[Wolfgang Ernst: SCRIPTS ON TECHNICAL MEDIA]

TEXT BLOCK "TIME-VARYING VOICE SIGNALS (PHONICITY)"

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THE PHONIC CHOQUE

The phonographic Nipper effect: "shocking" logocentrism

In their incubation phase, new technologies get media-archaeological (instead of mass-media) attendance. When a technology comes into being, it is usually subject to a closer description than retrospective discurse analysis alone would yield. Marcel Proust describes the experience of his grandmother's telephone voice at a time when this

electro-acoustic device was still not yet digested into everyday practice and rather perceived as a spectral "medium".[1]

"The voice, separated from its body, evokes the voice of the dead"[2], as exemplified by the narrator in volume three (*The Guermantes Ways*) of Marcel Proust's *In Search of Lost Time* for the case of a telephone talk with the distant grandmother. The affective-cognitive dissonance of experienced nearness in spite of the knowledge of distance results in a gap similar to the affective listening of a musical recording from the past: "A real presence, perhaps, that voice that seemed so near - in actual separation!"[3].

This gap is structurally akin to the central feature of trauma: a non-historicisable affect of presence. The way Proust seeks to describe the psychic schock induced by the phonographic voice reveals a special aspect of the overall novel theme of *la recherche du temps perdu*: It is impossible to integrate this temporal experience into narrative discourse; one can not symbolically representat real signals, "an instant that resists transmutation into discourse"[4]. What can be scientifically described, though, is the micro-eventality of signal transduction from phonographic record and its physiological processing in the human ear, the almost transient identification of the individual speech timbre and its micro-temporal creation of awareness ("presence") in human consciousness.

With the Edison phonograph, the auratic uniqueness of the ephemeral voice has been replaced by its very iterability - deferred logocentrism (in Derrida's sense). This shock has not yet been digested in the cultural unconscious.

On 1st of February, 2012, German Deutschlandfunk radio announced that the voice of the German chancellor Otto von Bismarck has been re-discovered - from and as medium. In fact, different from the early morning newspaper report on this discovery, the medium radio could actually perform what it talks about and re-play the Bismarck voice file.[5] The radio commentator remarked on the signal-to-noise ratio of this record: "Das Lauschen und Rattern der Tonwalze ist lauter als das, was der Reichskanzler sagt." The material glitch here is the message - signalling the media tempor(e)ality of non-historical voice memory.

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[1] Marcel Proust, Auf der Suche nach der verlorenen Zeit [Marcel Proust, Frankfurter Ausgabe, ed. Luzius Keller, Werke II], vol. 3: Guermantes, Frankfurt/M. (Suhrkamp) 199 6, 186

[2] Dolar 2006: 64

[3] Proust 2001: 419

[4] Paul Frosh / Amit Pinchevski, Introduction, to: same authors (eds.) 2009: 1-22 (8)

[5] See *Spiegel online*: "Tonaufnahmen vom Reichskanzler", http://einestages.spiegel.de/static/topicalbumbackground/24306/so_klang_bismarck.html

While for HiFi-trained listening today, in early phonographic music recording, the signal can hardly be discreminated from the noise of the rotating cylinder, on the other hand, in 1916, an experimental performance in New York's Carnegie Hall directly compared the living singer's voice to her phonographic recording: "Alone on the vast stage there stood a mahagony phonograph [...]. In the midst of the hushed silence a white-gloved man emerged from the mysterious region behind the draperies, solemly placed a record in the gaping mouth of the machine, wound it up and vanished. Then Mme. Rappold stepped forward, and leaning one arm affectionately on the phonograph began to sing an air from "Tosca." The phonograph also began to sing "Vissi d' Arte, Vissi d'Amore" at the top of its mechanical lungs, with exactly the same accent and intonation, even stopping to take a breath in unison with the prima donna. Occasionally the singer would stop and the phonograph carried on the air alone. When the mechanical voice ended Mme. Rappold sang. The fascination for the audience lay in guessing whether Mme. Rappold or the phonograph was at work, or whether they were singing together."[6]

On occasion of an analogous confrontation between vocal human performance and phonographic technical operativity, in the same year the Boston Journal reports: "It was actually impossible to distinguish the singer's living voice from its re-creation in the instrument."[7]

With the phonograph, all of the sudden, the ephemerality of the human voice and musical sound became disposable in a way Henri Bergson criticized for the phonographic illusion of technically capturing movement. Life, as it were, became artificial. Until phonographic recording, the performance of insubstantial musical works had been experienced as akin to the transience of
living beings:

"But ever since Edison heard his phonograph singing 'Mary had a little Lamb' in December 1877, he destabilized this metaphor, challenging the uniqueness of any single duration. [...] By fixing a reality, hitherto subject only to direct experience, Edison’s invention also apparently fixed the unfolding of time. [...] Sound could now be captured, commodified, and replayed; the passing of time, therefore, could be objectified, recalled, and re-lived; our existence - allied to that of time - could, with the aid of technology, be re-presented indefinitely. Our presence could thus quite literally be re-membered. If families do indeed listen to their deceased

[6] "Edison Snares Soul of Music", in: New York Tribune, 29th April, 1916, 3
[7] As quoted in: Emely A. Thompson, Machines, Music, and the Quest for Fidelity. Marketing the Edison Phonograph in America 1877-1925, in: The Musical Quartely vol. 79 (1995), 132. See Peter Wicke, Das Sonische in der Musik, in: PopScriptum 10 (2008), *online* http://www2.hu-berlin.de/fpm/popscrip/themen/pst10/index.htm

relatives, as Edison suggested, they - like Nipper - feel an eternalized presence; this, however, is nothing but the specter of one's remembrance, the flipside of which is that listeners experience the presence of their own mortality: an apparition inscribed as grooves onto a metallic tomb. "[8]

Acoustic signals, once recordable and thus replayable, transformed from an immediate sonic experience ("musical presence") to technically implicit "sonicity".

As has been iconized by the HMV record label *logo* (derived from Barraud's original painting), the dog Nipper literally listens to "His Master's Voice" on his very coffin.[9] The real stays with the corpse (Lacan). For Adorno Nipper in this painting is "the right emblem for the primordial affect which the gramophone stimulated and which perhaps even gave rise to the gramophone in the first place. What the gramophone listener actually wants to hear is himself, and the artist merely offers hm a substitute for the osn diage of his own person, which he would like to safeguard as a possession. [...] Most of the time records are virtual photographs of their owner [...] - ideologies."[10]

The priordial affect of listening to absent voices from phonograph stems from the technological impetus itself. Adorno here folds the two components of the Narcissus theorem into one: the "acoustic mirror" (failing to recognize the audio-visual rupture inbeteween). But in fact Adorno locates the driving "traumatic" force in the technical invention which led to the phonograph in the im/moretality impulse - just like Sterne's subtitle to *The Audible Past* reads: "Cultural Origins of Sound Reproduction". Only with such sound reproduction becomes the past audible in the sense of a "historic" record (literally). But media-archaeological close inspection reveals that is was phonetic research (Léon-Scott) which led to the Phon(auto)graph. There is an autonomous inner-technical logic(s) which leads to the apparatus; its powerful impact in fact derives from the coupling to a discours (the obsession with im/mortality in the Victorian age). "The inside of sound was transformed so that it might continue to perform a cultural function"[11], namely the desire for immortablity. But this confuses the scientific interest in phonography with a cultural discourse.

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[8] David Trippett, Composing Time. Zeno's Arrow, Hindemith's *Erinnerung*, and Satie's *Instantanéism*, in: Journal of Musicology 24 (2007), 522-580 (538)
[9] See "Prayers of a Phonographic Doll", http://forums.ssrc.org/ndsp/2014/01/29/prayers-of-a-phonographic-doll, accessed August 2014
[10] Theodor W. Adorno, as quoted in the extracts from Sterne 2003 in: Smith (ed.) 2004: 306
[11] Sterne 2003, as reproduced in Smith (ed.) 2004: 306

While historiography refers to times past which are by definition absent, audio-visual signal recording in fact creates repeatable presence. While symbolical historiography semiotically refers to an external temporal referent, signal recording keeps presence in latency which is a different category of technical and psychic time. While the status of the witness in terms of historical research is clear, media audiences are not simply recipients of someone else's testimony[12] but by the very electro-magnetic nature of live transmission (and its recording) actually become witnesses in repeatable event space. The non-decidability for human spectators between "live" and recorded sound & image leads to a kind of temporal Turing test (not of "intelligence", but of the "time sense"): Recorded past or actual present? This is not derived from a traumatic experience, but leads to a traumatic irritation of the human sense and metaphysics of "presence".

The role of the IBM computer in the *Jeopardy* quiz and in the film *Desk Set* reminds of the classic "Turing test" (now famous from the movie *The Imitation Game*). Traumatic affects or schocks induced by technology itself differ from trauma studies which are related to historical events. The human/machine difference worked well as long as Descartes could separate body-automata from the soul, but got more irritating when it came to experiments in artificial intelligence.

The vocal apparatus actually produces subvocalisation during silent reading - implicit phonography.[13] This subvocalisation is not only essential to the production of literary language but is a reverse engineering of the origin of the phonetic alphabet itself which introduced discrete vowel letters for recording the musicality of Homer's oral poetry.

Poulsen's patent description of the Telegraphone[14] points out that signal recording differs from alphabetic writing in being a different, non-symbolic inscription: graphical sound. Once vocal sound is no longer symbolically situated in the vowel characters of the alphabet but as signals in the machine, it can no longer be represented within the world of the text. The technological qualities of audiotape that changed the relation of voice and body: "Telephone and radio broke the link between presence and voice by making it possible to transport voice over distance"[15] - a perceptual shock disrupting occidental logocentrism.

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[12] See Paul Frosh, Telling Presences. Witnessing, Mass Media, and the Imagined Lives of Stangers, in: Frosh / Pinchevski (eds.) 2009: 49-72

[13] See Garret Stewart, Reading Voices: Literature and the Phonotext. Berkeley (Univ. of California Press) 1990, as referred to in Hayles 1999, 207

[14] Valdemar Poulsen, Method of Recording and Reproducing Sounds of Signals, reprinted in: Marvin Camras, Magnetic Tape Recording, New York (Van Nostrand Reinhold Company) 1985, 11-17

[15] Hayles 1999: 208

As long as archival records consist of coded symbols in alphabetic writing, a cognitive distance - in spite of the auratic qualities of handwritten manuscripts or autographs - can be more or less kept, since an act of decoding has to take place which involves the cognitive apparatus. But once photography and phonography, the first apparative media in its modern sense, became subject of the archive, the sense-affective, presence-generating power[16] of signal-based media cuts short the distance which is a prerequisite for *historical* analysis, in favor of mnemonic immediacy - the electric shock.

"Presence" generation nowadays oscillates between the analog and the digital, between "live" transmission and "real-time" processing.

"One can no longer distinguish, visually or aurally, between that which is reproduced and its reproduction [...] not even discern *that* or *when* reproduction or repetition, in the manifest sense of recording or replaying, is taking place. We must be informed whether or not what we are seeing is "live". [...] we cannot distinguish through our senses alone between what we take to be simply "alive" and what as reproduction, separted from its origin, is structurally posthumous [...]."[17] This chrono-traumatic irritation results in a cognitive-affective dissonance between what is conceived as "historical" and perceived as "present" indeed. What Derrida's *Grammatology* once coined the irreducible "iterability" of the mark has become electronic storage and re-play.

When audio-signals from the present are exposed to recording devices intended for future re-use, they have lost their uniqueness already in favor of archival addressability. The "life-logging" audio cassettes of the electronics avantgardist Erkki Kurenniemi, recorded during the 1970s, were intended for algorithmic re-calculation in 2048. In the (mostly pornographic) activities performed for, and recorded in Kurenniemi's video diaries, "[t]emporality is similarly split between the present tense and the future tense of a replay. The present is always folding into the future, the revisited and the re-edited."[18]

Sonic Shock: Disembodied Voices

Analog telephony *is* indexical, an acoustic touch, "audio-tactile" in McLuhan's sense, since such electro-acoustic transduction keeps the integrity of the physical signal even in "transformation" of mechanical

[16] See Hans Ulrich Gumbrecht, Production of Presence. What Meaning Cannot Convey, Stanford University Press 2004
[17] Samuel M. Weber, Mass Mediauras: Essays on Art, Technics and Media, Publications of the Power Institute, Sydney, Stanford UP 1996, 121
[18] Susanna Paasonen, Slimy Traces: Memory, Technology and the Archive, in: Erkki Kurenniemi. A Man from the Future, published by the Finnish National Gallery Central Art Archives, edited by Maritta Mellais, Helsinki 2013

into electric waves - while the electronic image reproduces light waves which are immaterial electro-magnetic waves itself.

The immediacy of the telephone voice has been irritated by image-augmented telephony, as became apparent with the *Picturephone* propagated by Bell System in the 1960s and earlier experiments with cable-based *Bildtelephonie* in 1930s Germany[19] until the failure of Panasonic V*ideophone* (experimentally used for the Van Gogh-TV Kassel Documenta installation *virtural plaza*). "Could there be a fundamental barrier to the acceptability of telephones with moving pictures?"[20]

Even technologically reproduced voices from the microphone and the speaker "are or appear - against the dominant positions in theories of voice, media and tehatre - by no means disembodied"[21]. Technically in between sound and sonicity, the "disembodied" radio voice is an interlacing of both physical voice transduction and immaterial electromagnetic ("wireless") transmission. Technical signal transmission here becomes a semiotic act: "A signal is an utterance of a discursive symbol or sign, deliberately placed by the utterer within what he believes to be the field of sensuous attention of another person [...]."[22] Still, the ear as such is "unsheltered against sonic violence.[23] Violent noise - sonicistic disturbance - is even the condition for the generation of oscillations which therefore can never be completely harmonic: An external disruption has to start the periodic event ("transients" as micro-traumatic eventality which is subliminally perceived by the ear nevertheless).

Is "warm" sound from analog sound recording media contrasted by "cold" sound from digital carriers? The difference is between "signalling presence" (analog phonography, signal-based) *versus* "archiving presence" (sampled audio signals, requiring algorithmic processing before transduced back into the analog speaker).

In the opera *Einstein on the Beach*, composed and orchestrated by Philip Glass / Robert Wilson / Lucinda Childs, a choir sings numbers and syllables. Einstein's voice here is not simply phonographically disembodied, but digitally transformed into acoustic clusters.

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[19] See Isabell Otto, Happy Birthday from Skype. Zur Darstellung von Temporalität in einer Online-Werbekampagne, in: Zeitschrift für Medienwissenschaft vol. 9, no. 2 / 2013, 53-65 (59 f.)

[20] A. V. Lewis / G. Cosier, Wither Video? Pictorial Culture and telepresence, in: Graham Walker / Phil Sheppard (ed.), Telepresence, Boston et al. (Springer Science * Business Media) 1999, 99-141 (101)

[21] Doris Kolesch, Touched by Voice, lecture at the conference *Resonances* (MPI Bildungsforschung, Berlin, November 2013), *abstract*

[22] C. J. Ducasse, Symbols, Signs and Signals, in: The Journal of Symbolic Logic, Bd. 4 (1939), 44

[23] Jacques Lacan, Die vier Grundbegriffe der Psychoanalyse, Olten 1978, 178

Speaking with the Dead

Signal recording media technologies, starting with photography in the visual, and with phonography in the audio realm, have almost immediately been associated with attempts to communicate with the dead. "By extending indefinitely the gap between the body and its traces, by exceeding the ontological opposition between presence and absence, media technologies conjure up a 'spectral logic'."[24]

"I can be touched, *presently*, by the recorded speech of someone who is dead. I can, *here and now*, be affected by a voice beyond the grave."[25] But maybe this double *mediumism* only takes place with analogue media and abruptly ends with digital data processing. Signal recording performs the *in*distinction between message and noise, referential recording and the articulation of the recording device itself, while binary data (though technically still being embodied in electrophysics and driven by current energy), *per definitionem* in communication theory, logically abstract from their material implementation.

Different from historiographical writing, the audio channel has an almost ahistorical power of presence, even if cognitively the recording from the past is immediately contextualized as historical. The recording of the acoustically, or optically, "real" physical signal is opposed to the 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, coded cultural symbol. With computing, though, this dialectic opposition becomes synthesized again, since Digital Signal Processing (notably sampling of audio events) is a function of discrete symbolization, a re-entry of the "alphabet" in numerical and logical form. If according to Walter Ong the electronic revolution in mass media communication devices like radio and television has led to a "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. By its digitization, the voice turns silent and still articulates - in its implicit mathematical sonicity which is the ultimate shock to occidental logocentrism.

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[24] Amit Pinchevski / Tamar Liebes, Severed Voices: Radio and the Mediation of Trauma in the Eichmann Trial, in: Public Culture 22:2 (2010), 265-291 (283, quoting an expression by Jacques Derrida and Bernard Stiegler, Echographies of Television, Cambridge (Polity) 2002, 117

[25] Jacques Derrida, Above all, no journalism, in: H. de Vries / Samuel Weber (eds), Religion and Media, Stanford, CA (Stanford University Press) 2001, 56-94 (71)

Case Kurenniemi

A media-specific kind of memory emerges when an individual becomes signal memory in electro-acoustic storage devices. From 1972 to 1974, Finnish artist-engineer Erkki Kurenniemi recorded private everyday entries on cassette tapes, just like in Samuel Beckett's one act drama Krapp's Last Tape the protagonist keeps a phonetic diary on magnetophone. From the early 1980s onwards Kurenniemi also kept a video and photograph log of his surroundings and personal events, "with the aim of producing material for a digital sampling of his life which, some time after his death, would algorithmically be revived.

Different from Goethe or Krapp's ledger (registry), Kurenniemi did not yet pre-structure it as an archive to "govern" his future memory in anticipatory ways as archival future-in-the-past. How to cope with such an abundant mass of audio-visual and textual data in terms of an "open" archive, that is: multi-variant access, multiple interfaces, no filtering meta-data, no unifying index, not reducing the raw data to taxonomy, not just tags for grouping and retrieval? The answer is in the software tools which have been applied to the Kurenniemi media memory by the Active Archive project (Constant, Bruxelles).[26]

Sono-chronic tunneling of historical distance

The inverse meaning of the term "contemporary" is the *entanglement* of times which have been traditionally clearly separated on the time line.[27] The reverse of the delayed present is the specifically media-induced "re-presencing" of the past: technological ways of re-generating and re-storing present moments.

In Marcel Proust's *Recherche*, involuntary memory stems from material objects like the Madeleine cookie. In Walter Benjamin's paraphrase, the past here is "unmistakably present in some material object or in the sensation which such an object arouses in us"[28]. But there is another present in the past which does not adhere to the material artefact in *stasis* but emanates from a processual unfolding: like images re-played in electro-magnetic induction from magnetic video tape. There is a wave / matter - dualism in affective re-presencing, oscillating between "presence in default" and "in default of presence".

Electronic storage media for audio-visual re-play generate a presence of the past by actually addressing the perceptual nerves within the human

[26] See Cox / Murtaugh / Mallevé, xxx, in: xxx
[27] See Daniel Rosenberg / Anthony Grafton, Cartographies of Time, New York (Princeton Architectual Press) 2010
[28] Walter Benjamin, On Some Motifs in Baudelaire, in: idem, Illuminations, New York (Schocken) 1969, 158

in signals, not by symbols (such as historiographical texts) which require de-coding and address the cognitive mind (where historical modelling takes place). Tele-communication is mostly associated with the bridging of spatial distance by communication media (Shannon), but actually it extends to temporal distance as well when by signal-recording media the temporal gap is being un-done in favor of immediacy in the moment of re-play.

There are technical conditions "under which the absent past can be said to have 'presence' in the present" indeed.[29] The affective present-in-absence is central to technological media especially in the sonosphere. The absence here is the phenomenal dissimulation of the technological apparatus of signal (re-)production in favor of a "Sirenic" presence - Sirenic in the sense of human-like presence generated by machines.

Rigorous attention to material signals and machines escapes the risk of falling into a romantic orientation here. The perceptual, phenomenomal impression of immediacy of the past when listening to the recorded human voice is a function of a concealed technology; the acousmatically hidden sound source has become techno-*logos* in the phonographic apparatus - which, in times before "hight fidelity" sound, has been still very present, both materially and in its self-co-expression as noise.

All temporality experienced by humans is in a constant present, as expressed in Henri Bergson's diagram of the "memory cone" where past perception is always compressed within perception of the present. "For beings living in the Now [...] not even past and future exist if not re- or pre-presented, respectively."[30] But while phenomenology makes use of such neuro-cognitive modelling (Husserl's "time diagrams" of perception of the present inbetween *retention* and *protention*), media archaeology tries to precisely identify the rather different operations of micro-technical signal transduction. All of the sudden, the top of the Bergsonean cone returns in the pick-up of a gramophone needle.

Sonic memory is arbitrary triggered by technological re-play such as a music record at the press of a button. Is what happens then "the re-living of an event that has already happened in linear time rather than an event as if it were happening now in repetitive or cyclical time"[31]? Does technology, even if invisible as it acousmatically is perceived, make a

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

[30] Georg Franck, Zeit und Geschichte / Time and History, in: Beiträge der österreichischen Wittgenstein Gesellschaft, vol. XIII, ed. Friedrich Stadler / Michael Stöltzner, Vienna 2005

[31] Ben Anderson, Recorded music and practices of remembering, in: Social and Cultural Geography, vol. 5, no. 1, March 2004, 3-19 (17)

difference to the quality of "presence" perceived? The con-temporary condition is technological.

Different from reading textual records from the past which need to be cognitively decoded (alphabetic symbols and words), with every listening to an ancient recording a gap between time-affect and historical cognition opens. Ears can perceive nothing but acoustic presence, while the historical imagination induced by linear writing takes place in the mind exclusively. The media-archaeological sense of *arché* tries to dislocate this acoustic imaginary.

There is a specific difference between the photographic *punctum* as described by Roland Barthes for visual short-cuts of temporal distance and phonographic *re-presencing* of the transitory impressions of sound art. The articulations of sound art are time-objects in themselves.

The physical presence of any acoustic situation (which is the "real" of vocal frequencies) short-circuits the "historical" distance, when e. g. the myth of the ancient Siren singing is tested against the signals of a sound-generating medium (the technical *aerophone*) on the spot of the Homeric Siren scene, the Li Galli islands close to the Amalfi coast in Italy.[32] Emphatic historical past and techno-cultural present fold into one con-temporary condition.

Especially voice recording enables direct contact that is separated when history time is stretched out on a continuous line[33] - a temporal "fold" (Leibniz) enabled by technology.

On the micro-physical level of technologies (transducing analog signals and processing digital data), there is a direct time-critical link between the (tempo-)real and the symbolic at the complete expense of the imaginary called "history".

The tempor(e)al interlacing between archiving the present and re-presencing the archival past becomes precarious when the focus is on traumatic memory. While a lot of such studies concentrate on Holocaust and extreme war time experience in terms of historical events, the media-archaeological analysis more radically assumes that a traumatic

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[32] See W. E., Towards a Media-Archaeology of Sirenic Articulation. Listening with media-archaeological ears, in: The Nordic Journal of Aesthetics, no. 48 (2014), 7-17

[33] Geoffrey Winthrop-Young, Siren Recursions, in: Kittler Now. Current Perspectives in Kittler Studies, ed. Stephen Sale / Laura Salisbury. Cambridge UK (Polity Press), 2015, 71-94 (93, note 5); manuscript version http://phenomenologymindsmedia.files.wordpress.com/2011/05/winthrop-young-siren-recursions.pdf

irritation which is communicated by recordings of witnesses, like Claude Lanzman's notorious documentary *Shoah* where the viewer is affected or even "co-traumatized" (Jan-Claas van Treeck), already (*en arché*) stems from the technological setting itself which continuously challenges and irritates the human sense of presence as it was familiar in traditional textual, pre-signal recording culture.

Disembodied voices from analog to digital analytics

At the end of World War II, the German Service of the BBC recorded voices of survivors immediately after the liberation of the concentration camp Bergen-Belsen to be broadcasted repeatedly *via* radio. Such recordings are preserved in the Phonothek of Deutsches Rundfunkarchiv in Wiesbaden. There is a momentum of temporal indexicality in such signal-witnessing, as expressed in the CD Booklet of the re-edition of these recordings.[34] The medium specificity embodies the character (or even timbre) of that epoque much more indexically than any printed text might ever achive - or *archive* in alphabetical transcription. Such *signal memory* allows for (and incites) new kinds of rather signal-b(i)ased linguistic analysis software like Praat. Such an analysis is less an emphatic recall of past sounds, but - in a kind of time-lense - a media-active archaeology of the *passing* in the vocal present itself which is not logo-centric any more but unfolds as something which is always already past when articulated.

Media technologies starting with photography have been associated with attempts to communicate with the dead - a "spectral logic" of re-presencing.[35]

Derrida defines his time sensation in voice recording: "I am always overwhelmed when I hear the voice of someone who is dead, as I am not when I see a photograph or an image of the dead person"[36] - in spite of the Barthean *punctum*. "I can be touched, *presently*, by the recorded speech of someone who is dead. I can, *here and now*, be affected by a voice beyond the grave" (ibid.). But this spiritism overtone only takes place with analogue media and abruptly ends with digital data processing.

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[34] Published on Compact Disc by the Institut für Zeitgeschichte (Munich / Berlin) 2003 *Dokumentation Obersalzberg. Tondokumente. Täter Gegner Opfer*, ed. by Albert A. Feiber / Volker Dahm, track 20 and 21

[35] See Amit Pinchevski and Tamar Liebes, Severed Voices: Radio and the Mediation of Trauma in the Eichmann Trial, in: Public Culture 22:2 (2010), 265-291 (283, quoting an expression by Jacques Derrida and Bernard Stiegler, Echographies of Television, Cambridge (Polity) 2002, 117)

[36] Jacques Derrida, Above all, no journalism, in: H. de Vries / Samuel Weber (eds), Religion and Media, Stanford, CA (Stanford University Press) 2001, 56-94 (71)

Discussing the essence of the *tone*, G. W. F. Hegel defines it in its temporal essence: "Ein Verschwinden des Daseins, indem es ist"[37]. - a disappearance of being, while it exits. This dramatically changes with sound recording media and with automata for continuous tone generation (the pneumatic organ, the electroacoustic synthesizer, and radio carrier wave oscillators). Whereas the archival record - as linear textuality - is conceptually linked to the historical past, signal recording triggers the temporality of latency - which is *implicit* presence of the past.

The audio engineering software Audacity allows e. g. for automatically tagging both intentional and non-intentional (even traumatic) "silence" in audio files - inaudible sound where time itself speaks, as provided by the "Analysis"-toolbar of the audio software Audacity under the explicit term of "Silence Finder". The "Effects" tool, on the other hand, allows for "removing silence" or to create "echo" from audio signals, which is manipulation of the sonic time event on its minutest level. The "echo" itself embodies the time figure of delayed presence or even "archiving presence": Only recorded presence can be echoed. In reverse, the echo is a temporal mirror of presence itself, thereby undercutting any clear observational distinction between presence and past.

DISCOVERING THE TECHNO*LÓGOS* IN MAGNETIC TAPE RECORDING

Archaeographies of a Medium

As it has been emphasized in the draft for the workshop *Tape Recording: Archaeologies of a Medium*[38], the magnetophone has not only been a techno-historical extension to mechanical phonography, but it has been its media-epistemic alternative from the beginning; almost immediately after the announcement of Edison's mechanical recording and replay of voices and sound on a revolving cylinder, Oberlin Smith proposed an electromagnetic recording on wire, which soon became technical reality in Valedmar Poulson's wire recorder (prize-winning at the Paris World Fair, in 1900). This asks for a rather media-archaeological than techno-historical approach to electromagnetic recording in terms of macro and micro media time - that is, a different temporal co-existence, and time-criticality within such a technology. As it has been expressed perfectly by the Twentieth-Century Music journal special issue on *Tape*, magnetic recording has not only been extending, but "rewinding" the phonographic regime[39], having been dramatically different from the phonograph "from

[37] G. W. F. Hegel, Enzyklopädie (1830), § 459 (Werke, Frankfurt / M. 1970, vol. 10, 271)
[38] Cambridge University, 25 / 26 September 2020
[39] Edited by Andrea F. Bohlman and Peter McMurray, vol. 14, no. 1 (2017)

its inception" (McMurray / Bohlmann 2019), that is: *en arché* (both in its temporal, and techno-logical sense). "[T]ape's particular technical affordances - erasing, re-recording, looping, portability [...] - can be understood as creating a radical break with phonographic practices" (ibid.).

Tape recording, as signal storage matter, connects to two different media-epistemic regimes: the material quality of the *tape* as technical (in-)formation, (which links to Konrad Zuse's ab/use of discarded 35 mm movie film by phsically punching it with binary data for the program control of his 1936 Z1 digital computer[40]), or the specific latency of magnetic recording (which links to the electro-magnetic regime: wireless signal transmission, the video recorder, and - "grammophone record" again - the disk of computer hard drives).

The tape loop, as a specific function of the reel-to-reel player, technically does not only cross-reference to cinema as well, but becomes metonymic of a media-epistemic constellation: "If large cycles belong to nature and (following Paul Ricoeur) linear narrative" - and cultural history - 'to humans, then the rapidly looping 'temporality of optical toys is closer to that of the machine'."[41] The timing technology of the tape recorder induces its proper time regime, its own chrono*lógos*, with a techno-traumatic effect (or subliminal, microtemporal affect[42]) upon human perception.

At that point, the path of media-archaeological insight bifurcates. In a soft, rather phenomenological, culture-oriented understanding (the McLuhan tradition), "the technical and material specificities of a medium help shape its uses and cultural impact"[43] - even if the father of discourse analytic archaeology of knowledge, Foucault himself, is not specific in that sense, when he famously declared the Iranean revolution, in parts, as a consequence of the audio cassette tapes in circulation as "counter-information"[44]. This refers to the divergent applications of tape recording on a global scale. Against this popular culture appropriation approach, a

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[40] Lev Manovich, Cinema by Numbers: ASCII Films by Vuk Cosic [1999]. Available online: http://manovich.net/content/04-projects/025-cinema-by-numbers/21_article_1999.pdf (accessed 5 November, 2019)

[41] Noam M. Elcott, Loops, or *The Wave*, in: Markus Krajewski / Harun Maye (Hg.), Universalenzyklopädie der menschlichen Klugheit, Berlin (Kulturverlag Kadmos) 2020, 227-231 (228), quoting Nicolas Dulac / André Gaudreault, Circularity and Repetition at the Heart of the Attraction: Optical Toys and the Emergence of a New Cultural Series, in: The Cinema of Attractions Reloaded, ed. Wanda Strouven, Amsterdam 2006, 227-244 (228)

[42] See Marie-Luise Angerer / Michaela Ott (eds.), Timing Affect, Zürich / Berlin (diaphanes) 2014

[43] Peter McMurray / Andrea Bohlman, workshop draft (December 2019) *Tape Recording: Archaeologies of a Medium*, University of Cambridge, UK

more rigid "variantology" (in Siegfried Zielinski's sense[45]) asks whether different cultural contexts actually results in significant modifications of technologies such as tape recording itself. This starts with Euro-American ("occidental") modernity.

To avoid the term "tape" becoming a mere umbrella term for all kinds of magnetophonic recording?

