a time-critical manner; *Film ist* announces the media-archaeological level in the existence of the apparatus, which – to paraphrase Foucault – corresponds to a monumental, discrete aesthetic, distinct from the documentary perspective of cultural history. As functions of a process of transmission, technologically generated signals are messengers of other things; at the same time, every electronic image, every electronically (re)produced sound always also a monument to itself, to its technology and – more radically – to the computer program which created it. This amounts to media self-reference. Media technology, while clearly emerging from human / cultural knowledge, results in an autonomous entity – a process that manifests itself via the technical feedback loop (the cybernetic paradigm of machine and mathematics). The development of feedback routes – as James Clerk Maxwell's *On Governors* (1868) had already shown prior to all explicit formulations of cybernetics – increasingly separates media systems from the discursive streams of culture. Thus, automation is defined precisely by the fact that "human controls have been disabled."²¹ When the field of electronic media is accessed in terms of the electromagnetic field, this distinction places technological media in opposition to traditional culture-technical practices. To remain within the terminology of

²¹ Klaus Szameitat, *Möglichkeiten und Grenzen der Automatisierung in der Statistik*, in: *Allgemeines Statistisches Archiv* 43 (1959), 316-316). Translated by Guido Schenkel.

electromagnetism instead of cultural historiography: with media, there is only mutual induction. The discovery of electromagnetism – theoretically posited by Faraday, mathematically calculated by Maxwell and ultimately empirically proven by Hertz – overcame the search for a representation of humanity in nature, and instead defined it as a set of processes that open up a new field between physics and culture. “We must we therefore understand the knowledge of electrical phenomena and their application as an exclusive product of the human intellect.”²² By using electricity, man has surpassed nature, and not simply performed an act of organ projection. “Once it is possible to animate an automaton that is better constructed than man himself, the world has reached its ultimate purpose.”²³ The media processes that are thereby set in motion no longer exclusively belong to either nature or culture. The Greek term *nómos* already implies a departure from *physis*, from nature itself.²⁴ Faraday taught us to understand this field as a form of independent reality with an intrinsic dynamic, detached from the corporeal realm²⁵, opening up a space for temporal and spatial free play; facing techno-mathematics by its rules, it derives not from cultural history, rather from Riemann spaces, where time and space become conflated. Michelson-Morley experiment from 1887 gloriously failed to prove the existence of “ether wind”; followed by the provocative Lorentz contraction theorem: instruments of measurement expand or contract along with the ether. Although this explanation considered obsolete today, it still holds the appeal of an alternate model of conceptualizing non-historical time in what is called culture

- culture no longer operates with primary natural “media” (air, water) alone and also posits no imaginary substances (“ether”), but rather – as in the case of electromagnetic carrier waves – forms its own media channels that can be both artistically and artificially *modulated*, the combination of media produced by cultural techniques and human speech acts generates the uncanny, siren-like attraction of media technology. Precisely because “the Sirens, who were only animals [...], could sing as men sing, they made the song so strange that they gave birth in anyone who heard it to a suspicion of the inhumanity of every

²² Raphael Eduard Liesegang's Das Phototel. Beiträge zum Problem des elektrischen Fernsehens, Düsseldorf 1891, x. Liesegang refers to an entry in: Electricitäts-Zeitung No. 24 (1890). Translated by Guido Schenkel.

²³ Liesegang ebd. Translated by Guido Schenkel.

²⁴ Anm. des Herausgebers zu Buch II (§ 371b) von Platon, Der Staat (Politeia), übers. u. hg. v. Karl Vretska, Stuttgart (Reclam) 2001, 503

²⁵ Carl Friedrich von Weizsäcker, Die Einheit der Natur, München (dtv) 1974, 147

human song.”²⁶ The temporality of media transmissions induces a similar discomfort. We know that Hitchcock’s *Psycho* is a historical film document every time it airs over television channels. But in the technical moment of transmission, it is actively present (unlike a painting in a museum) as an electromagnetically-induced process that shoots through our sense of time like an electric surge. The result is cognitive dissonance: the subliminal perception of the present, but with the cognitive awareness of an alternate perspective, namely that of the past.

What happens when waves are no longer oceanic matter (as in the *Odyssey*), but rather a matter of high-frequency technology? A study launched at Berlin’s Humboldt University in April 2004 proposed to examine Homer’s siren motif from the perspective of acoustic media archaeology.²⁷ Only through the technological act of measuring can the sonic element, as the most fleeting of all cultural goods, re-enter cultural memory. But by the same token, historical recollection is de-historicized and the cultural-historical model is replaced with technical parameters of measurement. On the one hand, media archaeology is an ancillary discipline of cultural memory; yet, on the other hand, in terms of its media-epistemological focus, it is a technology capable of training the visual and acoustic senses for non-cultural objects. Technology is thus no longer an organ projection of nature. Cultural knowledge effectively results in negentropic re-configuring products of nature into technological artefacts = argument Gernot Böhme, *Natürlich Natur. Über Natur im Zeitalter ihrer technischen Reproduzierbarkeit*, Frankfurt/M. (Suhrkamp) 1992, 118; when musing about the nightingale’s song, Kant points out that, in the absence of a bird, men knew to produce such sounding exactly like nature in *dissimulatio artis* (hiding acousmatically in a bush) = Böhme 1992: 119. Once analytical media measure the frequencies of sounds, they are able to synthetically subvert the sonic difference between humans and machines; a radio broadcast of a singing nightingale results in uncertainty whether recorded in nature or synthetically produced by electronic circuitry; Eduard Rhein, *Wunder der Wellen. Rundfunk und Fernsehen dargestellt für jedermann*, Berlin (Deutscher Verlag) 1935 (4th ed. 1939). When nature itself becomes reproducible, it is

²⁶ Maurice Blanchot, *Der Gesang der Sirenen*, in: ders., *Der Gesang der Sirenen. Essays zur modernen Literatur*, München (Hanser) 1962, 9-40 (11). [„The Song of the Sirens“, in Blanchot. *The Book to Come*. Stanford U Press, 2003, transl. Charlotte Mandell, p.3]

²⁷ See W. E., *Lokaltermin Sirenen oder Der Anfang eines gewissen Gesangs in Europa*, in: Phonorama. Eine Kulturgeschichte der STIMME als Medium, ed. Brigitte Felderer, Berlin (Matthes & Seitz) 2004, 256-266

technically legible. The age of the baroque cabinets of curiosities had an impartial view on these matters. Pre-electronic cultural techniques still oriented at nature as "an infinite resource for artificial machines that surpass all human inventions" = Johann Gottlieb Sulzer, *Versuch einiger moralischer Betrachtungen über die Werke der Natur*, Berlin 1750, 39 (transl. into English by Guido Schenkel). See Horst Bredekamp, *Antikensehnsucht und Maschinenglaube*, Berlin (Wagenbach) 1993. Radio waves not unnatural (*para physin* – according to Aristotle's *Physics*), rather reproduce the secret of their own wave movement in a generative kind of *mimesis*.²⁸ Artificial nature is baroque machine culture but becomes obsolete with algorithmic computing; see Böhme 1992: 196. Media-archaeological perspective of the trans-classical machine; culture defined by creating un-natural meaning functions (Flusser); operational logic of algorithmic machines, even if 100 % product of cultural engineering, neither reproduces natural, nor subjective objects; its *artefacts* are of a techno-logical kind.²⁹ Culture has not only created epistemology, but indeed also signal-processing machines, which are - in the operative moment - then by definition dialectically autonomous from culture. Computers and communication technology do not count (with) semantic aspects; they do not view images as icons; they do not perceive music as sound; they read texts with the aesthetics of a scanner (OCR)³⁰

The Autonomisation of Culture and History: The Micro-Time of Technical Media

- autonomisation of technological processes of media temporality illustrated by the emancipation of mechanical time from astronomical time in the early modern age. Mechanical clocks were more than just that: due to the micro-mechanism of escapement they became oscillators, bringing the previously celestially-oriented time down to earth. The chronologically discrete clock, in contrast to the category of time as flow, opens up an *éclat* between cultural meaning and operative media; see Ernst Jünger, *Das Sanduhrbuch*, 2nd ed., Frankfurt/M. (Vittorio Klostermann) 1954. When Nicole d'Oresme compared the movements of the celestial bodies to the rhythms of the mechanical escapement device of a clock in *Le livre du ciel et du*

²⁸ See H. Koller, *Die Mimesis in der Antike. Nachahmung, Darstellung, Ausdruck*, Berlin 1954

²⁹ See Eggert Holling / Peter Kempin, in: *Identität, Geist und Maschine. Auf dem Weg zur technologischen Gesellschaft*, Hamburg (Rowohlt) 1989, 138

³⁰ See Claus Pias (ed.), *Kulturfreie Bilder. Erfindungen der Voraussetzungslosigkeit*, Berlin (Kulturverlag Kadmos), forthcoming

monde, he modelled nature on technical mechanisms instead of modelling technology on organic archetypes. Quartz-driven clockworks finally define time units than the natural cycles (ellipses) in astronomy³¹ the mechanical media of time measurement dictate their non-discursive internal temporality to culture and turn the observer himself into their own medium. Galileo suggested that Christiaan Huygens should not to use the human heartbeat, but rather mechanical oscillations in order to measure time. The end result is the atomic clock, which is based on the oscillations of a Caesium isotope. "Atomic clocks are so precise that they are the ones defining chronological units now, rather than celestial phenomena" = Ibid., translated by Guido Schenkel. This moment marks the emancipation of the media of measurement from nature within the medium of nature. If time is that which is measured with a clock (the Aristotelian definition of time), then that is media time. Yet the historical temporality of chronology and calendars is nothing but a scaled clock and thus becomes a function of the media of measurement. From this perspective, the category of media history is turned inside out: it becomes a temporal fold.

- autonomisation of the technological media sphere from traditional cultural techniques; detachment of *engineering* from classical *techné* by mathematization; beyond simple "extensions of man", communication engineering as complete detachment of technical constructions natural or organic modes of operation; Wolfgang Krohn, preface to: Edgar Zisel, *Die sozialen Ursprünge der neuzeitlichen Wissenschaft*, Frankfurt/M. 1976, 25. Mathematical instruments and clockworks no longer extensions of human organs, rather *organon* in the Aristotelian sense, as "machines whose operation is only guaranteed by their compliance with their own internal laws and rules that can be verified and controlled" = Serge Moscovici, *Essai sur l'histoire humaine de la nature*, Paris 1969, 220 (transl. into English by Guido Schenkel); see Eleonore Kalisch, *Konfigurationen der Renaissance. Zur Emanzipationsgeschichte der ars theatraica*, Berlin (Vistas) 2002, 194 f.

- in computational theory, algorithm = ordered progression of step-wise problem solving equals the machine itself. Even if both (logical and material) machines are 100 % a product of human knowledge, they develop an intrinsic *Eigenzeit* as media technology where the real message is not the cultural content which is processed but as well something within the non-human world. With the "escapement" in mechanical clock, periodic oscillations have become a non-human

³¹ See Rudolf Taschner, *Der Zahlen gigantische Schatten. Mathematik im Zeichen der Zeit*, Wiesbaden (Vieweg) 3rd ed. 2005, 56

processual object (emancipating from heart beat) as a function of such techno-logics

- historical discourse a narrative order of imposing symbolic "time" on spatially coexisting records (the archive); 19th century grounded concept of unidirectional time's arrow in actual physical evidence: thermodynamic theorem of entropy

- temporarily, media archaeology gets suspended from the supremacy of historical discourse, which – disguised, e. g., as a history of science, tends to absorb all of its epistemological alternatives. The premature inclusion of the analysis of technological media processes in the category of cultural studies robs it of its explosive potential. Media archaeology deals with artefacts, particularly with those that are created only in the process of technological execution

- when a radio receives a broadcast. Regardless of whether this radio is an old or a recent model, the broadcast always takes place in the present. In contrast to media history – that is, the human vantage point (Vico) – media archaeology tentatively adopts the temporal perspective of the apparatus itself – the aesthetics of micro-temporal processes. A different kind of temporality is represented here. The oscillating string of an instrument still forces its sound – and with it its (intrinsic media) temporality – upon our ears. But these ears hear different harmonies in the same sound; they are culturally predetermined; differentiation of the acoustic (physics), the sonic (cultural conditioning), and the musical (cultural semantics) = freely adapted from Peter Wicke. Does the vibrating string sound the history of being to us? Any discovery of string-based octaves always short-circuits historical time.³² This also means that the human senses do not only conform to a seemingly immediate history of being, but also to the instrumental medium itself. These instruments are products of cultural techniques; that is, of a negentropic desire, such as the repeated acoustic experiment. This, in turn, is inscribed with a "historical" index (to paraphrase Walter Benjamin), which combines with our perception into a fulgurous constellation – media time, not history, is at work here. What is the relationship between the verisimilitude of a lab experiment and the contingency of discovery? The contingencies in the success of technical discoveries defy narrative logic. The relationship cannot be plausibly described within a classical causal model of history. Oerstedt came upon the effect of electromagnetic induction rather by accident during a lecture in which the magnetic needle began to twitch in the vicinity of an electrified wire. Here, a

³² See Friedrich Kittler, *Aphrodite (Musik und Mathematik Bd. 1.1)*, Paderborn (Fink) 2006, 282

micro-temporal process forms the foundation for a media-technological event and thus produces a new form of temporality in competition to the historical event. Sparks produce waves. Heinrich Hertz, a student of Helmholtz, realized accidentally that parallel to a spark, another one forms - a remote effect of electric beams. Hertz describes this phenomenon with the very mathematical theory of electromagnetic waves which Maxwell contributed to epistemology. Maxwell arrived at the theory of light as electromagnetic waves through pure mathematics; heuristically, however, his very concrete starting point has been Faraday's experimental discovery of electro-magnetic induction. From that epistemological constellation derives the media of electromagnetic waves (television, radio, mobile phones): a realm within its own, no longer simply cultural, laws.

- category of resonance between two temporal objects merely taken from acoustics as a metaphor or is it modelled on it directly? Resonance is produced when two tuning forks oscillate in perfect harmony. The vibrations of one excited fork - even if interrupted - cause the second to vibrate as well - a kind of wireless information transfer.³³ Does something similar occur in the actual reading of a "historical" text? If it resonates in the moment of reading, it is no longer historical. Does the ear hear this type oscillating event? "What kind of reality is produced in the act of listening to a loudspeaker is a question of cognition."³⁴ From the perspective of biological computing, Heinz von Foerster describes cognition - analogous to the neurobiological category of memory - as the "calculation of reality"; results in contractions of (cultural-)historical time

How Not to Write Media History?

- media time may be written as cultural historiography but not identical to it. Media also demand another mode of representation of their occurrence in time. An ex-historian has a sense of this, even if the positive formulation of this concern remains a provisional stammer. For cultural and media history, the pressing revolution of knowledge that unsettled the Newtonian world view around 1900, in the form of the physics of Max Planck and Albert Einstein, is yet to come. When historiography is no longer viewed as the simple relationship between an object and its perception, but rather as mathematically mediated (statistics) and - in terms of a concise media archaeology - as a

³³ See Eva Küllmer, *Mitschwingende Saiten. Musikinstrumente und Resonanzsaiten*. Bonn 1986

³⁴ Martin Supper, *Elektroakustische Musik und Computermusik. Geschichte - Ästhetik - Methoden - Systeme*, Darmstadt (Wiss. Buchges.) 1997, 32. Translated by Guido Schenkel.

combination of measured object, measuring apparatus and perception, then historical time will be transformed into an observable in the sense of quantum physics. It is the act of registration (recording) that inscribes this time with an irreversibility. The act of writing – that is, the transition between the continual flow of signals and their discrete recording – thus becomes comprehensible as a strictly media-archaeological moment, based not on its semantics, but on its operative execution which induces distinction between factuality (past) and potentiality (future)

- nothing in Foucault on radio or on television or on vinyl as such, just a passage on the typewriter

- media which do not merely refer to the axis of time (time-based media), but are capable of manipulating it (time-critical media), represent a new type of temporal statements. In contrast to historiography and historical monuments, for which time is the object but just symbolically represented, technical configurations are capable of operating (as) time itself; techno-intrinsic temporality demands another kind of media philosophy of time, such as "the temporality of ergodic art" = Espen Aarseth, Aporia of Epiphany in Doom and The Speaking Clock. The Temporality of Ergodic Art, in: Marie-Laure Ryan (ed.), *Cyberspace Textuality. Computer Technology and Literary Theory*, Bloomington / Indianapolis 1999, 31-42; Aarseth does not consider it in accordance with the probability mathematics of Norbert Wiener; Frank Furtwängler, Human Practice. How the problem of ergodicity demands a re-animation of anthropological perspectives in game studies, in: *The Aesthetics of Net Literature. Writing, Reading and Playing in Programmable Media*, ed. Peter Gendolla / Jürgen Schäfer, Bielefeld (transcript) 2006. Media archaeology constitutes an attempt to account for this alternate temporality of media. The linear prediction code – developed in the context of anti-aircraft defence and fire control during World War II, but used today as a probability indicator in all aspects of life – is the model here. It represents the calculations that form the basis of Wiener's time-critical research; analogy to current micro-temporal economies – such as computer games – insofar as their operativity is equally as time-critical as it is (seemingly) infinite in its combinatorics. In essence, this question was already raised by Leibniz in his fantasy "Apokatastasis panton," an early version of Poincaré's return on the basis of the combinatorics of all letters in a library. The difference between this and the infinite, but static space of *The Library of Babel* (Jorge Luis Borges), is the coupling of this thought experiment with media-operative and thus time-critical processes.