A media-archaeological reminder of magnetic recording's off-spring from electric telephony is vital, which is materially embodied in the technology of recording on *wire*. This sets it " dramatically different from the phonograph from its inception" (McMurray / Bohlmann 2019) indeed.

In a more "prospective" media-archaeological understanding of the momentum of tape recording[46], "Within a decade, magnetic tape had transformed not only audio recording but also video and computer storage" (workshop draft). At the King's College Archives in Cambridge, Turing's papers reminds of the notion of the "endless tape" which is technical condition (even the techno*lógos*) of a mechanism to calculate computable numbers. The Turing machine renders the computational machine closer to non-linear tape technology than to linear phonographic recording indeed.

For a better understanding of tape recording, what does it means to go "beyond the usual bounds of media archaeological approaches"?

The special emphasis of this Cambridge workshop on "expanding our understanding of tape's comparative histories in a global context" (McMurray / Bohlmann 2019), is "[g]oing beyond the usual bounds of media archaeological approaches" (ibid.) indeed, switching from non-narrative media-archaeological analysis of magnetophonic technologies in favour of media historicism. When "this workshop will also probe tape’s global histories", which so quickly after the second World War "gave rise to substantially different histories across a broad geography" (ibid.), this is a shift of focus towards Cultural Studies, with a focus on "popular media circulations" (ibid.) and its political, even religious practices, or more generally: the "uneven topographies of tape recording in the second half of the 20th century" (ibid.).

How to avoid the issue of tape recording becoming frozen into a bygone media-historical epoque?

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[44] Michel Foucault, La rivolta dell'Iran corre suir nostri delle minicassette, in: Corriere della sera, vol. 103, no. 273, November 19, 1978, 1 f.
[45] See Siegfried Zielinski / David Link (eds.), Variantology 2. On Deep Time Relations of Arts, Sciences and Technologies, Cologne (Walther König) 2006
[46] See Siegfried Zielinski, Prospektive Medienarchäologie, in: Moritz Hiller / Stefan Höltgen (eds.), Archäographien, xxx, Basel (xxx) 2019, xxx-xxx

Dense and archive-based, historization is warranted in tape recording research indeed, but there is kind of an uncertainty relation in focusing either on the historic context, or the techno-logical configurations and electronic laws which endure across such specific moments.

Another way, though, of "going beyond the usual bounds of media archaeological approaches" is *radicalizing* the media archaeology of tape recording, in terms of object-oriented ontology, and of media science rather than cultural studies. Media archaeology aims to unlock the fixation of tape recording in a specific epoch in cultural modernity, to identify the contemporary momentum of electro-magnetic existence in technology instead. While intransitive media historiography imposes the symbolical historical, and inter-cultural model textually upon the concrete technology, this media-archaeological approach requires a different kind of writing the medium transitively, from within technology: its archaeography.

One mode of such an transitive writing of magnetic recording is the circuit diagram:

[Fig.: Circuit diagram to patent *Verfahren zur elektromagnetischen Aufzeichnung und Wiedergabe von Licht- und Schallwellen auf einem Draht, besonders zur Herstellung sprechender Filme*, by Telegrapie-Gesellschaft m.b.H. System Stille, Berlin[47]]

In terms of such a diagrammatic understanding, magnetic recording is indifferent to the perceptional mode, in terms of human senses, from which the input derives: speech, sound, or images, once they are transduced into electromagnetic signals. They might as well encompass impulses which serve for digital computation. In grammar of the electric units essentially remains the same, open for specific reconfigurations.

More fundamentally, in a radical media-epistemic understanding, and deciphered in a media-archaeological way, electromagnetic recording on wire, or tape, is revealed as the reverse quality of electromagnetic transmission: the other of "radio", where the channel of transmission is temporarily suspended (or rather delayed) by the storage medium.[48]

"Where are the Ears of the Machine?" (Morten Riis)

Against a discourse-analytic investigation of the various applications of tape recording in cultural, military, and economic contexts - which is

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[47] Reichspatentamt no. 363642, class 42g, group 17 (1st September, 1918), issued for Germany 11 November, 1922

[48] See Horst Völz, Versuch einer systematischen und perspektivischen Analyse der Speicherung von Informationen, in: Die Technik, vol. 20 (1965), no. 10, 650-659

Science and Technology Studies -, a more radical media archaeology investigates the differential, even "diffractive" (Barad) unfoldings from within this electromagnetic technology itself, tracing its techno*lógos*. This means either concentrating on the phenomenological effects upon humans by the technical configurations of the tape recorder as "time object" (Edmund Husserl), induced by the linear reel-to-reel tape rolling, or the nonlinear addressing of its time stamps (the case of Samuel Beckett's drama *Krapp's Last Tape* from 1958)

What does the tape recorder itself "listen" to?

According to a technology-prone theory of media, inert physical matter requires to be set in motion, to be temporalized in signal processing, in order to be in a medium state (including, in reverse, storage as suspended media motion in latency). In that sense, the primary media-archaeological scene in the epistemic media theatre, Oersted's discovery of the electro-magnetic effect in 1819, becomes almost metonymical of technical media itself.

[Demonstration: Needle in a compass being deflected by the impulse of an electric current in a nearby conductor, which later becomes "wire recording" in the magnetophonic sense with Smith and Poulsen]

It is not only the explicit audio cassette recording, but the implicit sonicity of the electro-magnetic induction which make the magnetic tape recorder a case of genuine media temporality. Sound, in its acoustic, mechanical sense, is varying in frequency and amplitude; so does the magnetic field from the record head as well, thus imprinting a magnetic "picture" of the audio signal on the tape (as expressed by Riis, op. cit.).

A technical device has to get in motion, to transform into a *temporal object* (Husserl), in order to arrive in a media state. With the recording tape scrolling under the playback head, the moving magnetic fields induce a varying current in the head. This voltage produces an electrical "representation" (Riis, op. cit.) - rather an "analogy"[49] - of the magnetic signal on the tape. This is then passed through an equalization and amplification circuit so that the recorded music becomes audible at connected speakers

It is the core event of tape recording, the "singularity" of the electro-magnetic induction as it has been discovered by Oersted, systematically experimentalized by Faraday, and mathematically formulated by Maxwell, which links micro-temporal media archaeology with object-

[49] See Heinrich Barkhausen, Einführung in die Schwingungslehre nebst Anwendungen auf mechanische und elektrische Schwingungen, 6th ed. Leipzig (Hirzel) 1958, Preface

oriented ontology[50] and expands the field of sound studies to also include the nonhuman perspective of recording technology.

It is exactly because of its nonhuman listening capacity that tape recording results in more than the familiar historical document. While historiography in alphabetic letters is a merely symbolic (re-)*coding* of an event, one of the first stereo tape re*cordings* with the AEG-Telefunken K7 magnetophone by engineer Helmut Krüger for the Reichsrundfunkgesellschaft in Berlin is the so-caalled "air raid recording" of Beethoven's Concerto for piano and orchestra No. 5, Op. 73 in E-flat (soloist Walter Gieseking) with the Großes Berliner Rundfunkorchester (conductor Artur Rother) in the Haus des Deutschen Rundfunks in Berlin from 1944.[51] "In the cadenza and some quiet passages you can hear the artillery", writes the uploader of this recording for Youtube channel[52] - in fact the German anti-aircraft guns - "from outside the RGG-building (2'30*, 5'40+)".

Such an audio tape recording is no testimony of any "historic" event, but of the acoustic signal, an indexical trace of the real. Therefore its hermeneutic interpretation remains uncertain. In an alternative Youtube upload, the same stereo recording of Piano Concerto No. 5 from 1944 is presented in a "restored" version: "The extreme highs are recovered, The noise is reduced. I boosted the bass somewhat. The stereo image has been made close to the modern one, i.e. no 'inverse' 'behind the back' portion. [...] Some imaginative people have heard 'artillery fighting' in the recording. Sorry, but no, it was occasional noise from Gieseking's wonky pedal, and was removed. The 'artillery' also 'shot in singles' as he played I could see it here and there."[53]

Auditory retro-hallucination or not, the idea principally deserves media-scientific attention and media-active archaeology in terms of forensic signal analysis. Enhancing the bass low frequencies in the concert recording, such as from around min. 16:50 to 17:10 in track 1 of the CD edition from 1993[54], a specific kind of war time memory might be

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

[51] Walter Gieseking, World War II Performances Recorded by German Radio, available on Compact Disc by Music & Arts Programs of America, Inc., CD-815, 1994

[52] blechmusik, "Beethoven (1944, Stereo): Allegro from Concerto for piano and orchestra No.5 - Gieseking/RO Berlin", https://www.youtube.com/watch?v=EY7lvuVjjX4, accessed February 24, 2020

[53] Itapirkanmaa2, "Beethoven: Piano Concerto No 5, Gieseking/Rother/Berlin Radio S.O., 1944 restored", https://www.youtube.com/watch?v=xR_Nb6UJPB4, accessed February 24, 2020

[54] Non-commercial CD *The 50th Anniversary of Stereophonic Tape Recording* , published by from AES (Audio Engineering Society), Europe Region Office, Brussels 1993

detected. In theory, the stereo recording, in combination with knowledge of the room acoustics, would allow for the location of the anti-aircraft guns which were once positioned on a Flak tower close to the concert hall. "Acoustic space" (McLuhan) here is remembered by the architecture of an electro-magnetic device. What the de*tonations* of the 12.8 cm FlaK 40 reveal does not stay in any human war historiography, but it articulates a techno-trauma: a kind of "sound" which is not the result of Beethoven's arbitrary musical composition, but the evidence of a co-presence.[55] The position of an enemy airplane approaching Berlin would have been located by optical triangulation (from the Würzburg radar, or spot light, at night), and the measured distance then be transmitted as signal, in electric speed, to a "Kommandogerät, in fact a mechanical analog device to analyze the course of the airplane as *futurum exactum*, and to compute, in real time differential equation, the direction of the gun and the run time of the ballistic projectile in advance. Embedded in the projectile has been a clock work which exploded according to the pre-culculated temporal trajectory to hit the airplane just-in-time.

[Fig.: German anti-aircraft gun 12.8 cm FlaK 40, World War II, at Military Museum Helsinki[56]]

But not just the concert and the intermitting AA gun, the bandwidth of the recording medium itself becomes visible from the Fourier transform spectrogram.

There is no cacophony for the recording device. The human cognitive dissonance results from the real of electro-magnetic sound recording. But a human understanding of such sonic articulations is immediately semanticizing, differentiating the Beethoven signal from the war machinic noise. Different from semantically conditioned human listening, the tape recorder does not differentiate between an intentional drum signal from the orchestra, and the ballistic weapon noise. The recorder listens to, and knows, the acoustic "real" only. Media archaeology therefore concentrates on the spectrogram of the crucial sonic events which suspends the analysis from the trap of cultural semantics:

[Spectrogram of crucial clips]

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[55] As it has been identified by Jan Claas van Treeck, Media Studies, Humboldt University Berlin, February 2020. For another case of co-recording of "non-musical" sonic articulation, as revealed by spectrographic analysis, see Richard Beaudoin, Gould’s Creaking Chair, Schoenberg’s Metric Clarity, in: MTO. A Journal of the Society for Music Theory, vol. 27, no.1, March 2021, https://mtosmt.org/issues/mto.21.27.1/mto.21.27.1.beaudoin.pdf (accessed April 3rd, 2021)

[56] From: Wikipedia entry https://de.wikipedia.org/wiki/12,8-cm-Flak_40, accessed 19 February, 2020

In addition, there is a second kind of undoing historicity as well. While a mechanical gramophone recording of the concert event, after many replays, would have had an deteriorating signal-to-noise ratio resulting from mechanical erasure and material cracks in the shellac, the magnetic recordings remain almost time-invariant. As indicated in the cover information to the CD *The 50th Anniversary of Stereophonic Tape Recording*, "[t]he contents of this CD was transfered directly to digital equipment (Brahms) of from the first copy of the original tape without any processing". Only then, the signal became archival code, by digital (over-)sampling. It is the very nature of electro-magnetic induction that prevents the recording from ageing in the familiar entropic sense; this memory is rather of a re-generating nature, resulting in co-originary (*gleichursprünglich*) signals.

There is a gap opening between the phenomenological, popular, political and inter-cultural "global" usage of the magnetic audio cassette tape as a central device in sound culture, and its inner-technical operativity, a clash between the cultural studies approach to tape recording (the "histories" of its variant global usages) vs. radical media archaeology which insists that no global appropriation ever really changed the internal technology itself.

[Concerning the application of technologies, most scholars in the media archaeology field in fact do not consider the cultural difference trivial. A more "radical" media archaeology, though, suspects that the various cultural applications of a medium actually do not alter its underlying technology itself, just its interfaces. While "tape's history" notably differs as it unfolds in different places - as argued by Foucault, on the role of audio cassette tape distribution in the Iranean revolution -, "tape's archaeology" does not so.]

Focussing upon the "ears of the machine"[57], and different from the cultural discourse analysis of popular music emanating from practices of tape recording, the media-archaeological ears listens to the implicit sonicity, which emerges with(in) the electro-magnetic field. The magnetic tape does not only preserve the memory of cultural articulation, but also the frozen media knowledge (techno*lógos*) as it is embodied in the operational technology of the magnetophone itself. The arbitrary reconfiguration of the cassette recorder allows for such a media-epistemological experience.

By experimenting with the media object itself with the intention of media-philosophical insight (which is "carpentry" in Ian Bogost's sense), operative techno-logical *eigen*knowledge (techno*lógos* in being), as

[57] See Morten Riis, Where are the Ears of the Machine? Towards a sounding micro-temporal object-oriented ontology, in: Journal of Sonic Studies, https://www.researchcatalogue.net/view/219290/219291

interplay between physical and mathematical / cultural laws, as it is embodied in the operational technology, can be exposed by its use in an epistemologically "performative" context, reconfigured into a philosophical practice" (Riis, op. cit.). It takes both philosophical curiosity, and engineering competence, to arrive at such radical media-archaeological insights.[58]

In Morten Riis' setting, the self made sound on the sound switch and the use of loop cassettes changed the tape recorder status from an technological object into an object of carpentry, "a philosophical lab equipment used to practice philosophy. Layers of sound becomes superimposed upon each other, and furthermore various notions of recorded time gets superimposed upon each other, making the sound on sound loop tape difficult to analyze in a traditional textual manner, forcing us to shift our analysis perspective towards the actual recording technology itself" (Riis, op. cit.).

Object-oriented ontology, as coined by Graham Harman and further developed by Ian Bogost for electronic and digital devices, "a philosophical practice", in Riis' case: the "switch of carpentry" on a compact cassette recorder. In a precise description of its technological setting, this electro-magnetic device is not discussed as a medium of popular music distribution, as it is common in Sound Studies, but in its temporal action which offers a different understanding of its implicit sonicity.

In contrast to human perception in recording and replaying on / from tape, which is always subject to its cultural-semantic conditioning (the "sonic", in Peter Wicke's sense), from a media archaeological point of view, only technical media, from the phonograph, over the magnetophone, up to digital sound sampling, are capable of recording (and, for the digital case, recoding) physical real signals without immediately making "musical" sense.

Michel Foucault's *Archaeology of Knowledge*, at the only moment where a technical apparatus is mentioned at all, differentiates between the arrangement of keys on a typewriter, and its symbolic reproduction in a manual for teaching typewriting. In that sense, the cassette tape recorder, as electronic device, is non-discursive.

Even if "[t]he global technology transfer of tape in the immediate aftermath of the war hinged upon the literal seizure of tape recorders and tapes by the Allied Forces" (McMurray / Bohlmann 2019), the core

[58] This is why Riis equally refers to Ian Bogost, Carpentry vs. Art: What's the Difference? [2013], http://www.bogost.com/blog/carpentry_vs_art_whats_the_dif.shtml, and in practice to Walter G. Salm, Cassette Tape Recorders. How They Work - Care & Repair, Blue Ridge Summit, PA (Tab Books) 1973

impact of this media-historical transfer has not been political but technological: the German modification of tape recording dynamics by high-frequency magnetic pre-biasing (Papenburg 2008). A technical trick (*mechané*, in its ancient Greek sense) is applied here: At the erase head of a magnetic recorder, a high frequency (approximately 80 to 100 kHz) audio signal is sent to the erase electromagnet, which thereby randomizes the magnetic particles, erasing any previous recording on that tape.

While the sonic (tempo-)real, as registered in phonography, is still acoustically evident to human ears, in the electro-magnetic cassette tape mechanism the noise of the apparatus is less co-present to human perception, thereby dissimulating the machinic, non-human sonic agency.

In a combination of object-oriented ontology and the notion of micro-temporality, media archaeological research has developed the notion of the *operative* (rather than phenomenological *time*) *object*, which is tape issues in a more technical sense. The focus on micro-temporal media events concerns the actual functioning of technologies such as the tape recorder, not its human ways of usage, or their neural timing of affects. Time-invariant media events *within* technologies do not exclusively generate their meaning based on the historical dimension, but generate meaning and knowledge in their functionality, in the technical apparatus itself, short circuiting its historical implications, becoming suspended from cultural discourse.

Still, there are *direct* short circuits, and media-epistemic flashes, between the technological artefact and its cultural understanding (such as the discussion of the "real presence" of god's name in Jewish religion, once spoken on magnetic tape.

a) Radical Media Archaeology:

The Media-Archaeological Hypothesis

The human handling of tools - among them the traditional musical instruments - belongs to the practice of cultural techniques. But electronic media, based on variable circuitry, go beyond. The media-archaeological hypothesis is that there is a rather autonomous techno*lógos* within magnetic tape recording, which is revealed by both scientific or artistic research, just like the electronic experimentation of sound-modulated periodic waveforms on an oscilloscope in early media art.[59]

[59] See Derek Holzer, Vector Synthesis. A Media Archaeological Investigation into Sound-Modulated Light, 2019 (private book edition of M. A. thesis in Sound in New Media, Aalto University, Helsinki, 2019), chapter 4.0 "Vector Synthesis

In the course of such experimentation, the techno*lógos* articulates itself rather accidentally - either scientifically, or in engineering, or as a collateral by-product of media-artistic research. The high frequency AC pre-biasing, which increases the sonic danamics of tape recording to a signal-to-noise ratio which is sufficient for high quality signal reproduction, has been detected rather accidentally by Hans-Joachim von Braunmühl and Walter Weber at the Electroacoustics Laboratory of Reichsrundfunkgesellschaft (RRG) in Berlin around 1940. What is the relation between human intentionality in the creative and functional use of magnetic tape, vs. its technical auto-logics?

Even if the first public recording using the AEG Magnetophon was November 19, 1936, with the London Philharmonic orchestra conducted by Sir Thomas Beecham at BASF's own concert hall in Ludwigshaven, the tape's range in signal dynamics was poor when compared to gramophone recordings. In April 1940, Weber experimented with improving the dynamics of tape recording against tape noise, in order to achieve "musical" quality. Suddenly he remarks that tape noise disappeared in long passages of test recordings, finally detecting the cause: an amplifier connected to the circuitry unintentionally produced high frequency waves, which de-magnetised the running tape - minimising tape noise about 10 dB.

Different from a phenomenal or cultural analysis of tape recording as medium from outside, media archaeology traces the "archaeographies" which are written by the medium itself, granting agency to the non-discursive elements and processes of the machine, such as "one specific graphics technology, which renders images by sending voltage signal respresenting the horizontal and vertical / axes of a vector image to a Cathode Ray Tube monitor"[60]. Just like this vintage method of creating electronic images, tape recording "was abondoned as obsolete" (ibid.) in the meantime. The art of media-scientific argumentation, though, is to reveal how such technological operations persist and re-occur in different forms in the present, just like the mechanical typewriter actual returned within computing, with Alan Turing's hypothetical design of a computational machine inscribing (and erasing - closer to magnetic tape) symbols on a principally endless (loop!) ribbon.[61] And different from "historical" investigation in the text archives, media-archaeological inquiry involves re-enactment and "interaction with an ongoing and generative process"[62]; it is based on *actually* working analog signals from within the machine. "In such scenarios, the <media> artist is invited to consider alternate or hidden histories" - or at least layers, like in a

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Implementation", 53-92

[60] Holzer 2019: 3 f.

[61] See Holzer 2019: 8

[62] Holzer 2019: 3

painting - of apparently obsolete technological devices.[63] The notion of "alternate histories" (ibid.) conceptually remains within the frame of historical discourse; radical media archaeology, though, lets techno*lógos* itself articulate in the frictions or - as it is more harmfully expressed in engineering and media art - as "artefacts" and "glitches" which occur when a conceptual diagram is actually materially implemented.

Media theory differentiates between the techno-centric approach which seeks to identify the techno*lógos* from within electronics like magnetic tape recording (radical media archaeology), and the "cold" cybernetic approach which focusus on the man-machine communication up to circuit bending[64], on the one hand. On the other side, there is the phenomenological approach with its focus on the affects caused in perception by the medium event, such as the techno-traumatic irritation of the sense of the present caused by tape delay and loops.

In its more generalised version, media archaeology has a reservation against the domance of the cultural-historical discourse. It prevents the discussion of magnetic tape recording (music and otherwise) from becoming just a "historic" chapter in 20th century media culture.

"In the high fidelity medium of digital video, where each generation can be as imperviously perfect as the one before, artists are importing images of electronic dropout and decay, 'TV snow' and the random colors of unrecorded tape, in a sort of longing for analog physicality."[65] Against "tape recording" nostalgia which is about loss (a by-gone historical epoch, with no more actual relevance for the present), media archaeology identifies the momentum of its time-invariant, techno-logical presence.

While media discourse analysis tends to focus on the phenomenal effect (and affect) of technologies such as tape recording on human cultural practice, media archaeology radically focuses on the non-human, non-discursive signal event. The central agency for a radical media archaeology of tape recording is a close analysis and media-epistemic reduction to its principles (*archai*): the *Urszene* of electro-magnetic induction (as discovered by Oersted and Faraday), and its derived technical operations of electro-acoustic sound transduction which is reversible for recording and replay, thereby almost liberating media time from the irreversible thermodynamic, "historical" time arrow, and allowing for the almost lossless re-generation of sonic (or other) signal from magnetic tape.

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[63] Holzer 2019, subchapter "Media Archaeological Reenactment", 20-25 (20)
[64] See Morten Riis, Where are the Ears of the Machine? Towards a sounding micro-temporal object-oriented ontology, in: Journal of Sonic Studies [year?], https://www.researchcatalogue.net/view/219290/219291, accessed xxx
[65] Laura U. Marks, touch. Sensuous Theory and Multisensory Media, Minneapolis (University of Minnesota Press) 2002, 152 f.

Media-Archaeological Analysis *versus* Cultural Studies?

Different from such a media archaeological approache is the investigation of the global histories of tape recording in their social, even political impact, in terms of cultural studies ("beyond the usual bounds of media archaeological approaches", as expressed in the proposal). If this is not understood as irreconciliative, it turns out as a cutting epistemological edge: Beyond the issue of tape recording as such, on a kind of parallel meta-level, the question arises to what degree the media-archaeological approach can harmonise with the "global histories" perspective - or whether the differences between both ways of research might rather be productively enhanced.

Tape Recording between Memory and Storage

This difference concerns the very term tape "recording" itself. The English "recording", for Italian ears, evoking another sense: *riccordare*, which is: remembering. Tape recording is a "memory" medium in terms of cultural analysis, where practices of remembering are a direct function of technically recorded music.[66] But in technological analysis, tape recording counts as "storage", while finally, in archival terms, the record - a textual original - belongs to the symbolic order.

The form of the magnetic tape *versus* the grammophone "record" makes a fundamental difference in respect to its affordances towards human use, and its materiality in technical operations.

The Discretisation of Tape Recording for Data Storage

Audio recording on magnetic tape allows - on the signal level - what Turing designed for symbolic operations on paper: "Like the phonograph, audiotape was a technology of inscription, but with the crucial difference that it permitted erasure and rewriting."[67]

While tape recording has been applied for data storage practically, in early electronic computing, its apparent equivalent, the "endless" tape in the Turing machine model[68], is conceptually different. The Turing machine

[66] Ben Anderson, Recorded music and practices of remembering, in: Social and Cultural Geography, vol. 5, No. 1, March 2004, 3-19

[67] N. Katherine Hayles, How We Became Posthuman. Virtual Bodies in Cybernetics, Literature, And Informatics, Chicago / London (University of Chicago Press) 1999, 209

[68] Alan Turing, On Computable Numbers, with an Application to the Entscheidungsproblem, in: Proceedings of the London Mathematical Society (2),

consists of a *squared* tape of infinite length and a read-write head which can move left and right across the tape. For that mechanism to act in a non-linear mode, the tape is "remediated" to a previous storage medium, the celluloid film tape, since it offers a perforation for discrete transport, different from the time-continuous audio signal on the audio tape:

Fig.: Z3 35mm perforated program "tape"

Counter-"Mythologies"

The audio cassette tape edition of the conceptual music MYTHOLOGIES, composed and produced by David Berry and Barnaby Thorn (Truant Recordings 2019), traces the contradictions of digital society "through the dialectics of concept music and the materialities of media forms" (David Berry). The "physical" (tape) edition of MYTHOLOGIES turns the critical analysis of the contemporary media condition, which Berry and Thorn make in the accompanying text "Reflections of a Damaged Life", into a material argument. Nothing can be a better comment on "cloud" computing, and the algorithmicized daily environment, than the "hardware irony" of a recording of sonic signals on analog tape. Even more ironical, though, is the fact such audio cassette tapes have been used in early personal digital computing - the legendary Commodore "Datasette".

The early computer game cassette tapes are identical with audio cassettes familiar from popular music industry in the 1980s indeed.:

[Demo tape]

Only when operated in combination with an early home computer, it reveals its different sonicity, its meaning as binary data storage for electro-acoustically loading a video game into the actual RAM.

In terms of a very material media ecology, the "return" of the cassette tape, nowadays, is limited by the resource of ferroxyd for magnetizing the plastic tape (for which most tape duplicating machines in tape music editions have been constructed), with only one factory left which produces such raw material - while the alternative with better dynamics in signal recording, the chrome tape, is blocked for environmental reasons. This links a media-archaeological close reading of magnetic tape to "global histories" indeed, in terms of economy and politics. Media "retromania", therefore, is not simply about nostalgia for "dead media", but undead techno*lógos* as the intertwining of the symbolical order with the tempoReal of technified matter.

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Audio Tape Recording of / as Storage: The "Datasette"

An example for an object-oriented notion of memory is the peripheral cassette storage technology which has been used in early personal computers. There is not only implicit sonicity but actual sound which arises from the media-archaeological (that is: dynamic) archive. When an ancient "Datasette" is loaded from external tape memory into the ROM of a Commodore 64 computer, actual "data music" emanates techno-acousmatically. Such a techno-music like sound is no audio memory content like an old percussion-assisted song, but rather the sound of computer memory itself, that is: a software program which is "scripture" in the alphanumeric mode. Listening to the data archive does not trigger sonic memory but allows to literally "understand" the inherent sonicity of algorithmic computing.

There is a crucial difference, though, between the technical format of data storage on tape which is, first of all, addressed to the microprocessor, and the popular culture where the same cassette tape has served as an almost anarchival device for non-legal distribution of music immediately addressed to the human ears. The "sound of the archive" in computation itself could be experienced from the "Datasette" storage technology in early computing, when e. g. loading a computer game such as the Sinclair ZX81 Flight Simulation, 16k RAM, with the initial instruction: "Load and run by typing LOAD 'FLIGHT'". Side A says: "LOAD 'FLIGHT'", while side B (different from the more familiar use of such a device as music cassette) says "Blank Tape". Load time amounted to 6 minutes approximately, while the "POKE" command in BASIC allowed for direct access to the internal RAM and its data location, a direct "imaging" of the storage grid on the computer screen.[69] When loading the binary content of such a "Datasette" embodied in two acoustic frequencies was loaded from external cassette recorder to a computer, one could listen to the sound of a modem (or Fax) like rhythm of software memory. Such implicit sonicity radically articulates that digital memory is never *ready-at-hand* as an archive but comes into being only in "musical" operativity - while the traditional paper-based archive remains silent.

Liberation of Tape Recording Technopractice from Magnetophonocentrism

As long as tape recording is conceived as a mere technical extension of the phonograph, its epistemic horizon is phenomenologically tied to the audio regime (be it speech, or music). In both German and English, the very term given to the electronic recording device ("Tonband",

[69] See Nick Montfort et al., 10 PRINT CHR$(205.5+RND(1)); : GOTO 10, Cambridge, Mass. / London (The MIT Press) 2013

"Magnetophone"), privileges the machinic function of acoustic signal recording. When it comes to describe the process of analog-to-digital time-varying signal conversion in computing, Abraham Moles, in his work on *Art et Ordinateur* (1971), almost naturally discusses the digital sampling, and quantization, which enables the computer to "listen" to (Moles' quotation marks), to store, and to replay sound. Moles explicitly compares this A/D and D/A mechanism to "a giant magnetophone"[70], while at the same time accentuating that such signal transduction actually transforms the essence of the signal itself, which - literally in the meantime - becomes a string of data. Previously explicit acoustic sound becomes technically implicit sonicity. Even if the resulting sound, obeying the Nyquist / Shannon rules of sampling rates, for human perception, makes no difference to well recorded analog phonographic sound signal, in media-epistemological terms, there is a world of difference, since the continuous signal becomes mathematically analysable, and accordingly synthesizable, once is has been computationally quantized. Only this is the essential "computer revolution", inducing artistic creation to truly "computational thinking"[71]. The media-archaeological impulse is to break and set free magnetic tape recording from the phonographic regime. This shift cannot be explained by socio-cultural practice, but rather reveals a techno-logical necessity. While audio recording, in the understanding of popular culture, has nothing to do with digital computing, the application of the almost identical technical configuration of magnetophonic recording for purposes of computing is a corollary deriving from the material and electronic techno*lógos* of tape recording itself. From this point of view, the fixation of signals on magneticized tape, whether analog wave forms, or digital pulses, is nothing but a "magnetical disturbance"[72]. The difference is time-critical: The spool is replaced by the magnetically coated cylinder, in order to arrive at (depending on the drum cycling frequency) almost instant data access (the chrono-logics of Random Access Memory in computing), instead of having to wind or rewind the tape. Magnetic memory, thereby, is transformed from located to dynamic storage, where the delicacy is in the sychronization impulses for real-time computing.

[Fig. Magnetic drum computer "adding unit" (*Summandenwerk*)[73]]

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[70] Abraham A. Moles, Kunst & Computer [FO Art et Ordinateur, 1971], transl. Barbara Ronge, Cologne (DuMont Schauberg) 1973, 64

[71] Moles ibid.

[72] "Hierbei wird die Zahl ähnlich wie beim Magnetophon als Folge von magnetischen Störungen mittels eines Elektromagneten im Magnetpulver fixiert": Heinz Billing, Numerische Rechenmaschine mit Magnetophonspeicher, in: Zeitschrift für angewandte Mathematik und Mechanik, vol. 29 (1949), no. 1/2, 38-42 (40)

[73] From: Heinz Billing, Numerische Rechenmaschine mit Magnetophonspeicher, In: Zeitschrift für angewandte Mathematik und Mechanik, vol. 29 (1949), no. 1/2, 38-42 (41, fig. 1)

The "Musicality" of the Magnetic Tape

The musicality of the magnetic tape is not restricted to its use in electro-acoustics in the narrow sense of "tape music". There is an implicit sonicity even in the video tape in electronic imaging, and finally, the "algorhythm" of data recording on tape in computing, its time-structuring rhythm.[74]

Twentieth century "music" is embodied in tape recording in a much more subtle sense, with its signal range extending from the audio range to the visual *imaging*.