- engagement with time-critical media processes leads to reluctance to write the modes of execution of media in time simply as media *history*.

It provides a convenient model that can be practised with ease by trained scholars of the Humanities, Cultural Studies and Media Studies. But here, as well, an epistemological turn is coming, analogous in its ambiguity and uncertainty to the one quantum physics represented for classical mechanics. Because, on the level of a technologically-induced media temporality that can neither be written as cultural nor as media history, media time has long reigned on its own terms. Again: Written as History, media history and cultural history are connected. But wherever non-preconceivable media time processes are concerned – that is, processes which themselves subvert this historical model – the past of media must be written differently, as well. It is not history, but at most the incidental nature of cultural existence as affected by the temporal modes of technology. It holds true, in allusion to a concept from Heidegger's "Kehre" (turn), that no historical existence (*Dasein*) could have invented the radio, but that – conversely – technological media, such as the radio, determine historical ways of being (*dazusein*). In contrast to Heidegger, however, media archaeology tentatively shrugs off the confines of the historical; not for the sake of a postmodern questioning of temporal processes as such, but in order to approach them from the vantage point of the media operations themselves, rather than allowing itself to be entrapped by musings on origins and metaphysics. Let us try for a moment to suspend the voluntary self-restriction of the human temporal horizon by means of the category of history. In this way, the face of the historical human does not disappear like a figure on the beach in the breaking waves, but rather like the sand in an hourglass

Techno-culture studies and/or "cultural techniques"

- German term *Kulturtechniken* names practices like agriculture, mathematical symbol calculation or body movement such as rhythmic; dancing a kind of automatization or extension of the human; Kapp's notion of 1877 "organ projections"; these practices still essentially depend on the human body or mind to be *performed* - different from truly automated processes which are *operated* by (and inbetween) machines

"Left" vs. "Right Hegelians"

- Bernhard Siegert, *Cultural Techniques. Grids, Filters, Doors, and Other Articulations of the Real*, transl. by Geoffrey Winthrop-Young, New York (Fordham University Press) 2015

- split into "left-Kittlerians" and "right-Kittlerians"; "Sybille Krämer's and

Bernhard Siegert's explorations of 'cultural techniques' expand notions of the kinds of operation that might constitute mediality, which allows the human to reenter the discussion. One cornerstone of "cultural techniques" is an ontological reversal whereby activities such as counting *precede* the associated concepts such as number, normally thought to come first" = Winthrop-Young, Geoffrey, Cultural Techniques: Preliminary Remarks, in: Theory, Culture and Society 30, no. 6 (2013): 3-19 (15)

- door as cultural technique media-epistemologically differs from circuit switching / Thyatron vacuum tube: "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" = Paul Virilio, The Overexposed City, in: Zone 1-2 (1986), 545

- Guidonian hand as the embodiment of a long-standing cultural technique = Horst Wenzel, Von der Gotteshand zum Datenhandschuh: zur Medialität des Begreifens, in: Krämer / Bredekamp (eds.), Bild—Schrift—Zahl, xxx, 25-56

- "Kittler's media became practices in the hands of the proponents of cultural techniques, whereas the media archaeologists homed in on object-centered epistemologies. [...] From a media-theoretical perspective, the question of whether sounds are stored in the magnetic charges of a cassette tape, binary code, a music box, or indeed the muscle memory of a pianist is of central significance. Media archaeology argues that the medium is not merely a vehicle that is somehow external to music but is rather inextricably connected with it: the sounds exist only in and by virtue of the medium. And the study of cultural techniques explores seemingly mundane activities - pointing, flattening, grid-making - from the perspective of their medial import. According to either of these approaches, textual, analog, and digital forms of inscription constitute entirely different worlds" = Alexander Rehding, Introduction, in: Journal of the American Musicological Society, vol. 70 No. 1, Spring 2017, thematic issue "Discrete / Continuous: Music and Media Theory after Kittler", 221-256; <http://jams.ucpress.edu/content/70/1/221>

THE TECHNOLOGICAL LIBERATION FROM THE HAND

Gaming with the Pin Ball machine

- "liberation" of the painterly hand by photography (Henry Fox Talbot,

Pencil of Nature, 1844)

- just as human hand is coupled (in the cybernetic sense) to the Pin Ball game machine as known from public houses, as described in a typescript entitled "Flipper" by Friedrich Kittler from the 1960s or 70s which immediately anticipates the first generation of computer games (in the sense of Pias 2002); published in Kittler, Bagersee (2015)

- "Wenn der Mensch nur dort ganz Mensch ist, wo er spielt, so wird auch er, wenn sein Mitspieler Automat ist, zum Unmenschen" (Kittler ibid.); counts for the temporal realm as well; when discretely (not analog / diagrammatically) calculating either in his mind or coupled to pen / square paper, man is in (Turing-)Machine state (Lacan)

- "attack" in the keys of the electronic synthesizer; "Spiele, die ins rasche Reagieren einübten" (Kittler), since 19th century table tennis (finally resulting in "Tennis for two" game on analog computer)

- Wilhelm Wundt's psycho-physical laboratory established at Leipzig University (to be continued by Hugo Münsterberg in the Harvard Lab version later)

- challenge in anti-aircraft prediction in World War II from the point of view of the artillery, as confronted by Norbert Wiener - explicitly giving rise to *Cybernetics* itself (Wiener 1948, Introduction) - and by Claude Shannon in a different approach separating the physical laws of the machine (airplane) from the idiosyncratic (counter-)reactions of the human pilot.

- human Pin Ball machine player with his hand(s) as interface to the automaton has to adapt to the tempor(e)ality of the machine; the equivalent to tactics in the temporal field is time-criticality; that moment, he turns into a cyborg, a true cybernetic organism: part of a closed circuit (German *Regelkreis*) in terms of systems theory, becoming nothing more or less than one (analog) element within a system circuitry

- intransitive automatic regulation (literally: "cybernetics", government) replaces manual transitive control; even the gesture of directing a cup of tea to the lips (in Wiener's example, 1948), in close motion-tracking analysis, is revealed as an ongoing, in the worst case oscillating (tremor) feed-back between the motoric and the visual.

- function of the Serbian and Bosnian one-string instrument *gusle* in the oral poetry. They are not meant primarily to entertain the audience but they serve as servo-motoric feedback for the poet in the

performance and re-generation of "formulaic" (Milman Parry), thus: rhythmicized epic songs.

"Hands-on-time": time axis manipulation

- notion of hand-based instrument control extends to the term time-axis-"manipulation" as well (as known from cinematographic operations like the film cut and slow or fast motion).

- "Thumb movies" (German "Daumenkino") produces the cinematographic effect of movement by hand; hand-driven phonograph / gramophone

- ears as (supplementary) "time sense" organ in human perception much more time-critically sensitive to variances in speed resp. frequency of acoustic waves ("music", sound) than in the reproduction (and transmission) visual movement

- Talbot points out the non-human temporal efficiency of the photographic shot in *The Pencil of Nature* (referring to plate III „Articles of China“), that "the whole cabinet of a Virtuoso and collector of old China might be depicted on paper in little more time than it would take him to make a written inventory describing it in the usual way. The more strange and fantastic the forms of his old teapots, the more advantage in having their pictures given instead of their descriptions."

The phantasm of self-recording nature

- *Kymograph* as self-writing nature ("Selbstschreiber"); deriving from that: phonographic cylinder which is not score notation of musical performances by the human hand but immediate acoustic recording. But academic culture lags behind; see Bela Bartok's manual transcription of Hungarian folk song recordings

- coupling human hand - tool vs. alphabetical writing: symbolic notation. In music: score notation = without "hand on instruments", vs. instrumental play = Jens Gerrit Papenburg, *Der Synthesizer als Apriori. Körper und Maschinen in der Popmusik*, in: *Paragrana* 14 (2005) 2, 91-104 (94)

TECHNOLOGIES OF TRANSMISSION: BETWEEN SYMBOLIC AND MATERIAL (MICRO-)TRADITION

Re-thinking "historicity"

- resisting a reductive, linear narrative of technologies of tradition which would start in the past and result in the present condition ("from materiality to the virtual"), the media archaeological point of view is intended to analyze both the material (entropic) forms of cultural tradition and the immaterial, almost time-invariant codes of transmission (the physical and the symbolical mode, material embodiment and logical implementations), elaborating on the shift from archaeological materialities as cultural premise to technomathematics as the new form of enculturation.

- Martin Heidegger's differentiation between "historisch" - in the vulgar sense - and "Geschichtlichkeit" as (trans-)mission of being itself

- radical materialism as provocation to the historical discourse itself

- according to Harold Innis, inherent (endotemporal) to the material properties of a (culture-)technical medium are spatical and temporal determinations which are interrelated to modes of executing power.³⁵

Tradition: Transmission across space / storage over time

- "JavaSoft put it this way: 'Objects over space = a distribution, objects over time = persistence'" <Gelernter ibid.>. Both modes are extreme formulations of one and the same "tradition"

- using the term "transmission" instead of "cultural transfer" (which always implies a causal relationship, a traceable chain of the channels whereby cultural goods as materialities or cultural knowledge as information has been negotiated between cultures) a technological co-significance comes into play which has arisen with the epistemology of electric and electronic media since 19th century telegraphy: the idea of "wireless", that is: immaterial transmission of signals. Whereas this corresponds with the sender-receiver model in communication engineering, an alternative option is ["gleichursprüngliche"] co-emergence of structurally similar technologies without direct exchange of knowledge, according to the principle of the communicating tubes

³⁵ See Bernhard Siegert, Von der Unmöglichkeit, Mediengeschichte zu schreiben, in: Ofak / von Hilgers (eds.), xxx, 2010, 157-177 (174), referring to: Harold A. Innis, Das Problem des Raumes, in: ders., Kreuzwege der Kommunikation. Ausgewählte Texte, ed. Karlheinz Barck, Vienna / New York 1997, 147-181

(and resonance) - such as the development of printing with moveable type in Korea already before (and independent of) the Gutenberg press, or principles of the wheel-driven clock as developed in China before late-medieval European monasteries.

- knowledge transfer dependend on the receiver to resonate with its carrier frequencies - both as reason and as resonance (frequencies and oscillations).³⁶ Aby Warburg in his concept for an atlas of visual gestures in occidental cultural history refers to sub-cultural memes, somewhat replacing the notion of diachronic tradition by the notion of transmission between sender and receiver (tuned to each other by the [Schwingkreis])³⁷ - a model rather derived from the engineering of wireless communication than from historical hermeneutics.

- electromagnetic spectrum made up of many kinds of waves "and there is litte space for new mass communication media"³⁸; so-called *cognitive radio* (time hopping, frequency hopping) is the answer to this economic filter

- Harold A. Innis, in *Empire and Communications* (1950) differentiating between space- and time-accentuating forms of message transmission, depending on the materialities (if not "media") of communication

Lossless tradition?

- a symbolical (code level), time-invariant and an entropical, temporally decaying ("historical") physical real(ity) of the archive. As example for symbolical tradition, see the transmission of Euklid's *Elementa* from Greek antiquity to the European Renaissance *via* Arabic translation (intermediation). Here, the very name (the medium) is the message: *Elementa* is the name for letters (the ancient Greek alphabet) and numbers, which serve as the concrete symbolic medium of transmission.³⁹

- Different from the legal record which is meant to last, the quick notice on a random access data carrier (starting with the ancient wax tablet) fulfills its function as intermediary storage

³⁶ Siehe Veit Erlmann, *Reason and Resonance. A History of Modern Aurality*, New York (Zone Books) 2010

³⁷

³⁸ 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)

³⁹ See Michel Serres, *Elemente <einer Geschichte der Wissenschaft>*, xxx 1995, 306f

- an example of "direct recording" is: the immediate engraving of phono discs in the 1930s and 1940s: recordings used not for long-term storage but for short-term delayed re-play in broadcasting across temporal zones or on different program places, as long as magnetic tapes were not yet available <Schüller 1994: 29>. Their function was fulfilled with as intermediary storage - just like the intermediary film with washable emulsions on celluloid in early television transmission of out-door events by daylight; emphatic tradition here is replaced by delayed transfer. It would be a misunderstanding to categorize them under storage media; they were rather intermedia in the temporal sense (the time channel). The more informative they are when, by accident, they were not effaced but frozen over time, to be discovered in the present. Their information value (according to Shannon's communication theory) is reciprocal to their (non-)intention as "historical" records.

- In cultural historiography, similar technologies or mathematics in spatially or temporally distant cultures (such as China and Europe) are supposed to result from direct knowledge transmission; contrasting model: co-originary; Gabriel Tarde *Lois de l'imitation*

- frontispice to Lafitau's *Moeurs des sauvages Américains* (FO 1724) allegorises "<...> the encounter of writing and time in a closed space littered with "vestiges" coming from both Classical Antiquity and the New World. One holds the pen, the other the scythe, <...> which approach each other without ever touching, asymptotically. History deals with relics which can be seen, and seeks to supply explanations; ancient *things* which have become mute <archaeologically> through the degradation owing to time may to some extent become clearer if we invoke *customs* observed among contemporary savages. This operation needs a locus, which in the eighteenth century is the collection: a technique, which is that of comparison <...> and an author, an historian. <...> This 'Schreberian passion' of Lafitau <...> betrays the desire to fill all lacunae and generate a new order on the ruins of the paternal tradition" = Annette Lavers (reviewer), on: Michel de Certeau, Writing versus Time, in: Rethinking History, ed. M.-R. Logan / J. F. Logan, New Haven: Yale French Studies 59 (1980), in: History and Theory XXII, 3 / 1985, here: 330 f.

- Michel de Certeau enhancing his reading by drawing the configuration of Chronos and Clio abstracted to a diagram where the supposed prologued lines of the curved scythe and the linear pen become vectors. Directly deciphered in terms of mathematics, the pen-line (as x-axis, the abscisse) becomes the asymptote of the scythe as hyperbel (on the y-axis). There is no point where the function touches or traverses the x axis itself: no convergence between material

("historic") and symbolic ("historiographical") phenomena of time.

The allegorical figure of Chronos is equipped with the destructive scythe and embodies the physical reality of historical time which is entropical decay. The asymmetrically other aspect of historiography is embodied by the female allegory of Clio who records chronological events in the rather time-invariant symbols of writing.

The allegorical figure of Chronos is endowed with the scythe indicating devastation with time - in fact "noise" which happens in the temporal channel of transmission (to rephrase it in terms known from transmission engineering); such material loss of information is compensated by the female allegory of Clio "writing" history: copying of symbolic letters is almost lossless, replacing tradition. The loss though takes place at the moment when real matter or energy is symbolically filtered, that is: compressed.

Compressed time results when digital imagery is being transmitted in compression algorithms as defined by The Moving Picture Expert Group (MPEG-4) standard for streaming digital video, whether recorded - from the archive - or in "live" transmission; here the challenge is the separation of the intended signal from arbitrary noise by means of a *wave filter*: "Here, we have a message which has somehow become scrambled with another, unwanted message which we call noise. The problem of unscrambling these and restoring the original message with as little alteration as possible, except perhaps for a lag in time, is the problem of filtering."⁴⁰

"Writing vs. Time" (Lafitau, Mengs)

Anton Raphael Mengs' painting *Allegory of History* (1772/73) on the ceiling of the *Stanza dei Papiri* which links the Vatican Library with the Vatican Museums topologically and thematically represents the dichotomy between material and symbolical objects and records of cultural transmission: physical entropy *versus* symbolical (ahistorical) invariance. In the painting figures a *genius* transferring papyrus rolls to the personification of history (Clio), in fact performing *the archival* act; double sense of the archival "act" referring both to the logistical operation and the material record: Cornelia Vismann, Acts; rescuing physically endangered records from the past by transcription into

⁴⁰ Norbert Wiener, Time, Communication, and the Nervous System, in: *Annals of the New York Academy of Sciences*, Bd. 50, 1948/50, 197-219 (205)

symbolic historiography; operation of transcoding: "Das Herbeitragen der Rotuli versinnbildlicht das Sammeln, Aufbewahren und Auswerten der Papyri, die, der Zerstörungsmacht der Zeit entrissen, nun der Dauerhaftigkeit der Geschichte überantwortet werden": Steffi Röttgen, Das Papyruskabinett von Mengs in der Biblioteca Vaticana. Ein Beitrag zur Idee und Geschichte des Museo Pio-Clementino, in: Münchener Jahrbuch der bildenden Kunst 31 (1980), 189-246 (212); material record from the past (subject to entropy) thus translated into (negentropic) information, well known from the current massive digitization of, f. e., early sound recordings in the phonogramm archives of Vienna and Berlin - a chrono-economical exchange between the real and the symbolic, between aging and permanence.

As allegorically demonstrated in the genius delivering ancient documents, once a worldly event is coded into a textual record (an ancient papyrus roll or a medieval parchment), it becomes "der Zerstörungsmacht der Zeit entrissen, nun der Dauerhaftigkeit der Geschichte überantwortet"⁴¹, thus demonstrating the authority claim of the Roman church which is based on long-time tradition.