Before magnetic tape recording actually extended to video, grammophonic "video disc" recording of the 30line television signal occurred *avant la lettre*, which John Logie Baird appropriately called "Phonovision" in the late 1920s. Its frequency was still within the audible range when transmitted over radio.[75]

But the first magnetic video recorders which were equipped with the quadruplex rotating tape head system, built in the early 1950s, relied on very fast tape speeds; even when sonified, its sound receded into implicit sonicity.

The implicit, functional sonicity of magnetic video tape recording became explicit when the frequency-modulated sonic digital time code has been used for video editing.[76]

The implict sonicity[77] of the video tape has been made explicit by Bill Viola, both theoretically[78], and in terms of media art. Once more, just like the detection of AC pre-biasing of the magnetic tape for an improved signal-to-noise ratio, the trigger moment for his insight into "The Sound of One-Line Scanning" as "epistemic thing" (in the sense of Hans-Jörg Rheinberger) has been an accidental articulation of techno*lógos* from

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[74] See Shintaro Miyazaki, Algorhythmics. Understanding Micro-Temporality in Computational Cultures, *online* in: Computational Culture, Issue 2 / 2012 (http://computationalculture.net/algorhythmics-understanding-micro-temporality-in-computational-cultures)

[75] John Logie Baird, Television and Me. The Memoirs of John Logie Baird [1945], ed. Malcolm Baird, Edinburgh (mercatpress) 2004

[76] See Ina Blom, The Autobiography of Video. The Life and Times of a Memory Technology, Berlin (Sternberg Press) 2016, chap. 5 "Video Times"

[77] See W. E., Sonic Time Machines. Explicit Sound, Sirenic Voices and Implicit Sonicity in Terms of Media Knowledge, with a Preface by Liam Cole Young, Amsterdam (Amsterdam University Press), series *Recursions*, 2016

[78] Bill Viola, The Sound of One Line Scanning, in: Dan Lander / Micah Lexier (eds.), Sound by Artists, Toronto / Banff (Art Metropole & Walter Phillips Gallery), 1990, 39-54

within the coupling of devices in video studio equipment, the humming of the video signal output when it was erroneously fed back as video input by the video switcher.[79]

A core media archaeological concern is the question to what degree "tape recording" is strictly bound to the materiality of its storage medium; its linear form / temporal unfolding, vs. non-linear addressing of matrix (ferrit core memory); Turing "State of the Art" on difference between time-continuous paper / papyrus roll and time-discrete book page addressing

Between Storage and Interaction with the Present: Video Recording

In the 1920s, John Logie Baird invented what he called "Phonovision" for recording his electro-mechanically produced television signals on grammophone discs, while German television developed the intermediary film procedure ("Zwischenfilmverfahren") for broadcasting the Olympic games in Berlin almost in the live mode: In order to capture events in daylight, only celluloid recording was sufficiently sensitive (therefore not allowing for immediate actual news broadcasting); such film sequences were not meant for post-production or archiving but developed immediately after the event to be coupled with an electronic camera in the television automobile - with the photo-chemical emulsion being washed out immediately after for re-filming. This is the reverse of *kinescope recording* directly from monitor on 16mm film for storing electronic images before video tape technology.

"By electric tapes, synchronization of any number of different acts can be simultaneous. Thus the mechanical principle of analysis in series has come to an end."[80] The video recorder in private usage resulted in a "transition from unidirectional time flow (from present to future) to multidirectional time flow"[81], which has been brought to its technical point with the *start-over button*. "As long as a particular program is being broadcast, it is possible to start it over again", thus echoing synchronic and asynchronic broadcasting schedules.[82] Such is time axis manipulation in analogue video cassette recording. "To rewind means to reverse the direction of a roll of magnetic tape or various types of film. This term has outlived" - in a kind of technosemantic gap - "physical spool-based media and is now also applied to digital media" (ibid.). What

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[79] As explained in the catalogue Bill Viola, xxx
[80] Marshall McLuhan, Understanding Media. The Extensions of Men, New York (McGraw Hill) 1964, 152
[81] Mira Moshe, Media Time Squeezing: The Privatization of the Media Time Sphere, in: Television & New Media 13(1), 2012, 68-86 (74)
[82] Moshe 2012: 74

would media-based autobiographical re-collection as dramatised in Samuel Beckett's *Krapp's Last Tape* look like today?

Media-Epistemic Core Scenes I: Signal Transduction

An an ultimate reminder of the Wire Recorder, "[t]he record head of a tape recorder is similar to a transformer with a single windin. Signal current" - the actual "musical" semantics - "flows in the winding, producing a magnetic flux in the core material. *To perform as a record head*, the core is made in the form of a closed ring with a short nonmagnetic gap. When the nonmagnetic gap is bridged by magnetic tape, the magnetic flux detours around the gap through the tape completing the magnetic path through the core material. [...] When the tape is moved across the record-head gap, the magnetic material (termed oxide) is subjected to a flux pattern which is proportional to the signal current in the head winding."[83] Each magnetic particle "retains the state of magnetization that was last imposed on it by the shunted gap" (ibid.).

Media-Epistemic Core Scenes II: AC-Bias

The success of magnetic tape as signal or data storage medium can not be reduced to its original invention. During the 1935 Radio Fair in Berlin the Magnetophone (Telefunken) and the Magnetic Tape (BASF) presented to the public, but only an accidental effect in the experimental improvement of its dynamics triggered its media-cultural break-through.

For magnetic recording, the "bias" names the alternating current pre-magnetisation (and erasure!) of the tape by high frequency signals to improve the signal-to-noise ratio (dynamics), resulting in a techno-traumatic irritation for the human sense of the present since the broadcasting of speech or music recorded on tape became indistinguishable, for human sensation, to actual live transmission of a speech or concert.[84] The proper informative time signal thus is overlayed or pre-conditioned by a different *a priori* temporality.

What has been a philosophical (Bergson) or historical (Braudel, Koselleck) metaphor of temporal layers, became firmly *grounded* with magnetic tape recording (sound, video, data storage).

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[83] Magrab / Blomquist, xxx, 1971, chapter 5-5 "Magnetic Tape Recording", subchapter 5-5.1 "Direct Record", xxx; italics W. E.

[84] "[...] daß sie von der Direktübertagung nicht mehr unterschieden werden kann" Laszlo von Szalay, Moderne Technik. Elektrotechnik, Berlin (Safari) 1954, 523

[*Erdung* is a technical term in German electro-engineering, giving a precise sense to media-archaeological analysis. *Grounding* indicates that circuits in hardware - the "mass" - have to be connected with the ground, just like the antenna in ancient radios to avoid a lightning strike destroying the whole apparatus.]

In World War Two, the allied armies had been puzzled by apparent live converts transmitted by German radio in the middle of the night - which in fact was time-shifted radio broadcasting from Berlin, due to magnetophonic recording in high signal fidelity which resulted in the phenomenology of "live" hearing. Only a close reading of a specific technological operation - the high-frequency pre-magnetisation of the tape immediately before the recording head - explains for this tempo*real* irritation of human perception of the present. Soon after German capitulation, US army officer Jack Mullin introduced two such magnetophones to AMPEX company. At the East coast, Bing Crosby's radio studio production had to master the problem of time zones for broadcasting in USA; the solution was either repeated "live" broadcasting for different times zones (while the speed of electro-magnetic waves in broadcasting remains the same), or pre-recorded production which can then be at temporal random be re-played in different times (the reverse of Random Access Memory in computing). The magnetophone allowed for the "live" recording of the present event, then for time-shifted re-play - undoing the linear time line, while not undoing the "time object" of the technical device itself. In mass media production, this has resulted in a chrono-technical hybrid: so-called "live-on-tape".

Back in San Francisco, Mullin reassembled the two German magnetophones which he had transported from Paris at the beginning of 1946 and modified them with AC-BIAS – "the purloined knowledge from Bad Nauheim"[85] where he had learned about this German technique for an improved magntophone in the radio studio. Mullin demonstrated the magnetophones at the *Institute of Radio Engineers* in San Francisco, to convince the radio industry of their devices.

The introduction of the AC bias has not simply been a refinement of magnetic tape recording after its invention in Germany in the early 1930s; it rather links it, beyond the telephone regime (low frequency speech signals) to the high frequency regime of "radio".

The Magnetic Tape: Signal *versus* Symbol Recording

[85] Jens Gerrit Papenburg, Transatlantic Echoes. Elvis Presley’s Voice as a Product of German Magnetic Tape Machines and its Function in Americanisation of Postwar Germany, script version of a lecture read at the conference *Cultures of Recording*, April 10, 2008, Centre for the History and Analysis of Recorded Music, Royal Holloway, University of London, Egham, referrring to: Peter Doyle 2005: 184

In terms of electro-acoustics (the material definition), tape recording is no passive storage medium, but its signal replay is an active technical operation: "Electrical signals from a microphone (audio) or video camera (video) are stored as patterns of magnetized regions of iron oxide on magnetic tape. "When the recorded tape is played back, the original signals are generated."[86] - not simply read, but actually re-produced.

There is a media-archaeological discontinuity between punched tape and magnetic tape in artificial voice synthesis, where digital computers are used to generate human-like speech. Here, the punched cards (or paper tape) contained instructions which are thereby fed to the computer. The computer then "makes the necessary calculations and produces a special magnetic tape on which details of the synthesized speech waves are recorded. The "sounds are heard when the tape is played back over a special tape recorder"[87].

The Difference it Makes in Signal Recording: Phonograph *versus* Magnetophone

Media epistemology deals with technological paradigms rather than with what has been realised in varying cultural contingency. Media-scientific analysis detects the articulations of techno*lógos* across such concrete historical manifestations.

An alternative to the "direct" phonographic recording on aluminium discs, for ethno-musical (electro-magnetic) "field" research (Milman Parry), has been the magneticised wire (Albert Lord's Webster Wire Recorder) or tape. The difference is its degree of indexicality, that is: the physical link of the recorded signal to the actual event. While direct mechanical recording (the Edison phonograph) is most literally about inscribing the physical trace, magnetic recording is intermediated by electro-acoustic transduction, which transforms the acoustic signal into its electric voltage equivalent.

A Webster wire recorder, Model 80 (Webster Chicago Corporation), from 1948, is mainly composed of wire coils, a tube amplifier, and a built-in loudspeaker. As an electronic (vacuum tube-based) storage medium for conserving sound, it is based on the transverse-magnetisation of a steel

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[86] Leonard Feldman, entry "Video Recording," in: Microsoft® Encarta® Online Encyclopedia 2001

[87] Cecil H. Coker / Peter B. Denes / Elliot N. Pinson,"Manual" to: Bell Labs Speech Synthesis kit *Speech Synthesis: an Experiment in Electronic Speech Production*, designed by Homer Dudley (Bell Telephone Laboratories), Waverly Press, Baltimore, Md., 1963; *online* http://www.beatriceco.com/bti/porticus/bell/belllabs_kits_ss.html; accessed 9 March, 2015

wire drawn across a recording head; this kind of device has been developed by Valdemar Poulsen around 1900 and was originally intended for office dictation or to function as a telephone answering machine. It records with 2.200 meters of wire and a speed of around 60 cm/sec.; it is thus capable of storing up to one hour of sound. The Webster wire recorder has been nicknamed an "Electronic Memory".

Just like the difference between the vinyl record and the Compact Disc, the DAT recorder, on the contrary, translates analog signals into binary abstract symbols, cut off by the sampling mechanism from its direct link to the originary event. The indexical signal is replaced by its intransitive coding. "Digitization breaks the analogical relationship between object and image, henceforth rendered as information."[88]

In an object- and process-oriented media ontology, this shift of *lógos* can be technically located, in the materiality of the vacuum tube which makes the decisive difference (for Weber's "accidental" detection of AC-bias as well) between electro-mechanics and electronics. Electronic amplification enables electro-acoustic hearing, while the mechanical Edison phonograph articulates speech or music from simple physics.

There is no historical evolution "from" phonographic "to" electro-magnetic sound recording, but a media-archaeological co-originality. Oberlin Smith published a diagrammatic description of magnetic recording, a few years after his visit to Edison's lab in 1878[89], using an electromagnet with a string covered with iron filings. He may have actually built a working model but no device has survived. In Smith's circuit design, spoken words are transformed by the telephone A into an electrical sound signal and are recorded in the form of magnetisation patterns on the sound carrier C, passing through the recording head B. In addition, the apparatus features F (the battery), E (a take up reel, D (the supply reel), and J (the reel brake).[90]

Media archaeology is not deductive from theory, but radically inductive in the sense that is it draws epistemological insights from the minute inspection of technical details. It is the nature of latency in signal recording and storage (as defined by Sigmund Freud for unconscious memory in psychoanalysis indeed) which differentiate electronic devices like the magnetophone from the literal "inscription" in mechanical phonography where the groove can almost be "read" by human eyes directly.

[With electronics, technology intervenes, between the cultural object

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[88] Marks 2002: 148

[89] Oberlin Smith, Some Possible Forms of Phonograph, in: The Electrical World (September 1888), 161-163

[90] See "Magnetic Recording History", URL: xxx

(*lógos*) and its human reader. "All texts are useless without the technology to decode its symbols: the rules of Greek alphabetic writing [...], a tape-player [...]"[91]; still there remains a crucial difference between electro-acoustic signal recording, and digital sampling.]

Tape recording keeps signals in magnetic latency, where human senses have no direct access to. Latent signal 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).

The magnetic tape is not simply a techical variance of otherwise (electro-)mechanical phonography. The bifurcation is rather fundamental. While the phonographic record is directly linked to the acoustic vibration (and kymographic registration, as with Léon-Scott de Martinville's Phonautograph in mid 19th century), magnetic recording, by the intervention of electric transduction, links it to the telephonic (and radio) regime. Valedmar Poulsen's Telegraphon, by its very name already, indicates the hybrid of phoograph and telephone.[92] Wire or tape recording is the reverse of electro-magnetic wave emission; in that sense, storage is nothing but the inversion of transmission (*vice versa*).

Phonography *versus* Magnetophon: the Electronic Difference to Mechanics

"Radical" media archaeology is a techno-centered epistemology. When it comes to the media culture of tape recording, 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. [...] textual, analog, and digital forms of inscription constitute entirely different worlds."[93]

In 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

[91] Barry B. Powell, Writing and the Origins of Greek Literature, Cambridge u. a. (Cambridge UP) 2002, 6

[92] As it has been explicitely remarked by August Foerster, Das Telegraphon, in: Georg Malkowsky (editor), Die Pariser Weltausstellung in Wort und Bild, Berlin (Kirchhoff) 1900, 398-400

[93] 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

cockpit but as well the background noises which retrospectively signal the unfolding desaster. 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, generating a different sense of temporality than the familiar historiography.

Technical sound carriers do not just replace each other in an evolutionary course of technology. The phonograph respectively the gramophone record on the on hand, the magnetic record on tape on the other, and finally the digital recording, all represent fundamentally different materialities and essences in terms of their technological registering of time-variant signals, time-based forms of reproduction and their function as time-channel in individual communication *alias* cultural tradition. In the case of phonography *versus* magnetophone, electronics makes a difference. The technique of magnetic (audio) tape recording diverges from phonographic linear inscription and rather connects to "non-linear cultural techniques (splicing, looping, dubbing)", affording a "consistent interface with telephony, radio". In that sense, the tape acts "as counterpoint to the process of inscription at the foundation of the phonographic regime"[94].

Sound recording does not simply unfold as evolutionary course of technology in history, but the phonographic record on the on hand, the magnetic record on tape on the other, and finally the digital recording represent fundamentally different materialities and logics (literally techo/logy) 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 constrains, thus: from erasure over time; still the tube or transistor are subject to decay over time themselves.

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 transitive, invasive writing into a storage medium like the wax cylinder has been substituted by the electro-magnetic field, but writing

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[94] As expressed by the editors Andrea F. Bohlman / Peter McMurray, Tape: Or, Rewinding the Phonographic Regime, in: Twentieth-Century Music 14/1 (2017), special issue *Tape: Or, Rewinding the Phonographic Regime*, 3–24 (8)

nowadays re-turns 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 synthesis). The Technical Committee of the IASA in its standard recommendations from December 2005 points out that digitisation of analog sound carriers from the past does not necessarily mean a loss of information about the signal, but can in fact grasp the physical signal as information much more precisely than former analog recording where non-linear distortions of the signal in the process of technological transcription frequently take place. The Nyquist / Shannon theorem already fixes that with a sufficient sampling rate the original signal can be truly reconstructed; for archival needs a radical over-sampling up to 192 kHz does not just keep the blunt sound information, but the memory of noise (scratches) as well.[95] Nevertheless, digitalisation means a radical transformation in the ontology of the sound record - from the physical signal to a matrix (chart, list) of its numerical values. Media culture thus turns from phonocentrism to mathematics.

Entropy in the second law of thermodynamics (Ludwig Boltzmann) states that the energy circulation of any closed system tends to an uniform equilibrium. In technomathematical communication theory (Claude Shannon), the term has been reversed to measure the degree of information. Negentropic persistence against entropic time ows its ahistoricity rather to its different form of registering the physically real acoustic event not by signals, but by binary symbols.

Close to the Signal: Forensic Tape Analysis

Very close to Sigmund Freud's comparision of the human memory mechanism to the magic writing pad (*Wunderblock*) and its subsequent psychoanalysis, it requires a different kind of philological source critique - media "forensics"[96] - indeed to identify the machine as co-author of the media-theatrical drama. The Magnetic-tape-viewer allows for the visualisation of magnetically charged signals on tape for media-forensic analysis, such as the detection of manipulated recordings. Such a form of media philology makes the identification of manipulations on tape such as re-recording, overwriting, erasure, cutting impulses and splicing, even the original recording machine, possible.[97] Depending on the technical configuration, the wire recorder (Poulsen's *Telegraphon*) or the magnetophone (with its French term *écriture magnetique*) either erases the previous voice recording by new inscription; with neutral magnet erasure, co-present interference still shines through like an antique text

[95] See http://www.iasa-web.org/IASA TC03/ IASATC03.pdf
[96] Matthew Kirschenbaum, Mechanisms. New Media and the Forensic Imagination, Cambridge, MA (The MIT Press) 2008
[97] Christian Koristka, Magnettonaufzeichnungen und kriminalistische Praxis, Berlin (Ost) (Ministerium des Innern, Publikationabteilung) 1968, 9-28 (146 f.)

in a medieval palimpsest. The technical term for such an epiphany is appropriate in the literal sense of techno*lógos*: "crosstalk".

In 1954, it has been revealed that, in the course of a 1952 recording of a performance Richard Wagner's opera *Tristan und Isolde*, featuring Kirsten Flagstad and the Philharmonia Orchestra conducted by Wilhelm Furtwängler, two top Cs were sung for the then elderly Flagstad by the then young Elisabeth Schwarzkopf and edited into the master tape.[98] The recorded indexical real that listeners (apparently) expected has been violated by tape-based processes. A traumatic irritation of human sense of time and cultural memory results from the radically inhuman processuality of technical recording.

b) Cultural Analysis:

Human and / or Technical *lógos* from Tape

The cultural practices of tape recording, in their global and historical variances, reveal that tape recording media-epistemologically oscillates between cultural technique and genuine technology. "Hands on Media" are not simply a continuation of hands on tools; such *transitive* manual practices of and interfacing become *intransitive* by the transition from analogue to digital devices[99] - with electronic instruments such as the magnetophone starring in between.

The gap between symbolical time (as registered in the ledger as tape inventory) *versus* the time-continuous, but looped voice recording from tape reel, is a theme in Samuel Beckett's once-act play *Krapp's Last Tape* (1958). On occasion of his birthday, the protagonist literally recounts his previous birthday diary spoken on tape. While the actor - who is "subject" to the machine it its double sense - himself is irreversibly confronted with his own ageing, the magnetophone preserves the time-invariant record of his voice, with all its illusive phonocentrism. While the human actor is faced with biological entropy - his inevitable "being-to-death" (Heidgger) -, Krapp neg-entropically re-plays himself, rewinding and fast-forwarding the spool. An up-dated version of Beckett's play has replace the magnetophone by a video recorder (Tragelehn's mise-en-scène)

When in 1981 the Fortunoff Video Archive for Holocaust Testimonies has been created at Yale University, the original recording format has been three-quarter-inch U-Matic videocassettes. The drama of ageing is not restricted to humans like Krapp, or survivors, but extends to the media

[98] Peter Martland, Since Records Began: EMI - The First 100 Years, London (Batsford) 1997, 198 (referring to the record HMV ALP 1030–35)
[99] This has been discussed during the conference *Hands on Instruments*, University of Cambridge (Churchill College), 20-22th July, 2014, organised by Ramona Braun

mechanism itself. Against the material deterioration of the magnetic tape, the original videocassettes have been stored in a temperature-controlled room in the Yale archives, while the video testimonies available for viewing therefore have been VHS copies.[100] The vulnerability of material signal carriers to physical entropy is counter-acted neg-entropically by digitisation ("information" in terms of Shannon). This leads to a different kind of memory-in-the-present which becomes a function of numerical values - re/counting instead of telling. The technological transformation of media witnessing from an electronic analogue recording to digital signal processing allows for new forms of time-axis manipulation, simulation and referential illusions.

A contemporary challenge to Beckett's media theatre has been the computer already, where the act of rewinding the tape is not performed by a human any more, but by algorithmic machine operations.

The symbolical regime of the "ledger", which is opposed to the magnetic tape in *Krapp's Last Tape*, returns from within "analogue" signal storage in digital computing, where the "address" is a set of characters that identifies either a register, a location or a device in which information is stored. The address is a label, "usually in the form of numerical coordinates"[101].

The magnetic drum storage device for Random Access Memory in digital computing has directly been derived from the dispositive of tape recording in the early 1950s by Nikolaus Lehmann in the GDR (Dresden), who designed a prototype with parallel tape tracks wound around the rotating drum with multiple tape heads for writing and erasing the binary pulses..

Electrified Oral Poetry

A radical change from symbolic transcription to signal recording of oral poetry took place with the magnetophone. "Even Homer's rosy-fingered Eos changes from a Goddess into a piece of chromium dioxide that was stored in the memory of the bard and could be combined with other pieces into whole epics. 'Primary orality' and 'oral history' came into existence only after the end of the writing monopoly, as the technological shadows of the apparatuses that document them."[102] Magnetic recording of oral poetry operates not "beyond", but below symbolic textuality, with the actual signal.

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[100] Pinchevski 2012: 145, note 7

[101] Edward B. Magrab / Donald S. Blomquist, The Measurement of Time-Varying Phenomena, New York et al. (Wiley) 1971, "Glossary"

[102] Kittler 1999: 7, referring to: Walter]. Ong, Orality and Literacy. The Technologizing of the Word, London 1982, 27

Even if it does not make a crucial difference for cultural memory, oral poetry becomes a different existence if it is not mechanically recorded by phonograph or gramophone which is - as its very name suggests - still close to graphical "writing", but electronically on magnetic wire or tape, as performed by Albert Lord on the same ground around 1950? Apart from being of a different technological essence, such recordings stimulate a different kind of scientific analysis which is not just philological or musicological any more but researches the sub-semantic poetic articulation on the media-archaeological level (spectral analysis with electronic measuring media), thus revealing evidence of a different (but still poetic?) kind.

Techno-Trauma: God's Name on Magnetic Tape

In Hebrew religion, the written name of God itself - even if expressed in the symbolic regime of the alphabet - is "indexical" of a real (Amit Pinchevski). Therefore God's name writing shall be prevented from erasure, and even obsolete texts, as long as they are containing God's name, are therefore preserved in the synagogue attic (Genizah) for eternity. According to Rabbi Ovadia Yosef, God's name on analogue audio cassette tape is still allowed to be erased (for the re-usage of the tape) since no human eye can see it "written". The physical trace of sound is erasable on tape, since only with an electronic action it can be re-listened to. There are no forms of letters on tape, only the "transduction" of acoustic into electric signals for magnetic recording. In French, the term for tape recording is *écriture magnetique*. But there is no symbolic inscription in magnetic recording, rather signals. The case is different for the digital Genizah, depending on the "mode of existence" (Gilbert Simondon) of the letters of God's name. If it is represented graphically on the screen, it shall be treated like (holy) scripture, but when stored in ASCII as bit stream in memory chips or on hard drives, the character string is not recognisable as God's name, therefore erasable.[103]

Electronic Music as a Function of Tape Editing (Vilém Flusser)

According to media philosopher Vilém Flusser, "[t]he tape composed by the composers is the immediate articulation of the intellect. It means nothing, but it expresses directly the structure of thought"[104]. Flusser celebrates electronics as a cultural form induced by technologies based on the electro-magnetic field. The magnetic recorder is described by Flusser as the true archaeologist of the sonosphere, which listens with

[103] Paper presented by Noam Glinkewitch at the workshop *Archiving Presence: From Analog to Digital*, Hebrew University Jerusalem, Department of Communication, April 29 / 30, 2015

[104] Vilém Flusser, Sao Paolo lectures on (electronic) music (1965), Lecture 16; see Flusser STUDIES 17 (May 2014), *online*

technological ears without evaluating music from noise: "A random sound is recorded on tape: may be the sound of a bell, or of a locomotive, or of the human voice reciting a verse from the Bible. "The tape is recorded and then cut-up, and its segments are then submitted to deliberate manipulation. They are amplified, twisted or condensed. The segments thus manipulated are then re-composed onto a new tape, in a deliberate order and structure, that is, vertically, horizontally, diagonally and in a sequence hat is independent from the primitive tape. This is a composition in the strict meaning of the term" (ibid.). With such an argumentation, Flusser has been a true contemporary of William Burrough's audiotape cut-ups and their posthuman assumtions in the 1960s.[105] Different from the mechanical manipulations of direct phonographic recording, the magnetic tape is intellectualising music again (in the Platonic tradition), prioritising the act of composition. The inventory of magnetically recorded, "found" sound (Pierre Schaeffer) differs from the primary, media-archaeological electronic invention. Still, the electronic recording of music as intellectual concept (re-)turns into sound only when implemented into the physical world which is the moment when parameter *t* (the time axis) is involved: "The tape is then played through an apparatus for sound reproduction, and we can then experience this music acoustically, this is, in its temporality."[106]

Only the embodiment of musical compositions into electro-physical materiality provides it with a temporal dimension which prevents sonicity from becoming a pure Platonic, "musical" concept - just like an algorithm is not yet computing but needs an operative computer to be executed in time. Mathematics is not able to perform itself; a diagram for sound synthesis as well needs a real electronic synthesizer to happen as sound. The editing of vintage computer music composition has been programmed by punched tape, but in order to be edited as sound, it has been recorded on magnetic tape.

Flusser correlates the options of electronic music with non-Euclidean geometry as much as McLuhan, in his later work, links the world of electro-magnetic waves to "acoustic space"

Liberating Piano Performance from "Live" Logocentrism: the Tape-Based Electronic Studio (Glenn Gould)

Pianist Glenn Gould notablly preferred the electronic studio to live recording in the concert hall, for its productional (not only post-productional) options of analytic manipulation. In his interview by Tim

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[105] See N. Katherine Hayles, How We Became Posthuman. Virtual Bodies in Cybernetics, Literature, And Informatics, Chicago / London (University of Chicago Press) 1999, 208 f.
[106] Flusser 1965: Lecture 16

Page for *Piano Quartely* (autumn 1981), Gould celebrates that technology has made the live concert superfluous, since it creates a "climate of anonymity" which liberates the artists from his performative restrictions like nerve reactions and finger restrictions towards an improved aesthetic enunciation, eliminating the contingencies of an actual concert. The core operation of post-performative studio recording and editing has been the magnetic tape splice and cutting of "tape segments varying in duration upward from one twentieth of a second", that is: below the human hearing threshold of a continuous tone. This is not a completely "dehumanizing technique" (as criticized by the "antirecord lobby"), but rather a "schizophonia" (Schaffer) of a different kind, since here "inevitably [...] the functions of the performer and of the tape editor begin to overlap - which for the subsequent listener can not be neg-entropically differentiated any more, just as in montage cinema"[107].

William Burroughs "on" Tape

Time unfolds like a "tape running between two spools[108]. Paul Bowles' 1966 novel *Up above the World* is about magnetic tape experiments. One chapter in Steven Connor's work on *Beckett, Modernism and the Material Imagination* is called "Looping the Loop: Tape-Time in Burroughs and Beckett". For William Burroughs, human memory itself functions like a tape recording machine: "remember that your memory bank contains tapes that you have ever heard ... press a button, and a news broadcast you heard 10 years ago plays back"[109] like an Mellotron sound sampler. Once this analogy is admitted, it extends to electronic time-stretching as well.

In 1962 William Burroughs published *The Ticket That Exploded* describing visionary technologies inspired by magnetic recording.[110] "[I]t was a startling discovery to learn that one's voice could be taken out of the body and put into a machine, where it could be manipulated to say something that the speaker had never heard before."[111] As assumed by

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[107] Glenn Gould, The Prospects of Recording [from: High Fidelity (April 1966)], in: Tim Page (ed.), The Glenn Gould Reader, New York (Alfred A. Knopf) 1984, 331-353 (337 and 339)

[108] Timothy Scott Barker, Time and the Digital. Connecting Technology, Aesthetics, and a process Philosophy of Time, Hannover, New Hampshire (Darmouth College Press) 2012, 59 f., referring to: Henri Bergson, The Creative Mind, N. Y. 1934 / 1992, 164

[109] As quoted in Joe Banks, Rorschach Audio. Art & Illusion for Sound, London (Strange Attractor Press) 2012, xxx

[110] William Burroughs, The Ticket That Exploded, New York (Grove Press) 1967, chapters 9 and 10; as well same author, Electronic Revolution, Bonn (Expanded Media Editions) 1970

[111] Hayles 1999: 207

Arnold Gehlen[112], this is exactly what defines the human as different from other animals: He / she is orignary lacking completion, that is: always already coupled to symbolic or other forms of supplementation, therefore: rather an organic machine.

William Burroughs and Brian Gysin experimented with paper cuttings for poetry composition. While this surrealist poetry tradition remains within the regime of the symbolic, the magnetophone tape "cut-ups" which Burroughs started in 1959 subsemantically manipulates the voice itself, transforming its acoustic signals[113], much more radical than (contemporary) Beckett's Krapp, resulting, among others, in the 1981 LP edition of Burrough's magnetophone experiments, the album *Nothing here but the Recordings*. The split between the symbolic wording (literatur) and the real signal articulation (sound culture) takes place in machines: typewriter and phonography.

Burroughs, in his piece *The Ticket that Exploded*,[114] considers language as function of the word "virus" which pre-historically has chosen man as its host for symbiosis. Magnetophonic tapes once more have the capacity to infiltrate humans. This mirrors the actual technological process indeed where the electrically transduced voice signal induces an analog magnetization on the by-passing ferrogmanetic tape (and reverse). Cut-ups are possible only on tape (Fritz Pfleumer's "singing paper" from 1927, not on wire, as originally invented by Oberlin Smith and Valedmar Poulsen's wire recorder) and allow for non-linear jumps and loops unknown from phonographic time axis manipulation which still remains linear - closer to the cinematographic montage. Once language is recorded, it can be arbitrarily edited.