"[H]istory, in its traditional form, undertook to 'memorise' the *monuments* of the past, transform them into *documents*, and lend speech to those traces which, in themselves, are / often not verbal, or which say in silence something other than what they actually say; in our time, history is that which transforms *documents into monuments*. In that area where, in the past, history deciphered the traces left by men, it now deploys a mass of elements that have to be grouped, made relevant, placed in relation to one another to form totalities. There was a time when archaeology, as a discipline devoted to silent monuments, inert traces, objects without context, and things left by the past, aspired to the condition of history, and attained meaning only through the restitution of a historical discourse; it might be said, to play on words a little, that in our time history aspires to the condition of archaeology, to the intrinsic description of the monument."⁴²

On the borderline between history and archaeology, it is not clear what Clio performs in the museum: does she write or register?

- subject of the Stanza dei Papiri - both in its archaeological content and its painted allegory - are the cultural technologies of transmission

⁴¹ Steffi Röttgen, Das Papyruskabinett von Mengs in der Biblioteca Vaticana. Ein Beitrag zur Idee und Geschichte des Museo Pio-Clementino, in: Münchener Jahrbuch der bildenden Kunst 31 (1980), 189-246 (212)

⁴² Michel Foucault, *Archaeology of Knowledge*, transl. A. M. Sheridan Smith [*1972], London / New York (Routledge Classics) 2002, "Introduction", 3-19 (7 f.)

in time in their various forms: "Die historische Überlieferung in ihren verschiedenen möglichen Formen ist das Thema, unter dem sich nahezu alle Darstellungen unter der Decke des Papyruskabinetts, einschließlich der Zeugnisse, die in diesem Raum aufbewahrt wurden, vereinigen lassen." Steffi Röttgen, "Das Papyruskabinett von Mengs in der Biblioteca Vaticana. Ein Beitrag zur Idee und Geschichte des Museo Pio-Clementino", in: Münchener Jahrbuch der bildenden Kunst 31, 1980, 189-246 (211)

- Harold Innis expressed his critique of chrono-logical history where sequential counting of years suggests a progressive *raconter* (narrative) of history. "Significance of decimal system on history - fingers and toes - overemphasize role of centuries and of chronology, and neglect of spatial factors" <Innis 1946, Idea File>, and in another variation: "Use of centuries - fingers and toes - distortion of history" = Harold A. Innis 1947/48, Idea File; decimal fingers have been replaced by the binary code which can be algorithmically addressed, thereby creating a "writing" of times past which is rather characterized by non-linear jumps and loops than by linear story-lines

- archival materialism *versus* streaming electrons; emphatic transmission over time ("tradition") based on the archive. On the other hand, electronic "live" media (transmission across space), by definition (and essentially) are rather memoryless

- Ernst Kantorowicz's study on *The King's two Bodies*; memory records provide of two bodies as well. This is still true for digital media - though in a different way

- transformation of an epistemological dimension: the transformation of the classical, datacarrier-based, material storage-"archive" into an "e-motional" archive in electronic motion, in electromagnetic ephemerality and latency; gain of flexibility and computability paid with a loss of durability

When recently the Cologne Municipal Archive materially collapsed, it became apparent that most records, though being dirty and mutilated, materially survived this catastrophe, astonishingly resistable against the pressure of stones. In a similar way the first-generation ("analogue") audiovisual storage media turned out to be surprisingly resistant against temporal entropy (like the Edison-cylinder and gramophone records, as well as daguerreotypes, photographic negatives and film on celluloid). More delicate is the destiny of cultural memory based on electromagnetic storage; digital media, finally, tend to divest themselves completely from their material embedding - losing the "touch ground" by getting technically "virtual".

- "Bias" originally is a technical term in electronic engineering describing the necessary voltage polarization to operate a vacuum tube (esp. triode) - a literally pre-conditioning, a ground tension, an electric *a priori*. For magnetic recording, the "bias" names the pre-magnetization of the tape by high frequency signals to ameliorate the signal-to-noise ratio (dynamics). Traditional physical storage media, whether spatially or temporally "biased" as described by Harold Innis, have been orientated towards being literally inscribed (*graphein* in its old Greek sense): "There must be a writing means by which the information to be stored is introduced into the device"⁴³; against this latent storage devices (such as magnetic tape for audio and video) only reveal their memory content in the dynamics of the electro-magnetic field (thus rather "induced" than "introduced" in the traditional way of writing power and violence). Electrotechnical storage media have take place in a sphere which is different from the scriptural regime of the classical archive - a regime which, on the level of alpha-numeric codes, unexpectedly returns in techno-mathematical machines. This re-turn is a temporal figure which cannot be reduced to the linearity of media history; as a Möbius loop, we are confronted rather with a media-archaeological configuration (or better: contemporalization).

- two complementary approaches to the conservation of analogue memory carriers. The one cares for preserving the physical, especially chemical and electro-magnetic properties of the concrete media body - since all media technologies are hardware in the first place. The other, sometimes opposing approach is to preserve media-based memory as information, up to the extreme point of view that the material body might be abolished after its essential transformation into its pure binary information units.

But to which degree does the archival authority of an archival record still depend in its material physical embodiment? Is it no longer important by which carrier one generation passes on its information to the next? "We no longer collect the carriers, clay tablets, books or floppies, just the information" = Tjebbe van Tijen, We no longer collect the Carrier but the Information, interviewed by Geert Lovink, in: MediaMatic 8#1

- for signal-based medium in the technical sense, photography, in 1859 Oliver Wendell Holmes pointed to the fact that this symbolic trade of media and material was introduced by photography: "From now on,

⁴³ Ira M. Sage, Making Machines Remember, in: Product Engineering, Bd. XXIV (April 1953), 141-149 (141)

form is separated from material. In fact, the material in visible objects is no longer of great use, except when being used as a model from which the form is constituted. Give us a couple of negatives of an object worth seeing ... that's all we need. Then tear the object down or set it on fire if you will ... the result of this development will be such a massive collection of forms that it will have to be arranged into categories and placed in great libraries" = Quoted from: Wolfgang Kemp, *Theorie der Fotografie I (1839-1912)*, Munich, 1980, 121

- once continuous signals mechanically engraved (phonograph) or magnetically embedded (magnetophon, videotape) on material carrier has been transformed ("sampled") into digital pulses, transsubstantiation into "immaterial" information; can be (virtually lossless) "migrated" from one storage computing system to another

- permanence and archival endurance not achieved in the traditional way any more (which has been monumental fixation, *stasis* so far), but by dynamic refreshing

- "When two separate programs (or people) communicate, information passes through space. When a program stores data in a file (or a person saves a notebook in a desk drawer), the intention is to pass information through *time*" = David Gelernter, *Machine Beauty. Elegance and the Heart of Technology*, New York (Basic Books) 1997, 100

Material entropy

- no zero-entropy

- extending the notion of "media materialism" from a neo-Marxist to a physical meaning: Magnetic tape in audio-visual archives are a fragile medium; the "Vinegar Syndrome" (the chemical desintegration of the carrier material) can not be counter-chemically stopped, just slowed down. On the other hand, the very structure of the containing archive is negentropic: a symbolic order. Both converge in so-called "digitization", wenn no longer the media carrier in its physical entropy counts, but the content (signal) as information, stored in the symbolic (binary) code; micro-chemical analysis of such "endangered" material by, e. g., Fourier Transform Spectrography, is a very close, truly media-archaeological reading of such archival media materialities. Such micro-technologies are at work in what discourse emphatically calls "tradition" / "cultural heritage"

- the notion of "the material" becomes dynamic itself (Jussi Parikka,

Media Ecologies) - as identified by Henri Bergson (and re-interpreted by Maurizio Lazzarato in his *Videophilosophie*)

- material media with their individual entropy, characteristic probabilities of physical endurance - *Eigenzeit*. The physical media differ from the software-based media by embodying fundamentally different temporal regimes

- physically real temporality subject to macro-temporal entropy - the material deterioration of Edison cylinders and magnetic tapes. Digitized signals at first sight resemble the tradition of music notation, but are endowed with operational activity; they are algorithmically executable. Symbolic archival permanence is almost time-invariant, sublated from change with time, leading to ahistorical immediacy in the moment of re-play. Bartok commented the media memory conditions of the phonographic recordings of oral poetry made by Parry: "The records are mechanically fairly good <...> . Aluminum disks were used; this material is very durable so that one may play back the records heaven knows how often, without the slightest deterioration. Sometimes the tracks are too shallow, but copies can be made in almost limitless numbers."

Electronics makes a difference

- May 2011 two Black Boxes could finally be rescued from the ground of the Atlantic sea two years after the Air France aeroplane crash: the data recorder and the voice recorder keeping the last words of the pilots in the cockpit but as well the background noises which retrospectively signal the unfolding disaster. The recordings proved to be miraculously intact. Both data recorders consist of memory chips which keep their magnetic charge, different from mechanically vulnerable previous recording media. Whereas mechanical records still represent the culturally familiar form of physical impression (writing), electro-magnetic latency is a different, sublime, uncanny form of invisible, non-haptic memory. The voices and sounds emanating from such a black box are radically bodiless, being in a different time than the familiar historio-graphical time.

With a micro-physical *close reading* (or rather *listening* as "understanding") of sound, the materiality of the recording medium itself becomes poetical⁴⁴. Instead of musicological hermeneutics, the

⁴⁴ Karl Sierek, Die weiße Leinwand, in: idem., Aus der Bildhaft. Filmanalyse als Kinoästhetik, Vienna (Sonderzuahl) 1993, 115-130 (122), referring to: Umberto Eco, Semiotik, 263f

media-archaeological gaze (or rather: ear) is required here (very materially).

- sound recording not simply unfolds as evolutionary course of technology in history, but the phonographic record on the one hand, the magnetic record on tape on the other, and finally the digital recording represent fundamentally different materialities and logics (techo/logies) in terms of their ways of registering time-variant signals, time-based forms of reproduction and their "archival" being in time. The electronic tube, especially the triode, once liberated technical media from mechanical constraints, thus: from erasure over time; still the tube or transistor are subject to decay over time themselves.

Magnetic tape - different from mechanical records of acoustic waves - is less vulnerable to material abrasure; still, the material gramophonic groove promises much phono-archival endurance

The difference between mechanical and electro-magnetic audio recording is not just a technical, but as well an epistemological one. While the phonograph belongs to what Jules-Étienne Marey once called the "graphical method" (analog registering of signals by curves), the magnetophone is based upon the electro-magnetic field which represents a completely different type of recording, in fact a true "medium". What used to be invasive writing has been substituted by electronic recording; writing now re-returns as digital encoding in different qualities. Sampling and quantizing of acoustic signals transforms the time signal into frequencies as analysis and as a condition for re-synthesis: Fourier analysis and Fourier synthesis. Media culture turns from phonocentrism to mathematics

Archaeology *versus* history

- opposed to figurative, narrative (hi)story-telling, modular processing of past data concentrates on antiquarian modes of "archaeographical" representation under the auspices of digital computing techniques; René Ginouvès / Anne-Marie Guimer-Sorbets, *La Constitution des Données en archéologie classique. Recherches et expériences en vue de la préparation de bases de données*, Paris (Éditions du CNRS) 1978

- historiograms instead of historiography: instead of being governed by the apparently seamless logics of an unbroken literary, discursive text, figured and effected by rhetorical moves and dramatic emplotment, modular writing is governed by the non-discursive, diagrammatic logistics of vector fields

- "Archaeological *data* consists of recorded observations. These might

be measurements [...], the stratigraphical relationship between two layers or the geographical location of a site. Whilst archaeological data is frequently numeric, it can equally well be non-numeric, such as the name of the material or colour of an object. It also comprises visual data, such as photographs, plans or maps. Data *processing* is the name given to the manipulation of data to produce a more useful form, which we shall call *information*. <...> The sequence of operations required to perform a specific task is known as an *algorithm*" = J. D. Richards / N. S. Ryan (eds.), *Data Processing in Archaeology*, Cambridge U. P. 1985, 1f

- archaeology as close to the sciences as it is (usually) to the "humanities"; now Digital Humanities

Franz Georg Maier quotes pre-historical archaeologist O. G. S. Crawford about archaeology as a form of art which uses scientific methods = idem, *Neue Wege in die alte Welt. Methoden der modernen Archäologie*, Hamburg (Hoffmann und Campe) 1977, 27

- Riederer / von Rohr (eds.) 1973: *Kunst unter Mikroskop und Sonde. Naturwissenschaftliche Untersuchungen an kulturhistorischen Objekten*

- Maier calls the new technological methods in archaeology a second "pioneer age" in archaeology - in fact from the material (digging / material excavation) to the data-processing epistemology <Maier 1977: 27>.

- contributors to a publication by F. R. Hodson / D. G. Kendall / P. Tautu (eds.) *Mathematics in the Archaeological and Historical Sciences* (Edinburgh / Chicago: Edinburgh University Press / Aldine Atherton, 1971) point out that the statistical methods, quantification and computer processing of data does not relieve the technically registered data from the need to be interpreted but human evaluation. Mathematics can - in a circular argument reminiscent of Alan Turing's statement on "computable numbers" (1936/37) - only be helpful in sharpening aspects of analysis which *can* be made pure mathematical (Kendall), not establishing certainty but reducing the level of uncertainty <front flap>.

- structural affinity between archaeology as material-orientated science (as opposed to philology - as long as its hermeneutic method is not being replaced by statistical analysis⁴⁵) and computing, in a

⁴⁵ See Liliana I. Boneva, A new approach to a problem of chronological seriation associated with the works of Plato, in: Hodson et al. (eds.) 1971, 173-186

auxiliary and a methodological sense. Inbetween the material monument and the philological text record stands the inscription.⁴⁶ Furthermore, the practice of constructing genealogical filiation of manuscript tradition in the diagrammatic form of *stemma* applies a mathematical method; monks copying an ancient manuscript for tradition "made mistakes, either involuntary (carelessness) or voluntary (the desire to correct the source)" = Sorin Cristian Nita, Establishing the linkage of different variants of a Romanian chronicle, in: *ibid.*, 401- 410 (402)

- distinguish "*descriptive 'archaeography'*" of material findings "from more *interpretative archaeology* in a narrower sense"⁴⁷

- Anthony Grafton, *Bring out your dead. The past as revelation*, 2001, 338 (notes to pp.193-196), note 63: "*Jacques Spon, Recherches curieuses d'antiquite*, Lyons 1683, Preface, sig. a3r: '*Archaeographia est declaratio sive notitia antiquorum monumentorum*'"

- not by coincidence one of the first sciences in the humanities department applying machine computation has been archaeology; publication by J. D. Richards / N. S. Ryan, *Data Processing in Archaeology* (Cambridge / New York / Melbourne: Cambridge University Press, 1985). At the same time, data processing as archaeology (for that reason the book mentioned is, for its most part, an introduction into computer programming). Media archaeology is not just a way of remembering "dead media", but rather a mathematical aesthetics; modelling, statistics and especially cluster analysis (e. g. for the distribution of objects in a grave field) one the fields where archaeology made use of data processing with electronic computers

- mathematization of archaeology: "In my view the contribution of IT and statistical techniques have a central role to play in supporting archaeological interpretation. The archaeological judgment must take precedence yet making that judgment is frequently not straightforward. Even the beneficial contribution of such 'hard' science such as radio carbon determinations of date or ground penetrating radar to archaeological interpretation, rely on operators having a close empathy with archaeological material, the context of discovery and the role of post-depositional processes. If the post-processional reaction to the scientific inductivism of the 'New archaeology' of the 1960's shows us anything it is that we need to be aware of the contexts in which we may apply our tools, be they computers or trowels" = Peter Rauxloh, Information Strategy Manager, Museum of London, e-mail July 2002

⁴⁶ See Alexandra Stefan, Applications of mathematical methods to epigraphy, in: *ibid.*, 267-275

⁴⁷ C. A. Moberg, Archaeological context and mathematical methods, in: *ibid.*, 551-562 (533)

- avantgarde among academic disciplines (within "Humanities") to apply electronic computing has been Archaeology, not by chance but reveals as structural affinity. Archaeology, esp. (appropriately so-called) pre-historisch archaeology, deals with pure (material) data, no narratives (textual tradition) like classics (Greek and Roman philology). In many ways, archaeology is close to mathematics. Epistemologically, this becomes clear with Michel Foucault's propositional *archéologie* = Martin Kusch, xxx

- mathematical methods (like stochastics in "cluster analysis" of graveyards, f. e.) are being applied in archaeology:

J. D. Richards / N. S. Ryan, *Data Processing in Archaeology*, Cambridge / New York / Melbourne (Cambridge University Press) 1985

Message or noise?

Claude Shannon's mathematical theory of communication (1948/49) which concentrates on media channels bridging spatial distance can be extended to the mechanism of emphatic cultural tradition

- "We may assume the received signal E to be a function of the transmitted signal S and a second variable, the noise N . <...> The noise is considered to be a chance variable just as the message <...>. In general it may be represented by a suitable stochastic process".⁴⁸

What historians hermeneutically term probability of tradition, as *Überlieferungs-Chance* (Arbold Esch), can be mathematically expressed more exactly: $E = f(S, N)$. Let us add the temporal dimension which might be considered a channel of communication ("merely the medium" in Shannon's terms) with all its noise: $E = f(S, N, t)$. The time axis is the diachronic Dimension for the transmission of encoded signals; such a technically informed semiology cannot distinguish meaningful chance from random events (accidents, noise) <see Thompson 1981: 95>.

- Claude Shannon's analysis of techno-mathematical enemy aircraft movement anticipation, where the human factor (the pilot's intentional manoeuvres) is superseded and limited (corrupted) by the mechanical behaviour of the airplane and other physical parameters⁴⁹

⁴⁸ Claude E. Shannon, *The Mathematical Theory of Communication* [1948], in: ders. / Warren Weaver 1963: 29-125 (65)

⁴⁹ See Axel Roch / Bernhard Siegert, xxx, in: Schade / Tholen (eds.), xxx

Norbert Wiener developed his applied time series analysis in the context of tactical *anti-aircraft prediction*. In this model the real die position of the enemy airplane at the temporal moment t is considered the "message", whereas registered deviations represent "noise".⁵⁰ Wiener's biographer Masani formulated right at the beginning of his book the problem of biographies in the very same notion of *signal-to-noise ratio*:

The basic proposition of cybernetics that signal = message + noise, and that the message, and not the noise, is the sensible term in communication, is applicable in all sorts of contexts <...>. Wiener is the signal, and for us the Wiener-message, and not the Wiener-noise, must be of significance. <ebd., 19>.

Analog and digital communication, based on continuous signals or discreet symbols like telephone talks and archival lectures 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" = Norbert Wiener, 1942, *The Extrapolation, Interpolation und Smoothing of Stationary Time Series with Engineering Application*, Typoskript datiert auf den 1. Februar 1942, 3: National Archives and Records Administration, Record Group 227 (Office of Scientific Research and Development), College Park, Maryland (USA), MFR, DIV.7-313.1-M2. Siehe Roch 2009: Kapitel 2.4 "Statistik gegen Geometrie", 61 ff.

Towards a mathematical theory of archival memory communication

- archival transmission already implying an intentional act, an addressing of posterity to which the historian (researching in the archive) places himself as the receiver. The term sending, here, is not "destiny" in a metaphysical sense but a concrete act of posting as an act of engineering. In a different, rather co-originary way, Benjamin defined the "historical index" when images from the past are provided

⁵⁰ P. R. Masani, *Norbert Wiener 1894-1964*, Basel / Boston / Berlin (Birkhäuser) 1990, 186

with an implicit time code: "For the historic index of the images doesn't simply say that they belong to a specific time, it says above all that they only enter into legibility [Lesbarkeit] at a specific time. And indeed this entering into legibility constitutes a specific critical point of the movement inside them. Every present is determined by those images that are synchronic with it: every Now is the Now of a specific recognizability [Erkennbarkeit]" = Walter Benjamin, *Konvolut N*, in: *Gesammelte Schriften* vol. V.1 (Das Passagen-Werk) N 2a, 6, 577, quoted after Christopher Fynsk, *The Claims of History*, in: *diacritics* Bd. 22 (1992), 115-126 (116). Thereby "[t]he address of the past in all its power *will have been* if it is read by the present that it enables; if it is not, it disappears without a trace. [...] translatability, after all, comes about only in time and for a time, and translation is not a mere transcription."⁵¹

Intended for tradition, records from the past are endowed with addresses (to posterity) which implies a (virtual) notion of the organizational archive already, as opposed to random transmission of past remnants (noise rather than message).

In antiquity, Ptolemy's *Geography* developed a model for lossless, negentropic tradition by means of coding the image (that is: informatisation). Ptolemy faced to risk of errors in manual copying of charts by radical digitization:

- "Technisch lassen sich Impulse trotz Verzerrung oder Rauschen im Kanal relativ einfach detektieren, filtern und regenerieren" = Roch 2009: 102 - by application of the *repeater-regenerator*, a medium of quasi-invariant transmission. Binary information here beats the traditional entropic parameters of "historiographical" tradition: "By using binary (on-off) PCM, a high quality signal can be obtained under condition of noise and interference so bad that it is just possible to recognize the presence of each pulse <...> almost independent of the total length of the system" = *ibid.*, 154

- noise in the transmission channel is replaced by noise on the signifying level: "signal-to-noise ratio in PCM systems is set by the quantizing noise alone" = *ibid.*, 155

- assume the received signal E to be a function of the transmitted signal S and a second variable, the noise N . <...> The noise is considered to be a chance variable just as the message <...>. In general it may be represented by a suitable stochastic process.⁵²

⁵¹ Fynsk 1992: 123 ff.

⁵² Claude E. Shannon, *The Mathematical Theory of Communication*

- probabilities of future preservation of cultural artefacts in mathematical terms: $E = f(S, N)$; add temporal dimension to the communication channel: $E = f(S, N, t)$.

Norbert Wiener's biograph Masani formulates at the beginning of his work the problem bio-graphy in terms of such a *signal-to-noise ratio*: "The basic proposition of cybernetics that signal = message + noise, and that the message, and not the noise, is the sensible term in communication, is applicable in all sorts of contexts <...>. Wiener is the signal, and for us the Wiener-message, and not the Wiener-noise, must be of significance" = P. R. Masani, Norbert Wiener 1894-1964, Basel / Boston / Berlin (Birkhäuser) 1990, 19

- rather transition between "transmission" and "storage", case magnetic sound recording, Oberlin Smith 1888: "Imagine that speech could be transmitted over a telephone line at a very slow 'rate of travel', so that at a particular point in time the entire message would be somewhere in the wire between speaker and listener"⁵³

- literally "medium" (Shannon's definition of the transmission channel as "merely the medium"); use of same technology as delay memory in early digital computing

Modular Readings: The Case of *Lapis Satricanus*

- Bernhard Siegert, in his definition of "Kulturtechnik"⁵⁴, refers to the representation of corrupt letters in the ancient Roman inscription *Monumentum Ancyranum* in Andreas Schott's edition (Antwerpen 1579) is expressed by subsequent dots (110 f.). But a sequence of dots and dashes in Morse telegraphy is not simply a symbolic event, but the symbolic is embedded in a physical time signal, thereby unfolding in a world of its own. During transmission (the $\Delta-t$ interval of the *medium* channel) the intended message is suspended from the symbolic and temporarily assumes a non-cultural existence.

- Not only that the present now communicates with a digitized past; the past already has been symbolically, even digitally registered: as alphabetic recordings for communicating with the immediate future

[1948], in: ders. / Warren Weaver 1963: 29-125 (65)

⁵³ Friedrich Karl Engel, A Hundred Years of Magnetic Sound Recording, in: Journal of the Audio Engineering Society, Vol. 36, No. 3 (März 1986), 170-178 (171)

⁵⁴ Bernhard Siegert, entry "Kulturtechnik", in: Harun Maye / Leander Scholz (eds.), Einführung in die Kulturwissenschaft, Paderborn 2011, 95-118

- where symbolical writing (history, people, authority) and materiality (archaeology, objects, authenticity) meet; close reading of an inscription *Lapis Satricanus* from late 6th or early 5th century B. C., discovered 1977 by the archaeologists of the Dutch Institute of Rome during their re-excavation of the temple of Mater Matuta in Le Ferriere (Latio), the ancient Satricum;
<http://www.telemaco.unibo.it/rombo/iscriz/satricum.htm>

- text (like flat files in computing today) does not itself separate words; therefore any transcription is already an interpretation. The epigraphical reading presents the text like this:

[.....]EISTETERAIPOPLIOSIOVALESIOSIO
SUODALESMAMARTEI

This early Latin inscription of just two lines which looks like a votive inscription in itself already deficient, with something missing at the beginning: there is no *arché-logos*. This initial lack which remains to be supplemented keeps the discussion of hypotheses going on. A revision of the earliest photographic documentation of the stone *in situ* by D. J. Waarsenburg in 1994 - a kind of secondary dig in the archives of archaeology itself - revealed that the literally "i"nitial lacuna can, at least partly, be completed by the letter "I", while another apparent fragment of a letter on the photography, blown up media-archaeologically by computer analysis, turned out to be a blade of grass = Versnel 1997: 180; what is the message, or what is missing: truncated first letter/s or noise (a scratch in the stone)?

- photograph of the primary situation of this inscription when just being excavated *in situ* today is the only recording of its state before the cleaning of the stone from earth and its removal into an epigraphic museum.

The completion of the first word(s) would require either a reverse lexicographic statistical processing of letter sequences, or an analysis of Markov chains as proposed in the mathematical theory of communication (Shannon and Weaver 1963); our certainty depends on statistical probability.

Claude Shannon in his essay on prediction and entropy: "The errors, as would be expected, occur most frequently at the beginning of words and syllables where the line of thought has more possibility of branching out."⁵⁵

⁵⁵ C. E. Shannon, Prediction and Entropy of Printed English, in: The Bell

Only a proper name (poplios = Publius?) makes it secure to discriminate a verbal entity; names turn out to be the ultimate rigid denominator (Saul Kripke). The problem of reading the inscription is with how to group and de/compose the letter series in front of this name: the analysis of *ieisteterai* and the problematic integration of the 4-6 letters missing already at the left corner of the inscription, turning this epigraphical case into an allegory of readability of the past (which is by definition absent and deficient). Only a statistical *ars combinatoria* (somewhat at the origins of computing) can offer different readings by sequencing these letter-data:

A) [4-6]*ie iste terai*

B) [4-6]*iei stet erai*

C) [4-6]*iei steterai*

D) [4-6]*ieis tet erai*

E) [4-6]*ieis teterai*

F) [4-6]*ieist et erai* = C. De Simone, L'aspetto linguistico, in: C. M. Stibbe, G. Colonna, C. de Simone and H. S. Versnel, with an introduction by M. Pallottino, Lapis Satricanus. Archaeological, Epigraphical, Linguistic & Historical Aspects of the New Inscription from Satricum, 's-Gravenhage 1980, 71

mage processing routines may be applied to enhance e. g. shallow inscriptions and thereby support their deciphering; a calculated enlargement of this close-up by digital filtering (in PhotoShop); digital media themselves act as active "archaeologists" of this past; techno-mathematical signal correlation of (missing-to-existing) letters

- Archaeology is not just an auxiliary discipline to history, but as well a genuinely alternative model of processing data from the material archives of the past. While historical discourse strives for narrative coherence, the archaeological aesthetics deals with discrete, serial strings of information which - in an age of computing - gains new plausibility against literary forms of historical imagination developed in the nineteenth-century.

- dissonance between archaeology and history is exemplified by the controversial interpretations of an ancient inscription discovered in Italy some thirty years ago, the Lapis Satricanus which seems to bear (and thus authenticate) the name of one of the founders of the Roman republic hitherto considered to be a rather fictitious character in ancient historiography. This case at the same time figures significantly in the methodical debate between the Arnaldo Momigliano

and the Hayden White schools of history. The insistence on archaeological aesthetics, i. e. discrete and non-narrative data analysis in the representation of this fragmented bedrock of evidence, turns out to be a quality of resistance against the national or ideological will for narrative myth--building in history.

In his demand for textual information the historian tends to forget about the materiality of the data carrier. Let us take as an example the early Roman inscription of Satricum:

"Once the position of the block with the inscription had been photographically documented and sketched <...> this and the two others displaying the same characteristics were transported to the Dutch Institute at Rome for preparation of the publication and to await placement in a museum" = C. M. Stibbe, *The Archaeological Evidence*, in: Stibbe u. a., 1980, 21-40 (27)

- act of discursivation, i. e. the scientific publication and subsequent discussion of this archaeological sensation made the material original almost redundant; in the meantime the inscription stone stayed away hidden in the store of the Dutch Archaeological Institute in Rome - in the architectural "unconscious" of this institution, surrounded by shelves which keep other artefacts from the Satricum excavation. As if the hermeneutic focus on the *historical* meaning of the texts and its mediatisation (communication / information) by its publication got rid of its very materiality; its memory here belongs to the task of storage (as encryption)

Annales Sangallenses

- Where does cultural techniques end and technological media begin?

- medieval annals not equal to syntactical word listings in Weizenbaum's KI program ELIZA

- Present digital (media) culture triggers a new kind of awareness of past cultural practices, "retro-actively" in Freud's sense ("somehow always known, but never thought of" = "Eigentlich immer gewußt, nur nicht daran gedacht": Sigmund Freud, *Erinnern, Wiederholen und Durcharbeiten* [1914], in: S. F., *Gesammelte Werke*, vol. X, Frankfurt/Main 1946, 126-136 (128): not from the past derive memories, but memories relating to the past

- early Medieval Annals perform the discrete time sequence of a "sampled" continuous function called reality; translation from analogue

perception to digital registration (technically: A/D conversion)

- Different from the Annals of Saint Gall is the micro-temporality in operativity of data processing (synchronization) which replaces the traditional macro-time of the "historical" archive, of emphatic historical consciousness - a change in aggregation, a literal "quantization"

- the Annals of Saint Gall, a record of annual events referring to early 8th century Europe. Neither *discours* nor *histoire*; the disorder implied by some of the events is stabilized only by the regular, unbroken procession of years, a cultural technology of formalization (counting) instead of narrative:

709. Hard winter. Duke Gottfried died.

710. Hard year and deficient in crops.

711.

712. Flood everywhere.

713.

714. Pippin, Mayor of the Palace, died.⁵⁶

In McLuhan's terms, this "cold" list requires a reading technique different from "hot" historical (or historiographical) imagination. Remarkably, there can be (no) entries as well for the absence of events. Annals offer their readers „one thing after the other“, corresponding with the very nature of the von-Neumann-architecture of computers which operate strictly sequential, one bit / cycling unit after another -, while proper narratives provide their readers with „one thing because of the other“⁵⁷

- "sequence of operations required to perform a specific task is known as an *algorithm*"⁵⁸ - the alternative to story-telling, a digital aesthetics of writing a mere sequence of events in serial, sequential order

- time now is being organized by technology itself, Paul Virilio declares⁵⁹ - just like the story-teller can be replaced by the cold camera

⁵⁶ Annales Sangallenses Maiores, dicti Hepidanni, ed. Ildefonsus ab Arx, in MGH, series Scriptores, ed. Georg Heinrich Pertz, vol. 1 (Hannover, 1826; Reprint Stuttgart 1963), 72f. Translation quoted from: White 1980: 11

⁵⁷ Robert F. Berkofer (Jr.), Beyond the Great Story. History as Text and Discourse, Cambridge, Mass. 1995, 117, unter Bezug auf: White, Value of Narrativity, in: Content of the Form, 1987, 42ff, und Aristoteles.

⁵⁸ J. D. Richards / N. S. Ryan (eds.), Data Processing in Archaeology, Cambridge U. P. 1985, 1f

⁵⁹ Paul Virilio, Technik und Fragmentierung, in: Karlheinz Barck u. a. (eds.), Aisthesis. Wahrnehmung heute, Leipzig (Reclam) 1990, 71-82 (71)

eye (Dziga Vertov); cinema still has a dramatic concept unfolding in time⁶⁰, vs. non-linear hypertextuality

- algorithms displace classical story-board; script is not a screen-play any more (story-telling), but code lines; programmer is not interested in stories any more; rather he writes discontinuous jump addresses to Hot Spots. Designing a Computer Game today means 95 % of digital administration (setting links), and requires just 5 % "authorship". This programming practice is deconstructing narrative scenes into its most elementary morphological units. Linearity (which in the case of film is based on the irreducible material linearity of celluloid already) has artificially to be introduced on CD-ROMs for guide-lines

Museums as agencies of cultural transmission across time

- Collecting - storing - editing: The nineteenth century project of a German national museum of cultural history (Germanisches Nationalmuseum) at Nuremberg, in its juncture of memory based on archives, on the collection of objects and on its library, matches the criteria of technologies of tradition in its proper sense. The enterprise undertaken by the Freiherr von Aufsess, a repertory of sources on German medieval history, drastically separated (archaeological) monuments and (historical) information, creating a data bank on national history until the year 1600 and thereby creating somewhat Vannevar Bush in 1945 termed a *memory extender*. Thus the GNM asks for a re-reading in terms of media theory, discourse analysis and the science of documentation: the (re)construction of the past as a function of its reco(r)dings. Biblio-museal-archival memory, it will be argued, is at the same time an effect and the deconstruction of (literally) „collective“ historical consciousness.

- mechanisation of library; "cold storage" (different from "hot" historiographical imagination) = title of YouTube video produced by MetaLab, Harvard University, on the infrastructure of its library, inspired by Alain Resnais, *Tout la Mémoire du Monde*

Transatlantic alliance: Media Archaeological Lab / MAF

- Lori Emerson's Media Archaeological Lab (University of Bolder,

⁶⁰ Monika Halkort, Datenbankbasiertes Broadcasting - Neue Erzählgenres im Netz, in: do it yourself! Kunst und digitale Medien: Software - Partizipation - Distribution, hg. v. Andreas Broeckmann / Susanne Jaschko, Berlin (transmediale.01) 2001, 155-159 (155)

Colorado); MAL and Media Archaeological Fundus (Media Studies, Humboldt University, Berlin) somewhat complementary (with "Signal Laboratory" inbetween, keeping alive computer game platforms). MAL concentrates on electronic literature, while MAF investigates the "literature" (programming and hardware circuits) of early computing (and other media); conceptual exchange between literature, digitality and electronics

- Media Archaeology Lab run at University of Colorado at Boulder. "tries to both preserve and provide access to several interrelated aspects of our cultural past: historically important works of digital literature, generally from before the era of the WWW, along with the platforms they were created on and for; and historically important computer hardware and software, such as the Apple IIe, Apple Lisa, Apple Macintosh, NeXT Cube, and Hypercard"; the lab's underlying philosophy "driven by several different strands of media archaeology" = e-mail Lori Emerson, November 6, 2012; basic information: <http://loriemerson.net/media-archaeology-lab>

- for Library of Congress, vision for the lab and its relation to the field of media archaeology and digital preservation: <http://blogs.loc.gov/digitalpreservation/2012/10/media-archaeology-and-digital-stewardship-an-interview-with-lori-emerson>

- Lynn Hersman-Leeson's film *Conceiving Ada*; by code the present time can be in touch with the past - a media-archaeological rather than media-historical short-circuiting of (media) times; reminds that media archaeology is not just about the digging metaphor, but about mathematical clearness as well.