The philological risk is that Burroughs scholarship reduces his language "virus" thereme to the idiosyncratic mind of the author. Such visions are rather a symptom (articulation) of a techno-trauma induced by the magnetophone and an epistemological which is cybernetics: be it machines or animals, once coded (be it the human acquisition of language, or source codes implemented as software in computers), both are subject to the symbolic order and become compatible as systems.

In the "writing machine" section of *The Ticket That Exploded*, Burroughs locates the writing scene itself within the technological artefact: inner media theatre, "a room with metal walls magnetic mobiles under flickering blue light and smell of ozone"[115], which obvisouly is the inside of a magnetophone based on thermionic tubes.

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[112] Arnold Gehlen, Die Seele im technischen Zeitalter. Sozialpsychologische Probleme in der industriellen Gesellschaft, Reinbek b. Hamburg 1957, esp. 7 f.
[113] As explicitely referred to in Kittler's *Grammophon Film Typrewriter* 1986: 167
[114] New York, NY (Grove Press) 1987
[115] TTE: 62, quoted here after Hayles 1999: 216

In Burrough's experiments with time-axis-manipulated voice recordings, the temporal event is fragmentized: magnetophonic cut-ups of human language, as described in his manifesto *The Electronic Revolution* (1970). Nothing here but the recording? In *The Ticket that Exploded*, Burroughs "[...] took seriously the possibilities for the metonymic equation between tape-recorder and body. He reasoned that if the body can become a tape-recorder, the voice can be understood not as a naturalized union of voice and presence but as a mechanical production with the frightening ability to appropriate the body's vocal apparatus and use it for ends alien to the self."[116]

Already in Platon's primordial critique of alphabetic writing *Phaidros*, the real "dialogue" is not between philosopher Socrates (which is rather an invention by Platon himself) and his pupils (the deceptional "content"), but between reader and writing. This corresponds with Beckett's Krapp's Last Tape drama where the script notes asymmetric dialogue partners: "KRAPP" and "TAPE". By externalising the "inner monologue" of human consciousness by mechanical manipulation of tape recordings, Burroughs joins the Turing / Lacan hypothesis that in the moment a human is algorithmically processing sequences of symbols (be it numbers in mathematics, be it letters in writing / reading), he / she is in an operative (rather theater-performative) mode and becomes machine itself. It is not by coincidence that Alan Turing (1936) models his algorithmic machine according to the newest electronic medium of his days: the magnetophone, with the "write / read head" moving across an (ideally) endless tape.

The "bloody" cutting of magnetic tapes with mechanical scissors (Oskar Sala, Burroughs, Stockhausen) still links electro-magnetic recording to "handy" cultural techniques ("ready-to-hand", with Heidegger, Being and Time 1927). With the digital time code, cutting becomes non-linear, and complete machine operation (just like, in Martin Heidegger's argumentation, the mechanical typewriter alienated the human hand from "hand"-writing[117]).

The Cassette tape actually prevents the direct *mani*pulation as practiced in cut-ups.

c) Time-Critical and "Deep" Temporality of Tape Recording:

Deferred Present / Tape Delay

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[116] Katherine Hayles, How We Became Posthuman. Virtual Bodies in Cybernetics, Literature, and Informatics, Chicago: University of Chicago Press, 1999, 211, referring to William S. Burroughs, The Ticket That Exploded, New York (Grove Press) 1967, 49

[117] Martin Heidegger, Der Satz des Anaximander, in: idem, Holzwege, xxx

When confronted with the recent communication medium telephone, Walter Benjamin felt unsheltered when being exposed to the electric voice.[118] With Valemar Poulsen's presentation of the wire recorder at the Paris World Exhibition 1900, the telephone line which functioned as the (subjectively experienced) immediate transmission of telegraphic and tele-phonic communication turned out to be, in technical reversal, a potential storage medium for delayed replay. From that resulted an irritation in the trust of presence in electric tele-communication.

The technical staff of the Philco Radio Time show, searching for a new storage medium to bridge the time gap between East and West coast broadcasting in the US, tested recording equipment. In August 1947, Bing Crosby Enterprises finally applied magnetophones with AC bias. But the inverse relation between the emission and recording of electro-magnetic waves, that is: "live" transmission and recording, is more fundamental than such symbolical time manipulations; it radically roots within the techno*lógos* of the signal event itself. High frequency EM oscillations are the carrier wave for audio or visual (or "data") low frequency signals in radio transmission, while in audio tape recording, the high frequency AC pre-biasing is the condition for an improved dynamics for musical quality.

The magnetophone recording registers unintended presence, in a kind of Proustean *mémoire involontaire*. In the recording of a performance of Donezetti's opera *Lucia di Lammermore* featuring Maria Kallas as Lucia at the Milano Teatra della Scala in 1954, all of the sudden a radio interference occurs in the act of the primal microphone recording. Digital sampling allows for a micro-analysis of such signal events, time-discretely temporalising the present.

While "live" transmission of radio (and television) signals carries the risk of unpredictable technical or symbolical accidents, tape recording allows for a "delayed present"[119], resulting in the chronopoetic oxymoron of "live on tape" in broadcasting. Tape delay has been the material condition for "dead time" ("Totzeit") of 6,4 seconds between telephone and radio broadcasting in US Broadcast Obscenity Policing (censorship)[120], before it was appropriated by artists as a time tool to play with.

Dan Graham's looped video tape installation *Continuous - Present - Past(s)* in 1974 confronted the gallery visitor with its own delayed presence by an 8 seconds tape loop image recording.

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[118] Walter Benjamin, Berliner Kindheit um Neunzehnhundert [Berlin Childhood circa 1900], in: same author, Gesammelte Schriften, vol. IV, ed. Tillman Rexroth, Frankfurt / M. 1972, 235-304 (243)

[119] See W. E., The Delayed Present. Media-induced interventions into contempor(e)alities [*The Contemporary Condition* series], Berlin (Sternberg Press) 2017

[120] Kittler 1986: 66

Micro-Temporal Hysteresis: Delayed Phonocentrism

Different from the phenomenological description of the voice from wire or tape in its effects on (and media-induced irritations) of human "inner time consciousness"[121], media archaeology approaches the event from within the technical media drama itself. Elvis Presley's "slapback" voice, resulting from the usage of two Ampex tape recorders in the Sam Philips' Sun Record studios, is an extremely condensed version of the protagonist's voice recording in Samuel Beckett's media theatre Krapp's Last Tape, a micro-"remembering" resulting from tape delay echo within the 100 millisecond interval.[122]

Presley as well as his gitarist Moore and bassist Black "*first* found their voice in the Sun Studio"[123]. Alvin Lucier's tape-based media installation *I'm sitting in a room* (19xx) which consistes of echo-delayed re-recording of a sentence has been a seminal moment in site-specific and time-based media art. In popular music, Elvis Presley's pop-musical voice actually "did not exist until it was recorded. Dealing with the echo, Presley developed a vocal style which had the function of exposing the echo."[124] And "it is *in* the voice. As a consequence a dualism of an intrinsic sound and an extrinsic effect is undermined here"[125] - "a special organization of time" from within the magnetophone.[126] Techno-chronopoetically, "the reproduced and delayed signal can be directed via the mixer to the other tape recorder [...], where only the recording head is activated. At the mixer, the slightly delayed signal is mixed with the other signal of the other microphone. This means nothing else than that the band is recorded not only once but twice by the second tape recorder [...]. [...] Sonically this time lag becomes perceivable as a kind of echo on the voice"[127].

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[121] See Edmund Husserl, On the phenomenology of the conciousness of internal time (1893-1917), transl. John Barnett Brough, Dordrecht (Kluwer Academic Publishers) 1991

[122] See Tilman Baumgärtel, Schleifen. Geschichte und Ästhetik des Loops, Berlin (Kulturverlag Kadmos) 2015, 122

[123] Peter Doyle, Echo & Reverb. Fabricating Space in Popular Music Recording 1900-1960, Middletown 2005, 183

[124] Jens Gerrit Papenburg, Transatlantic Echoes. Elvis Presley’s Voice as a Product of German Magnetic Tape Machines and its Function in Americanisation of Postwar Germany, script version of a lecture read at the conference *Cultures of Recording*, April 10, 2008, Centre for the History and Analysis of Recorded Music, Royal Holloway, University of London, Egham, referrring to: Peter Doyle 2005: 184

[125] Papenburg 2008, referring to Théberge 1997: 210

[126] Papenburg 2008, referring to Manuel DeLanda's description of such temporal effects and affects. See DeLanda, Intensive Science and Virtual Philosophy, London / New York (Continuum) 2002, 72 f. and 111 f.

[127] Papenburg 2008

Chronopoetic Affordances of the Magnetic Tape

It is the elementary combination of both the form and (in-)formation of the plastic ribbon ("tape") and magnetic particles, with the record head as electro-magnetic transformer, which techno-logically allures human curiosity of knowledge to scientific, or artistic, experimentation. When it comes to tape recording, "archaeologies of a medium"[128] are understood in Marshall McLuhan's sense (1964): the archaeological momentum of a "new" medium is the time interval, or media-epistemic epoch, when the technical medium is the actual aesthetic, or scientific, message. Media artist Nam June Paik, in his 1963 installation *Random Access*, suspended the magnetic tape from being just a passive medium for sound recording, by turning it into an active electro-acoustic instrument: Such tapes were mounted at the gallery wall, so that a visitor, by means of a mobile record head, could "compose" his own "music" from moving across them. When Laurie Anderson constructed her Tape-Bow Violine in 1977 (as can be seen in her film *Home of the Brave*), where the horse hair of the bow has been replaced by magnetic audio tape, with a record head mounted on the violine bridge to transduce the signal back- or forwards, this fell back into remediation (in the sense of Bolter / Grusin), where a previous medium, the acoustic violin - again according to McLuhan's "laws" of media - became the content of a new one.[129] When Sebastian Omatsch constructed his Tape Bow Violin # 2, he developed Anderson's model into a more autonomous piece of "magnetic tape art" ("Magnetband-Kunst") by replacing the pre-recorded bow tape by an empty one, for (re-)recording and feedback in real time, as a kind of sampller.[130] And Jimmy Hendrix' vinyl record Electric Ladyland, before letting the electric guitar articulate, is preceeded by tape recordings of violent noise, which is actually registered, in the accompanying songbook, in terms of the magnetophonic machine: "Vorläufe und Rückläufe, Bandgeschwindigkeiten und Meßpunkte"[131].

Multi-track tape recording has spatialised the linearity of sequential time signals. "By electric tapes, synchronization of any number of different acts can be simultaneous. Thus the mechanical principle of analysis in series has come to an end."[132]

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[128] Subtitle of the workshop *Tape Recording*, planned by Peter McMurray and Andrea Bohlman at the University of Cambridge, UK, for September 2020
[129] See Vera Bódy / Peter Weibel (eds.), Clip, Klapp, Bum, xxx, 115
[130] See https://omatsch.files.wordpress.com/2011/11/tapeviolin.jpg, accessed September 17, 2019
[131] Friedrich Kittler, Grammophon - Film - Typewriter, Berlin (Brinkmann & Bose) 1986, xxx
[132] Marshall McLuhan, Understanding Media. The Extensions of Man, London (Sphere Books) 1964, 164

Timings of the Tape: Spools, Loops

Bergsonean "duration" is like the temporality of a magnetic tape running between two spools[133] - as opposed to the micro-temporal "samples" in William Burrough's magnetophonic cut-ups. Temporal loops materialise in the un- and refolding tape. In Samuel Beckett's one act drama *Krapp's Last Tape* (1958) the magnetophone itself figures as central memory agency, and its spool represent the loops in which Krapp's autobiographic recursions get lost.

In a variance of what later became notorious in Alvin Lucier's magnetic tape insetallation *I am sitting in a room*, Christine Kozlov's 1969 piece *Information: No Theory*, a tape machine which is equipped with a continuous loop tape, continuously "refreshes" the acoustic signal which occur in a closed room.[134] In its indifference to phonocentrism, the machine indiscriminately even refreshes silence.

Katja Nick, a Berlin circus artist, has been specialised in backward-speaking. Not only that the performance of back-speaking is inspired by the dominant reel-to-reel tape technologies of her days, but the magnetophon itself, in a stricter sense, served as a non-subjective proof of her claim. As a proof that she did not make up but actually reversed correctly what a member of the audience had told her to speak backwards, she recorded her articulation on a specially modified tape recorder which could literally "play back" her reverse-speech performance.

Fig. / Artefact: Katja Nick's spiral-coloured magnetic tape reel

At the moment when Katja Nick spoke backwards, she has herself been in a tape recording machine state.

Quantization of the Tape Temporality: Time-Stretching

The epistmological rupture between "analogue" and "digital" electronics, incorporated in a literally transitional device: the analog-to-digital converter which is based on "sampling". Sampling replaces the manual cutting up of magnetic tape snippets by digital "quanta"[135]. Immediately after World War II, Denis Gabór had experimented with mechanisms to apply compression-expansion for frequency conversion by granular, "quantised" sound. Based on the sound film technology, Gabór

[133] Barker 2012; 59, referring to Henri Bergson

[134] As it is discussed in the dissertation by Ioana B. Jucan, Brown University (forthcoming)

[135] See Denis Gabor, Acoustical Quanta and the Theory of Hearing, in: Nature Nr. 4044, 159 (Mai 1947), 591-594

developed the "kinematical method" first, using a film projector with a photocell, followed by fully electrical arrangement: the frequency converter with magnetic tape in a loop. "After reading each section of the tape it would be erased and something new could be recorded before that section of the tape got read again. This way it could be used infinitely without running out of film, and it could be constantly updated." German company Springer actually built a commercial time/pitch changing device of that kind for analogue electronic music production, such as Herbert Eimert's 1963 composition called Epitaph für Aikichi Kuboyama (Wergo 60014).[136]

Appropriately at a moment of world-historical changes in the political sense, in 1989, a time-stretching feature has been added to the digital audio sampler AKAI S1000. Real-time calculated time-stretching makes all the difference to linear tape-based recording.[137] Different from the Mickey mouse effect known from voice on tape, this feature allowed for samples to be played back at variable speed.

"The phonograph is [...] incapable of achieving real-time frequency shifts. For this we need rock bands with harmonizers that are able to reverse - with considerable electronic effort - the inevitable speed changes, at least to deceivable human ears. Only then then [...] women can be men and men can be woman again."[138] A voice transposer who does not simply want to produce the Mickey-mouse effect by speeding up tape recordings of a voice must contain a micro-processor (which in Kittler's case had been programmed in Assembly language). The electronic Harmonizer has been applied for the acoustic transposition of male into female voices, *vice versa*. The Springer Tempophon time-stretching device allows to transpose audio without changing it's length, similar to the Variphrase technology from Roland company.

The sampler plays either more or fewer samples at the same rate, affecting the length of the sample but not its overall pitch - a technical reoccurence of the special purpose German military magnetophon *Tonschreiber* for the decryption of accelerated Morse code. This techno-mathematics contributed to a widening of the time window of the present.

"... else loop forever": The Loop as Time Figure in Analog and Digital Media

[136] http://www.granularsynthesis.com/hthesis/gabor2.html, accessed 6th November 2014

[137] A theme which is dealt with by Andrew Lison in his forthcoming book on New Media and the End of History

[138] Friedrich Kittler, Gramophone - Film - Typewriter, Stanford (Stanford UP) 1999, as quoted in: Jonathan Sterne (ed.), Sound studies reader, London (routledge) 2012, 243

The media-chronopoetic figure of the loop, which has once been technologically induced by magnetic tape recording, has survived in a different, now symbolic, regime: the loop in programming, and the challenge of non-terminating algorithms.

Alan Turing's design of a symbolical mechanism is an instantiation of a "limitation" of computing in both its axiomatic and temporal sense. "Computable" numbers are those which are calculable by *finite procedures*. It is principally impossible indeed for mathematics to decide beforehand whether a complex algorithmic task will ever come to an end or not - "... else loop forever".

"Eternally" iterative loop structures have been a characteristic time figure of analogue recording media already, like the classic magnetic tape (reel-to-reel). The poetic computer program line "... else loop forever" reminds of Samuel Beckett's play *Krapp's Last Tape* (first performed in London 1958) which ends with the director's note "tape runs on in silence" - an endlessness which has been answered by technology by introducing the auto-stop mechanism at the end of a tape. There is a growing asymmetry between media time, the tapes which replay Krapp's voice almost invariant to temporal progression, whenever it is activated by the magnetophone by electro-magnetic induction, and Krapp's biological existence which is subject to entropic ageing.

The computational *Halteproblem* (among other *Entscheidungsprobleme*) searches for an algorithm which can decide, if programs, or automata, will ever stop in case of certain inputs or not. Almost paradoxically the "sense of ending" in the Turing Machine as *finite automaton* is based on the (purely theoretical) infinite, endless tape for intermediary notation and symbol storage. Different from the continuous magnetic tape loops in "closed circuit" audio and video art[139], the iterative configurations of a loop in digital computing are radically discontinuous. Iterative and recursive procedures are the predominant *chrono-tropes* in computing time, culminating in the backpropagation of "big data" within artificial neuronal nets in "deep" machine learning.

The Preservation of Tape-Based Electronic Art (Sound, Image)

Different from immobile museum objects in *stasis*, time-based technological artifacts are in their "media" (art) state only when being in dynamic operation. In order to functionally re-enact Dan Graham's video installation *Present - Continuous - Past(s)* from 1974, the analog recorder tape delay may be emulated in digital signal processing. But the media-

[139] See Tilman Baumgärtel, Schleifen. Geschichte und Ästhetik des Loops, Berlin (Kulturverlag Kadmos) 2015

artistic message (the irritation of "presence") can only be preserved in its specific materiality which once triggered the idea of delayed presence, the reel-to-reel video tape and loop. Graham's installation has been a pure function of an electronic diagram: the *feedback circuit*, creating a re-entry within the actual present, as effect of technically delayed video tape signal transduction.

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

"In his piece Spirit of ‘76 [= Simon Emmerson, Spirit of ’76 (Manuscript, 1976)] a reel tape machine is used to create an accelerating tape delay. This effect is being realized by letting one of the two reel tape machines drag an empty tape spool around the performance floor. Although the sonic effect of the delay can easily be reproduced with digital means, for example a Max/MSP patch, the theatrical effect or the sliding spool gets lost. It is therefore of utmost importance to leave the dogma of ‘the score tells it all’. The notion that a sound or video recording might suffice as proper documentation for the intentions (or what is more, the technology used) is being rightfully rejected by Bernardini and Vidolin since."[142]

Synchronizing signals are recorded on a video tape itself, along with picture and sound information. This sync information enables the images to be played back in a stable fashion, oriented properly both vertically

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[140] Joseph Auner, Reich on Tape: The Performance of Violin Phase, in: Twentieth-Century Music 14/1 (2017), special issue *Tape: Or, Rewinding the Phonographic Regime*, eds. Andrea F. Bohlman and Peter McMurray, 77–92 (77, abstract)
[141] Romana Schuler (ed.), Peter Weibel. Bildwelten 1982-1996, xxx, 69
[142] Sebastian Berweck, It worked yesterday: On (re-)performing electroacoustic music. Doctoral thesis 2012, University of Huddersfield, http://eprints.hud.ac.uk/id/eprint/17540/1/sberweckfinalthesis.pdf; see as well Simon Emmerson, In What Form Can "Live Electronic Music" Live On?”, in: Organised Sound 11, no. 3 (2006), 209–219

and horizontally. Changes in these synchronizing or timing signals cause time base errors that result in disturbances to the images, to be matched by the Time Base Corrector (TBC). Video itself takes place not simply in cultural time but is always already a technological time object itself, chrono-poetically manipulated by artists.

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

"Deep" Media Time of Tape Recordings: Tape Ageing

The "deep" time of recording media such as the magnetic tape is rather of physical than of "historical" (cultural) nature. Tape recording is not only an agency of time-axis manipulation[143], but subject to entropic, techno-cultural, and "historical" time itself. Next to the physical decay of signal-informed magnetical particles on tape, there is the chemical qualities of the magnetic tape. More abstractly, there is its conceptual materiality: its actual reel format.[144]

Once the archival "record" is no more ink on paper, but electronic storage, it becomes a matter of media archivology. For signals which can not be perceived by human senses directly, but need technical media to become audible or visible, there is an archival need for re-operative hardware (or its software emulation). For the compilation of the decennial population census in the early 1960, the U. S. Census Bureau retained records on magnetic tape in what it regarded as permanent storage. In 1976, in a core archival act, the National Archives identified seven series of aggregated data from the 1960 Census files as having long-term historical value. "A large portion of the selected records, however, resided on tapes that the Bureau could read only with a UNIVAC type II-A tape drive. By the mid-seventies, that particular tape drive was long obsolete, and the Census Bureau faced a significant engineering challenge in preserving the data from the UNIVAC type II-A tapes. By 1979, the Bureau had successfully copied onto industry-standard tapes nearly all the data judged then to have long-term value."[145] This data

[143] See Friedrich Kittler, Real Time Analysis, Time Axis Manipulation, in: idem, Draculas Vermächtnis. Technische Schriften, Leipzig (Reclam) 1993, 182-209
[144] On formal materialism, see Matthew Kirschenbaum, Mechanisms. New Media and the Forensic Imagination, Cambridge, MA (The MIT Press) 2008
[145] http://lyra.rlg.org/ArchTF/tfadi.intro.htm#fragility, accessed xxx

rescuing challenge itself created a signal event in its double sense, since it moved the Committee on the Records of Government six years later to proclaim that "the United States is in danger of losing its memory" (ibid.). When the computer tapes containing the raw data from the 1960 federal census came to National Archives and Records Service, only two machines operative for reading those tapes: one in Japan "and the other already deposited in the Smithsonian as a relic"[146].

Different from such technological aspects of ageing, there is the media-cultural "historisation" of tape recording - the age as "epoch".

THE TECHNICAL VOICE

Vocal Machines

In occidental logocentric epistemology, there is a vibrational event which looks most human: the voice. Machines for artificially synthesizing vowells like "a-e-i-o-u" have been construced. Once sound waves and frequencies of the human voice were mathematically (that is: "really", not simply symbolically by the vocal alphabet / *stoeicheia*) analyzed, they became computable, starting with a Leonard Euler in St. Petersburg, a contemporary of Immanuel Kant, when in 1739 he developed his music theory and chose the analytical way to approach human articulation (the Euler equations).

Truly *media*-archaeological analysis of cultural articulations (be it artefacts of voices) takes place when media themselves become the technical tools of analysis, just like in early chrono-photography which was meant to analyze the movement of horses unpercetable by human eyes since too fast. The interest is not in representation but in techno-operative measuring, as opposed to the performative use of cinematography for narrative film projection.

Beyond media-anthropomorphism, the technical function can be performed much better by not imitating living beings, but adopting to the genuine physical signal event. Such media are not McLuhan's extensions of man any more, but rather they subject man to the apparatus. In 1878, Edison describes in a patent one of the possible uses of the phonograph as speech generator, "to teach the relationship between each letter of the alphabet and its sound: a set of typewriter keys, each labelled with a single letter, activated the playback of individual sections of a long cylinder that contained the spoken forms of those particular letters".[147]

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[146] Committee on the Records of Government 1985:9, 86-87

[147] Hugh Davies, A History of Sampling, in: Feedback Papers 40, Cologne (July 1994), 2-15 (4)

Siren songs and *Musurgia*

Media archaeology has a different reading of the Siren songs in Homer's *Odyssey*. The epic explicitely (by using the grammatical archaic form of the dual at song 12 line 52 and 167) names t w o Sirens which can only be explained by an archaeology of early Greek music (enharmonics, the double-flute *auloi*). A literal reading of such "ambiguity"[148] surrounding the Sirens' song comes close to Maurice Blanchot´s interpretation of the "superhuman"[149], not even anthropomophic Siren motive. Thus the Sirens do not simply "present the most serious female challenge to the authority of the *Odyssey* narrator"[150], but rather a challenge to the idea of the human voice as such, just like in the so-called Turing Test the gender question and uncertainty is extended to the human-machine communication at all.

Already Descartes deciphered animals as automata. Media archaeology refers to the uncanny in the human itself (unlike von Kempelen's chess-playing automaton with a dwarf hidden inside, referred to in Benjamin's *Theses on the notion of history*). Siren voices - what did they sound like? Operative media archaeology actually explored the acoustic uniqueness of the Li Galli isands in the Gulf of Positano at the Italian Amalfi coast in early April 2004: a range of experimental sounding and measuring, from two opera singers performing the Siren song lines which are in Homers´ *Odyssey*, up to an electronic sampling of the kind of noise which is produced on these islands by bees, by the wind, by the waves. Thereby the sono-sphere has been given the chance to express itself by help of most advanced sonic technologies, assuming that (like Schliemann excavating ancient Troy) the Sirens were not just poetic fiction but there is implicit local knowledge which has been preserved in cultural aocustic memory. Sound frequencies belong to the regime of the real, not the symbolical, and (according to Jacques Lacan) the real always returns to its place. Media archaeology is as close to natural or technical sciences as it is to academic humanities.

A recurrence of bodiless or technological (thus: monstruous) voices is the phonograph which for the first time made the voice not only symbolically (alphabet) but physically signal-recordable. Reverse phonography is acoustic media-archaeology. In Gregory Benford's novel *Time Shards*[151], workers at the Smithsonian Institution prepare a time capsule to be buried in 2000 AD, while a scientist tries to resurrect voices from 1000 AD. As suggested in Paul DeMarinis' media-artistic installation *The Edion effect* we can listen to the voices of people from a thousand years ago by

[148] Lillian Eileen Doherty, Siren Songs. Gender, Audiences, and Narrators in the Odyssey, Ann Arbor (University of Michigan Press) 1995, 61
[149] Doherty 1995: 136
[150] Doherty 1995: 139
[151] Orig. 1979; electronically *online* 2000: FictionWise eBooks

rading grooves on pottery.

Different from such wave forms is discrete acoustic signal processing, known from an instrument appropriately called "Siren" for war attack or fire warning. The technical Siren was developed by Charles Cargniard La Tour in 1819 and improved by Hermann v. Helmholtz, linking discrete sound production (the siren / the alphabet) to the mathematics of Fourier series: auditory perception as a machinic process. The composer Edgard Varèse, in his piece *Ionisation*, performed this "corporification de l´intelligence qui est dans le sons". With the introduction of the optical film soundtrack in the end 1920s, sound could be photoelectrically recorded on a narrow track beside the visual images and therefore even be monitored and visually analysed itself. Most of the early electro-acoustic instruments like photoelectric organs from the late 1920s and the 1930s were based on a rotating disc that interrupted the passage of a beam of light between its source and a photocell to avoiding mechanically direct contact with the surface of the recording. "Many of these sytems used a principle derived from that of the siren, interrupting the light-beam by a rotating opaque disc in which holes or slits had been cut."[152] Synthesizers take over - between the analog and the digital. Athanasius Kircher once designed a machine to compose music with stardardized set pieces, the *Arca musarithmica* from his study on Baroque music in 2 volumes *Musurgia universalis* (Rome 1650). Music automata, as the precursors of computer-programmable music, allowed for music to unfold without a human musician being present.[153]

The Sirens in Homer´s *Odyssey* uncannily remind humans that their own voice may not be that individual but be reproducible by a technical vocoder. Such automata are by no means imaginary or allegoric but rather, with Descartes, they reveal the automativity within the animal itselt, just like Norbert Wiener's *Cybernetics* (1948) explictely correlates communication and control in the animal and the machine. The sublime epistemological challenge of technical media addresses the notion of humanness itself. In fact, the media archaeological impulse and method - as apposed to media anthropology or media sociology - is to take the perspective of the machines in order to get liberated for moments from the subjective human view.

Voice signal recording

[152] Davies 1994: 6

[153] See Sebastian Klotz, *Ars combinatoria* oder "Musik ohne Kopfzerbrechen". Kalküle des Musikalischen von Kircher bis Kirnberger, in: Musiktheorie Bd. 14 (1999), Heft 3, 231- 245; for the link between music automata in Arabic medieval culture and current computing, see Shintaro Miyazaki, Algorhythmisiert. Eine Medienarchäologie digitaler Signale und (un)erhörter Zeiteffekte, Berlin (Kulturverlag Kadmos) 2013

The nature of memory agencies like the archive or the library has changed since signal recording (like phonography, or video) started to rival the traditional textual record. While archival document criticism and the historical method of organizing past data is necessary and plausible in remembering cultural pasts, it is not the only way to model past times. There is a shift of emphasis; to take an example from sonic archaeology: the phonographic collection of early voice recordings (Lautarchiv) based at Humboldt University, Berlin. The phonological target was inscribed into the Lautarchiv by its promotor Wilhelm Doegen from the beginning. The Lautarchiv encompasses a) voice samples by famous characters, b) truly archival recordings of local speech dialects, and c) recordings for musical ethnology, mostly Africans and Indians from the French and British Army prisoners in the World War One "Halbmond" camp at Wünsdorf south of Berlin. While cultural analysis concentrates on this ethically ambivalent historical and discursive context, with a different epistemological vantage point media archaeology lends its ears to knowledge which can be derived from the actual media articulation contained in the technical archive itself.

Even the most rigid media archaeological argumentation as academic method is still verbal or textual. But it allows for non-discursive matters to be recognized. Technical media have become time objects in themselves, they enact the drama of signalling past to present, such like Enrico Caruso's voice from an ancient gramophone recording all of the sudden is being experienced as radically present voice in the human listening perception. The media-induced affect is radical presence, or "re-presencing" (Vivian Sobchack).

Towards a media archaeological "understanding" of the human voice

If sound is evasive, liquid, in itself unrecordable and transferable beyond the bodily range, then technical media (different from alphabetic phonetic writing which "freezes" the human voice by reducing it to a range of a very limited symbolic code) are able to de-freeze recorded voices in all its frequencies in re-play as heritage of the Edison wax cylinder. The author Arthur Schnitzler knew it, when speaking into the phonograph on 19th March 1907, thus admitting that confronted with the phonograph literature had lost its unique privilege to transmit the memory of human language.[154] But any replay of such a recording will result as well in the scratching, the noise of the recording apparatus itself. True media archaeology starts here. The auditive equivalent to the media-archaeological cold gaze is cold listening.[155]

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[154] Phonograph record signature Ph 536 in the Vienna *Phonogrammarchiv* (Austrian Mediathek)

It is still an undigested shock in the cultural unconscious, that humans are able, today, to listen to bodyless human voices which exterminated hundred years ago, by applying laser reading of the wax cylinders which do not destroy its source in the act of re-play. But what do we hear: Message (the vocal articulation) or noise (the scratch)? The micro-physical *close listening* to sound, where the materiality of the recording medium itself becomes poetical, dissolves any semantically meaningful archival unit into discrete blocks of signals. Instead of musicological hermeneutics, media-archaeological understanding is required here. The media archaeologist, without passion, does not hallucinate life when he listens to recorded voices; his exercise is to be aware at each given moment that we are dealing with media, not humans, that we are not speaking with the dead but dead media operate.