- the mathematical layer of media-archaeological research and teaching; <http://blogs.loc.gov/digitalpreservation/2013/02/archives-materiality-and-agency-of-the-machine-an-interview-with-wolfgang-ernst>

- MAF (Media Artefact Pool) as teaching collection made up of "antique" / techno-archaic artefacts that are (anachronistically in the media-archaeologica understanding of technological temporality) highly relevant to our contemporary media culture - ranging from an electron-ray indicator tube to a temperature sensor used as a periphery device on an early Commodore 64 computer; oriented around the concept of an operational Media Theatre; objects not presented as examples of design; instead, focus primarily on the objects' function and internal aspects / functionality

Flat temporality: transitive analysis and the microscopic gaze

- Pierre Laffitte (from the school of Auguste Comte) once defined the role of history of science as a sort of "mental microscope" = look at scientific knowledge from a compressed distance / "telescopic" view

- metaphor of the micro- or telescope (for identifying ultra- and sub-time-critical intervals) turns history into a laboratory experiment - the artificial extension or condensation of an (apparently) given development (known from the time axis manipulation in the simulation of physical processes like kinematics by analog electronic computers), which - on the other hand - depends on this technology in order to be detected at all⁶¹

- just like Walter Benjamin defined the "optical unconscious" which is revealed only by the photographic lense

- "Tradition is nothing if not diachronic."⁶² Really? The meaning of "tradition" shifts its focus from its previous emphatic macro-temporal ("historical") notion to the analysis of the time-based and time-basing micro-mechanisms of transmission. While tradition has been associated with long-time memories across deep historical time so far, this emphatic horizon now shrinks to a mere extension of the present (as its re- and protentive short-term "working memory") - a dramatic shift of the temporal prefix in the age of algorithmic, that is: generative (instead of inherited) memory. Algorithmic re-production is the post-scriptum to Walter Benjamin's interpretation of post-traditional perception of works of art - a kind of oral (in the sense of: dynamic, variable) memory returns.

In the age of algorithmic, that is: generative (instead of inherited) memory, a kind of secondary "orality" returns to the archive: "the individual *poiesis* of tradition" as known from the definition of oral poetics <Foley 1990: 200> and emerging as the art of live-coding today

Oral epic poetry (as performed by Serbian *guslari* until today) communicate knowledge of the past not in the mode of historical discourse, but as an operative memory, relegating the (national) past to the present not by notational or signal recording (like presence-

⁶¹ See Georges Canguilhem, *Wissenschaftsgeschichte und Epistemologie*, Frankfurt/M. (Suhrkamp) 1979, 25

⁶² John Miles Foley, *Traditional Oral Epic. The Odyssey, Beowulf, and the Serbo-Croatian Return Song*, Berkeley / Los Angeles / Oxford (University of California Press) 1990, 3

generating media such as the phonographic record) but by variable iteration: invariance in dynamic transformation: "The nation comes about and indeed 'occurs' during the production and emergence of the songs. Absence has been transformed into presence, death into life, muteness into announcing" = = Tanja Zimmermann, The folk instrument *gusle* and its resistance to electrification, lecture at the conference xxx, Konstanz, published in: xxx, referring to the interpretation by Leopold von Ranke, Die serbische Revolution. Aus serbischen Papieren und Mitteilungen, Hamburg 1829, first chapter ("Lage der Dinge vor den Bewegungen. Nationale Sinnesweise und Poesie"), 35f

Neg-entropic information of matter (Frauenkirche Dresden)

Physical (entropic) decay of cultural materialities from the past may be diagrammatically registered and presented like a signal, that is: as a continuous function of the time axis (e. g. a building, slowly degrading into a ruin or finally a heap of bricks). The alternative temporality is discrete, a sudden change of state which then remains invariant over a long period of time (interval) - close to PCM in digital data transmission (based on impulses rather than on continuous signals). This results in a dramatic increase of data compression, since only the changes (between two states) have to be coded. Thus the physical time axis is being replaced by coded time.

- Frauenkirche cathedral in Dresden from the Baroque times remained intact (as documented in countless paintings, engravings and photographs). After the great fire in Dresden, February 1945, resulting from the serious bombarding of the city by British airplanes in Second World War, the building (with a slight delay of two days after the actual bombardment fire) suddenly collapsed (having been burned from inside), from then on remaining more or less unchanged as a almost de-figured heap of stones; with aid of IBM computing, out of the (available) original stones the cathedral has been reconstructed, reversing the collapse which happened after the Dresden bombardment - a negentropic violation of the second law of thermodynamics defining entropy which provides the scientific explanation for the notion of a time arrow. *Informational* aesthetics informs matter itself.

Software embodiment as implementation

- link to the physical world, the necessity of material implementation of all logical systems in order to become dramatically active. Symbolical analysis (Schaltalgebra) in itself can not operate, only when being

implemented into switching circuits (like electro-magnetic relays)⁶³; crucial difference between the mathematical model of the Turing-Machine of 1936 and the really implemented machinery called "computer" today which brings time as a critical parameter into the event

- mental processes as well depend on their implementation in bio-cybernetical hardware (neuronal synapses)

- department *Computing and Control* at National Museum of Science and Industry in London, faces the challenge of the preservation of software as museum object; Doron Swade, *Collecting Software: Preserving Information in an Object-Centred Culture*, in: *History and Computing* Vol. 4 No 3 (1992), 206-210

- "software" new kind of cultural artefacts: not a material object any more, rather an executable file which unfolds only when being processed (a truly processual time-object); computer as hardware can be traditionally displayed as an immobile object, but its time-critical and "bit-critical" processes are never in *stasis*, just like frequency-based acoustics (sonic evidence in museums) needs performance in time to take place - different from visual evidence which persists in space.

- with electronic computing, traditionally separated categories of durable materiality *versus* immaterial time-based performance collapses, in a way analogous to the essential tempor(e)ality of sonic articulation. Once the single tone has been discovered as the basic element of manipulation in composition of electronic music, it could be treated as "material" with its micro-historicity itself. What has been acquainted as the ordering of sound in *marco-time* ("music") turned out as *micro-temporal* essence itself - the tone as a frequency event. "Die Trennung 'akustischer Vorordnungen' *im* Material und 'musikalischer Ordnungen' *mit* diesem Material müßte dann aufgehoben werden."⁶⁴ Likewise, around 1900 Henri Bergson elaborated his philosophy upon the phasical insight into the essentially oscillating nature of "material" elements (electrons, atoms); as such, materiality itself is in micro-motion already.⁶⁵

With classical archaeology (classics) and cultural studies

⁶³ See Claude Shannon's master thesis: *A symbolic analysis of switching relays*, in: xxx

⁶⁴ Karlheinz Stockhausen, *Die Einheit der musikalischen Zeit*, in: Dieter Schnebel (ed.), *Karlheinz Stockhausen. Texte zur elektronischen und instrumentalen Musik*, Bd. 1, Köln (DuMont) 1963, 211-221 (214)

⁶⁵ See Maurizio Lazzarato, *Videophilosophie*, Berlin (b-books) 2002

(Kulturwissenschaften) media archaeology shares the interest for material culture. What differentiates technological objects from archaeologically excavated cultural artefacts is their being (technically as well as logically) coupled and - contrary to a museal assembly - capacity of acting - under currency - by themselves. This escalation is articulated in the different emphasis of the subject of two publications - one being "kulturwissenschaftlich", the other being of media-epistemological nature: a) Steven Lubar / W. David Kingery (Hg.), *History from Things. Essays on Material Culture*, Washington / London (Smithsonian Institution Press) 1993; b) Peter Galison, *Image and Logic. The Material Culture of Microphysics*, Chicago (University of Chicago Press) 1997

Software belongs to the class of "generic objects (media)" <Swade 1992: 208>. "One bit wrong and the system crashes" <ebd.>. "In arachaeological terms the operational continuity of contemporary culture cannot be assured" <209> as soon as the material embodiment in which such a software has to take place in order to actually run is not available any more; solution to this material dilemma lies in transforming the material aspect of computer culture itself into software, that is: emulating past hardware digitally. Suddenly cultural tradition turns out to be an operation of de-materialization (*Verundnglichung*), "logical replication as distinct from physical replication" <209> - operational things, in fact: media (actually not "things" at all any more).

"Tradition" of cultural knowledge in terms of communication engineering

- media-archaeological dispositive for this type of (almost) lossless reproduction of information by identical symbols has been the Gutenberg printing technology (as opposed to handwritten copies of manuscripts) with its negative types to re-produce letters positively in identical numbers - a form of reproduction later re-vented by the photographic negative, the Talbot Kalotype (as different from the unique Daguerre positive), which led Walter Benjamin to remark that reproduction technology both disconnected and freed ("er/löst") the reproduced object from the realm of tradition, by replacing the unique event (the condition for its "auratic" character) by its mass multiplicity. Temporal tradition is thus replaced by a rather topological dissemination⁶⁶

⁶⁶ Walter Benjamin, *Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit* [originally published in its French translation 1936], Frankfurt/M. (Suhrkamp) 1963, 13

- monopoly of communication once held by state-owned mailing and telephone systems, according to an argument by Bernhard Siegert, ended with the digitalization, where transmission itself (in its traditional sense) runs out, becoming a mere function of mathematised (rather than materially transmissional) signal processing (realtime, compressing etc.) = Siegert 2003: 285

- long cultural tradition of techniques to preserve knowledge across generations: "How, by what channels and by what techniques, were the spiritual *arcana ecclesiae* transferred to the state so as to produce the new secular *arcana imperii* of absolutism?"⁶⁷; cp. Lasswell "communication studies" formula vs. Warren Weaver, Recent Contributions to the Mathematical Theory of Communication, in: Claude E. Shannon / same author, The Mathematical Theory of Communication, Urbana, Ill. (University of Illinois Press) [*1949] 1963, 1-28; opposed to redundant (secure) transmission, the degree of information increases with improbability

- tele-communication across spatial distance taking place in the more or less synchronous temporal mode (real-time), while knowledge communication is remarkably asynchronous (postponed, "delayed transfer" in terms of Jack Goody) - the "letter" paradigm of humanistic knowledge exchange, asking for a media theory of storage

- "Spikes" serve to visualize correlation analysis of signals. See Günther Wernicke, Holographische Zeichenerkennung an Keilschrifttafeln, in: Humboldt-Spektrum 4/1995, 22-27, Fig. 5 "Intensitäten der Korrelationsignale bei Verwendung verschiedener angepaßter holographischer Filter"; spectral correlation diagrams for time frequency detection (TFR) in signal analysis: Boualem Boashash (ed.), Time Frequency Signal Analysis and Processing. A Comprehensive Reference, Amsterdam et al. (Elsevier) 2003, 505. Correlation allows for a memory induced by the signals themselves; therefore Nuclear Magnetic Resonance, for example, is non-metaphorically at work in the concept of a ten thousands of years radio memory

- there is "involuntary memory" (Marcel Proust) from within technology. Such a memory is less culturally, that is: context-dependent in the short-term.

- Michel de Certeau, Writing vs. Time: History and Anthropology in the

⁶⁷ Ernst H. Kantorowicz, Myteries of State. An Absolutist Concept And Its Late Mediaeval Origins, in: Harvard Theological Review vol. 47 (1955), 65

works of Lafitau, in: Rethinking History. Time, Myth, and Writing, ed. M.-R. Logan / J. F. Logan, New Haven: Yale French Studies 59 (1980), 37-64

- notion of "half time" exists for the discourse of knowledge as well. Knowledge measurement (bibliometry); Wilhelm Dilthey; time in which a publication is heavily read, borrowed from libraries and quoted; citation index; see the origin of the "PageRank algorithm" for the search engine Google

- only non-human, culture-free storage of text, sound and image, can be still retrieved when the defining semantic or iconologic context has already been lost; see Claus Pias (ed.), *Kulturfreie Bilder. Zur Ikonographie der Voraussetzungslosigkeit*, Berlin (Kulturverlag Kadmos), forthcoming

- long-time security and visibility of nuclear deposit sites, in: FAZ xxx, on Gregory Benford, *Deep Time. How Humanity Communicates Across Millennia*, xxx (Avon) 1999: Report on strategies to symbolically mark nuclear waste depositories (such as in Carlsbad, New Mexico, where the radio-active half time is calculated for 10 000 years). One of the options is a *Gestalt* diagram ("Mister Yuk"), in fact a human face which by geological move of the North pole will change its expression from angry to friendly within such 10 000 years. This "slow motion" communication exemplifies the option of (auto-) "correlation": invariant self-similarity of signals over time

- Ventris deciphered the Mycenaean "Linear B" writing from ancient Greece, trained in war time decipherment of coded messages⁶⁸

- proper names are "rigid" denominators in Kripke's sense; they do not change with context. Alan Turing managed to crack, in Bletchley Park's decipherment huts, the German military code (codes by the Enigma machine) by concentrating on proper names in the sequence of encoded letters, just like the decipherment of "Linear B" by Ventris / Chadwick and of the Rosetta Stone by Champillon (the pharaoh's name, marked by graphic accentuation). When the decipherment becomes time-critical (which is not true for nuclear deposits) - a computer became vital as mechanised mathematics. Mathematical knowledge here replaces semiotic decipherment.

- Semiotics as a branch of communication deals with the study of "the formulation and encoding of messages by sources, the transmission of these messages through channels, the decoding and interpretation of

⁶⁸ See Michael Ventris / John Chadwick, *Documents in Mycenaean Greek*, Cambridge 1956

these messages by destinations, and their signification" <as defined in Sebeok 1985: 451>; Eco, sign vs. signal

- "mathematical theory of communication" is not concerned with the "semantics" of the transmitted signals; that is why "noise" here is not just a distortion but as well a possible source of information (just like in secret coding)

- Secret knowledge seems to be a most secure insurance for tradition; vs. political ethics of "open source" / GitHub

TECHNOMATHEMATICAL IMPLEMENTATIONS: NON-HUMAN FORMS OF EMBODIMENT

Signal analysis and dis-embodiment

- relevant time structure for understanding technical media not its historicity but the time structure of the signal event itself, in technical layers like tuning systems (resonant circuit), techniques to build and to en-act (bias) hardware, principles of parameter setting. Knowledge of media history has its legitimation when the question is how technologies are embedded in broader cultural textures. But this can only be the secondary step; the first has to be a reconstruction of the specific time structures unfolded by signal processing in technology itself, its temporal relations

- Micro-tempor(e)alities; time-critical signal processing in humans and machines; either analogue (continuous) or discrete time; electronic synthesizer: "Attack" and "Decay"; notion of "transients" in signal processing; discrete time signal processing for signals defined only at discrete points in time (quantized in time, but not in magnitude), such as telegraphy (Morse code)

- Media as agents of signal analysis: biological data (from the human body) are retrieved (and transformed) by time-varying measure media (such as sonography, electrocardiograms); signals being defined as "time-varying or spatial-varying physical quantities". "In the context of signal processing, arbitrary binary data streams and on-off-signals are not considered as signals, but only analog and digital signals that are representations of analog physical quantities" = entry "Signal Processing", online <http://en.wikipedia>, accessed on 25 November 2010

- media-archaeological levels: "In communication systems, signal processing may occur at OSI layer 1, the Physical Layer (modulation,

equalization, multiplexing, etc) <...>, as well as at OSI layer 6, the Presentation Layer (source coding, including analog-to-digital conversion and data compression)" = en.wikipedia

- Operative diagrammatics = physical "embodiment" of symbolic languages; computational mathematics, implemented in the physical world, means being-in-time; Warren S. McCulloch applies term "embodiment" of logical (Boolean) algebra in neurons

- J. C. R. Licklider researched the essentials of what constitutes "hearing" in humans and animals (auditory analysis): "Is there, built into the auditory nervous system, a *mechanism* <W. E.> [...] that supplements the cochlear frequency analysis?"⁶⁹ His very use of terms stems rather from electronic engineering, thus dis-embodimenting the analysis of human hearing

- businessman becomes a servomechanism of his clock, and explicitly "the cyberneticists - and soon the entire world - of his computer" = Marshall McLuhan, The Playboy Interview: Marshall McLuhan, in: Playboy Magazine, März 1969 (*online* www.columbia.edu/~log2/mediablogs/McLuhanPBinterview.htm), as quoted here from: Martina Leeker, Camouflagen des Computers. McLuhan und die Neo-Avantgarden der 1960er Jahre, in: Derrick de Kerckhove / Martina Leeker / Kerstin Schmidt (eds.), McLuhan neu lesen. Kritische Analysen zu Medien und Kultur im 21. Jahrhundert, Bielefeld (transcript) 2008, 345-374 (350)

- Licklider, Man machine symbiosis, 1960

Implementations

- In computer science, implementation is the realization of a technical specification or algorithm *as a program* (software) = <http://en.wikipedia.org>, entry "Implementation". When a piece of computer hardware can interpret a programming language *directly* (in a transitive way), that language is called *machine code*. A so-called *native code compiler* is one that compiles a program into machine code.