RESONANCE OF SIREN SONGS

Conditioned by the vocal alphabet

Homer's *Odyssee* has been among the first oral poetry recorded by the vocal alphabet which thereby became the very condition of a new technology of heritage, passing Homer's epics in a post-oral poetry age. According to Barry Powell's thesis, the explicit addition of single vowel symbols to the known Phoenician alphabet has happened in early Greece for the xpplicit purpose of recording Homer´s epic.[156] Thus the sonicity of the human voice which resides in vowels could be registered in an early form of grammo-phony.

According to Marshall McLuhan, different from its actual massage, the content of a new medium (or rather cultural technique, in this case) is always the previous one. For literally *gramma*-phonic literature in alphabetic writing, this is oral poetry.

With explicit letters for notating phonetic vowels, what had remained exterior to writing - the voice, as poetically expressed by the Siren songs - enters the writing scene itself. This "heating" of writing has a hypnotic consequence.

The theoretization of the Siren songs requires a differentiation between sound as physically measurable and (Fourier-)analyzable event on the spot as opposed to symbolically written sound as phonetic alphabet.

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[155] "Der Phonograph hört eben nicht wie Ohren, die darauf dressiert sind, aus Geräuschen immer gleich Stimmen, Wörter, Töne herauszufoltern; er verzeichnet akustische Ereignisse als solche." Friedrich Kittler, Grammophon - Film - Typewriter, Berlin (Brinkmann & Bose) 1986, 39 f.

[156] Barry B. Powell, Homer and the Origin of the Greek Alphabet, Cambridge 1991

Auralisation of Sirenic voices

Auralisation makes implicit, latent sonic situations explicit, that is: accessible for human hearing. This method becomes a tool, an auxiliary science (German "Hilfswissenschaft") for exploring a new kind of sources (rather than "evidence" which is a visual term) in historical research. Not only room acoustics in closed spaces but past sonospheres thereby become accessible again. Different from textual literary records which do not allow for an experimental reconstruction of the author's original mind-setting, archeoacoustics places the "observer" in a co-original listening situation.

Facing the Amalfi coast south of Naples, the Li Galli islands (Gallo Lungo, Castelluccio and La Rotonda) have been known since antiquity as home of the Sirens. The media-archaeological question is this: It there something like a physically given setting, a grounding in the "real" of signal processing, that kept cultural memory insisting on that place?

According to Homer, Ulysses could hear the Siren song just because a divine power (a *daimon*) calmed down the sea around the Siren islands to get a perfect signal-to-noise ratio. A media-archaeological research expedition by members of Humboldt University Berlin (assisted by the Center for Media Arts and Technology Karlsruhe) in early April 2004 experimented with sound propagation at the supposed original place of the Sirens' singing, the Galli Islands. Both synthetic signals (sine tones, white noise) and natural voices (vocalizations of Monk seals, voices of two female singers) were broadcasted *via* loudspeaker. The signals were then recorded along a supposed line along which Ulysses might have approached the Siren Island. The acoustic analysis of the recordings revealed an acoustic effect which tentatively explains the nature of the Sirens myth: The specific position of the islands (two rock formations opposed to a large curved island) results in a deformation of emitted vocal signals by amplification and changes in the timbre - which only resonates with hearing tuned in archaic Greek enharmonic musical perception.

Fig.: "Spectrogramm of a vocal sung by two female sopranos exploring the Sirens' songs in the midst of the Li Galli islands"[157]

But to what degree is this acoustic latency (as revealed by media-archaeological research) evidence for a conscious use of such reverberations in ancient times? The correlation between this acoustic

[157] From: Karl-Heinz Frommolt / Martin Carlé, Der Gesang der Sirenen. Homers Dichtung und akustische Realität, in: Hugo Fastl / Markus Fruhmann (ed.), Fortschritte der Akustik. Plenarvorträge und Fachbeiträge der 31. Deutschen Jahrestagung für Akustik DAGA 2005 in München, Berlin (DEGA), vol II, 797

latency as revealed by cold measuring evidence with a conscious use of such reverberations in ancient times induced by the semantically heated transmission of the Siren songs in the vocal alphabet strikes the central question of cultural tradition when conceived in techno-mathematical terms of communication theory. Any such deduction of sonic significance from archeoacoustics oscillates between signal or noise.[158] What remains undecidable is the degree to which a conscious use of resonance in ancient times has been applied to such acoustic settings. But the key hypothesis based on such findings is that the data won by acoustic measurement correlate with essential assumptions in ancient Greek musical theory and enharmonics. The clue to the location of the Siren songs might therefore be that the sonosphere specifically struck the Greek ear which was tuned by its culture of musical listening.

(Hyper-)Sonic beams

The poetic subject of the Siren songs is rooted in writing, a kind of epic phenotype of the cultural-technological genotype of the alphabet.[159] Sound can be symbolically registered only in its specification as *vocal* alphabet, but only with the media epistemic condition of technical signal recording the media archaeological investigation of the Siren motive arose in non-philological ways. In the age of acoustic media, sonic hallucinations such as the Siren singing is not a function of phonetic writing any more but of technical signals. That is why the Siren voices Ernle Bradford claimed to have heard at the Sirenuse islands appeared "soul-less", "somewhat im-material"[160]. It requires a special device (method) to decode these acoustic memory grooves: the media-archaeological ear, i. e., an archaeology of sound.[161] Synthesis of the voice deceive the human ear. Brain wave simulators, just like MP3 audio file compression, are built on both psycho- and media-acoustic facts. An ultrasound packet, whatever it contains, is only heard in the head of the target person, where the skull bones function as a resonator which changes the hight frequency waves back into audible sound, that is: demodulation, just like with radio waves.[162]

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[158] See Chris Scarre / Graeme Lawson (eds.), Archaeoacustics, Cambridge et al. (McDonald Institute for Archaeological Research) 2006

[159] Barry Powell, Homer and the Origin of Writing, Cambridge 1991

[160] Ernle Bradford, Ulysses Found, London (Hodder and Stoughton) 1963, 156

[161] "Versuchen wir eine akustische Archäologie." Friedrich Kittler, Das Alphabet der Griechen. Zur Archäologie der Schrift, in: Knut Ebeling / Stefan Altekamp (eds.), Die Aktualität des Archäologischen in Wissenschaft, Medien und Künsten, Frankfurt / M. (Fischer) 2004, 252-260 (260)

[162] Olaf Arndt, Wer nicht hören will muss fühlen (Voices of the Mind III), in: Babel No 4 (May 2004), 32-41 (38), referring to the *Dictionary of Non Lethal Weapons* edited by John B. Alexander

Phonographic sirenism

The human voice became media theatre with the arrival of the Edison phonograph. With an analogous human / machine performance in the New York Carnegie Hall, the Edison Company in 1916 convinced the (literally) *audience* (not sight-focused, like in traditional theatre) of the sonic fidelity of phonographic recording: "Alone on the vast stage there stood a mahagony phonograph [...]. In the midst of the hushed silence a white-gloved man emerged from the mysterious region behind the draperies, solemnly placed a record in the gaping mouth of the machine, wound it up and vanished. Then Mme. Rappold stepped forward, and leaning one arm affectionately on the phonograph began to sing an air from 'Tosca.' The phonograph also began to sing "Vissi d' Arte, Vissi d'Amore" at the top of its mechanical lungs, with exactly the same accent and intonation, even stopping to take a breath in unison with the prima donna. Occasionally the singer would stop and the phonograph carried on the air alone. When the mechanical voice ended Mme. Rappold sang. The fascination for the audience lay in guessing whether Mme. Rappold or the phonograph was at work, or whether they were singing together"[163]; a similar confrontation between performance with human voice and replay from the apparatushas been commented in the *Boston Journal* the same year: "It was actually impossible to distinguish the singer‘s living voice from its re-creation in the instrument."[164] The Homeric Siren motive returns as the sonic variance of the Turing Test in coded communication[165], as much as *His master´s voice* has been experienced by the dog Nipper as the phantasmatic illusion of being present, induced by technical *recording*.

This extends to the time axis as well. Communication between the human sensory apparatus and the signal record can short circuit historical distance, since phonographic culture has been apparently been accommodated to the disembodied voice. But a cognitive-affective dissonance remains. While the historically trained mind knows that the phonographic mediated voice is actually absent, acoustically it is very much "re-presenced" (Vivian Sobchack).

Artificial voices, uncanny

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[163] Article "Edison Snares Soul of Music", in: New York Tribune from 29th April, 1916, 3, quoted here after: Peter Wicke, Das Sonische in der Musik, in: Das Sonische. Sounds zwischen Akustik und Ästhetik, in: PopScriptum 10 (2008), *online* http://www2.hu-berlin.de/fpm/popscrip/themen/pst10/index.htm

[164] Emely A. Thompson, Machines, Music, and the Quest for Fidelity. Marketing the Edison Phonograph in America 1877-1925, in: The Musical Quartely, vol. 79 (1995), 132

[165] Alan Turing, Computing Machinery and Intelligence, in: Mind, vol. 59 (1950), 433-460

Exactly when the Sirens appear to perform the most beautiful in human articulation - the musical voice -, they remind of the uncanny in human experience of electro-acoustic voices: a reminder that the apparently most intimate voice might be machinic in itself, and that the human hearing apparatus is not able to separate human from inhuman voices.

Maurice Blanchot has desribed the Siren sound as paradigmatic for what can be re-defined as media-cultural state of uncertainty. In the age of voice synthesis, humans can not be sure any more whether the sounds they are confronted with are organic or technologically produced.

Located between the extreme borders of "signal" on the one hand (Homer lets them sing in Greek language) and "noise" on the other, the sono-poetic trope of the sound of Sirens offers itself to theoretization in terms of communication theory. Only in written literature the Siren sound became defined as lyrical. The media-archaeological ear, on the contrary, recognizes sine waves.

GUSLARI *ON-LINE*. A technological interpretation of "oral poetry"

Electrified memory

The legacy of Milman Parry's and Albert Lord's research into "oral literature" can not be reduced to their philological transcriptions, but extends to their collection of phonographic recordings as well.

With the phonographic recording of the real voice, an irritation of the temporality of cultural memory took place. Next to the traditional notions of archival historicity, with the recordability of oral poetry as a physical audio-event (not just symbolically like in the phonetic alphabet) a kind of freezing of past performances takes place whose media-inherent temporality differs from the established notions of cultural memory. Such technologies allow for almost time-invariant cultural feed-back: What happens when such a recording is being re-played these days to the local culture in Serbia from previous sound recordings using the same device? On the other hand, are contemporary oral poets (*guslari*) similarly positioned when recorded with a re-enacted Webster Wire Recorder like Albert Lord had applied half a century ago?

"Critical listening practices like recording provide the anthropologist with a lasting record of what was heard, which affords further analysis. Steven Feld [...] refers to the recording process as acoustemic stratigraphies: layers of sound that can be examined, just as one might discover new layers of meaning at an archeological site."[166]

[166] Ely Rosenblum, Composing Sonic Ethnography, referring to: Steven Feld, Acoustemic Stratigraphies. Recent Work in Urban Phonography

But here, a dilemma arises: By recoding the acoustic signal, it is exactly the tempoReal essence of oral poetry, its very transience, which is missed. Once recorded, the voice is ephemeral, and enduring, at the same time[167], which poses an epistemic challenge to the human sense of "historical" time.

Furthermore, the digital processing of such recordings for analysis is not just another technical extension; it rather transform the very essence of oral poetry. In a crude way, algorithmic processing of poetic rhythms, as genuinely re-generative, might be closer to the "formulaic" principle detected by Parry than any other kind of technical reproduction was before.

The tradition of songs and tales, for millenia, happened in mnemotechnics of oral transmission, increasingly accompanied (supplemented, deferred) by notational writing which symbolically tried to emulate the musicality of oral speech (the vocal alphabet, musical notes). The 20th century enabled a media-induced re-entry of orality, a secundary orality (Walter Ong) based on analog recording technologies like phonography and magnetic tape and cinematography. In the 21st century, a symbolic notation has re-entered, this time actually sub-alphabetically analysing the sampled event in the form of the alphanumeric code within computing. For digital audio files, the media-critique of writing as recording device, articulated once by Platon in respect to the ambivalence of technical memories, has to be rewritten.

From this situation arises the "archival" question: What happens to the genre of oral poetry when the "online"-instrumentation (the *gusle* string) and the "online"-recordings (literally Lord's wire spools) become accessible "online" (in the World Wide Web sense)? A note to Ismail Kadare's novel *The File on H.* emphasizes: "In fact, part of the Milman Parry Collection of Oral Literature at Harvard has been digitized, and it is now possible to hear some of their field recordings *online*!"[168]

Re-Discovering the Sound of "Texts": Oral Poetry

[originally published in: Sensate, March 2011], web site of Centre for Imaginative Ethnology, https://imaginative-ethnography.com/imaginings/affect/composing-sonic-ethnography, accessed March 30, 2021

[167] An obvious reference to the title of Wendy Chun, Wendy Chun, The Enduring Ephemeral, or The Future Is a Memory, in: Huhtamo / Parikka (Hg.) 2011: 184-203

[168] http://www.amazon.com/File-H-Novel-Ismail-Kadare/dp/1559706279; accessed September 22, 2006. For such "online" recordings, see http://www.chs.harvard.edu/mpc

While Florens Chladni was already experimenting with visualisations of acoustic wave figures in sand as created by the vibrations of the violin bow, Goethe's definition of literature did not even mention "acoustic data flows"[169] which concern oral poetry.

The practice of oral tradition has been silenced by the general textualisation and „only survived in written format; that is, under pretechnological but literary conditions. However, since it has become possible to record the epics of the last Homeric bards, who until recently were wandering through Serbia and Croatia, oral mnemotechnics or cultures have become reconstructible in a completely different way“, Kittler writes referring to Walter Ong's study on the technologizing of the word.[170]

The usual media-critical argument (since Platon's dialogue *Phaidros*) is that alphabetic recording kills the living memory culture of oral poetry by dead letters. At a conference organized by the Milman Parry Collection at Harvard University), one topic has been „The textualization of oral traditions“.[171] Has Parry's theory of formulae-based oral poetry itself been an effect of its analysis in a transcribed, thus: textual form - just like Aristotle gained his insight into the phonetic character of speech only after its literary elementarisation by the phonetic alphabet? The alphabetization of phonographically recorded oral poetry in philological studies (Homer studies, classics) lead to an oblivion of its essential nature which is sound. In a somewhat oxymoronic and at the same time significantly honest way, the name given by Albert Lord to the impressive archive of recorded oral poetry from the former South Yugoslav countries located at Harvard is "Milman Parry Collection of Oral Literature" by now. But media-archaeologically recognized, there is no text but recorded voices and sound, which only afterwards became transcribed into literature and musical notation (among others, by Bela Bartók).

The signal-based recording of oral poetry operates not "beyond", but below textuality (both subliminal in the neuro-physiological sense and "sublimely" in the poetic sense).

Memory in the age of electro-mathematical media has become transitory, more than ever known from so-called oral cultures. In analogy to Ong's famous analysis, a kind of "second mem/orality" takes place.

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[169] Kittler 1999: 7

[170] Kittler 1999: 7, referring to Walter Ong, Orality and Literacy: The Technologizing of the Word.
London 1982, 27 „and (more reasonably) 3“

[171] *Singers and Tales in the 21st Century: The Legacies of Milman Parry and Albert Lord* (December 3-5, 2010), on occasion of the 50th anniversary of the publication of Albert Lord’s seminal *Singer of Tales* and the 75th anniversary of the death of his mentor Milman Parry who developed the Oral-Formulaic Theory

Transcription *versus* technical recording

Since the Edison phonograph, for the first time, the sound of language could not only be recorded symbolically (as by the phonetic alphabet), but as a real audio signal. The archaeology of sound at stake here is "closely connected to recording technologies that simultaneously [...] shape our sensory experiences of oral poetry".[172]

The "musical" aspect of oral poetry performances lies not in its harmonic (melodic) but its rhythmic aspect - the chrono-poetic and time-critical aspect of prosodic articulation. Only highly sensitive measuring devices (as applied in computational ethno-musicology or in the micro-tonal analysis of piano play) can analytically cope with the subtleties of such *chronoi* (Aristoxenos).

In the case of the legendary *guslar* Avdo Mededovic, Parry and Lord recorded 45000 poetic lines on phonographic discs, and 33500 lines in manual transcription.[173] In order to subject (and open) cultural articulations like "oral poetry" to academic research, these speech and sound events first had to be symbolically or technologically recorded and archivized in order to slow them down for careful and detailled analysis. Time axis manipulation ("slow motion") is the *a priori*, the condition for the scholarly analysis of time-critical processes which Edmund Husserl once called pro- and retention - which in terms of neuroscience is the three-second time span ("window of presence") for a sung verse line (such as an ancient Homeric hexameter).

In listening to such songs from the Milman Parry Collection online, one tends to be trapped by the referential illusion, believing that we are confronted with the audio signal. But in fact discrete bit-strings are being processed - sublime textuality, operating on the subliminal level of our understanding - an unexpected technical realization of what Gottfried Wilhelm Leibniz once described as unconscious ("nesciens") mathematical calculating perception (when listenting, f. e., to breaking waves at the sea shore).

While "analog" phonographic signal recording has been "beyond textuality", a different textuality returns powerfully within technomathematical machines. The alphabet returns in a secondary writing, which is: the alphanumeric code - even if disguised as

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[172] Peter McMurray, There Are No Oral Media? Aural and Visual Perceptions of South Slavic Epic Poetry, typoskript of a talk given on occasion of the Milman Parry half-centennial conference at Harvard

[173] Gertrud Leuze, Homer und "Oral Poetry". Milman Parrys These und mene Erfahrungen im ehemaligen Jugoslawien, in: Würzburger Jahrbücher für die Altertumswissenschaft. Neue Folge, Bd. 26 (2002), 5-12 (note 8)

„secondary orality“.

In the mid-1930s, Harvard scholar Milman Parry investigated the South Yugoslavian unwritten memorizing techniques of epic singers (the *guslari*) as a living analogy to Homer's ancient singing. Not directly the phonographic sound recordings on aluminium discs but their symbolic transcriptions formed the analytic basis for the resulting theory that the hour-long oral tales were regenerated for each occasion from a stock of existing formulae (the formulaic theory of oral poetry).

In 1950/51, Parry's assistant Albert Lord returned to the scene to repeat or continue some of the first recordings, sometimes with the same singers. But this time he used a new technology, a magnetic recording device (based on steel wire). Which difference does it make if popular song recording does not take place gramophonically on aluminium discs any more but electro-inductively *happens* on magnetic medium? Mechanical recording is a passive storage techology; electromagnetic recording, though, requires a dynamic re-enactment to be reproduced.

A wire recorder like the "Webster Chicago" used by Lord is not a phonograph, which, as the name suggests, is still part of the tradition of graphical recordings, but instead transforms the sound memory into a different physical state; process of electromagnetic recording and reproduction not a continuation of writing in a new form, but rather a fundamentally different and genuine technical media event born of the very nature of electricity

Technical recording vs. symbolic transcription (Bartok)

Ancient Greeks added vowels to the Phoenician alphabet for the explicit purpose of making the musicality of oral poetry, in fact: Homer's epics, recordable.[174] But this notation is still symbolic, like the musical transcription which Bela Bartok provided for Milman Parry's recordings of Guslari songs on aluminium disc. What the discs were able to record, though, was a surplus: the non-musical articulations, noise or bird-singing in the background, even Avdo Mededovic's cough.

A „Webster Wire Recorder“ had been used by Albert Lord for his South Yugoslav recordings of oral poetry. When a *guslar* sings into the wire recorder microphone accompanied by his *gusle*, a knee-held violin, a correspondence between the vibrations of the vocal chord, the string (horse-hair chord) that is being bowed, and the recording wire (steel) takes place. In such oscillations, the most human is at the same time the

[174] Barry B. Powell, Homer and the Origin of the Greek Alphabet, Cambridge 1991

most inhuman - when the machine with its coldest technical ear listens to poetry.

Different from notational transcription into musical scores, technical signal-recording of cultural articulation allows for the electro-physical measuring of recorded events (digitally done by "sampling"). This subjects the cultural event to experimentation, thus enabling a non-hemeneutic analysis of cultural articulation on the sub-philological, even sub-alphabetic level.

So not just oral poetry was recorded but as well noise, while the transcriptions into musical notation treat the sonic event as "oral literature" (as the Harvard Collection actually calls itself), thus keeping the analysis within the disciplinary discourse of philology (Parry) and musicology (Bartók), reintegrating sound into the symbolic order.

Singers and Tales in the 21st Century: digital memory

The Legacies of Milman Parry and Albert Lord at the end of the 20th century became transformed into digital files (both the textual and pictorial documentation of the Yugoslavian research journeys and some of the recorded Guslari songs themselves). Does this digitization (by sampling) transform the essence of such a memory? And which is the new "archive" to which such files *online* give access?

The tradition of songs and tales, for millenia, happened in mnemotechnics of oral transmission, increasingly accompanied (supplemented, deferred) by notational writing (the vocal alphabet, musical notes). The early 20th century enabled a media-induced re-entry of orality, a secondary orality (Walter Ong) based on analog recording technologies like phonography and magnetic tape. In late 20th century, the symbolic notation took revenge by its re-entry: in the form of the alphanumeric code within computing. The digital sampling of the audiovisual legacy of Parry and Lord on aluminium discs and wire spools makes a media-ontological difference - even if not to the human ear which is betrayed by the "sampling theorem" of digital signal processing.

Mathematically discovering sub-semantic poetic articulation

It makes a media-archaeological (rather than philological) difference for the notion of "oral poetry" when its notation for analysis does not take place in symbolical writing (the phonetic alphabet since the age of archaic Greece, or more recently, musical notation) any more, but by (electro-)physical recording media like the phonograph, as performed by Milman Parry on aluminium discs. Micro-events in performing oral poetry might thus get under consideration, near-discontinuous change,

probabilities of transitions, re- and protentions which require stochastic rather than simply statistical analysis (known from Claude Shannon's analysis of dynamic toys, described as "Mathematical Theory of Little Juggling Clowns"[175]). Oral poetry can be re-generated by the machine indeed, transforming the *formulae* (as defined by Parry); "deep learning" *aka* algorithmic intelligence will finally result in composing oral poetry by Avdo Mededovic *post mortem*. Claude Shannon defines artificial languages abstractly as "a stochastic process which generates a sequence of symbols"[176] - which is exactly the definition Jacques Lacan gives to the mechanism of signifiers in the human unconscious.

ORAL-FORMULAIC TECHNICS AS A FUNCTION OF RECORDING TECHNOLOGIES

a) De-Colonizing the Techno-Archival Regime of Oral Poetry Research?

Ethnopoeticical Recording, and the "Post"-Colonial Issue

Media-archaeological inquiry into the technical means of recording Oral Poetry in former South Yuguslavia may - somewhat unexpectedly - start with the recall of a semi-historical scene of cultural imperialism: Werner Herzog's film Fitzcarraldo (G 1982) where an opera lover plays Caruso's voice from gramophone to the indigenous people from a ship on the Amazone river.[177]

In reverse, and from the critical perspective of postcolonial studies, the recordings of epic *guslari* songs from the Balkans resulting from the Milman Parry and Albert Lord enterprise and their technical devices (phonography and magnetic wire), as preserved in the MPC at Harvard, look like a form of Western academic "imperialism", an imposition of philological and ethnomusical research upon local communities down to epistemic violence in conversations with the *guslari*.[178]

The Parry and Lord enterprise may be an occasion to rethink key academic concepts including "peripherality, coloniality of power, and decolonial thought". In the field of cultural memory studies, art historian Aby Warburg has been accused (Friedberg) for his intrusive stepping-

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[175] Axel Roch, Claude E. Shannon: Spielzeug, Leben und die geheime Geschichte seiner Theorie der Information, Berlin (gegenstalt Verlag) 2009, 163 f.
[176] Claude Shannon, Collected Papers, Piscataway (IEEE Press) 1993, 5
[177] Videotrailer: https://www.youtube.com/watch?v=qDebgOb4tMc
[178] See Slavica Ranković, Managing the "Boss": Epistemic Violence, Resistance, and Negotiations in Milman Parry's and Nikola Vujnović's Pričanja with Salih Ugljanin, in: Oral Tradition 27, no. 1 (2012). On the items in the MPC as museal "boundary objects" see McMurray 2015

over, in the course of his cultural studies, of indigenous sacred / secret rituals as performed the Hopi community in the South-Western United States around 1900.

This discourse is part of a larger discussion concerning the "restitution" of ritual items from former colonies, as preserved in Western museums, to their indigenous communities. But such items have not been acquired as trophies and prey but as material arguments in a chain of scientific inquiry for the sake of comparative cultural studies. Such a comparison requires a locus[179] for which the museum or the media archive - like the black & white photographies of comparative world art history for André Malraux' concept of the *musée imaginaire*, and the auditive, visual and textual records in the MPC at Harvard University - serve as laboratory. If this academic approach is labeled "Western", this is no spatiotemporal or geopolitical definition, but a designation for an enlightenment epistemology that may as well be identified in various global cultures for non-hierarchical, non-religious, even non-philosophical modes of though and scientific research.

In contrast to post-colonial criticism, a media archaeological approach to the secrets of formulaic oral poetry composition sets aside the discursive (political, ethic and aesthetic) ramifications of the Parry-Lord expeditions, in favour of an analysis of its non-discursive, literally techno-logical mechanism.

[The oral-formulaic theory (as termed by Lord) has been applied to "classical, late antique, and medieval European literature, including Anglo-Saxon poetry, poetry in non-European language traditions such as classical Arabic" to explain the poetic mechanism of some parts of the Quran[180], as well as to "contemporary improvised genres including jazz and hip-hop" (workshop draft).]

If the formulaic theory is "crossing spatial and temporal divides" between ancient Greek Homeric epic and other compositional traditions worldwide"[181], it turns out as a linguistic structure that co-originally deconstructs any historicism in the analysis of cultural knowledge transfer.

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[179] See Michel de Certeau, Writing versus Time, in: Rethinking History, ed. M.-R. Logan / J. F. Logan, New Haven: Yale French Studies 59 (1980)
[180] Andrew G. Bannister, An Oral-Formulaic Study of the Qur'an, Lanham, Maryland (Lexington Books) 2014
[181] From Ananya Jahanara Kabir's (King’s College London) draft for the exploratory workshop (proposed for the EXC 2020 "Temporal Communities. Doing Literature in a Global Perspective", Research Area 3 »Future Perfect«): Homer, the Balkans, and the World: Milman Parry, Albert Bates Lord, and the Oral-Formulaic Imaginary, Free University Berlin, March 5, 2024

[Should "decolonial thought" be applied in terms of a "critical philology" (workshop draft) for cases of "archiving presence" such as the Phonogram Archive in Vienna, the Lautarchiv in Berlin, or the MPC at Hardard? Increasingly, the academically inherited methods of scientific research get into a defensive position. Has Parry's and Lord's techno-scientific approach to epic practices like by the *guslari* singers in the Balkans kind of "colonizing", a Western academic imposition on local cultures that ask to be de-colonized or even "unlearned"? Scholarship, though, proudly insist on the achievements of enlightened, rule-governed research.]

The structuralist "oral-formulaic theory" approach - in terms of universals of *poiesis* - clashes with the recent sensitivity towards subtle local contextualities. Should therefore the academically and archivally inherited Western scientific music-ethnological and philological approach be "unlearned" in favour of "situated knowledge"[182]? Should a more "participative", empathetic, a more psychological, phenomenological, "reasonant"[183] and immersive approach replace the common "objective" mode in the investigation of local cultures? It is the epistemology of scientifically distanced observation that is technologically radicalized by recording machines. In the course of cultural evolution, "man" has constructed technologies in order to achieve a more dis-embodied world perception for analysis - just like the trained draughtsman Henry Fox Talbot once explicitly celebrated his invention of a photographic *Pencil of Nature* (1844) as a liberation, a disembodiment of his idiosyncratic subjective vision and partiaity of his painterly hands. Corresponding with this cold media-archaeological gaze, acoustic research as well is driven by the quest for distant, that is: *scientific* listening. Only phonographic recording turns its poetic "content" into consciously *artificial* signals and thereby invites to apply technologies of Digital Humanities and cultural *analytics* (Manovich) - rather than philological analysis and cultural studies. Such computational research drives out the "imaginary" (Anyana Kabir) from the Oral-Formulaic theory and rather reveals its symbolic regime as a *poiesis* of the machine.[184]

Parry's and Lord's technologies are actually intertwined with the alphabet-centred, therefore analytic (McLuhan) method of research and with the claim for more objective scientific observation achieved by technical instrumentation for measuring, recording, and (finally)

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[182] Donna Haraway, Situated Knowledges. The Science Question in Feminism and the Privilege of Partial Perspective, in: Feminist Studies, 14/3 (1988), 575-599

[183] Haraway 1988: 588

[184] See Friedrich Kittler, The world of the symbolic – a world of the machine, in: J. Johnston (ed.), Literature, Media, Information Systems, London / New York (Routledge) (1997), 130–146

counting. Should such archiving then have to be questioned in favour of a more "situated" approach (that unexpectedly coincides with the more sensor- than symbol-oriented "situated" and "embodied" approach in Artificial Intelligence[185])?

[For this critical view from the local perspective see Albanian author Ismail Kadare's "fictionalization" of the Parry-Lord expedition in his novel Dosja H (Albanian original 1981) that itself had been "triggered by an encounter between Kadare and Lord at a conference in Ankara."[186]]

But that would question the modes of scientific research as inherited from ancient Greek philosophy of nature, early modern European science and Kantean enlightenment as liberation of thought from discursive restrictions.

The current "urgent questions of decoloniality, creolization, reparation, racialization, the Global South, and world literature" are in fact questioning the rigid scientific (in terms of philology even logocentric[187]) Parry / Lord approach. Their recording apparatus at first glance looks like an external intrusion of advanced Western technology into local Balkans cultures indeed.[188] But it is that very equipment that brought the understanding of culture closer than ever to the poetic event of the *guslari* epic song tradition.

The apparent "colonization" of local musical cultures by Western technologies like the phonograph and the wire recorder are necessarily corresponding with the scientific approach turning "situated" implicit knowledge into explicitly inter-subjective and verifiable (tec-)knowledge. Current "post-colonial" alternatives - with their emphasis on "unlearning" inherited academic methods (Dona Haraway) - are post-scientific: at the price of losing critical distance in favour of more "entangled", but htereby less analytic research.

Admittedly even Milman Parry had affective moments when he not only "immersed himself" (workshop draft) in the poetic sphere of the *guslari* singers in the Balkans between 1933-35, but even dressed in their kind

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[185] Günther Görz / Josef Schneeberger / Ute Schmid, Handbuch der Künstlichen Intelligenz, München (Oldenburg) 5. erw. Aufl. 2014, 12

[186] See Erica Weitzman, Ismail Kadare's The File on H. and the Comedy of Epic, in: Modern Language Review 111, no. 3 (2016), 818-839, and Denis Bizhga, The Epic of the Kreshniks in the literature of Ismail Kadare and a description of the rhapsodes of the Albanian mountains, in: Polis 22 (2023), 114-117

[187] Proverbial "ein Mann ein Wort"

[188] For a critical perspective on the technical a priori in current media studies, see the thematic issue "X | KEINLAGEBERICHT", zeitschrift für medienwissenschaft vol. 26, no 1/2022

of costume to get locally embodied. To resists or even counteract this empathic seduction, his recording devices were applied to gain (on the spot) and maintain (in the archive) a distanced relation that is the condition for possible *critical* analysis of the poetic event. The gap between the scientific approach and the local culture that has been induced by such technology has not been a deficiency but a conscious manoeuvre in favour of genuinely academic modes of research.