⁶⁹ J. C. R. Licklider, Auditory Frequency Analysis, in: Colin Cherry (Hg.), Information Theory. Papers read at a Symposium on 'Information Theory' held at the Royal Institution, London, September 12th to 16th 1955, London (Butterworths Scientific Publications) 1956, 253-268 (254)

- the "instance" refers generally to any *running* process, specifically to an object as an instantiation of a class; the sister concept to "embodiment" from a media-archaeological point of view. the Smalltalk programming language e. g. is conventionally implemented by compilation into bytecode, which is then either interpreted or compiled by a virtual machine

Measuring "embodiment" with technological devices

- critique of neuro-scientific laboratory equipment als *dispositif*:
"Neuroimaging techniques requiring the test participant to lie in a scanner, however, are inappropriate to investigating the process of music-making: the confines of the scanner make for unnatural bodily posture and limited movement; the noise in the scanner would prevent the participant from concentrating on musical-auditory events. Electroencephalography (EEG) does not allow the musician to move their heads freely, as it is difficult to remove motor artifacts from EEG signals. Functional near-infrared spectroscopy (fNIRS) technology, as explored in a pilot study carried out by the author and colleagues using NIRScout, a portable NIRS system, imposes minimal physical constraints on the participant (when playing piano or a string instrument); nonetheless, current neuroimaging techniques require many more improvements to be reliable tools for investigating the process of music-making. On the whole, the question of what the dynamic processes of kinaesthetic simulation underlying the process of musical shaping towards fulfillment (and the co-shaping process taking place in music perception as well) look like can be most efficiently addressed by investigating the neurodynamic processes involved in music-making and music perception; such an approach does more justice to the temporal process of (co)shaping a piece of music than current structure- or function-oriented neuroscientific methods."⁷⁰

- In neurophenomenological (vs. media-archaeological) investigation of the aesthetic experience of music (Helmholtz 1863); temporal structures from neuroimaging data can be analyzed most efficiently when using a neurodynamic approach, whereas at present structure- and function-oriented neuroscientific approaches are dominant = 168

- embodiment as (not only loose, but tight in Heider's sense) integration of the human into the (time-based) machine (Jan Claas van

⁷⁰ Jin Hyun Kim, Shaping and Co-Shaping Forms of Vitality in Music: Beyond Cognitivist and Emotivist Approaches to Musical Expressiveness, in: Empirical Musicology Review, Vol. 8, No. 3-4, 2013, 162-172 (167)

Treeck); the human becomes a chrono-prosthesis of the machine, analogous to Turing's insight from 1936 that, when calculating, man is in the "machine state"

- "Implementation" of the symbolic (algorithms) into the real; "embodiment" extends (beyond the biological body) to what media archaeologists call "implementation" (from informatics), being essentially a (diagrammatical) question of being-in-operativity as comparable - yet distinct - to human performativity; common denominator: "music" and (neo-logically) "algorhythm"

RADICAL MEDIA ARCHAEOLOGY

Radical Media Archaeology against the soft archaeological metaphor

- For Media Archaeology, the notion of proper archaeological "layers" (stratigraphy) is metaphorical and misleading; with integrated circuits and logical arrays, with the miniaturization of electronics prevails two-dimensionality (and "2 1/2 D" material extensions). But: layer-wise erasure of micro-chips from Western production in East German computing industry in the 1980s and 1990s (Völz). The topological "field" rather than "layers" is appropriate for media archaeological research - again a metaphor from archaeology proper (excavation "field", "field archaeology").

- "[A] more geologically tuned deep time - down to mineral excavation, themes of a media ecological sort: A media excavation into the mineral and raw material basis of technological development, through which to present some media historical arguments as to how one might adopt a material perspective in terms of ecological temporality." (Parikka, 2012a⁷¹)

- *Radical* media archaeology - in its technically "grounded" version - takes its departure from technology itself. It concentrates on the epistemological insights which can be derived from the close analysis of electro-mechanical artifacts, electronics, and finally computational machines; literally "fundamentally", media archaeology takes the *arché* at its mathematical face value: algorithmic rooting in numbers.

⁷¹ Quoted here after: Michael Goddard, Opening up the black boxes: Media archaeology, 'anarchaeology' and media materiality, published 28 April 2014 in the online journal: New Media & Society, <http://nms.sagepub.com/content/early/2014/04/27/1461444814532193>

The *logo* of media archaeology therefore is the square root symbol

- archaeology proper not concerned exclusively with the material artefact any more; radical mathematisation (by computing) takes place, kind of Digital Humanities *avant la lettre*:

- Complexity nowadays can be coped with by computational probabilities in a non-linear way. That is where Digital Humanities (or computational philology) becomes a twin method to media archaeology

- Gabriel Tarde defined „deux sortes de recherches que notre temps a mises en grand honneur, les études archéologiques et les études statistiques“; der Statistiker, wie der Archäologe, „jette sur les faits humains un regard tout abstrait et impersonnel“ = Gabriel Tarde, *Les lois de l'imitation*, Paris 1890, chap. IV (Qu'est-ce que l'histoire?), section „L'Archéologie et la Statistique“, esp. 99 and 114: the statistician, like the archeologist, „jette sur les faits humains un regard tout abstrait et impersonnel“

- no longer absorbed by hermeneutics: *posthumanistic archaeology*

- In a radicalized operation, the *media*-archaeological gaze converges with the technical medium itself - like an optical scanner or "imager" (for deciphering QR-codes) recognizes the material artefact. The application of techno-mathematical tools of analysis to archaeology⁷² results in *media-active* archaeology

MATERIAL "MEDIA ARCHAEOLOGY - METHOD & MACHINE"

The non-human meaning of "media archaeology"

- What does it say about communication inbetween humans if its effect can be achieved by intermediary transsubstantiation into binary data processing, storage, compression and transmission, like in smart phones? Human communication itself is signal processing first. When the "most human" in cybernetic and communication engineering analysis turns out to be the most symbolic, very deeply dis-covers (*aletheia*) the *within-human*

⁷² See F. R. Hodson / D. G. Kendall / P. Tautu (eds.) *Mathematics in the Archaeological and Historical Sciences* (Edinburgh / Chicago: Edinburgh University Press / Aldine Atherton, 1971

- just like Digital Humanities, in its algorithmic approach, performs "cultural analytics" (Lev Manovich).
- Media archaeology refers to non-human procedures when not looking at media on the level of their surface effect on humans (phenomenal interfaces), but rather uncovers the hidden agenda of technomathematical artefacts, their artefactuality. Nicole Starosielski's research on the undersea cables of international communication is "reminding readers about the materiality of the virtual. Circulation takes place not in the ethereal clouds, she writes, but in cables underwater" = Niko Higgins, in: Twentieth-Century Music 14/1 (2017), 153-158: 157, referring to Nicole Starosielski, *The Undersea Network* (Durham, NC (Duke University Press) 2015
- point of view of the machines themselves (measuring, sensing and processing), kind of "inhuman hermeneutics", knows things which are hidden from sensual perception. At the same time, technologies as materialized knowledge are product of theoretical reasoning and cultural engineering, therefore not alien to human perception but in alliance with procedures within the human itself, like the language machine and cognitive calculation. Instead of defining technologies as "non-human" agencies (Latour), discover signal events within the human machinery itself such as voice-as-frequencies below logocentrism (the cybernetic "communication" assumption). Shannon's "Mathematical Theory of Communication" temporarily relieves "information" from all semantic references; a transmitter of radio waves "communicates" with the radio receiver; computers communicate within the in-between *alias* Internet
- No technological analysis is complete unless we possess a notion of its appropriate time-concept; *media* archaeology is concerned with media not only on their structural but as well on their *operative* level, in the sense of the "rôle intermédiaire du diagramme entre le geste et le symbole".⁷³ Any media event is "Zeitfunktionen der Signale"⁷⁴, with a signal being the physical representation of a message respectively information
- Media archaeology not a simplification, but analytical reduction to techno-logical essentials and *principles* (the Latin equivalent to *arché*);

⁷³ Guerino Mazzola, *La Vérité du Beau dans la Musique*, Paris (Delatour France) 2007, 153, unter Bezug auf Jean Cavailles, Gilles Deleuze, Gilles Châtelet und Charles Alunni

⁷⁴ Karl Küpfmüller, *Die Systemtheorie der elektrischen Nachrichtenübertragung*, Stuttgart (Hirzel) 1974, 393

when Hermann Helmholtz published his seminal *Lehre von den Tonempfindungen* in 1863, the subtitle declares a kind of sonic *arché*: the "physiologische Grundlage", that is almost literally foundation, for the theory of music; media archaeology aims at an *archaic* media experience: a "rarification" of discourse (Foucault)

- technological structures become evident in beginnings: "It is the beginnings of invented things, which appeal to me", writes Lance Sieveking (who wrote one of the first television dramas transmitted by the BBC in the Baird system), and explains: "For it is at their beginnings, that we may detect their true nature", that is: their epistemological essentials. Sieveking is quoted here as the *motto* of *Television and Me. The Memoirs of John Logie Baird* = edited by Malcolm Baird, Edinburgh (mercatpress) 2004, which is a very archaeological insight into first steps of the electro-mechanical television apparatus indeed. "In principle, the *televisor* is both simple and ingenious", comments the brochure accompanying the model kit *The Televisor*, developed as teaching device by the Middlesex University, www.mutr.co.uk

- analogy between (media-)archaeological and surgical (non-)invasive gaze; Benjamin 1936: camera-man; see Markus Buschhaus, *Über den Körper im Bilde sein. Eine Medienarchäologie anatomischen Wissens*, Bielefeld (Transkript) 2005

- capture the difference between media archaeology and classical archaeology. While sharing with classical archaeologists attention of the static artefact ("hardware"), essence of media archaeology comprises the *operative*, processual mode of technological media as well

- replacing lengthy answers on e-mail request by directly showing the artefacts = <https://www.youtube.com/watch?v=V37S95AE3Pc>; haptic approach, "operative" machine and "performative" human hand, revealing the human / apparatus coupling of such things called media

Media archaeology - theory and method

- media as physical channels of communication and as technical artefacts which are operated by symbolic codes and streaming data, ask for analysis in ways different from texts; the archaeological gaze = enumerative rather than narrative, descriptive rather than discursive, infra-structural rather than sociological, taking numbers into account instead of just letters and images

- Positioned between archeology as academic discipline of analyzing

material culture and the Foucauldian notion of the *archive* as the set of rules governing the range of what can be verbally or audiovisually expressed at all, media archeology is an awareness of moments when media themselves, not exclusively humans any more, become "archeologists" of epistemic objects (imaged-based image retrieval); beyond Marshall McLuhan, media are not just extensions of men any more

Media materialism

- *Archaeology*, in Michel Foucault's notorious definition, does not imply the search for a beginning; it does not relate analysis to a geological excavation; it rather 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 - which is implemented algorithms today

- Between the phenomenological surface of media and their concealed *arché* opens a dramatic gap. Technological media are non-discursive formations which can rather be addressed in technomathematical terms. Media archaeology performs a micro-epistemology, that is: discovering, analysing and describing the epistemological sparks which spring from the most concrete level of technology itself, such as the delicate mechanism (the electronic saw-tooth signal generator) which creates the jumps of single cathode ray lines within a television set in order to create the impression of an electroic image for (lagged) human perception at all; see A. J. Klopow, *Grundlagen der Fernsehtechnik*, transl. and supplemented by P. Neidhardt, foreword Manfred v. Ardenne, Berlin (VEB Verlag Technik) 1956, chapter 5 (50-99)

- term "digital" reminds of the archaeological meaning of computing, its hardware relais, signal processing by electric fluidity and swichting boards = 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*). Not simply a structural law, advanced technologies is dynamic: all the difference between an algorithm as a symbolical mathematical notation (traditional archival record) and its implementation as running program

- an enunciation is what is *not* immediately visible = AdW: 158, rather geno- than phenotextual⁷⁵; not a relation like surface and deep ground, but rather a Moebius-loop-like dynamical relation of back and forth

⁷⁵ See Falk 1976: 310f

Circuit bending

- analog electronic circuit which detects the presence of 13.56 MHz RFID tags used in plastic cards; <http://shop.marcboon.com/snifferkit.pdf>

- short-circuiting of (low-current) electronic devices in "catachretic" ways, in the field of sound to create new kinds of sounds by means of a "jumper" cable which connects two points in the circuit in a way not intended by the engineers; experimenting with mis-connecting results in interesting sounds, the result is being hard-wired; <http://absurdity.biz>, and the compilation CD *Noise and Toys* vol. 1 (2006); unearthing previously un-discovered sounds in electronic devices is a media archaeology of acoustic, of the "implicit knowledge" of an electronic medium; Lev Theremin's mis-using radio technology to create his *Theremin-vox* = circuit-bending by interference of the bodily gestures as variable capacitor within the antenna circuit

Soft media archaeology

- *Telharmonium Press* in Hollywood, California, Garnet Hertz = book in the spirit of Sterling's *The Dead Media Handbook*, entitled itself in an "antiquarian" fashion of an 18th century book-title: *A Collection of many Problems Extracted out of the Ancient and Modern Philosophers: As, Secrets and Experiments in Informatics, Geometry, Cosmography, Horologigraphy, Astronomy, Navigation, Musick, Opticks, Architecture, Statick, Mechanicks, Chymistry, Water-Work, Fire-Works, etc.*, Wherennto is added, *Dead Media* (2009). If we single out by chance (that is: by random access) any of these items, we find e. g. the drawing of a geometrical system for the measurement of dimensions, apparently from the late Renaissance, or - another case - the switch-board of an early computer installation in an office. The book is supplemented by scraps of paper stripes with embossment which apparently is Morse code. But what is declared as "dead media", in this case can principally be re-enacted (thus: deciphered, read, sonified), just like the measurement instructions are mathematically valid still, and the switch-board continues in present day computing, though in alternative miniaturized forms. Melancholy is the expression of nostalgia for something we long for but can not reach any more, since it is entropically (irreversibly) gone; media-archaeological approach is non-melancholic; past media are un-dead, principally (*arché*) to be re-activated and thus in a potential latency state ($\Delta-t$); media-archaeological artefacts are embedded in another temporal logic which defies historicisation; as long as they are not operative, they remain in "museal" latency; at any moment, though, they can be re-activated,

like signals as a function of time

Against history / narrative

- Fourier-Analysis replaces the time axis by the frequency domain: "Eine Archäologie dieser Frequenzen wäre in dem Moment gewährleistet, in dem "es gelingt, einen Zeitbereich ganz ohne Metaphysik und Geschichtsphilosophie in den Frequenzbereich zu transformieren"⁷⁶
- gap widens between epistemologically oriented history of knowledge and techno-epistemological media archaeology; the latter rather looks at operativity of circuit diagrams which transduce electric signals
- technical devices become "media" only in instantiation; such operativity embodies a different temporal logic compared to "historical time"
- in McLuhan's terms, "cold" listening to technologies differs from "hot" historical (or historiographical) imagination
- cybernetic epistemology implied by the "digital retro-action" idea of a feedback-loop between analogous past and digital present addresses the "archival", discrete paradigm of past-as-databank(s) as opposed to analogue, narrative historiography in linking past to the present
- digital retro-action in a techno-active sense takes place, actually, by the digitization of analogue source material from the audio-visual (broadcast media) archives and in the present: translating analogous world into a digital matrix; referring to the past, digitization of records from the past affects paper with new options of accessibility by intelligent search algorithms, as well images and sound; micro-temporality in the operativity of data processing
- computers "retro-actively" transform narrative aesthetics into non-discursive, algorithmic configuration of events

Media as archaeologists (archaic video recording)

- what developed into mass media later, once used for analysis: measurement or storage devices for experiments; phonograph,

⁷⁶ Friedrich Kittler, *Draculas Vermächtnis*. Technische Schriften, Leipzig 1993, 200

kinematograph, radio and electronic television first developed for experimental research; television tube was developed out of a measuring device, Ferdinand Braun's electronic oscilloscope; Edison's phonograph "preceded" by Léon Scott's Phonautograph, created to register the frequencies of the human voice for analytic purposes, before the media epistemology was reversed into synthesis

- Donald McLean, *Restoring Baird's Image* (literally); original misunderstanding of grammophone records in the archives of the BBC: no musical sound; attached to oszilloscope: figurative shapes appear and suggest line-by-line television; Bill Viola's definition of the electronic image as the "sound of one-line-scanning", close to the phonographic records

- sonification of the electronic image in fact served as an acoustic-archaeological tool. Baird reports about his experiments to enhance the luminosity of his early television images: "In testing out the amplifiers I used to use headphones and listened to the noise of the vision signal made. I became very expert in this and could even tell roughly what was being televised by the sound it made. I knew, for example, whether it was the dummy's head or a human face. I could tell when the person moved, I could distinguish a hand from a pair of scissors of a matchbox, and even when two or three people had different appearances I could even tell one from the other by the sound of their faces. I got a gramophone record made of these sounds and found that by laying this with an electrical pick-up, and feeding the signal back to a television receiver I could reproduce the original scene. <...> If the cinema had never been invented the 'Phonovisor', as I christened the device, might have been / worth developing; it was certainly an intriguing process. Vision into sound and sound back into vision" = *Television and Me. The Memoirs of John Logie Baird*, ed. Malcolm Baird, Edinburgh (mercatorpress) 2004, 64 f. But only by the inter-medial application of specially written filter software, i. e.: digital processing of the damaged signals, could these original grammophonical recordings be "restored" (reconstructed?). It is not the original recording we replay, but an re-enactment

- "The stream of numbers is created into a list of values that are stored in the computer as a data file holding the raw, unprocessed data. The signal is now digital and is the starting point for digital signal and image processing" <McLean ibid.>. "Line by line, the correction values plot out the profile of errors in the signal's timing" <McLean 2000: 93>

- Technology as active media archaeologist: If it were not for computer technology, Baird's *grammophone videodiscs* would continue to be curiosities that merely hinted of a time before television as we know it.