[The (to play with words) *acad*"emic" approach is an insider's perspective, which looks at the beliefs, values, and practices of a particular culture from the perspective of the people who live within that culture."[189] The "etic" approach, on the other hand, is "an outsider's perspective, which looks at a culture from the perspective of an outside observer or researcher. [...] The etic approach often involves the use of standardized measures and frameworks" - and more concretely: recording technologies - "to compare different cultures and may involve the use of concepts and theories from other disciplines, such as psychology or sociology." (Wikipedia ibid.)]

The method of scientific analysis is bound to such advanced technologies of recording and measuring that are always "alien" to the investigated local cultures. Such apparent "technicolonialization" is inextricably bound to the early modern European scientific and Enlightenment ambition of "revealing" non-discursive truths behind the phenomenal local articulations.

Technical Recording and its Resulting Techno-Trauma: a Phenomenological Approach

In the strange alliance between the guslar performance and its operative technical recording[190], a techno-traumatic ambivalence is at work. Ironically, it has been technical recording which at the same time saved and muted the "illiterate" culture of non-alphaebtic Oral Poetry, just like cultural historian Aby Warburg once remarked on the electrification of local "pagan" cultures that telegraphy and telephony actually have destroyed their cosmic world view.[191]

What actually happens when, in music-ethnological field research, a singer (*guslar*) confronts a recording device such as the wire recorder?

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[189] https://en.wikipedia.org/wiki/Emic_and_etic, accessed February 25, 2024

[190] See W. E., Drahtseilakte / Tight-Rope Act, in: Institut für Medienarchäologie (ed.), Zauberhafte Klangmaschinen. Von der Sprechmaschine bis zur Soundkarte, Mainz (Schott) 2008, 110-111

[191] "Telegramm und Telephon zerstören den Kosmos." Aby Warburg, Schlangenritual. Ein Reisebericht, Berlin 1988, 79

And what affect arises from within the machine in the moment of re-presencing such electrified voices? What kind of wonder actually occurs when, after such a strange encounter of a *guslar* with the wire recorder, a poetic voice emanates from the coldest wire spools?

A disruptive gap opens from this affective / cognitive dissonance: There is a special melancholic - if not traumatic - beauty which arises, in human perception, from the coldest technical recording.

While oral memory (such as the audiovisual testimony of individual Holocaust survivors in the Yale archive, or collective oral poetry in former South West Yugoslavia by Parry / Lord) has been preserved by technical recording for philological analysis, such projects have at the same time a more ambivalent, even uncanny ratio: It is under the threat of possible extinction of cultural expression (be it global modernization, or ideological violence) that such enterprises have been undertaken. The signal archive thus becomes accomplice of exchanging media memory for cultural death (or its artificialization). The act of archiving poetic voices is an eth(n)ically sensitive issue, in the sense of Philip Scheffner's film The Halfmoon Files (GER 2007) on the origin of the Berlin phonographic *Lautarchiv* from academic voice recordings of colonial soldiers in German prison camps during the First World War: "complex relationships between politics, colonialism, science and media" arise indeed.[192]

b) Grammophonization of Oral Poetry Research:

The Milman Parry Collection of "Oral Literature" - a Criticism

Parry learned about the Balkans *guslari* tradition on occasion of his doctoral studies in Paris in 1928 with Antoine Meillet.[193]

[A contemporary role in the formulation in the so-called Parry-Lord Oral-Formulaic Theory (with its notable accent on "formalism" in an almost mathematical structual sense) played the Prague linguistic circle, notably Roman Jakobson and Matija Murko. Such research-inspiring "epistemic" encounters - as well as the later one between Lord and Kadare in Ankara - have not simply been historically contingent[194], but result from a "thick" discursive formation that interrelates the formalistic linguistic approach

[192] Web site Filmgalerie 451, https://www.filmgalerie451.de/en/films/the-halfmoon-files (accessed March 2, 2024)
[193] See Thérèse de Vet, Parry in Paris: Structuralism, Historical Linguistics, and the Oral Theory, in: Classical Antiquity 24, no. 2 (2005), 257-284
[194] A thought inspired by Slavistic studies scholar Susanne Frank (Humboldt-University Berlin)

with the machine.[195] To what degree is discourse analysis intertwined with the advancement of knowledge on oral *poiesis* and an up-date of the oral-formulaic theory as such?]

But what has been discussed in such circles has still been philological, text-based, symbolic knowledge.[196] Parry's discovery of "Homer"'s formulaic epic composition as *cultural technique* (or Maussean "body-technique") has itself, though, not simply be enabled, but is as well a direct function of non-symbolic recording technologies for research.

The oral poetry of "temporal communities" can either be fixed by the alphabetic code and the musical score, or by phonographic signal recording. While Albert Lord's cataloguing of the phonographic and photographic archives of their Balkans fieldwork for Harvard University's Widener Library has been a metadata approach, signal archaeology investigates the poetical trace from within.

The Milman Parry Collection of "Oral Literature", by its very name, is confusing linguistic concatenation (poetic language processing) with its symbolic notation in the form of alphabetic song transcriptions and the musical score (Bártók).

Just like archaeological evidence should be checked against a a purely philological study of Medieval epic poetry like the Beowulf epos[197], media-archaeological evidence sets a barrier against a purely text-based justification of the oral-formulaic hypothesis. It is the materiality of recordings that makes the MPC not only a sensuous ["sinnlich"] archive[198] but allows to turn the place into a signal laboratory of experimental cultural epistemology and techno*poiesis*.

What is hidden in the MPC is the option of another "route to decolonial recovery" (workshop draft) of Oral Poetry performance: its rescue from the subjugation to the alphabetic regime by virtue of its recording *as a signal*, contrary to Parry's / Lord's / Bartók's philological imperative to transcribe the poetic and musical event symbolically into text & score.[199]

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[195] See Haun Saussy, The ethnography of rhythm. Orality and its technologies, Now York (Fordham Univ. Press) 2016

[196] See Milman Parry and Adam Parry (eds.), The making of Homeric verse: The collected papers of Milman Parry, Oxford University Press 1987

[197] A notice by Andrew James Johnston

[198] See Peter McMurray, Archival excess: sensational histories beyond the audiovisual, in: Fontes Artis Musicae (2015), 262-275

[199] Albert Bates Lord (ed. and trans.), Serbocroatian Heroic Songs, collected by Milman Parry, with musical transcriptions by Béla Bartók and prefaces by John H. Finley Jr and Roman Jakobson, 2 vols, Cambridge / Belgrade (The Harvard University Press / The Serbian Academy of

Homer philology already long ago had remarked the stylistic difference between the Iliad and the Odyssee - up do Giambattista Vico's assumption of two different authors as such.[200] As it has been explained by classicist Barry Powell[201], the specific Greek modification of the Phenician syllabic alphabet into a system with discrete letters for single vowels has been itself incited by the drive to symbolically record Homer's oral poetry in its musical quality. This has been kind of "phonography" (not *avant* but *avec la lettre*).

Concerning this medium discontinuity between the Iliad and the Odyssee, the intervention of the alphabet into oral poetry came not from the out-, but from the inside (Powell), as it becomes most evident in book XII with the techno-animistic vocal notation of the Siren songs.[202]

But even the ancient Greek vocal alphabet represents the actual *mousiké* of the poetic voice only by symbols. A further step towards preserving the actual signal has been technical phonography as "inscription" of the acoustic real.[203] Phonographic recording allows for a sub-symbolic approach to the mechanism of "oral-formulaic" epic song creation, to analyse microtonal signals (such as pauses and the actual sound) instead of their alphabetic transcription or their musical score that still maintains the restricted regime of philology (Milman Parry) and ethno-musicology (Bela Bartók).

In analogy to the alphabetic gap that separates the primary orality of Homer's Iliad from the alphabetic notation of his Odyssey, Parry's recording (first) and transcribing (second) the *guslari* live performances is no seamless transition but creating epistemic cuts: first from oral performance to signal recording, then its translation into the regime of the symbolic (philological) code. It is such alphabetization that makes the signal recording apt for scientific (not ethnomusical) analysis (literally: elementarization, owing to the very alphabet that has been modified to symbolically record the musicality of Homer's voice).

Enhancing Electric Recording Against the "Phonographic Regime"

Sciences), 1954

[200] A notice by Anne Eusterschulte

[201] Barry Powell, Homer and the Origin of the Greek Alphabet, Cambridge (Cambridge UP) 1991; ders.: Writing and the Origins of Greek Literature, Cambridge, (Cambridge UP) 2002

[202] See W. E., Homer gramm(at)ophon, in: W. E. / Friedrich Kittler (eds.), Die Geburt des Vokalalphabets aus dem Geist der Poesie. Schrift, Zahl und Ton im Medienverbund, München (Fink) 2006, 299-314

[203] See Kittler, GFT 1999

The technical *a priori* for Parry's study of oral-formulaic composition, his specifically modified recording apparatus (a double turntable with a toggle switch for continuous recording of lenghty songs, powered by his Ford car battery as "mobile" medium), has disappeared long ago. Its engineer, Lincoln Thompson[204], had provided Parry with a direct cutting aluminium disc phonograph with two drives for continuous recording of the lenghty *guslari* epic songs. He as well supplied Parry with a motion picture camera (used for the Avdo Medjedovic "Kino") because of interest in developing technologies for the recent sound cinema.[205]

From that results the "Kino Movie" AV recording of legendary Bosniak "Homer" *guslar* Avdo Medjedovic).[206] It is this media memory only that allows for a close analysis, by motion capturing and audio-visual signal correlation analysis, of the cyborganic coupling between the *guslar* and his *gusle*. The instrumental function is less musical entertainment than providing the servo-motoric, acoustic feedback for time-critical oral-formulaic verse composition.

Via early recording and storage devices like the aluminium disc, humanly embodied oral poetry is coupled to - and even absorbed by - the machine. The *guslar* becomes signal. But the cybernetic coupling of singer and *gusle* (as a rhythmic device senso-motorically helping to compose formulaic verse lines) has been a mechanism already.

[This corresponds with Eduard Sievers' scientific concept of sound analysis ("Schallanalyse"). Such a "philology of the ear" (Sivers) is concerned with the fact that speech, no matter whether we are dealing with poetry or prose, tends to be accompanied by certain movements, postures, and tonus regulations. Sievers therefore graphically "transcribed" auditory sequences as found in poetic and prose speech into a graphical notation of motor sequences.[207]]

When in the 1950s, Albert Lord returned to Yugoslavia and visited Albania, he added to the archive "a new layer of materials collected through advances in recording technology." (workshop draft) But this "advanced" technology - magnetic recording - not only enhanced, but actually transformed the nature of research as such, opening a different epistemic (electro-magnet, as well as ethnomusical) "field" of study - all

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[204] Founder of the Sound Specialties Company in Waterbury, Connecticut
[205] Electronic communication David Elmer (chief curator of Milman Parry Collection), January 2007
[206] Recording from Bielo Polje, August 10, 1935, item no. PN12470 in the MPC
[207] Eduard Sievers, Ziele und Wege der Schallanalyse, Heidelberg (Carl Winter) 1924), 65-111, as quoted in the Transcript of the New York Macy Conferences on Cybernetics in 1950 (discussion of paper Shannon, "The redundancy of English", remark Heinrich Klüver, 256)

the difference Lord's magnetic recording makes to the "phonographic regime". Magnetic recording has not only been extending, but literally "rewinding" this technical condition of (vocal) sound analysis.[208]

Parry's aluminium disc recordings still preserve the indexical vocal trace as a direct function of electro-mechanical vibrations, while Lord's magnetic wire recording already translates the vibrational event into the electro-magnetic regime with its different affordances and technical connectivities - up to digitization, that is: the transcription of the indexical trace into the symbolic algorithmic regime.

The actually "great" transcription of the *guslari* heritage is the digital one. Digital sampling (and its losses compared to the original signal, in spite of the Nyquist-Shannon sampling theorem) and processing of analog recordings is not simply another (cultural-)technical escalation but a a techno-logical transformation of the very essence of oral poetry. Ironically (or recursively), the algorithmic processing of poetic rhythms, as genuinely re-generative operation, is closer to the "formulaic" principle detected by Parry than any other kind of phonographic reproduction has been before.

Sonic analytics and its software tools like spectrography thereby allow, e. g., to identify micro-temporal patterns in the most basic sense of oral prosody that - according to Albert Lord's understanding - does not consist of (textual) words but (phonetic) sound groups. Phonography, in that sense, is closer to the poetic event. Signal archaeology thereby suspends such rhythmic articulation from logocentrism.

Strange Encounters: Oral Poetry between the Human and the Machine

Against textual historicism concerning the philological Homer question, the "peripheral time" of the *guslari* performance practice allowed, for Parry and Lord, to make use of their spatiotemporal presence as a laboratory for the literally anachronistic study of "the making of Homeric verse"[209] *in vivo*.

It has been the literal philological "love" for the (ir)retrievable prosody of epic Homeric songs that induced Parry and Lord to record *guslari* "singers of tales"[210] for the study of oral poetry composition by "analogy" in its

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[208] See the special issue of: Twentieth Century Music, edited by Andrea F. Bohlman and Peter McMurray, vol. 14, no. 1 (2017)
[209] Adam Parry (ed.), The Making of Homeric Verse: The Collected Papers of Milman Parry, Oxford: Clarendon Press 1971
[210] Albert B. Lord, The singer of tales, Cambridge, Mass. (Harvard University Press) 1960

dual sense of an anachronistic re-enactment and "hearing"[211] of Homer and of *analogue* phonographic media.

["*[A]nalog* is usually used in relation to electronics, while *analogue* is often used in the sense *something that bears analogy to something else*."[212]]

While the oral recitation of Homer is inaccessible for *scientific* research for ever, it turned out that its mechanism is still being practised, such as the Albanian, Bosnian and Serbian oral epic poetry in the Balkans. Here, "oral-formulaic composition could be observed and recorded ethnographically"[213].

Media-archaeological re-enactment goes one step further. Some recordings from the MPC at Harvard University have been actually re-played to the contemporary local singer community during a more recent expedition to Novi Pazar in this contemporary Bosniac enclave of Serbia. Does the wire spool freeze or bring alive such epic voices?[214]

[The file with the documentary traces of this trip has been destroyed in the meantime - somewhat in counter-analogy to the act of destruction in Kadare's novel File on H. (where a Serbian monk destroys the Homer scholars technical apparatus and cuts the magnetic tape into bits), in order to focus on the analysis of the inner-technical event of *guslari* voice recording, storage, replay and "technical reproduction" (Benjamin) via magnetic wire and not to be diverted by the multipe cultural studies aspects that are associated with the "paper archive". As playfully expressed in Kadare's novel, the time-delayed re-recording of epic songs from the same bard has been essential to the formulation of the Homeric verse composition mechanism indeed.]

It is not by philological but only by technological means that a second-order "re-encactment" of the Homeric situation of Lord's "field" work (literally) is co-originary enabled (or "afforded") by a Webster Chicago Wire recorder (type-identical to Albert Lord's one).

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[211] See Robert Kanigel, Hearing Homer's Song: The Brief Life and Big Idea of Milman Parry, Knopf 2021

[212] Web site Grammarist, entry "Analog vs. analogue", https://grammarist.com/spelling/analog-analogue, accessed February 28, 2024

[213] https://en.wikipedia.org/wiki/Oral-formulaic_composition, accessed February 17, 2024

[214] See Dmitri Zakharine / Nils Meise (eds.), Electrified Voices, Konstanz (V&R unipress) 2012. Compare as well David Boder's wire-recorded narratives in Displaced Persons Camps in 1946, as researched in: Alan Rosen, The Wonder of Their Voices: The 1946 Holocaust Interviews of David Boder, Oxford (Oxford UP) 2010

c) Oral Poetry Analytics:

Oral-Formulaic Composition and AI

Walter Ong has sub-titled his seminal study on Orality and Literacy "The Technologizing of the Word"[215]. The "oral-formulaic theory" understands such *technologizing* literally. If the composition of epic poetry is "formulaic", can Serbocroatian *guslari* performances then be automatized?

[Already Friedrich Salomon Krauss, in his early fieldwork with *guslars*, believed these storytellers depended on "the fixed formulas from which he neither can nor wishes to vary"[216]. Such formulas "can also be combined into type-scenes, longer, conventionalised depictions of generic actions in epic like the steps taken to arm oneself or to prepare a ship for sea"[217].]

"In Homeric verse, a phrase like *rhododaktylos eos* ("rosy fingered dawn") [...] occupies a certain metrical pattern that fits, in modular fashion, into the six-foot Greek hexameter, which aids the *aoidos* or bard in extemporaneous composition."[218] Media theory takes that insight further into the regime of electromagnetic literal "field" recording as technical condition for cultural analysis: "Even Homer's rose-fingered Eos was thus a goddess transformed into a piece of chromium dioxide that was stored in the memory of the rhapsodes and could be combined with other material to create entire epics."[219] The formulaic mechanism is not external, but internal to human oral poetic composition like a Turing machine. All of the sudden, technical recording is not a simple extension of philological research, but co-originary to the momentum of *poiesis* itself. And once more, technical specificity makes a decisive difference here: Only magnetic tape recording, instead of Lord's wire recorder, allows for an easy "cut-up" of expressive sonic articulation[220] that comes

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[215] London (Methuen) 1982

[216] In his 1908 paper "Von wunderbaren Guslarengeldachtnis", as quoted in https://en.wikipedia.org/wiki/Oral-formulaic_composition#cite_ref-11. See as well John Miles Foley, The Theory of Oral Composition: History and Methodology. Bloomington (Indian University Press) 1988

[217] https://en.wikipedia.org/wiki/Oral-formulaic_composition, accessed February 17, 2024

[218] https://en.wikipedia.org/wiki/Oral-formulaic_composition, accessed February 17, 2024

[219] Kittler 1986 / 1990: xxx

[220] See Maximilian Haberer: Tape Matters. Studien zu Ästhetik, Materialität und Klangkonzepten des Tonbandes, PhD thesis Heinrich-Heine University Düsseldorf, 2023

close to the ancient Greek rhapsodic (literally "stiching together") practice.

And if such a mechanism is apparently trans-cultural, the hypothesis of a poetic techno*lógos* of its own is arising.

["[È] dalle tesi di Milman Perry sulla questione omerica che sappiamo che la letteratura è, in essenza, una combinazione di materiale linguistico a disposizione."[221]]

Literature has been identified as a "symbolical machine" already: an *ars combinatoria* of discrete alphabetic elements grouped into words and sentences according to statistical probabilities of transition (Shannon). But this mechanism only works with discrete elements. Oral poetry, though, is alive in the non-scriptural regime.

This allows for the Large Language Model from current "Deep" Machine Learning to be applied to the oral-formulaic theory - a stochastic (instead of syntactically listing) approach to poetic expression.

A comparison of ChatGPI Markov chains with Milman Parry's "formulaic" theory of oral poetry composition is therefore warranted, that is: an analysis of its transitional, literally "algorhythmic"[222] word processing according to metric probabilities. The *guslari* poetry is therefore mechanizable.

In the scholarly study of epic poetry, the Oral-Formulaic Theory explains the "process by which oral poets improvise poetry", with its key idea being "that poets have a store of formulae (a formula being 'an expression that is regularly used, under the same metrical conditions, to express a particular essential idea')"[223]. By "linking the formulae in conventionalised ways, poets can rapidly compose verse" (Wikipedia ibid.), as it has been expressed by Antoine Meillet in 1923 already.

["Homeric epic is entirely composed of formulae handed down from poet to poet. An examination of any passage will quickly reveal that it is made up of lines and fragments of lines which are reproduced word for word in

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[221] Francesco Striano, Miseria delle illusioni riformiste sull’intelligenza artificiale, in: AnarchIA, https://dzine.deditore.com/it/anarchia, accessed May 25, 2023

[222] Shintaro Miyazaki, Algorhythmics. Understanding Micro-Temporality in Computational Cultures, in: Computational Culture, Issue 2 / 2012; http://computationalculture.net/algorhythmics-understanding-micro-temporality-in-computational-cultures

[223] https://en.wikipedia.org/wiki/Oral-formulaic_composition, accessed February 17, 2024, referring to Milman Parry, L’epithèt traditionnelle dans Homère (Paris, 1928), p. 16

one or several other passages. Even those lines of which the parts happen not to recur in any other passage have the same formulaic character, and it is doubtless pure chance that they are not attested elsewhere.'[224]]

While philology tends to discard and to dispose the analog phonographic recordings of *guslari* singers on aluminium discs or magnetic wire after their subsequent transcription, it is the sheer material insistence of the archive (the MPC) that anachronistically preserved the unforeseen media-archaeological option of to execute a trans-philological analysis of Oral Poetry "close the the signal" with the help of advanced computational technology. By this media tempor(e)ality of an (an)archival "future in the past", the notion of "temporal [poetic]communities" is given another sense.

The digitized legacy of the Parry / Lord recordings actually invite for a "deep" neural net-based modelling of "formulaic composition" in oral poetry in terms of Natural Language Processing in the Generative Pre-Trained Transformer architecture.

This poetic mechanism offers itself more to scientific "informational aesthetics" (Max Bense), to Digital Humanities, and recently to "Deep" Machine Learning.

Computer Prints for Albert Lord (MPC 1982)

Just like Aby Warburg's conceptual idea of the Pathosformel in visual culture, which identifies formulae for the expression of extreme passion, the Oral Formulaic theory renders itself for analysis via computational humanities as "an attempt at 'operationalizing' the concept, transforming it into a series of quantitative operations"[225].

The materiality and technologies of recording as applied by Parry and Lord actually "interact with the orality being captured for comparative analysis" (workshop draft).

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[224] Antoine Meillet, Les origines indo-européennes des mètres grecs, Paris (Presses Universitaires de France) 1923, 61 (Adam Parry's translation, revised), as quoted in https://en.wikipedia.org/wiki/Oral-formulaic_composition, accessed February 17, 2024

[225] Abstract of lecture "Operationalizing Aby Warburg’s Atlas of images", January 26 2017, Indiana University, http://sicv.activearchives.org/logbook/operationalizing-aby-warburgs-atlas-of-images for an analogy to tradition of visual poetry

Like for Warburg's Mnemosyne Atlas and André Malraux' "imaginary Museum", it requires b/w standardized records (photographies) for a comparative approach to identify new intellectual criteria like "style".

The formulaic composition mechanism renders itself to be decoded by means of computational (digital) humanities and "cultural analytics" (Manovich).

Back to the archive, this calls for a re-examination of the file printouts from May (?) Hyde for Albert Lord, dated 02/06/82 in the Milman Parry Collection. The application of software (algorithms) for the analysis of prosodic patterns in oral poetry looks like an early example of "digital humanities" research *avant la lettre*. Georg Danek (at Vienna University) has carried out similar experiments in computer analysis of oral poetry, that is: re-engineering the Homeric verse patterns.

Peter McMurray has kindly supplied a transcription of additional notes from the computer programmer to Albert Lord, with its very first line: "At long last you get some output!," written on a printout deemed a "job fail" (idem).

The Lord / Hyde computer printouts in the MPC box invite for a kind of double computer philology: to identify the program code and re-engineer the automated search on the one hand, in combination with the handwritten remarks on the other hand. Media archaeologically, the "rhythmic" patterns of oral-formulaic composition are literally woven into the printout with its spacing.

THE SOUND OF *LÓGOS*. Its Human and Non-Human Forms of Embodiment

Chrono-Vibrational Resonance: (Re)Experiencing the Monochord

Media temporality is experienced by operating physical and techno-mathematical media themselves, such as the reenactment of the experiments once conducted by Pythagoras. Pulling the string on the monochord enables to experience the relationship between numerical integer ratios and harmonic "musical" intervals. Both *lógoi* (in the ancient Greek sense) remain stable, invariant against historically changing cultural time. Like historiography, music (as conceptual, notational scheme) is symbolical ordering of "time"; actual temporality comes in only with the linear (analog) or sequential (digital) machine.

Even if the present listener is not in the same "historical" situation as a Pythagorean ancient Greek, and the current mode of listening must be considered to be very different, then the monochord is still a time machine, inviting to share, participate at the original discovery of

musicological knowledge. This approach of re-enactment, close to the practice of experimental archaeology, gives access to the invariants of knowledge in time; the physical objects themselves function as technological time capsules or time machines. "Entering a time machine implies isolating an item from its context. Consequently, particulars can be made persistent, but not their total context or 'world'."[226]

Resonance is a form of instantaneous communication and "allows things to respond to each other in a nonlinear fashion."[227] It is technologically well known within the electro-magnetic field (such as the communication between radio sender and radio receiver), extends to the techno-temporal relation between presence and past as well, which thereby ceases to be a historiographically linear one.[228] Being appropriately "tuned" (Heidegger) in the present leads to a different kind of communication with the past. In *implicit sonic* resonance, a different kind of *lógos* unfolds.[229]

In moments media time, the artefactual *lógos* emancipates from its human-made "historical" context. Technology is rather rooted in a different "world" of technical and logical infrastructures. Such a redefinition allows for a non-historicist, techno-hermeneutic form of access to technical operations from the past, such as the "physical modelling" of conventional music instruments.

The "auralisation" of a silenced concert hall is achieved by computational modelling, a media-active retro-measuring and emulative mapping of room acoustics.[230] By such media-active archaeonautics and acoustic diagrammatics, the *lógos* of passed sonosphere is induced to re-articulate itself, as becomes explicit in the technical term of *impulse response* to measure room acoustics. In such reverberations, the very materiality of wave forms allows to (re-)define the qualities of the system into which they have been embedded as initial impulse, by listening to its technical medium meassage, and body vibrational massage.[231]

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[226] René Munnik, Technology and the End of History. From Time Capsules to Time Machines, in: Liisa Janssen (ed.), The Art of Ethics in the Information Society, Amsterdam (Amsterdam UP) 2016, 106-109 (109, note 4, referring to Heidegger's *Sein und Zeit* from 1927)

[227] Erik Davis, Acoustic Space, Riga 1997, http://www.techgnosis.com/acoustic.html

[228] See Rupert Sheldrake, The Presence of the Past, New York (Time Book) 1988

[229] On reverberating *lógos* and Heidegger's notion of "Gestimmtheit", see Veit Erlmann, Reason and Resonance. A History of Modern Aurality, New York (Zone Books) 2010, 327, and Heidegger's lecture on logics (Logik-Vorlesung) 1934, 129 and 135

[230] See Stefan Weinzierl, Beethovens Konzerträume. Raumakustik und symphonische Aufführungspraxis an der Schwelle zum modernen Konzertwesen, Frankfurt / M. (Erwin Bochinsky Verlag) 2002

Time-critical signal processing in humans and machines

Lógos, whether poetic, mathematical, or as technical diagram, requires bodies and matter to articulate itself in present (or from past) times. "The functioning of machines [...] cannot be reduced [...] to logical / mathematical articulations [...]. Instead of logic and phenomenology, what is needed here is a science of machinics [...]."[232] Any science of embodiment inevitably leads to the analysis of time-critical signal processing both in animals and in machines (encompassing both electronic and technomathematical systems), thus reactivating the cybernetic premise.[233] The specific perspective on micro-tempor(e)alities makes all the difference between the symbolic order and its technical embodiment.

The expression "in animals and machines" recalls the programmatic subtitle of Norbert Wiener's *Cybernetics* from 1949.[234] Signal processing as a topic of applied mathematics - in the cybernetic sense - does not refer to electrical engineering only, but to organic bodies as well.[235] Signals are there on the basic archaeological level, being defined as time-varying or spatial-varying physical quantities, once analysed. Once they have been analysed, signals then can be technologically turned into active synthesis: operations on signals, ranging from immediate sound and images to telecommunication (such as radio signals). Measuring media, in this context, act as agents of signal analysis themselves, when such signals are retrieved and transformed into sonography, or electrocardiograms. Technical sensors which monitor and sample human bodies (self-tracking) as well as physical environments[236] transform the temporal "now" into a real-time window of the present in terms of what Husserl had identified for the inner human, subjective sensation of time, dynamically unfolding between cognitive re- and protention.[237]

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[231] See Axel Volmar, Zeit-Räume der Signalverarbeitung. Eine kurze Geschichte der Impulsantwort, in: Hiller / Höltgen (eds.) 2019, 85-100

[232] Félix Guattari, Molecular Revolution. Psychiatry and Politics, Harmondsworth (Peregrine Books) / New York (Penguin) 1984, 146

[233] See J. C. R., Licklider, Man-Computer Symbiosis, in: IRE Transactions on Human Factors in Electronics. HFE-1 (März 1960) No. 1, 4-10

[234] Norbert Wiener, Cybernetcis or Communication and Control in the Animal and the Machine, 1948

[235] See J. D. North, Application of Communication Theory to the Human Operator, 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, 372-389

[236] See Jennifer Gabrys, Program Earth. Environmental Sensing Technology and the Making of a Computational Planet, Minneapolis (University of Minnesota Press) 2016

[237] Edmund Husserl, On the phenomenology of the conciousness of internal time (1893-1917), transl. John Barnett Brough, Dordrecht (Kluwer Academic

When J. C. R. Licklider researched the essentials of what constitutes "hearing" in humans and animals (auditory analysis), he explicitly asked: "Is there, built into the auditory nervous system, a mechanism [...] that supplements the cochlear frequency analysis?"[238] His terms rather stem from electronic engineering than from traditional physiology. Inserting microelectrodes into the auditory nerve for recording signal transmission thus disembodies the analysis of human hearing. "The analytical properties of the ear cannot be explained entirely in terms of the mechanics of the cochlea"[239], but rather requires psychoacoustic research - the cognitive *lógos*.

Poetic *lógos* and nervous feedback

From Homer in ancient Greece to more recent Southern Slavic *guslari*, the memory technique in oral poetry performances by singers of epic tales relies on senso-motoric synchronisation and feedback, frequently coupled to a string instrument.[240] "La diffusion nerveuse est comparable à la propagation du courant électrique à travers un réseau de fils conducteurs."[241] The poetic *lógos*, once embodied as form of *kinesthetics*, epistemologically activates the assumption that both machines (technical or mathematical) and animals are governed by analogous feedback-processes. "By consistently embracing all these technologies, we inevitably relate ourselves to them as servomechanisms", just like the businessman becomes a servomechanism of his clock, and explicitely "the cyberneticists - and soon the entire world - of his computer". McLuhan concludes: "This continuous modification of man by his own technology stimulates him to find continuous means of modifying it [...]. Man's relationship with his machinery is thus inherently symbiotic."[242] In

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Publishers) 1991

[238] J. C. R. Licklider, Auditory Frequency Analysis, in: Colin Cherry (ed.), 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)

[239] J. T. Allanson / I. C. Whitfield, The Cochlear Nucleus and its Relation to Theories of Hearing, in: Cherry (ed.) 1956: 269- (269)

[240] On controler-based vibrotactile feedback between human and musical instrument and / or electronic machine affordances, see Jin Hyun Kim, (116); furthermore idem, Toward Embodied Musical Machines, in: Christoph Lischka / Andrea Sick (eds.), Machines as Agencies. Artistic Perspectives, Bielefeld (transcript) 2007, 18-33

[241] Marcel Jousse, Le Style oral rythmique et mnémotechnique chez les Verbo-moteurs, in: Archives de Philosophie vol. II, Cahier IV: Études de Psychoogie Linguistique, Paris 1925, 17

[242] The Playboy Interview: Marshall McLuhan, in: Playboy Magazine, March 1969; http://www.understandingnewmedia.com/mm1/class_materials/mcluhan-playboy.pdf (accessed May 6, 2019). See as well J. C. R., Licklider, Man-Computer Symbiosis, in: IRE Transactions on Human Factors in Electronics. HFE-

such a concept, embodiment is not the secondary materialization of a primary spiritual ("musical") idea, but its co-emergence. While even this perspective is still media-anthropological in its phenomenology, media-archaeology radically shifts attention from human body-centered to system-orientated, entirely technological incorporations of *lógos* in, or as, informed matter.

Lógos from Wire: Oral Poetry Recording

Contemporary media culture, when dealing with articulations from the past, is confronted with a depersonalised *lógos*: technological signal storage, rather than individual or social memory. Instead of prosopopoietic "speaking with the dead", recording media reproduce signals. Whereas the scripture-based classical archive is a static array of texts on the grand scale and letters on the microscale, which can be activated only by human (or automated) reading as decoding, the Edison phonograph has been the first form of a truly operative signal memory, since its recording (notably the early ethnographic field recordings around 1900, leading to the Vienna Phonograph Archive and the Berlin Phonogramm Archive) is based on a rotating, technically moving apparatus both in recording and in re-play.

What oral poetry performs is actually close to the neurological mechanism of memory, assisted by the hexametric verse as mnemotechnique, combined with *l'archive* in Foucault's sense, i. e.: a generative grammar. Two kind of *lógos* here interfere. Even the same singer does not repeat the same epic when performed (time-shifted) next time. In "re-generation", the prefix "re-" refers to memory, and the "generative" refers to *l'archive*.

As opposed to an "archival" transcription of oral poetry by alphabetic or musical notation, its recording by phonograph or gramophone creates a presence in latency, a different temporality, since these sources can be replayed with equiprimordially. While there is temporal difference between each act of replay on the macro-temporal time axis, there is identical reproduction on the inherent signal event level of such technical time objects, almost invariant towards "historical" change. Poetic *lógos* can only ideally be identically preserved, since stochastic material noise and physical degradation leaves as much direct traces of time on the recording medium than the linear inscription of a time-varying signal *as* phonography can achieve.[243]).

Béla Bartók once transcribed Yugoslav folk music of gramophone

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1 (März 1960) No. 1, 4-10

[243] For a comparison with film see Bernd Herzogenrath, Matter that Images: Bill Morrison's *Decasia*, in: idem (ed.) 2015: 111-137, 113

recordings (both from aluminium disc or later from electromagnetic wire recorder) in the Milman Parry Collection of Oral Literature at Harvard University, thereby translating the physically real articulation into the symbolical regime which increases "information" in terms of order and selection, but looses additional information like the individual intonation, the temporal subtilities and the accidents, the "noise" as the authentic trace of the unique performance event. One can listen even to his coughing before a *guslar* (singer) starts to sing in the recordings from the Yugoslavian research of Milman Parry in 1934/35.[244] Such non-semantic expression is phonographically registered as the interruption of the symbolic melodic order by the corpo/real - a memory which the alphabetic transcript or musical score can hardly preserve.[245] Since the age of technical reproducibility of movement and sound, cultural memory has been liberated from restrictions to symbolical notation, resulting in a bifurcated memory: the symbolical against the indexical material trace. The coughing which interrupts the singer's performance actually corresponds with the cracks in the recording medium itself. Provided that there is still a player, the poetic recordings can not only be decoded but analyzed in subverbal, even asemiotic ways. The acoustic event can be measured by oscillographical visualisation or spectral, techno-mathematical, non-logocentric, almost culture-free analysis.

The psychoanalytic *apparatus* theory has been techno-materially modified (and grounded) for a decisively media theoretic comprehension of communication engineering, signal storing, and data processing. Correlating the gramophone with the real, the typewriter with the symbolic, and film with the imaginary, the real is aligned with sound. "The gramophone records all the jumbled fragments of the real, before it is edited into a coherent picture in other forms like film. Kittler associates the real with the physiology of the voice, the actual waves of sound captured by the recording."[246] The real “forms the waste or residue that neither the mirror of the imaginary nor the grid of the symbolic can catch: the physiological accidents and stochastic disorder of bodies"[247]; in a metonymic shift, though, the alliance between gramophone recording and the real occurs in another, truly media-archaeological sense as well. In the very act of inscribing or imprinting alternating wave forms into the matter of the wax cylinder or in shellac, all kind of "noise" and material

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[244] Online accessible https://curiosity.lib.harvard.edu/milman-parry-collection-of-oral-literature/catalog?f%5Bdigital-formats_ssim%5D%5B%5D=Audio&utm_source=library.harvard (accessed May 6, 2019)

[245] See Arne Stollberg, Die Partitur als Körper-Archäographie, in: Hiller / Höltgen (eds.) 2019: 149-182

[246] Morten Riis, Where are the Ears of the Machine? Towards a sounding micro-temporal object-oriented ontology, in: Journal of Sonic Studies, issue no. 10, published October 10, 2015, online https://www.researchcatalogue.net/view/219290/219291, referring to Friedrich Kittler, Gramophone - Film - Typewriter [GO 1985], Stanford (UP) 1999, 93

[247] Kittler 1999, 15 f.

frictions occur, as an articulation of the *techno-lógos* itself. Here, the medium itself makes all the differences for encounters of the intentional signal and its recording matter. While the acoustic signal in the phonograph is captured with only the temporal delay caused by air as channel, a main difference between magnetic and phonographic recording is the implicit phenomenon of *hysteresis*. A kind of (non-psychic) latency is thereby introduced in magnetic storage that - besides tape time delays - reminds of electromagnetic induction as the primary scene of electric media culture itself (since Oersted, Faraday, Maywell, and Hertz). A micro-temporal delay is inevitably created when the electrical current becomes converted into magnetic movement. "When the material current becomes immaterial electromagnetic induction it becomes transmissional" - the very condition of radio as telecommunication. In that sense, the tape recorder becomes a merger of transmission and inscription (Riis ibid.). Therefore, the combination of philosophical questions (the epistemic *lógos*) and micro-temporal analysis reveals an alternative reality of a concrete technological device like the operational tape recorder - "[a] reality that in its core is un-historical, meaning that the specific function of the machine is in someway outside history, and to some extent outside human discourse. But not outside the discourse of cassette tape itself, shifting the perspective to the conceptualization that the technological moment becomes comprised of media, not humans, and this media is not dead, but operating. Thus a merger of object oriented ontology and media archaeology presents itself, bringing an awareness to the moment when media themselves become active archaeologists of knowledge. The exposition of magnetically saturation points towards the duration of media, [...] a conceptualization in which time and technology meet, not history and technology - in an attempt to differentiate the sonic from the acoustic - thus focusing on the inaudible vibrational events within the technological apparatus."[248]

In the movie of the epic singer Avdo Medjedovic - one of the first uses of sound film for ethno-musicological documentation indeed[249] -, at 1:20 min., the sound recording abruptly ends in the middle of a verse line ("Ni bih ..." / "Nor would I ..."), while the sound of the recording rotating disc takes over rythmically: Now the medium speaks. A few seconds later (1:37), the visual filming abruptly breaks down as well. With that rupture, the real of the medium is at work, and physically breaks into the symbolic cultural scene. But with human watching or listening to such a record, an anthopological mis-reading happens: the tendency to forget about the recording apparatus, in favour of concentrating on the body and voice of the singer, looking at him as if he was still alive, being

[248] Riis op. cit.; see W. E., Sonic Time Machines. Explicit Sound, Sirenic Voices and Implicit Sonicity in Terms of Media Knowledge, with a Preface by Liam Cole Young, Amsterdam (Amsterdam University Press), series *Recursions*, 2016
[249] See and listen: https://mpc.chs.harvard.edu/gallery/avdo.html (accessed May 6, 2019)

touched by his performance which is in fact nothing but a technological re-play.

Media archaeology contrasts this emotional affect by focussing on such a recording as a technological event, reminding constantly that there is no human voice but a machine voice, in the sense of the transduction of body-based voices into a electronically reprocessed voice. The frequencies, even the timbre of the voice, miracolously, is still the same in both "media". The phonographic recording of Yugoslav *guslari* turns improvised oral poetry into a fixed inscription. But at second glance, the electromagnetic recording preserves a unique feature of the oral performance (different from its alphabetic, immobilizing transcription) which can be derived from how French language calls the recording device: *écriture magnétique*. Electromagnetic recording, by its very physical immateriality, only comes into existence as part of a dynamical process, the *inductive* act of re-play (writing different from printing). In his preface to Albert Lord's *The Singer of Tales* Harry Levin remarks: "The Word as spoken or sung, together with a visual image of the speaker or singer, has meanwhile been regaining its hold through electrical engineering."[250]

When around 1950, Parry's former assistant Lord returned to the scene to repeat some of Parry's first aluminium disc recordings with the same singers, in the meantime, technology had advanced in that direction indeed. Lord made use of a magnetic steel wire recording device. The wire recorder is not a phonograph, which - as its very name still suggests - is part of the tradition of "writing" technologies; instead, the wire recorder registers sound in non-mechanical ways, in the dynamics of the electromagnetic field. Electromagnetic recording and reproduction is not a continuation of writing in a new form, but a different existence of "memory". When a singer is replayed in electronic form in "high fidelity", the technology itself seems to efface itself in a way which apparently lets the originality and individuality of the singer shine through the apparatus, as dead as he might biologically be. The cultural, human aspect is expressed in the most inhuman medium; the circle of vibrations and frequencies in technology and poetry is complete. Thus the coldest media archaeological device is the best way to memorise unique moments of human culture, such as oral poetry.

Undoing Musical Historicity: Phonographic Signal "Re-presencing"

For most of the musical activities in the past, there is an obvious necessity to "historicise" by indirect, contextual reconstruction of the past sound event, as long as technical (mechanic or electronic) recording

[250] Albert B. Lord, The Singer of Tales, Boston (Harvard University Press) 1960, xiii

is missing. Villiers d'Isle-Adam's novel *L'Éve future* from 1880 expresses regret for all the sounds which have been lost for posterity in the pre-phonographic era. The inventor of the phonograph, Thomas Alva Edison, laments: "Voici tantôt soixante-douze siècles [...] qui, d'ailleurs, à titre de précédent immémorial, controuvée ou non, eût échappé à toute phonographie."[251] The technical recordability of the physically real of sound and images suspends the clear-cut difference between presence and absence.

Can the present human voice logocentrically be separated from its machine recording, or even its logical reproduction by sound analysis and synthesis? In order to convince the audience of the sonic fidelity of phonographic recording, the Edison Company in 1916 arranged for an experimental setting in the New York Carnegie Hall: "Alone on the vast stage there stood a mahagony phonograph [...]. In the midst of the hushed silence a white-gloved man emerged from the mysterious region behind the draperies, solemnly placed a record in the gaping mouth of the machine, wound it up and vanished. Then Mme. Rappold stepped forward, and leaning one arm affectionately on the phonograph began to sing an air from 'Tosca.' The phonograph also began to sing 'Vissi d' Arte, Vissi d'Amore' at the top of its mechanical lungs, with exactly the same accent and intonation, even stopping to take a breath in unison with the prima donna. Occasionally the singer would stop and the phonograph carried on the air alone. When the mechanical voice ended Mme. Rappold sang. The fascination for the audience lay in guessing whether Mme. Rappold or the phonograph was at work, or whether they were singing together.[252] In an analog anticipation of Turing's "imitation game" for human-computer communication[253], a similar staging of human vocal performance *versus* apparative acoustic operativity has been commented by the *Boston Journal* in the same year: "It was actually impossible to distinguish the singer's living voice from its re-creation in the instrument."[254] Like for the dog listening to *His master's voice*, the phenomenal illusion of being present is induced by technical recording.

Signal- instead of Text-Criticism: Sound Recording *avant la lettre*

Digital Humanities, in the sense of "algorithmic hermeneutics", is the application of computational software as active archaeologist of cultural

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[251] Villiers d'Isle-Adam, L'Éve future, Lausanne (L'Age d'Homme) 1979, 34

[252] "Edison Snares Soul of Music", in: New York Tribune, 29 April 1916, 3

[253] Alan Turing, Computing Machinery and Intelligence, in: Mind, vol. 49 (1950), 533-460

[254] Quoted after: Emely A. Thompson, Machines, Music, and the Quest for Fidelity. Marketing the Edison Phonograph in America 1877-1925, in: The Musical Quartely Bd. 79 (1995), 132. See Peter Wicke, Das Sonische in der Musik, in: Das Sonische. Sounds zwischen Akustik und Ästhetik, in: PopScriptum 10 (2008), http://www2.hu-berlin.de/fpm/popscrip/themen/pst10/index.htm

knowledge hidden within techno-physical signals. Media philological criticism derives insight from the analysis of signals, now that algorithms allow for their micro-critical studies. By analog-to-digital conversion of optical signals and application of digital filters, it is possible to digitally trace past acoustic signals from records. Patrick Feaster succeeded in re-sonifying Léon-Scott's 1859 phonautogram of the children song *Au Claire de Lune*. Such a retro-active recovery of an acoustic past from a generation before the invention of the Edison phonograph (or the recovery of early 30line television images from so-called "Phonovision" recording by means of algorithmic image processing[255]) is possible by means of highly sophisticated algorithmic filters only which becomes itself the active archaeologists of signal intelligence.

The oldest archival record of sound in Norway is a tinfoil, flattened to a "document" and annotated by a remark by its former collector, as exhbited within a frame at the Technical Museum of Oslo. The Sound Archive Project at the School of Engineering Sciences at the University of Southhampton attempted a digital restoration, by sampling the whole artefact's surface topology with high precision optical sensors. Subsequently, the audio content has been recovered by applying signal and image processing methods to the measured data. "The measurement process for this artefact took three weeks of continuous scanning. Initial attempts at audio recovery from the surface data using existing processing techniques were largely disappointing, leading to the development of a more sophisticated methodology based on feature tracking through the groove. Out of six short tracks found on the foil, four contained significant audio portions featuring both music and speech, the remaining two tracks were both short and contained negligible content."[256]

From such a digitally enhanced restauration of vintage sound recordings the human listener expect sound. What could primarily be heard from the unfiltered signal was noise - which in terms of communication theory is a message as well, that is: the communication of the recording medium itself.[257] In the case of the recording from Norway which survived as a tinfoil flattened to a „document“, an annotatation by the former collector claims this has been the first Norwegian recording of music on Edison cylinder. Finally, the extracted (and reproduced) signal results in true

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[255] Donald F. McLean, Restoring Baird's Image, London (The Institution of Electrical Engineers) 2000

[256] P. J. Boltryk, J.W. McBride, L. Gaustad, Frode Weium, Audio recovery and identification of first Norwegian sound recording, lecture at JTS 2010 conference in Oslo (Digital Challenges and Digital Opportunities in Audiovisual Archiving); https://eprints.soton.ac.uk/152891/1/JTS2010_-_Norwegian_artefact_scanning_PJB_laga.pdf, accessed June 1st, 2018

[257] Listen to https://www.nrk.no/kultur/xl/kan-verdens-eldste-opptak-av-edison-ha-ligget-i-en-norsk-kjeller-siden-krigen_-1.13727285; accessed November 13, 2017

media philology, falsifying the accompanying alphabetic annotation: "The extracted audio [...] was not the expected psalm singing as documented in the contemporary sources, but a mixture of shorter extracts."[258]

TRACING HUMAN *LÓGOS* BY TECHNOLOGICAL SIGNAL ANALYSIS. Voice recognition, and the other "Lautarchiv"

Techno-productive "operational" surveillance: The MfS "Stimmenarchiv"

The very name of the Berlin *Lautarchiv* is media archaeologically understood in its literal meaning. German *Laut* is not the musical, but the phonetic parameter of audio communication and therefore asks for signal analysis rather than for hermeneutics of cultural *lógos*. It turned out from the files in the archives of the Ministery for State Security (MfS) in the former GDR, that publications on forensic voice recognition have been read intensively, and in 1985 an IT project called "Phonotek" (which refers both to the technologies of voice identification in the sense of "Phonotec", and the audio archive in the sense of "Phonotheque") started systematic analysis of "operativ-relevanter Sprecherstimmen"[259].

This sounds like a classical topic for archival research by media historians, reconstructing the discursive, administrative and technical context. The media-archaeological research track, though, has a different emphasis; it does not focus in the ideological implications and suppressive power mechanism of acoustic surveillance, but on the productive surplus of acoustic knowledge which actually arose from the application of voice-identifying technologies. In the former MfS, it has been the so-called "Technisch-Operativer Sektor" which developed or applied such tools. In a Foucauldean understanding, any paranoia (especially in agencies of state power) actually generates new methods and technologies of increasing knowledge. Media archaeology takes the very term "operative" (which is the key expression throughout almost all MfS files) in a productive sense: information provided by machines. Knowledge which results from techno-operative research is "timeless" beyond its limited historical or ideological discourse, since the language of what Nick Montfort la belled „technical report“[260] here deals with signal evidence rather than with semantic heuristics.

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[258] Boltryk et al. 2010

[259] File MfS JHS [Juristische Hochschule Potsdam] 22035: Gärtner, Andreas, Die Bedeutung der Sprechererkennung nach meßtechnischen, hörtechnischen und operativen Faktoren bei der Bearbeitung der gegnerischen Geheimdienste und anderer relevanter Bereiche durch die HA III. Die Anwendbarkeit der meßtechnischen Faktoren einer Stimme als mögliche Recherchekriterien im Informationsgewinnungsprozeß, typescript, 18.3.1989, GVS [Geheime Verschlußsache] o026-344/89, JHS [Juristische Hochschule Potsdam], Diploma, p. 8

At the MfS, the term "operative" is not just an umbrella word for all kind of surveillance activities, but even technically tighly linked to the archive. A brochure on computing defines the Random Access Memory as such: "Arbeitsspeicher (auch: Hauptspeicher, Operativspeicher, Zentralspeicher) ist Bestandteil der Zentraleinheit einer Datenverarbeitungsanlge."[261]

Beyond ideological barriers in terms of cultural analysis and political correctness, there is a techno-formal language from the files which "speaks" to the reader in a non-historical way once our attention switches from the historian's to the media archaeologist's mood. In a remarkable document which deals with applications of psycho-acoustic science and signal acoustics (the polygraph) to speech identification, an epistemological rupture in the analysis of acoustic evidence is described: the human voice becomes subject of analysis in a double way: object of observation, but "subject" to machine listening. Understanding of human speech is no exclusive agency of human ears any more. The author, an MfS officer, makes use of the appropriate metapher of breaking through the "sonic wall".

["Eine wesentliche Seite der tschekistischen Theorie stellen all jene Erkenntnisse dar, die sich mit der Rolle des Menschen als Subjekt und Objekt der operativen Prozesse beschäftigen. Gleich, woher die Impulse aus diesem Teil der operativen Theorie kommen, ob aus der operativen Erfahrung [...] ob aus den Ergebnissen der Wissenschaften [...]."[262] And further: "[...] haben wir in der operativen Theorie vom Menschen eine 'Schallmauer' durchstoßen - so relativ das Bild auch für die Dimensionen unserer Arbeit sein mag."[263]]

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[260] Nick Montfort, Beyond the Journal and the Blog. The Technical Report for Communication in the Humanities, in the *online* journal Amodern, 1, thematic issue „The Future of the Scholarly Journal“ (2016), http://amodern.net/article/beyond-the-journal-and-the-blog-the-technical-report-for-communication-in-the-humanities, accessed February 11, 2016

[261] BStU, file MfS Abt. 26, Nr. 820: brochure (print) *Technische Kommunikation. Überblick über wichtige Grundbegriffe der technischen Kommunikation (Computer, CAD/CAM, Telekommunkation)*, zusammengestellt von Hans Maschke, ed. by Zentralinstitut für sozialist. Wirtschaftsführung beim ZK d. SED, 2nd, revised ed. Berlin 1985 ("Nur für den Dienstgebrauch"), 28

[262] File MfS JHS No. 165 "Gutachten zu den Forschungsergebnissen [...] 'Die wissenschaftliche Bewertung des psychophysiologischen Verfahrens der Stimmanalyse, seine Einsatzmöglichkeiten - Grundsätze in der politisch-operativen Aufklärungsarbeit des MfS' (vorgelegt von Oberstleutnant Roitzsch und Hauptmann Lips)". Typescript, p. 3 (signed: "Scharbert, Oberst", Potsdam, 2nd October 1979, Juristische Hochschule Potsdam)

[263] Typescript p. 5

Due to the abrupt ending of that East German state, the administrative files on voice recordings (*Stimmenarchiv*) in the archives of the former State Security of German Democratic Republic have survived and are immediately accessible in terms of academic textual research. But what about the technical accessability of the audio files themselves?

The challenge which arises from the actual telephone voice recordings by former GDR State Security is not the obsolete hardware to read magnetic data.

At the archives of the former MfS, there is a special department for recovering ("Erschließung") machine-readable data from obsolete magnetic storage discs, headed by Stephan Konopatzky who has asked the Signal Laboratory of Humboldt University Media Studies for help in retro-computing the data hidden on large antique magnetic recording hard drives. In its last decade, GRD State Security increasingly had changed from type-written to computational data processing indeed.

The cassette tapes remaining from the so-called "voice archive" ("Stimmenarchiv") is analog audio signals which can still be accessed by any commerical tape deck. This is voices in rather technical than traditionally archival latency which, as long as they require electro-magnetical transduction for re-play, can first of all (i. e. on the media-archaeological level) be "heard" by machines only.

[When the pick-up transduces phonograpic grooves from mechanical "inscription" of physical sound into electro-magnetic current, is this "listening"?

The GDR State Security's definition for "Speaker archives" (*Sprecherarchiv*) was storage and retrieval systems for audio tapes on the basis of what was called "operative data" on the one hand and "speaker-typical characteristics" on the other.

["Sprecherarchive sind rechnergestütze Speicher- und Recherchesysteme, die auf der Grundlage operativer Daten und Sprechertypischer Merkmale arbeiten."[264]]

Nowadays, many automated search operations in news broadcast archives, f. e., are rather based on the speech recognition of the clippages, searching for key-words. In its radical techno-mathematical foundation, this appraoch is media-archaeological research.

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[264] File MfS BdL No. 273 , letter (typescript) from 16th November 1989, concept by the Operativ-Technischer Sektor [BStU archival page no. 3-5]: *Dienstliche Bestimmung zur künftigen Arbeit mit Sprecherarchiven im MfS* (November 1989)

It makes a crucial difference if the administration and retrieval of analog voice recordings is not only computer-aided on the level of metadata, but the audio recordings themselves transform *from signals to data* by digital sampling. Then *signal* recording transforms into *information* storage.

There is a difference between *collections of phonographic analog audio signals* and *digital storage of sonic data* indeed, since this is an essential change of medium state indeed.

At the moment of the break-down of the GDR State Security in autumn 1989, surveillance of telephone voices had reached the point of changing from human identification of recorded voices (supplied by computer-based meta-data retrieval) to the application of fully *algorithmic* software for automatic voice recognition - which would created a completely different kind of "archive".

["Und es ist bereits abzusehen, wann Sonogramme" <sic> auch zum computergesteuerten Sprachvergleich im öffentlichen Telefonnetz gespeichert werden können. Der ehemalige BKA-Präsident Horst Herold malte [...] aus, daß Computer in der Lage sein werden, Inforemationen wie mit den Sinnen eines Menschen zu erfassen. Dann, gegen Ende des Jahrzehnts, könne es technisch möglich werden, die Fahndung nach gesuchten Straftätern unmittelbar auf Maschine zu übertragen."[265]]

A special task force investigated options of the application of computing algorithms for automatic voice identification; here computational intelligence and secret „intelligence service“ converge. One report insists on the remaining, unbridgable gap between human hearing ("Höranalyse") for issues which require *semantic* understanding, and analysis by sonagraphic *audio-signal* processing. Such "Meßanalyse" enables *differential* realtime voice identification, by comparing the signal output to similar recording evidence - which is the functional "archive", the *Sprecherarchiv*.

Once more the name Koristka turns up which has been the academic mastermind behind such reasoning on acoustics. Among the MfS files, there is Koristika's article on forensic voice analysis.[266] Koristka himself wrote his habilitation with Horst Völz on the forensic use of magnetic tape recording: "Im Speicherzustand erreicht die 'aufgenommene' Information gewissermaßen statische Eigenschaften, die verschiedentlich auch durch die Bezeichnung 'eingefrorene Information' charakterisiert werden."[267]

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[265] Typescript Gärtner 1989, p. 57 (BStU p. 57), quote from West German journal *Der Spiegel* (No. 26, 23 June, 1986)

[266] Christian Koristka, Stimmanalysen - eine neue Methode der kriminalistischen Personenidentifizierung, in: Forschungen und Fortschritte, vol 41. 19xx, no. 10, 310-316, in: file MfS Abt. 26, Nr. 820

[267] Christian Koristka, Magnettonaufzeichnungen und kriminalistische Praxis, Berlin (Ministerium des Innern, Publikationabteilung) 1968, 24

Koristka refers to L. G. Kersta's report on "Voiceprint Identification", in: Nature 196 (1962), 1253 ff. but differentiates the fingerprint as "direktes objektives Abbild" from the more contingent external conditions which envelop the recorded voiceprint <314>. Koristka defines the human Hearing Analysis (*Höranalyse*) as "subjective method", and the Measuring Analysis as "objective" <313>.

An expert report on voice analysis defends the *Höranalyse*, since such heuristic *resonance* only results from empathetic listening.[268]

As has been argued in Licklider's seminal article on "Human Machine Symbiosis" in 1960, it is the differential combination of the "narrow band", but parallel signal processing human brain with the accuracy of the digital, though sequential computer which results in most efficient human-machine communication.[269]

Semantic emphasis, as well as unintended psychic articulation, can be identified as a function of tonal pitch in the recorded voice, just as Max Planck - in a recording from 1939 in the Berlin Lautarchiv collection "Stimmen berühmter Persönlichkeiten"[270] raises his voice with the very German word "erhebt" ("raise") itself, and lowers it with rhetorical skill at the end of his phrase in the last word "Gelehrten" (scholars). The techno-mathematical analysis of intonation, performed by Nikita Braguinski with the software Sonic Visualizer, reveals Planck's application of quasi-musical phrasing and thereby bridges the gap between semantics and affect. But even voice sonagrams only serve for an intuitive first interpretation; future voice identification will be data (rather than signal) based, allowing for "automatic analysis"[271]. In this algorithmic approach, surveillance practice and recent methods called "Digital Humanities" converge in media ethically ambivalent, through knowledge-generating alliance.

There is a temporal gap in the correlation between an actual voice recording with a signal from the *Stimmenarchiv*. In remarkable clarity - after removing circumstantial noise in the recording media and in background acoustics - an individual voice stays invariant against delay

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[268] "Kein Analysegerät ist in der Lage, die subjektiven Einschätzungen von solchen Paramtersn wie Gesamteindruck, stimmfülle, Klangfarbe usw. in objektiven Tatbeständen vorzunehmen und darzustellen." File MfS - HA XXII, Nr. 17247, typescript "Planaufgabe 2051. Thema: Konzeption für die Schulung von Mitarbeitern operativer Diensteinheiten zur sachkundigen Beschaffung von Ausgangs- und Vergleichsmaterial für die Personenidentifizierung anhand der Stimme und Sprache", chap. "Meßanalyse", 243

[269] J. C. R., Licklider, Man-Computer Symbiosis, in: IRE Transactions on Human Factors in Electronics. HFE-1 (März 1960) No. 1, 4-10

[270] Lautarchiv signature B8-29 Max Planck

[271] Koristka: 316

on the time axis[272], and its acoustic-phonetical characteristics are robust even against the speaker's intentional dissimulation.[273] This became media-theatrical drama in Samuel Beckett's one-act play *Krapp's last tape* from 1959.

Especially in the case of radio archives, the tapes preserved by the sender significantly differ in quality from the sound quality actually received (and occasionally recorded on magnetic tape by amateurs) in concrete radio sets, esp. in the case of international radio via short wave transmission.

The focus on the message of sound archives as technical medium significantly differs from the focus on the cultural "content" of such sound recordings. Is the historical reading an "othering" (Vivian Sobchack[274]) or even obscuration of the arte-factual sound archive by the discourse of political correctness?

A document from 1988 in file MfS OTS No. 1635, differentiates between "Auditive und messanalytische Parameter zur Sprecherklassifikation" - which is human *listening* (performance) vs. non-human signal recognition (operative); another file <MfS Abt. 26 Nr. 790: page no. 38 / 39> explicitely differentiates between "Höranalyse" (human listening) and "Meßanalyse" (machine measuring of the physcial articulation) by sonography; both methods are explicitely put into a complementary (if not even "dialectic") relation.[275] In addition to this channel of transmission, possible technical noise sources are taken into account.[276]

„Listening“ *without* the human ear leads to a different kind of sonic hermeneutics, a differnt kind of understanding. Machines do not "hear" language but measure audio signals - which is its weakness and strenght. They have a different insight into sound and voice recording, exactly because they do not "listen" but radically analyze.

This is in full accordance with Mara Mill's findings on previous physiognomic uses of sound recordings which resulted in the development of machinic speech recognition.

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[272] See f.ig. 3 "Relative Übereinstimmung der Ausgangsinformation (AI) und der Vergleichsinformation (VI) des Stimmspektrums einer Person, die über Telefon gesprochen hatte [...]. Zeitspanne der Aufnahme der AI und der VI 12 Wochen", in: Christian Koristka, Die Verwendung der menschlichen Stimme zur Identifizierung einer Person, in: Forum der Kriminalistik, vol. 1 (1965), no. 3, 32-36 (34)

[273] Gerhard van der Giet / Hermann J. Künzel (Bundeskriminalamt Wiesbaden) "Rechnergestützter Stimmenvergleich für forensische Anwendungen", in: Kriminalistik 9 / 81, 341-346 (345)

[274] Sobchack 2011, "Afterword"

[275] Archival page no. 50 / no. 51 on auditory analysis by sonagraphy

[276] Archival page no. 45 / 46 on possible technical signal disturbance

"Collections of phonographic 'vocal portraits' - such as the recordings of 'criminal' speech in Berlin’s Lautarchiv - prompted investigations into the features of the individual voice, for the purposes of characterology, lie detection, and speaker identification. Visual recordings of speech (oscillograms and spectrograms) were at first applied to the same purposes. Voiceprint identification” was eventually abandoned as hopelessly inexact, but the generic speech features described in the era of Stimmphysiognomik subsequently enabled the beginnings of speech recognition by machine."[277]

Ironically, machine-based voice surveillance results in tools which can now be applied for scientific research of sound archival heritage as well. Surveillance and research are two sides of one algorithmic coin in audio signal processing.

Historians tend to read archival files on the application of speech analysis tools by former GDR State Security in their political context which has been a totalitarian state. While our conference *Listening to the Archive* is sub-titled "Histories of Sound Data in the Humanities and Sciences", let me replace "histories" by archaeology.