Their latent images would remain unseen and the information imbedded in them would still be completely unknown. <McLean 2000>

- media time is latency; Baird's *Phonovision* no "dead medium" (Bruce Sterling) but techno-logical aggregation waiting to be enacted in order to get into medium state - a temporal form of existence, coinciding with the technological event of induction

"Media archaeology"

- operative diagrammatics; understand digital media how it puts mathematics into operation, makes formulas into commands, and how engineering routes and automates functions that we mistake as human

- not tap only to the past but dedicate to opening up technologies in an artistic vein: hardware hacking, open software and circuit bending. Media archaeology is hence also about microtemporal processes; for such media artistic practices; Microresearch lab, Berlin

- counting, algorithmics etc. precede narration; still not relegate media archaeology as part of sciences faculties (mathematics); make "hermeneutically" explicit the epistemological insights which are implicit in the technical commands, executions and operations

- media archaeology a-historical; not about contextual information about past media, but creating situations where getting into contact with media in its radical operability and temporality; in King's College archives, inspection of Turing's estate does not result in a historian's interpretative touch but by sharing the mathematical situation in its non-historical presentness; applies to (turing-)machines as well; their functioning operations are the media archaeological moment that is at its core un-historical

EXPERIMENTING MEDIA-TEMPORALITY

Introducing "Experimenting media-temporality" (Pythagoras, Hertz, Turing)

- "Circular Causal and Feedback Mechanisms in Biological and Social Systems"⁷⁷

⁷⁷ The original title of the so-called Macy-Conferences in New York, ed. by Heinz von Foerster 1949, and subsequently by v. Foerster / Mead /

- one level of temporality which is in a flash-like manner revealed in the "experimental event" is the micro-temporal behaviour of the media in question; the second one is what it does to (or with) the "temporal sense" of the human experimentator, and c) what are the consequences for the historiography of such experimental settings: On the one hand, they clearly belong to what we call and describe as cultural history (or "history of knowledge" in more Latoureaan terms), but on the other hand (from the point of view of the media themselves, that is: the media-archaeological perspective) there is something at work which is indifferent to historical change, the "time-invariant event"

Against reduction to discursive effects

- "Experiment as event" reformlated as "experiencing eventuality"

- a media-experimental setting is an artificial configuration based on cultural knowledge - but still it is nature, since there are electro- or even quantum-physical laws at work which are not completely dependend on the respective cultural discourse. The media-experimental event cannot be reduced to discursive effects. Just like the historian Reinhart Koselleck insisted - against the relativity of historical interpretation - that there is always the "Veto-Recht der Quellen", there is an equivalent in media-technischal experimentation.

Applying the media-archaeological method

- media-archaeological method is close to the experimental. In media-experimental settings, not static ontological objects, but micro-momentary processes are being unrevealed (a kind of Heideggerian *aletheia*, "Lichtung" / electric lightning). The figure/ground dichotomy, so prominent since early *Gestalttheorie* (Edgar Rubin 1915, Max Wertheimer xxx) and returning in Marshall McLuhans model of "tetrads" in media-historical configurations (*The Global Village*), here transforms into a dynamic essence: "Die Gestaltpsychologie in dieser Form ist nur vor dem Hintergrund der Erkenntnisse der Elektrodynamik von Maxell, Faraday, Helmholtz und Hertz über das elektrische Feld denkbar. <...> Die Weise, wie sich potentielle Figuren innerhalb eines Grundes (Feldes) verhalten, ist dem elektrischen Feld analog."⁷⁸

Teuber 1950, 1951, 1953, 1955

⁷⁸ Kathrin Kadelbach, Der Versuch einer Zeitfigur der Fotografie, Hausarbeit (2009) zum Seminar *Irritationen und neue Formen der*

- epistemological focus: media temporality in a flash-like manner revealed in the "experimental event"; the micro-temporal behaviour of the technological media in question (that is: "under experiment"); secondary (derived) phenomenological aspect = what it does to (or with) the "temporal sense" of the human experimentator; audio-visual and computing media address humans at the existential essence of their sensation of being-in-time. While media historiography concentrates on the figurative phenomena, electronic media archaeology reveals the ground or rather: field

Looking *versus* listening at the monochord

- Charles Sanders Peirce on *diagrammatic reasoning*: "Similar experiments performed upon any diagram constructed to the same precept would have the same result."⁷⁹

- reenacting procedure which Pythagoras experimented with the monochord in the 6th century B.C. today, that is: when pulling such a string, actually reenacted is the techno-physical insight of the relation between integer numbers and harmonic musical intervals which once led Greek natural philosophers to muse about the mathematical beauty of cosmic order in general (including the experience and fear of deviation of this aesthetic ideology resulting in the "Pythagorean *komma*", that is: irrational number relations). Admittedly, when we pull the string, we are certainly not in the same historical situation like Pythagoras, since the circumstances, even the ways of listening and the psycho-physical tuning of our ears, is different. But still the monochord is a time-machine in a different sense: It lets us share, participate at the original discovery of musical knowledge, since - in an almost Derridean sense (expressed in his *Grammatology*) - the original experience is repeatable; the experiment allows for communication across the temporal gap (bridging a temporal, not spatial distance like mass media do).

- Peter Heering / Falk Rieß / Christian Sichau (eds.), *Im Labor der Physikgeschichte. Zur Untersuchung historischer Experimentalpraxis,*

Zeitwahrnehmung durch Medien (Sommersemester 2008) am Seminar für Medienwissenschaft der Humboldt-Universität zu Berlin, 32 (unter Bezug auf ein Argument in: Richard Zakia, Perception, Evidence, Truth and Seeing, in: *The Concise Focal Encyclopaedia of Photography*, Elsevier (Focal Press) 2008, 239-250 (242)

⁷⁹ Charles Sanders Peirce, *Collected Papers*, Bd. II: *Elements of Logic*, Cambridge, Mass. (Harvard UP) 1932, 350 <prüfen!>

Oldenburg (Bibliotheks- und Informationssystem) 2000, esp. 9-23 (on textual vs. artifactual evidence), and 142 (on the ideosyncracies of the experimental setting ("Eigendynamik"), and *eigenzeit*

- Vincenzo Galilei undertook a number of experiments with a lute to investigate the nature of musical harmonics" = As described in: Vincenzo Galilei, A Special Discourse Concerning the Unison, trans. in Claude V. Palisca, The Florentine Camerata. Documentary Studies and Translations, New Haven / London (Yale University Press) 1988, 203-205; kind of media-based archaeology of the acoustic: "Galilei employed the lute here not as a musical instrument but as a piece of laboratory equipment [...]." Once within experimentation time, it can be re-enacted.

- reproducing nature with cultural means; *physis* is here both agency (measuring instruments, subject to physical and mathematical laws) and object of experimentation, in a co-originary way

On the diagrammatical level, the re-enactment is time-invariant; on the operative level of implementation, the materiality of the medium itself seems to impose certain vetoes rooted in the historicity of the instrument, but in fact, the epistemological operation remains intact in principle (*archaeologically*): "I [...] set out to replicate this experiment using a lute built in the 17th century by an unknown maker [...]. The present condition of the instrument required the use of some substitutions for the materials originally used by Galilei in his experiment; however, these did not affect the basis tenets of the experiment."⁸⁰

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

- another "instanciation": the pendulum; Christian Kassung, Das Pendel. Eine Wissensgeschichte, München (Fink) 2008

- experimenting media-time as media-temporal experience

The media-electronic equivalent to the vibrations of the monochord

⁸⁰ Claude V. Palisca, Was Galileo's Father an Experimental Scientist?, in: Paolo Gozza (ed.), Number to Sound. The musical way to the scientific revolution, Dordrecht / Boston / London (Kluwer) 2000, 191-199 (195)

string is, of course, the electromagnetic wave. On experimenting media time, let us refer to the archaeology of television in John Logie Baird's system.

Intermezzo: Re-experiencing Baird's television

- once human senses are coupled with technological settings (media settings), man is within an autopoietic temporal field, a chrono-regime of its own dynamics (or mathematics, when data are registered digitally). Such couplings create moments of literal ex-ception: Man is taken out of the man-made cultural world (Giambattista Vico's definition of "history") and confronts naked physics. Another "instanciation" of my argument would be the pendulum (as experimented by Galileo Galilei and Christiaan Huyghens)

- media-electronic equivalent to the vibrations of the monochord string: the electromagnetic wave; refer to the archaeology of television in John Logie Baird's system; best method for *understanding media* is their re-engineering and putting into function; in this case: an operative model of Baird's *Televisor*. Nowadays in England, the Narrow Bandwidth Television Association (www.nbtv.org) since 1975 takes care of such early electromechanic, low-definition television. "The Association continues to extend its achievements, including the spanning of the Atlantic in January and February 2003 in emulation of J. L. Baird's 1928 exploit."⁸¹ *Nota bene* the use of the term "emulation", which signifies a kind of re-enacting which is co-temporal to the original itself. There is an experimental *Televisor* kit offered by the Middlesex University as a "teaching resource" (www.mutr.co.uk); accompanying brochure brings out that media time is about functional equivalence, in fact: repeatability, functional re-enactment (to take a notion developed by the historian Collingwood) in experiencing high-tech media time is closer to the criteria of an experiment in natural sciences than to historicist idea of history: "The *televisor* you have just purchased works in exactly the same way as the original, but uses modern components such as an LED instead of a neon lamp for picture illumination." And more specifically: What difference is between a functionally equivalent electronic component and its actual embodiment (such as the electronic vacuum tube and its functional replacement by the transistor)?

"It is about one third of the size of the commercial *televisor* - but the performance is as good" <ibid.> - a transformation of original to model (in simulation respectively emulation). The central a-historical criterium

⁸¹ Quoted from the brochure accompanying the *Televisor* kit offered by the Middlesex University as "teaching resource"; see www.mutr.co.uk

remains: "performance" as *gleichursprüngliches* re-enactment.

Sound and vision as radio and light waves (Heinrich Hertz)

- Wolfgang Hagen, Technische Medien und Experimente der Physik. Skizzen zu einer medialen Genealogie der Elektrizität, in: Rudolf Maresch / Niels Werber (eds.), Kommunikation, Medien, Macht, Frankfurt/M. (Suhrkamp) 1998, 133-173 (*online* www.whagen.de)

In 1879 Hermann von Helmholtz initiated a prize (Berlin Academy of Sciences) to answer the dispute which was the true theory of electricity: Weber / Neumann (no wave-like transmission, broken through an intermediary medium, but rather immediate re/action, in the tradition of Newtonian physics), or James Clerk Maxwell: Electromagnetic waves are part of an encompassing electromagnetic spectrum like light, thus subject to temporality, a limited speed.⁸² Radio waves, on the very media-archaeological level (that is, before becoming part of a mass-medium called "radio"), in other words, have a *sense of ending*.

- electric sparks known since pieces of amber rubbed with textile, named after Greek *elektron* since Thales of Milet; such sparks already behaved like "radio" - but missing detector, both mentally (in humans) and technocally (no "detector" until Eduard Branly's "Coherer" since 1890, invented as a laboratory device, further developed by Oliver Lodge in 1894). Radio as such "found" but not invented in the laboratory; rather put together by entrepreneurs like Giulielmo Marconi who combined the Hertzian apparatus with Branly's device and Popov's antenna to a functional tool for transmitting wireless Morse code); still, the experimental system "knew" it already: Douglas Kahn, Radio Was Discovered Before it Was Invented, in: Golo Föllmer / Sven Thiermann (eds.), Relating Radio. Communities, Aesthetics, Access. Beiträge zur Zukunft des Radios, Leipzig (Spector) 2006, 24-32. Such alreadyness as index of a non-historical media temporality which is equally original each time ("gleichursprünglich")

- media archaeology concerned not with inventions but dis-coveries

- experimenting vibrations: electro-magnetic wave propagation, that is: the media-archaeological experience of technological media, is not (merely) prehistory, but alternative approach to what has become the mass medium called "Radio"; Heinrich Hertz' discovery that electromagnetic waves propagate by means of high-frequency

⁸² See Wolfgang Hagen, Das Radio, Munich (Fink) 2005, 30

excitation of an open oscillating circuit, the result of a research query. Radio meant at first specifically not language and music but rather radio waves for wireless telegraphy, particularly radio telegraphy in marine radio after 1900. Term "radio" accordingly meant literally, in order to emphasize the specific properties of electromagnetic fields, namely the radial effect of the waves, broad-casting on the physical plane. It is therefore not enough to characterize radio simply as a device for receiving radio broadcasts, referring primarily to their content. Based on radius, that is, ray, the message is above all the medium: electromagnetic waves and high-frequency electrical signals, transmission, and sound, enunciated in latency

- electrotechnical transformation of speech into signals, of signals into waves, into recording and radiation

- Marconi took coherer as thunderstorm detector, combined it with the idea of a transmitting antenna. Marconi practicing wireless telegraphy; in 1901, communication bridged the Atlantic using electromagnetic waves for the transport of coded signals; "wireless" not always been synonymous with radio; patent registered in 1904 by Marconi's engineer John Ambrose Fleming, further developed an effect detected by Edison in light bulbs, by which electricity can flow from filaments to an additional enclosed electrode, even if no direct contact exists. In his patent manuscript of 1884, *A Manifestation of the Edison Lamp*, Edison explicitly describes electricity flowing through the vacuum «without wires»—literally «wireless,» radio inside the evacuated, etherless tube itself]

- spark gap transmitters generate pulse-shaped waves; why Heinrich Hertz did not already consider radio as acoustic content in his experiments; early radio was closer to Morse Code than to what we know as radio today, or, to put it differently: it was literally digital before it became, through speech and music modulation, an analog medium. The digital managed its reentry through pulse code modulation—with which radio in fact finds its way back to its original potential as broadcast medium; 1906, when the International Wireless Conference in Berlin regulated the handling of wireless communication; only with the introduction of tube technology that the human voice or music lastingly replaced Morse Code. Radio as function of a technological escalation: the vacuum tube; opposite of such electronics based on low-voltage current the Telefunken high-frequency machine transmitter of 1912 with a frequency of 10 kHz, which could be transformed up to 170 kHz, making telephony attempts from Königs Wusterhausen to Vienna possible in 1913; mechanical limits of such wave generation forced the paradigm change to the field of nearly inertialess electronics, the realm of the modulatable electron stream in

a vacuum / electron tube transmitter

- invention of the electronic vacuum tube by Robert von Lieben in Vienna and Lee de Forest in the USA at the same time and independently in 1906 as the decisive technohistorical mark of co-originality; 2006 therefore "one century of radio"? even antique radio, when successfully transducing signals, never in a historical state, rather in a present state; technological medium does not conform to the historicism of linear epochal concepts but infrastructural *durée* as *epoché*; in actuality, it undermines this logic and sets a different temporal economy

- an original recording resonating today from an old tube radio, provided it is still run on 220 volts, hardly makes history audible. A tube-based radio thus practices compressed time as respects sensory perception, as long as this is not overlaid with «historical meaning,» which cognitively does not correspond to the actual media workings of radio but rather to the logic of inscribed historiography

Technological addressing of human being (in time)

- experimental means of investigating eventuality, temporality, duration, and becoming; primary level of temporality in a flash-like manner revealed in the "experimental event"; the micro-temporal behaviour of the technological media in question (that is: "under experiment"); the second one is what it does to (or with) the "temporal sense" of the human experimentator; AV media address us at the existential essence of our sensation of being which is the temporal sense

- AV media address human senses at the existential sensation of being temporal phenomenology. They re-generate temporal experience, thus addressing the human on the sensory (aisthetical, physiological) level as radically present, while our cognition puts it into a "historical" context: here, a dissonance takes place, a gap opens, a *différent* in Jean-François Lyotard's sense (referring back to Kant)

The genealogy of mass media from measuring (experimental) media

- "No analysis of natural science, whether it be physics or biology, is complete unless we possess a proper analysis of its appropriate time-concept" = Norbert Wiener, Time, Communication, and the Nervous System, in: Annals of the New York Academy of Sciences, Bd. 50, 1948/50, 197-219 (197)

- "In experimental settings nature tells us something which does not exist somewhere in the natural world" (Haley)

- electro-physical measuring / recording of cultural articulation (digitally by "sampling") subjects the signal event to experimentation, thus enabling a non-hemeneutic analysis of cultural articulation on the sub-philological, even sub-alphabetic level

- media-archaeological context which led to what later became mass-media like the phonograph, cinematography, electronic television; such media have first been developed for experimental research, for analytic, not projective purposes (even the genuinely theory-born computer). To put it roughly: Any listening to music on records or to radio programs therefore is essentially experimental, a kind of reverse experimentation. The well-known television tube has developed out of a measuring device, Ferdinand Braun's electronic oscilloscope, like the Edison phonograph has been preceded by Léon Scott's "Phonautograph" to register the frequencies of the human voice for analytic purposes. Tuning (analog) radio is experimenting with radio waves and their electromagnetic resonances. The public use of "synthetic" mass media is *reverse experimentation* of analytic media (a term alluding to the media-archaeological practice of "reverse engineering").

The time-critical dimension as a genuine form of media experimentation

- both in humans and machines where micro-temporal events are crucial for the whole process to succeed at all - as an epistemological object of knowledge not only relatively new in occidental culture but one which came into focus only by high-precision time-measuring media itself. The time-critical dimension is a genuine form of active media knowledge and archaeology. Only with such instruments as Christiaan Huyghens' pendulum clock, leading to the introduction of minutes and even seconds on the clock scale, and more specific with electro-mechanic measuring devices as developed by Hermann von Helmholtz to cope with the speed of communication within nerves, and finally with electronics, the micro-temporal delays (Δt) which happen within brain functions could be analyzed; Adrian's electro-physiology with its technological *a priori* = the thermionic tube

Experimental time *versus* history of knowledge

- technological eventuality is time signal vs. history; the experimental diagram vs. historiography which is the act of symbol registering, both by measuring media or humans, in the laboratory

- Edgar Wind, *Das Experiment und die Metaphysik* [habilitation thesis 1929], Frankfurt/M. (Suhrkamp) 2001, esp. chap. "Theorie des Experiments", 70 ff.

- experimental settings, being unnatural / artificial, clearly belong to what we call and describe as cultural history (or "history of knowledge" in Latoureaan terms); on the other hand, from the point of view of the media themselves, that is: the media-archaeological perspective, there is something at work which is indifferent to historical change, the "time-invariant event"

Media-eventuality

- Heinz von Foerster's relational definition of *object* and *event*: "Eine mögliche graphische Metapher für die Komplementarität von 'Ereignis' und 'Objekt' ist ein rechtwinkliges Gitter, das von beiden gebildet wird" = Heinz von Foerster, *Bemerkungen zu einer Epistemologie des Lebendigen*, in: idem, *Sicht und Einsicht. Versuche zu einer operativen Erkenntnistheorie*, authorized version in German by Wolfram K. Köck, Braunschweig / Wiesbaden (Vieweg) 1985, 81-93 (87); AO: *Notes on an Epistemology for Living Things*, in: *Biological Computer Laboratory Report No. 9.3*, University of Illinois, Urbana 1972

- diagrammatic laboratory, where objects and relations meet

- in software engineering, so-called "event" is meant to govern a momentary use of the computer program in non-linear ways (often user-orientation at interfaces); the "interrupt", f. e., makes the mechanism wait for signal input from outside, and in modelling an arbitrary input leads to related events in the simulation.

- "time" and "event": concept of event-orientated programming

- In philosophical phenomenology, the "event" a singular and instant act which can not be subsumed unter general terms but is still constitutively at work for being, acting, knowing. In Martin Heidegger's late philosophical work, the fundamental notions of being (Sein) and time (Zeit) konverge in the event (Ereignis) = Martin Heidegger, *Beiträge zur Philosophie (Vom Ereignis)* [Gesamtausgabe III. Abt. Unveröffentliche Abhandlungen Vorträge - Gedachtes, vol. 65], Frankfurt/M. (Klostermann), 3rd edition 2003

- analytic ontology (Alfred North Whitehead) focuses on the processual "event"

- processual ontology is close to the essence of media technologies itself (since only when being in operation a medium is in its medium state). Media archaeology (different from the apparant archaeological metaphor) does not uncover artefacts but events.

- use of the term "operational"; employment of scientists in WKII (esp. British) operational research with the impact of mathematical-statistical methods, OR opens a temporal horizon ("future in the past", the anticipatory prediction of enemy aircraft behaviour), a truly experimental *eventuality*

Beyond experimentation

- in historical research, experimentation does not give access to historic knowledge, since past events can not be experimentally re-enacted (except in experimental archaeology, maybe); argument of historians usually applied to differentiate their hermeneutic discipline from the natural sciences; media-archaeological experimentation (as opposed to historicism) gives access to the invariants of knowledge in time Hermann von Helmholtz declares at the climax of historicism

- "How should an experimenter proceed when faced with a Black Box?" = Wilhelm Ross Ashby, *An Introduction to Cybernetics*, London 1956, 87. Cybernetic replaces experimentation with modelling, culminating in simulation, f. e. of nuclear reactions, by electronic analog computers first (and stored-program digital computing later)

- "referential" writing (as transitive *mimesis*) itself becomes operative: In science, "mathematical symbols <...> have a particularity: they reveal structures"⁸³, in fact: they become media-archaeological operators themselves (*poiesis*).

Mathematics is diagrammatical in the sense of Charles Sanders Peirce's "diagrammatic reasoning": "Mathematics is just the detection

⁸³ Max Born, Symbol and Reality, in: Objectivité et réalité dans les différentes sciences, Archives de l'Institut International des Sciences Théoretiques, Brüssel 1966, 151f. See Charles Alunni, Gustave Juvet (1896-1936). Un Pionnier Oublié des Études Cliffordiennes, in: Advances in Applied Clifford Algebras, Basel (Birkhäuser) 2009, 14-38 (26)

and investigation of structures of thinking which lie hidden in the mathematical symbols."⁸⁴

- distinction between referential and operative writing correlates with the distinction between semiotic and signal-processing systems

Artistic experimentation as metaphor?

- artist group *Ohio* produced video movies from experimental settings, such as the behaviour of a model rocket in a wind tunnel = video edition *Ohio* # 13 (2004) = www.ohiomagazine.de. "Nicht das Ge- oder Misslingen dieser Experimente ist für die Künstlergruppe Ohio von Interesse, sondern die Bilder sind es, die von ihnen gemacht worden sind."⁸⁵ Diagrammatically, media recording has a transitive, techno-aesthetic relation to the experimental event, being a form of cinematographic analysis of the kinetic event, while its media-artistic re-play has an intransitive, esthetical value. Film essayist Harun Farocki, made such cinematographic reflection another form of media theory itself: *Auge / Maschine*

- media artists Jan-Peter Sonntag, in his "Son:arc project", re-stages historical experiments on electricity as "research art"; a similar "experimentation as *art* event" takes place in his investigation of the Polar Light (Performance at the Alfred Wegner Institut Bremerhaven, October 30, 2009), tracing the so-called "Warden Sprites". There is a kind of electro-magnetic Tsunami caused by solar turbulences, as seen in September 1859 as emanation of "Nordlichter" around the globe. Nineteenth century electric telegraphy was disturbed by such "natural radio" even before radio as cultural broadcasting had been invented - a kind of retro-media archaeology. SPRITES are ultra-short appearances of light between the troposphere and the ionosphere (the reflecting medium for short wave radio) which cause echoes in (natural) ELF waves (Extrem Low Frequency). Such "events" are used by Jan-Peter Sonntag to modulate fluorescent tubes fill with lightning gas (causing "TESLA-light") and to cause perceivable sound out of these ultra- and infra-sonic waves. "Sferics" is the technical term for atmospheric long-wave radio signals caused by thunderstorms et al.

- Beam Forming: "acoustic camera", based on a microphone array, makes acoustic events in space visible in ways which locate the source of sound. Thereby one sees what is heard synaesthetically, based on

⁸⁴ Born *ibid.*

⁸⁵ Ohio (Uschi Huber / Jörg Paul Janka), in: Zeitschrift für Medienwissenschaft 1/2009, 104-113 (104)

time itself as a channel: signal runtime differences (Δt). What looks like a spatial operation, takes place in the time domain and thus turns space into an event. The experience of space by temporalization is known in its crudest form by binaural hearing in humans, and as echo location. But such mechanical evidence in Newtonian space fails within the electromagnetic field.⁸⁶ The Siemens Studio for Electronic Music, as preserved and displayed in the Deutsches Museum at Munich, demonstrates how the very existence of electro-acoustic as art form is a direct function of measuring media. Only electronic devices develop an "ear" for the EM

Media-archaeological experimentation

- contrasting the chrono-photographical experimental setting of Eadweard Muybridge to answer the question if horses in the course of galloping at one moment lift all four legs above ground (which it too fast to be noticed by human eyes, such as the painterly gaze), laboratory setting constructed by Ernst Mach and xxx Salcher to measure the speed of a bullet by electro-photographical short-circuits made use of the electric spark as subject and object of photography itself. In both cases, the camera time-critically recognizes events which the human eye does not see at all.

- In her installation *Blow up TV* the media artist Angela Bulloch uses a key visual, a sequence from Michelangelo Antonioni's film *Blow Up* (1966): the protagonist, a photographer, hiding behind a tree taking photos to discover a murder; but in trying to identify the spot, the closer the camera looks, the less is the apparent murder an evidence [siehe Karl Krauss? "Je näher man ein Wort anschaut, desto ferner schaut es zurück"]. The artist extends this process of identification by yet another magnification, enlarging the digital scan of this scene in great blocks of its single pixels. Thus the image *implodes* by slowing down the cinematographic motion to one digit per second (thus undermining the copyright which is based on the recognizability of the motive for the spectator), and on the other hand the original image *explodes* within a sequential modular system of purpose-build so-called *pixel boxes*, where one pixel is represented in a 50 x 50 cm monitor which are attached to complex RGB lighting systems which can be generated and programmed with any digital information⁸⁷ - a

⁸⁶ See Johannes Gfeller, Der Referenzgerätepool von *AktiveArchive* an der Hochschule der Künste Bern, in: Schubiger (ed.) 2009, 212-221 (215)

⁸⁷ Such is the installation *BLOW_UP T.V.* of Angela Bulloch in the gallery Schipper & Krome, Berlin, September to November 2000

desillusion of the image betrayal of the human eye, revealing the scanner-gaze of the computer which is "looking" at a different kind of evidence, not looking for letters any more. The pixel modules - which also point at the fact that digital images are hyper-indexically composed by pure information, as opposed to the referential image like the classical photography which still suggest a pre-discursive real - were developed by Angela Bulloch and Holger Friese, indicating that multi-media archaeology requires high-technical skills.

- pixel = smallest conceivable picture element, which makes sense in a semantic way only when appearing within a group. When the square of light made by a single pixel is 50 x 50 cm, the distance between the viewer and the group of pixels must be large in order to discern the image; the closer the media-archaeological look, the more distant the "image" becomes

- in addition to spatial distance, a temporal extension. In order to perceive a "movie" (moving images composed here by pixels), the momentary glance does not reveal the temporality. It takes time (like David Gordon's *24 Hours psycho*) to see a movie this way.

- media experimentation basically experimentation of temporal figures

- Swiss video artist Jean Otth manipulated the line deflection electronics of a TV set in order to create a simple horizontal line on the screen which is pulsed by the intended, but not realized line transfer rhythm. He called this 1974 piece *Exercice IV de l'abécédaire télévisuel*; reconstruction of this video installation in Kunstmuseum Luzern (2008), catalogue: Irene Schubiger (ed.), Schweizer Videokunst der 1970er und 1980er Jahre. Eine Rekonstruktion, Zürich (ringier Verlag) 2009, 92. A measuring test of the signal flow on the oszilloscope proves that this has been a conscious manipulation and not just a defect of the apparatus.⁸⁸

- media archaeological analysis gains insights from the technological devices in operation. Disassembling and re-assembling devices; as well *symbolically* opening the "black box" to get insight into what media do; investigate program close to the machine like Assembly; Signal Laboratory focuses on operational media analysis; computer platforms are in working condition; „hands on“ approach is imperative; historicity vs. functional equivalence in Retro-Computing

⁸⁸ Johannes Gfeller, Anmerkungen zum restauratorischen Hintergrund der Ausstellung, in: Schubiger (ed.) 2009, 124-135 (125, figs. A and B)

DIAGRAMMATICS OF DIGITAL MEMORY AND CHRONOPOETICS

- January 2014, by chance discovery of a waste TV, half covered by years of dust, grass and leaves: an old tube-based television set in the woods north of Berlin; careful "excavation" happens with reflecting in parallel about the multiple tempor(e)alities of decay / entropy which are involved in such a device - from the almost indestructible vacuum tubes down to the electric circuits which partly dissolve into something like abstract geometry; re-enacting TV set from reading its electronic circuitry = operative media diagrammatics

Operational media archaeology

- storage = crystallization of temporal objects resp. recycling; endurance of storage is becoming increasingly more short-term. ROM (long-term read-only memory) challenged by RAM, by random access. Final storage transforms into interim signal buffering; still, storage does not disappear; "cloud computing" emblematic of the other kind of distancing that takes place when a range of storage is outsourced and increasingly calculation is externally performed ("apps"); proprietary servers with implications for data retrieval (and reuse). Such data whether from the fleeting messaging patterns of mobile cultures or data saved on external servers retrievable in computer forensics applied now to digital cultural heritage practices; Matthew G. Kirschenbaum, Ovenden, Richard; Redwine, Gabriela (2010) Digital Forensics and Born-Digital Content in Cultural Heritage Collections Council on Library and Information Resources (CLIR) publication 149, <http://www.clir.org> Washington; question of who legally has access raises a different set of questions not touched upon by the more technologically focused approach

- in *Mechanisms - New Media and the Forensic Imagination*, Kirschenbaum examines digital media and electronic writing against the textual and philological traditions that govern writing, inscription, and textual transmission as cultural techniques: erasure, variability, repeatability, and survivability; significant attention to storage (hard drive); distinction between "forensic materiality" and "formal materiality"; computer forensics techniques; the humanities examines books as physical objects and traces different variants of texts; computer forensics encourages to perceive algorithm-driven media in terms of specific versions, platforms, systems, and devices

- link between technological frameworks and aesthetics; in the sonicist sense, "music" models media time. The sonic and the

rhythmic as exemplary cases in understanding of algorithmic media: how are instructions executed, how the executive operationality of data takes precedence to interpretation or semantics. Manovich claimed that the logic of database replaces that of the narrative in digital media = Lev Manovich, *The Language of New Media* (Cambridge, MA: The MIT Press, 2001), appl a similar idea from the point of view of temporality. Referring to Vilém Flusser, model of historical time was deeply intertwined with alphabetic writing which reduced the multidimensionality of architecture and images to linear, sequential lines

- television as a specific regime of the image that is not static but continuously regenerated in cycles of scanning of the cathode tube ray - line by line, which implies a different linearity to that of the narrative. Digital networks incorporate the temporality of “pings” of the ICMP protocol: echo request, echo reply are the basic communication rhythms that sustain the transfer of information over the net. (cf Pias 2011). This brand of media studies starts from the signal as the basic unit for analysis - and as Wendy Chun has noted, “signal” affords itself both towards “physical events and symbolic values” = Wendy Hui Kyong Chun, *Programmed Visions. Software and Memory* (Cambridge, MA: The MIT Press, 2011): 156; signal processing capacities of technological devices dependent / aimed at / communicate with sense-specific human perception physiology; online streaming, especially with slightly slower Internet connection that halts at times to load the content; this reliance on the signal as a time based process in earlier mass media; technological signal processes addressed / oriented at human perception; the signal-to-noise ratio is governed by complex diagrams familiar to engineers and mathematicians: the statistics inherent in transmission, or the specific colour worlds this has related to

- "the broadcast of any football game illustrates the signal-to-noise ratio between plays on the field and amorphous shots of the spectators in the stadium only statistically. The archeology of media searches the depths of hardware for the laws of what can become a program. [...] Even today, the color blue has a mediatic veto in chroma key resolution; the same goes for the blue screen, and for manipulations of resolution and color filters." For media archeology, the only message of television is this signal: no semantics

- technologies of *aisthesis*; Claude Shannon's engineering perspective on the primacy of channels and signals that temporally processed in channels as grounding (McLuhan) on which data, information and hence cultural forms are being sustained and distributed in technical media culture; mathematical codes and in their algorithmic execution,

processes defined by patterns of signals unfolding in time; *dynamic ontology*: frequencies instead of beings, quantities instead of qualities and functions instead of attributes, to paraphrase Bernhard Siegert (referring to Max Bense) = "Cacography or Communication? Cultural Techniques in German Media Studies", 40: "Like physics, aesthetics is a science whose primary object is signals, the physical materiality of signs."

- technological media is to be understood from the viewpoint of its channel capacity which counts with time (bits/sec.). It is less about the objects of/in those channels than about the operations which introduce the patterns, pulsations and intervals through which information becomes a reality of the channels before becoming a reality for the phenomenological viewers/listeners/readers of media

- a technological medium is defined as the physical passage which mediates something codified, and gets decodified at the other end; emphasis on the primacy of the channel for the toolbox of the media theorist: the blunt existence of a channel as a physical reality is where media starts, literally "metaphorical"

- underlying processes of signal processing, operating, executing, and synchronization form media microtemporality and time-criticality as the road for media archaeology; distinguish the uniqueness of media studies from "cultural studies"

- software points us back to operating systems, then back to the BIOS (basic input/output system), and so forth – tracking a "kind of descent from software to hardware, from higher to lower levels of observation" = Friedrich Kittler, "There is no Software" Ctheory-journal, 10/18/1995, <http://www.ctheory.net>; at the end, we just reach voltage differences