The decipherment of audio records not as „historical“ documents but as sonic monuments with media-archaeological interest rather asks: To what degree did (and still does) surveillance paranoia result in analytic technologies which actually create knowledge?

The MfS "Speech archive" project raises the question: To what degree does inhuman listening provide insight which is otherwise hidden by sympathetic human listening to the archival voices? Paranoia, as we learned by Michel Foucault, does not only lead to a suppressive power regime, but is productive for knowledge as well.

So why not use the clever algorithms applied by MfS or NSA for voice recognition since the 1950 on computational basis for cultural analysis? Or does this rather degrade "digital" humanities to a second-hand justification and ornament of non-academic practices? Would it be naive to apply algorithmic tools for scientific research without being aware that such tools have been developed for forensic, surveillance or military application (as "Heeresgerät" in the Kittlerean sense)? Is there a "good" cultural use of "evil media“?

A Different Kind of Oral Testimony

[277] Vocal Features: From Stimmphysiognomik to Speech Recognition by Machine. The physiognomic uses of sound recordings between 1926 and 1953, abstract

Oral testimony from Holocaust survivors (like the Fortunoff Video Archive for Holocaust Testimonies at Yale University[278]), out of necessity (the material deterioration of the magnetic tapes), has been digitized. The audio tracks can be extracted and used as data bank for new algorithmic creation of so far hidden knowledge. A proposal by Amit Pinchevski, media scholar at the Department of Communication of Hebrew University in Jerusalem, calls for an experimental data mining of Holocaust testimony. If all these voices are thrown - contrary to their hyper-individualization - into one data pool and tumbled algorithmically, step by step, out of the phonetic chaos patterns will emerge like in a minimal music composition by Steve Reich (phase shifting / "phrase shifting"): syntactic formulas and repetitive expressions. It will become apparent to what degree the oral history interview dispositiv already creates narrative conventions which are subliminally at work even if the actual recollection is the most dramatic individual experience.

The same composer Steve Reich who once created, with assistance of magnetic recording, *Piano Phase*, later created the techno-musical composition *Different Trains* where he correlated phonetic parts of oral testimony of former American train porters to "different" train sounds before, during, and after World War II.

What if that "other listener" of oral testimony is non-human, but in fact a techno-mathematical ear? If such an active computer-graphical diagramm is developed in the Signal Laboratory for opening up the Phonogrammarchiv and the Lautarchiv to so-called Digital Humanities - even at the risk that this might end up in algorithmic inhumanity. What if not humans but algorithms "listen" to the recorded voices? Does the "cold ear" of media archaeological *listening to the archive* correspond with the telephone voice surveillance practice of former GDR State Security? Here a critical question arises. Does the active application of "digital humanities" tools transform the memory essence, and miss the ethically "sensitive" issues of archival audio collections such as the Lautarchiv with recordings from World War I, or to oral history projects of former Jewish prisoners in German camps immediately after World War II such as David Boder's wire recorded narratives in Displaced Persons Camps in 1946[279], or the Fortunoff Video Archive for Holocaust Testimonies at Yale University, where videotaping Holocaust survivors began in 1979, resulting in today more than 4400 testimonies and some ten thousand hours of video, or finally, the "Stimmarchiv" of the State Security of former GDR?

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[278] Website: http://fortunoff.library.yale.edu

[279] See Alan Rosen, The Wonder of Their Voices: The 1946 Holocaust Interviews of David Boder, Oxford (Oxford UP) 2010

The techno-*lógos* of automated speech recognition

The core techno-logical drama of (in-)commensurability between technically formed (modulated) physical matter and human wetware on the one hand, and *lógos* or programmed computation on the other hand, becomes literal with research into the regonition of *lógos* by humans and / or machines.

What de Saussure's linguistics identified as the difference between *langue* and *parole*, continues with the difference between the computational algorithm and its actual implementation - the *in*formation of matter and energy - as software (computation vs. computing), or the Lacanean symbolical order in its frictions with the real.

The IBM Continuous Speech Recognition Group research, since 1972, decided for a statistical, data-driven approach (training the technical system). This has been a logo-technical turn, an epistemic break with the previous physiology-oriented research (based on analysis of the human hearing apparatus) not simply in terms of historical succession, but as epistemic alternative.[280]

Robert Mercer and Frederick Jelinek transformed speech recognition research into probabilistic analytics. In the "noisy channel" approach, the channel is not simply understood as transmission medium, but as stochastic input already. The statistical methods for speech recognition aim at emulating, techno-mathematical templates, real speech properties in the human. But it does so in a radical non-anthropocentric way, just like the mathematical analysis of human speech (Euler) once retrained from any temptation to re-build the human speech organs (von Kempelen).

Up to the auto-complete functions in text-based Internet search engines and mobile communication devices, today, statistical speech recognition calculates probabilites in terms of the mathematical theory of communication. Here, the application of the hidden Markov model is no asssumption about language any more at all, rather a hidden state space.

Automated feature description as a media-archaeological tool

[280] A central argument in Xiaochang Li's lecture "From Gray Matter to Black Box: Speech Recognition and the Drive Towards Data" (Max-Planck-Institute for the History of Science, Berlin, research group "Episteme of Modern Acousetics), 14 February 2019, Humboldt University, Insititute of Musicology and Media Studies, Media Theatre

The plea for truly sonic knowledge necessarily leads to a critique of (re-)visualizing the sonic archive by software tools like "Sonic Visualizer", e. g. in computational ethno-musicology.[281]

Automated feature description as a media-archaeological tool is close to the methods of Systematic Musicology: "[...] large electronic collections of music in a symbolically-encoded form [...] have enabled music researchers to develop and test [...] empirical theories of music on large data sets." The availability of such music data "creates a new perspective for Systematic Musicology, which [...] often sets out to explain or describe music through the induction of empirical laws, regularities or statistical correlations in relation to music objects or music related behaviour"[282] - such as the servo-motoric feedback between the *guslar* singer and his string instrument, the *gusla*.

For the M^{4}S project (Modelling Music Memory and the Perception of Melodic Similarity), hosted by the Computing Department of Goldsmith's College (University of London), the term "symbolically-encoded music" means "[...] music in a computer-readable format where the fundamental unit of representation is the note."[283]

"Symbolic formats can be contrasted with audio formats which, instead of capturing notes explicitly, encode the sonic aspect of a musical performance by representing sound as a complex waveform. The best known formats are audio CD, the WAV and AIFF formats used primarily in computers and iPods, and MPEG-1 Audio-Layer 3 (mp3) as a compression format used for web-based and portable applications."[284]

The "semantic" listening (concentrating on *musical objects* like a melody) makes the difference to the media-archaeological "(h)ear(ing)" which focuses on the *sonic object*. Whereby a melody is basically a contour kept and recognized in memory "over time" (in both senses), the time-critical approach of media archaeology rather concentrates on non-harmonic micro-figurations of temporality within the sonic event. Thus special algorithms are needed which identify such temporal qualities (such as dynamic time warping[285]), and efficient algorithms "for extracting the repetitive structure of an audio recording"[286].

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[281] See George Tzanetakis et al., Computational Ethnomusicology, in: Journal of Interdisciplinary Music Studies, Fall 2007, vol. 1, issue 2, 1-24
[282] Daniel Müllensiefen / Geraint Wiggins / David Lewis, High-level feature descriptors and corpus-based musicology: Techniques for modelling music cognition, in: Systematic and Comparative Musicology: Concepts, Methods, Findings, edited by Albrecht Schneider, Frankfurt (at Main) et al. (Peter Lang) 2008 (Hamburger Jahrbuch für Musikwissenschaft, vol. 24), 133-153
[283] Müllensiefen / Wiggins / Lewis 2008: 133
[284] Müllensiefen / Wiggins / Lewis 2008: 133
[285] See Müller 2007: 69

"The most ambitious corpus-based musicology project was one based in Princeton University concerned with Josquin scholarship. From 1963 to the beginning of the eighties, researchers, led by Arthur Mendel and Lewis Lockwood, generated electronic scholarly editions of the complete works of Josquin [...], many including concordances, and relevant related works. From this, statistics for cadential progressions and modal indicators were compiled and subjected to statistical analysis primarily in order to study issues of authorship and stemmatic filiation (see [...] various papers in Computers in the Humanities between 1969 and 1978). The ambitions of this project, though great, never extended to revealing cognitive processes, being limited, essentially, to style analysis."[287]

A similar data aesthetics has induced Alan Lomax to develop his "cantometrics" analysis of folk music into a comparative computational Global Juke Box.[288] "In folk music research, feature extraction and the use of computers have been employed as a means for the (automatic) classification of songs (mainly melodies) according to their musical characteristics. In a comprehensive study Steinbeck (1982) classified European folk melodies into six homogeneous groups by employing Ward's classification algorithm with 35 relatively simple features derived from the monophonic melodies. He was able to show that this classification was in close correspondence with the melodies' regional origin and functional uses" (ibid.).

At the borderlines of the *semantic gap*, to most musicologists "the evaluation of musical relationships is not a task amenable to automation. The quantification discussed above is a statistical one and, whilst its usefulness will be greater as more information is provided to the system, it is cognitive experiment and musicological reasoning that must prove the final arbiter of the system's performance. Furthermore, such an approach can only offer limited assistance to those wishing to perform detailed analyses of single works—which is the standard paradigm in traditional music analysis" (ibid.).

"The power of the quantitative [...] lies in the new kinds of access to interpretation it provides." *Distant hearing* (as slighty modified in respect to Fitzpatrick's review of Moretti's approach) inevitably raises the question not of *whether* one ought to hear distantly, but of *what* one can hear *only* distantly, and what one requires closeness in order to capture.

But while such an analysis focuses on an individual song recording (which can be "big data" in itself, for hour-long oral poetry performances like the

[286] Meinard Müller, Information Retrieval for Music and Motion, Berlin / Heidelberg / New York (Springer) 2007, 165
[287] Muellensiefen et al.: 136
[288] https://theglobaljukebox.org. See Henry Adam Svec, Folk Media: Alan Lomax' Deep Digitality, in: Canadian Journal of Communication, vol. 38 (2), 2013, 227-244

guslari performances in Bosnia and Montenegro in the tradition of Homeric epics, stochastic signal analysis covers "big data" of a whole sound archive.

A non-historicist approach to sound archives takes its point of departure from the recorded signals themselves which stay invariant towards the passing and changing historical and cultural contexts happening in the temporal progress around the durable material record. Cultural contexts change, while the physical laws of speech articulation and recording change according to a different temporal rhythm which is not historical time.

"Listening" to the archive with media-archaeological ears

"Listening" to the archive is not only a historical, discursive way to approach past sonospheres, but about a signal-focused audio-listening as well. The latter approach performs "close listening" to the materiality of both sound, and its recording technologies, and the former decenters such non-discursive practices by widening the scope of analysis in cultural and historical (text-based) contextualisation. There are "two bodies" of the archives here: the sound archive in technical terms, and the historical archive in which the sound recording is not an active agency but an object of research.

Different from the archive as symbolic order, which is composed of records in historiographic, that is: in alphabetic notation, there is a para-archival modality of sub-textual, signal-based recording: the sound of times past. The BBC World Service has launched the "Save our Sounds" project, looking to "archivize" sounds that may soon be lost due to the post-industrial world - but caution, this is not yet an archive: As long as an algorithm is missing which rules the transition of contingent sound provenance to permanent storage, it is just an idiosyncratic random collection.

Is There a "Sound of the Archive"? Silence

Silence itself can become part of the archive. The software for sound analysis *Audacity* actually provides for a tool called "Silence Finder". The shere endurance of periodic frequencies is a Bergsonean time which passes. While an empty space within a painting positively endures with time, silence in acoustics is always a temporal (though negative) event itself, its "sonicity". This term reminds of the fact that explicit sound is just a thin slice of a wider spectrum which is audible to humans. But below and beyond this phenomenological range, sonicity media-

epistemologically refers to implicit sound as an object of knowledge about temporal forms of the vibrational event, to time signals as such.[289]

The spatial, text-based archive is familiar as a radically silent place. Acoustically, this silence might be re-interpreted as an enduring negation of time-based sound, as performed in John Cage's piece *4'33*.[290] Historians are aware that there is no unmediated access to the past. But in the negative sound of the archive, its silence, one listens to the past in its truest articulation. Just like in typography and typewriting, the *spatium* is an enunciation in the symbolic order as well, media-archaeological listening pays respect to silence as negative sonification of an absence, instead of converting it into the specters of a false memory. Written records or printed texts necessarily miss sound matter. But in the deeper sense there is implicit sonicity even in images, diagrams and graphs which are derived from sound sources; any sonagram keeps an indexical relation to the sonic event.

But there is sound even from the digital archive. When a sonically coded BASIC program has been loaded from an external tape memory (the "Datasette") into the ROM of a Commodore 64 computer, one could actually listen to data music. What could be heard was not sound as memory content like an old percussion-assisted song[291], but rather the sound of computer memory itself, that is: a software which is sonified "scripture" (though in the alphanumeric mode). Such a data archive is not sonic memory but sonicity.

Audio-recordings and their media-archaeological understanding

Dis-covering the temporal implications (rather than metaphorical "layers") of the archive is not just an operation of the mind or the eyes, but of hearing and literally archival "understanding" as well (German *verstehen* refers to auditory as well as to cognitive perception).

Whereas the-classical archive, which is based on alphabetic scripture, is a static array of records (like parchments and papers) on the grand scale and letters on the microscale, which can be set into motion only by the act of human reading line by line, the Edison phonograph at first glance

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[289] See Steve Goodman, The Ontology of Vibrational Force, in: same author, Sonic Warfare. Sound, Affect and the Ecology of Fear, Cambridge, Mass. (MIT Press) 2009, 81 ff., and Peter Price, Resonance. Philosophy for Sonic Art, New York / Dresden (Atropos Press) 2011

[290] On the occasions which led to this composition see Seth Kim-Cohen, In the Blink of an Ear, New York (Continuum) 2009, 160 ff.

[291] For an analysis of the interplay between technical memory and affective remembrance see Ben Anderson, Recorded music and practices of remembering, in: Social and Cultural Geography, vol. 5, No. 1, March 2004, 3-19

looks like the first form of "archive in motion", since its "records" (notably the early ethnographic field recordings around 1900, leading to the Vienna Phonograph Archive and the Berlin Phonogramm Archive) are based on a continuously rotating, technically moving apparatus both in recording and in re-play.

Strictly speaking, the phonographic record which consists of infinitesimally continuous signals instead of alphabetic or other elementary symbols is no "archive" at all - with the archive being both composed of and itself representing the symbolical order of discrete elements (letters on the lower level, archival tectonics on the upper oganizational level). Phonographic inscription is different from cinematographical recording and projection of visual momevent which is based in discrete, mechanically interrupted frames.

When listening to an ancient phonographic record, *the audible past* (alluding to Jonathan Sterne's book title) very often refers rather to the noise of the recording device (the ancient wax cylinder) than the recorded voice or music. Here, the medium talks both on the level of enunciation and of reference. What do we hear most: the cultural content (the formerly recorded songs) or the medium message such as limitations in vocal bandwith, even noise (the wax cylinder scratch and groove)?

With digital sampling and processing of audio-signals, analog noise is usually significantly filtered, thus: silenced. But the former noise is being replaced by an even more endangering challenge: the "quantizing noise" on the very bit-critical (technical) level of signal sampling, and the migration problems of digital media data and the physical vulnerability of electronic storage media in terms of institutional (cultural) sound tradition. This is not just a technical question, it has an epistemological dimension as well.[292]

"Forensic" signal (instead of textual) criticism: First audio recordings

In common history of technology, the first melodic voice recording is supposed to be the childen song "Mary had a little lamb" as performed by Thomas Alva Edison himself on his tin-foil phonograph in 1877.

But caution, *arché* (the core term in the notion of media archaeology) does not primarily denotate a beginning in the history of technologies but rather a governing principle. Indeed the earliest sound recording has been preserved (in Johann Gustav Droysen's sense) as relic ("Überrest"), as phonogram which was never intended to be re-played: Édouard-Léon

[292] See Arild Fetveit, Medium-Specific Noise, in: Liv Hausken (ed.), 189-215

Scott de Martinville's notational traces of acoustic vibrations produced by his "Phonautographe" on a rotating cylinder, produced for phonetic analysis. Only media-active, non-human archaeology, that is: with technologies themselves as archaologist like the „virtual stylus“ (or the „variable width“ technology), opens this silent archive of sound in order to let is resonate again.

[Foucault's archaeology silences talkative historical narratives: "history, in its traditional form, undertook to [...] 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.*[293]]

[A (re-)sonification of the phonautographic sound recordings has been achieved by the First Sound Initiative co-founder Patrick Feaster (Indiana University), and by the radio historian David Giovannoni.]

Not by coincidence, one of the earliest of these recordings which Scott deposited at the French Institut National de la Propriété Industriel in 1859 is a media-archaeological sound indeed, originating from a measuring tool: a tuning folk vibrating at 435 Hertz (at that time adopted as the official French reference pitch for musical performance).

It is a hybrid technology of sound re-synthetisation which made these oscillation curves vibrate again: optical scanning of acoustic signal lines (as known from sound film for ages). All of the sudden, once more a children song re-sonates: "Au clair de la lune, Pierrot répondit“, 8. April 1860, Paris.[294]

What looks like the pick-up of sound images by a "virtual digital gramophone needle"[295], is indeed a registration of a new kind: digital, time-discrete sampling and mathematical quantization.

Only mathematized media technology can trace and re-veal such a sonic knowledge *(mathesis*) which leads to an extended notion of the text-critical method as known from the philological disciplines so far - towards a veritable signal critique which is no more exclusively performed by human scholars but as well (and even more) by the measuring media and their implemented algorithms themselves.[296]

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[293] Michel Foucault, Archaeology of Knowledge, transl. A. M. Sheridan Smith [*1972], London / New York (Routledge Classics) 2002, "Introduction", 3-19 (7)
[294] http://www.firstsounds.org/sounds/1860-Scott-Au-Claire-de-la-Lune-09-08.mp3
[295] Harald Haack, Die erste Klangaufzeichnung. Eine Audiografie, *online* http://newsbattery.blogsport.de/2008/05/07/die-erste-klangaufzeichnung-eine-audiografie
[296] On forms of media-archaeologically augmented textual criticism see Matthew Kirschenbaum, Mechanisms. New Media and the Forensic Imagination,

[To give another example: The earliest known sound recording in Norway has been produced on February 5, 1879, by an Edison tin-foil phonograph in Kristiania (the previous name of Oslo). The tradesman of musical scores Peter Larsen Dieseth is supposed to have sung a liturgic psalm. In 1934 Dieseth presented the Norwegean Museum of Science and Technology a phonographic tin-foil which was flattened and glued on a piece of paper and enclosed by a picture frame; since then the artefact hang silently at one of the museum walls (the most secret and silent archives are the sound archives). Next to the tin-foil piece Dieseth had manually written that this was the original of the earliest sound recording; all the evidence thus is a tinfoil flattened to a "document" and annotated by a remark by its former collector. This resulted in the first officially archivized record of sound in Norway. The recording itself remained un-playable.]

In a joint project the Norwegean Museum of Technology (Oslo) and the National Library started the effort to dis-cover the auditive content from this artefact, by applying the method of non-invasive, touchless optical scanning (as developed by the School of Engineering Sciences at the University of Southhampton). By means of optical scanning of signals and application of digital filters, it is possible to digitally trace past acoustic signals from such records. From such an operation we expect sound. The digital "reading" of this record by the laboratory in Southampton led to a re-sonification where the ear wants to detect something like music or speech but hear nothing but noisy patterns. "Message or noise?", Foucault once asked on occasion of a medical conference about the nature of bodily symptoms. The results of this radically "superficial" reading have been presented at the JTS 2010 conference in Oslo (Digital Challenges and Digital Opportunities in Audiovisual Archiving):
The whole artefact's surface topology is mapped to high precision using optical sensors, and the audio recovered by applying signal and image processing methods to the measured data. The measurement process for this artefact took three weeks of continuous scanning. Initial attempts at audio recovery from the surface data using existing processing techniques were largely disappointing, leading to the development of a more sophisticated methodology based on feature tracking through the groove. Out of six short tracks found on the foil, four contained significant audio portions featuring both music and speech, the remaining two tracks were both short and contained negligible content.[297]
Such a technological (re-)sonification of transcoded signals is not just a concentional acoustic re-play; the media-archaeological *momentum* is

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Cambridge, MA (The MIT Press) 2008

[297] P. J. Boltryk / J.W. McBride / L. Gaustad / Frode Weium, Audio recovery and identification of first Norwegian sound recording, lecture at JTS 2010 conference in Oslo (Digital Challenges and Digital Opportunities in Audiovisual Archiving)

ahistorical: "probably the first time it has been reproduced since the original recording date" <ibid.>. At the same time, this leads to a new kind of text criticism (in all its meanings); the real word of recorded acoustic signals reveals that the enclosed alphabetic commentary is historically untrue:

"The extracted audio [...] was not the expected psalm singing as documented in the contemporary sources, but a mixture of shorter extracts. Features of the grooves and the extracted audio may confirm that the foil is a small portion of the recorded foil, and that portions of the remaining foil could have been distributed to other guests of the event, consistent with contemporary practice" (ibid.).

From such an operation sound is expected, but really what primarily can be heard is noise - just like the first (archived) recording of sound in Norway, a tinfoil flattened to a „document“ and annotated by a remark by a former collector who claims this has been the first Norwegian recording of music on Edison cylinder. The digital reading of this record (at a laboratory in Southampton) lead to nothing but noise. What articulates „it“self is noise such as can be expected in any transmission channel according to the theory of communication developed by Claude Shannons - a theorem which can be extended to transmission in time as well, that is: tradition. In such noise articulates itself what baroque allegories showed as the nagging „tooth of time“ - the articulation of physical entropy, the manifestation of the temporal arrow; according to the Second Law of Thermodynamics each system tends, over time, to increasing dis-order.

[Digital copies of digital records can indeed be produced almost without loss of data (except the quantization noise).]

Against the noise of physical decay, techno-logical, that is: „digital“ culture poses a negentropic insistance, a negation of decay and passing (away). Once digitized with an appropriate sampling rate, sound can be re-produced frequently with stable quality which was utopean in recent times of analoge recording. The secret of this temporal unvulnerability is that it is just numbers which are electronically written; even after a thousand copies a physical representations of a zero stays zero and one probably remains one.[298]

All of the sudden, a non-literary texture, a binary pattern, saves the signal - the ultimate textual irony.

[298] Rudolf Taschner, Der Zahlen gigantische Schatten. Mathematik im Zeichen der Zeit, Wiesbaden (Vieweg) 3. Aufl. 2005, note 77

TECHNOLOGICAL VOICING OF TRAUMATIC MEMORY AND SONIC MEDIA TESTIMONY

From the phenomenological to the media-archaeological perspective: media-induced tempor(e)alities

Audiovisual signal recording has resulted in new kinds of temporal awareness and practices. From the phenomenological perspective, signal replay in photography, phonography, cinematography, videography, the magnetic tape, and finally digital recording affects the human and even animal sense of time. Specifically the phonographic irritation has been iconized by the HMV record label *logo* (derived from Barraud's original painting) where the dog Nipper literally listens to "His Master's Voice". In telephone directories of post-war West Germany, a special icon after the numerical address signified the possible interaction of an answering machine as a warning against the subsequent irritation of the present call.

This situation has been described by Walter Benjamin (referring to cinema) more acutely as a "chock" for sensation. Although for generations media records as text, sound or images have become accommodated in every day consumption, this intrusion into the sense of presence has not yet been cognitively digested and continues to irritate what might be called the "unconscious" of cultural time - in an explicit analogy to Walter Benjamin's neologism of an "optical unconscious" (inspired by Sigmund Freud's psychoanalysis), describing evidence which is not accessible to human senses but to the camera only - as revealed in slow motion and fast forward display.

Such media-induced temporal interruptions and incisions are traumatic tempo*realities* - pluralising the tightly coupled time triad of past-present-future into a whole cosm of micro-temporal figures of delay, anticipation and intra-temporal (time-critical) moments. These temporealities share central features with what in recent academic memory studies has become known as the unhistoricizable of traumatic remembrance. Next to "the distinctive role of media in mediating collective trauma"[299], there is trauma induced by media technologies themselves.

An escalation of this situation is so-called *media witnessing* where crisis is not experienced as an exceptional eventality any more like historical revolutions or natural desasters in the past but "as a generalized and routine background condition - a persistent crisis-readiness" (Frosh / Pinchevski). In a more techno-radical reading, this background is no

[299] Amit Pinchevski / Tamar Liebes, Severed Voices: Radio and the Mediation of Trauma in the Eichmann Trial, in: Public Culture 22:2 (2010), 265-291 (267)

diffuse condition of contemporary society as described by sociology, but is rooted in the time-critical conditions of such media technologies.

Broken presence: Ring broadcast ("Weihnachtsringsendung") x-mas 1942

Phonographed voices do not simply articulate the original body but embody the co-articulation of the transmission technology itself. In the recording of the radio Christmas-greetings from several points of the war front, broadcasted by the German Großdeutscher Rundfunk on December 24, 1942[300], the human voice is traumatically distorted by electro-magnetic transmission itself.

What is Christmas spirit (German *Weihnachtsstimmung*) here? The booklet of the Compact Disc edition of this recording reminds that such recordings are essential for the testimony of 20th century history. "Without them mentalities and tunings [*Stimmungen*] of that epoque can hardly be communicated."[301] But such tunings are not only cultural but directly results from the technical mode of AM transmission itself to which the present listener gets "attuned" (expressed in Martin Heidegger's sense).

Signal recording is not a witnessing of "Geschichte" which only takes place in historiographic narrative. Instead, it is an auto-referentialty of the transmission technology itself. The original (or even studio-manipulated) signal distortions are an index of authenticity of live radio transmission across long distances over the Short Wave military channels, a short-cut between soldiers at the war front and their families at home which can only take place in the technological radio-sphere. While this was meant to have a calming effect of synchronicity between relatives in Christmas time, sensation at home was at the same time irritated by the technical reminder of the spatial gap, the "shock of absence" audibly incorporated within the apparent temporal immediacy (Jan-Claas van Treeck). The liveness of the joint singing of "Stille Nacht, heilige Nacht" is spectral - both in its phenomenological sense (ghosts, the undead), but as well literally: the electromagnetic spectrum of the

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[300] See Dominik Schrage, "Singt alle mit uns gemeinsam in dieser Minute". Sound als Politik in der Weihnachtsringsendung 1942, in: Daniel Gethmann / Markus Stauff (eds.), Politiken der Medien, Berlin (diaphanes) 2005, 267-285

[301] "Ohne sie können Mentalitäten und Stimmungen dieser Epoche nur schwer vermittelt werden". Booklet to the Compact Disc published by Institut für Zeitgeschichte (Munich / Berlin) 2003, *Dokumentation Obersalzberg. Tondokumente. Täter Gegner Opfer*, ed. by Albert A. Feiber / Volker Dahm

radio signal. The Freudean unconscious "It" expresses itself on the media-archaeological level, as a traumatic *momentum*.

The acoustic reverberations which take place, just like the spectral distortions and filters, provde the "live" transmission with a micro-temporal irritation. The present here is already distanced to itself, while at the same time letting a most intimate signifier of the German soul (the song *Stille Nacht*) shine through.

Amit Pinchevski and Tamar Liebes define radio wave transmission as "signals from afar that make intimate contact". While this applies to electronic communication media in general, "radio constitutes a distinctive configuration of presence-at-a-distance through the separation of body and voice and the reconstruction of a disembodied voice. [...] the body cannot endure transmission, whereas the voice can."[302]

This split between an original sound source and its electroacoustical recording results in what R. Murray Schafer called "schizophonia" to describe the splitting of an original sound and its electroacoustic reproduction[303], a dissonance between the affective and the cognitive awareness of sonic time signals.

In electro-magnetic "acoustic space" (McLuhan[304]), a different tempor(e)ality reigns which allows for a rather "symphonic" resonance between past and the present which - what ever the semantic content - is the media-archaeological message of the technological condition for such radio transmission and reception itself: the "resonant circuit" in electronics (German *Schwingkreis*).

Even generations later the impact of such acoustic transmission of an event can still be "re-presenced" (Vivian Sobchack) in auditory perception which is the human surrogate time sense. The impact of the acoustic "real" does not only "affirm the effect of the original event"[305], but irritates and micro-traumatically undermines the symbolic time order of historical distance.

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[302] Amit Pinchevski / Tamar Liebes, Severed Voices: Radio and the Mediation of Trauma in the Eichmann Trial , in: Public Culture 22:2 (2010), 265-291 (271)

[303] en.wikipedia.org/wiki/Schizophonia#cite_note-1, accessed December 23, 2013, referring to: R. Murray Schafer, The New Soundscape: A handbook for the modern music teacher, BMI Canada, 1969

[304] See Edmund Carpenter / Marshall McLuhan, Acoustic space, in: Explorations in communication, edited by Edmund Carpenter and Marshall McLuhan, Boston (Beacon) 1960

[305] Amit Pinchevski and Tamar Liebes, Severed Voices: Radio and the Mediation of Trauma in the Eichmann Trial , in: Public Culture 22:2 (2010), 265-291 (274)

Black Boxes of sonic memory

In May 2011 two aeroplane Black Boxes could finally be saved from the submarine ground of the Atlantic - the data recorder *plus* the voice recorder keeping not only the last words of the pilots in the cockpit but as well the background noises which might retrospectively signal the unfolding desaster. The wave forms and sonagrams both voice signal and all kind of noise, mixed, often undistinguishable. Both devices proved to be miraculously intact two years after the 2009 crash of the Airbus of Air France. Both data recorders consist of memory chips which keep their magnetic charge, different from the mechanically vulnerable turning cylinders, discs or tape or wire spools of previous recording media. Whereas mechanical records still provide the culturally familiar form of physical impression (writing), electro-magnetic latency is a different, sublime, uncanny form of insivible, non-haptic memory. Listening to the recovered voice recorder from the cockpit after a plane crash is traumatic immediacy, rather re-enactment than protocol. The voices and sounds emanating from such a black box are radically bodiless, being in a different temporality than the familiar historiographical time.

"Radio play" and the irruption of the media-traumatic "real" into the symbolical time-order of drama

With his steam-driven acoustic synthesiser mechanism, research artist Morten Riis at a former Transmediale festival in Berlin, and a subsequent demonstration in the Media Theatre of Media Studies at Humboldt University, staged and revealed a dissonance between perception and cognition, since at unpredictable moments the mechanism collapsed and needed rebooting. Is this kind of media theatre a planned accident or a genuinely involuntary malfunction? Can "the real" be given its place within the symbolic order, which is the theatrical framing, or does it rather occur in the extra-dramatic field exclusively?

"Hörspiel" as an art form in German, the radio play, in the anglophone world is often called "radio drama"[306]. This expression is still oriented at the definition of drama as literary script and in a way logocentristic (orientated at literature), as opposed to a radical medium-centristic (radio-phonic) approach. Instead of the word-based radio play the acoustic-based "Schallspiel" dramatises the materiality of radio transmission itself - a genuinely media-dramatic approach.[307] But even here the apparent noise is still a controlled one.

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[306] See Tim Crook, Radio Drama. Theory and Practice, London / New York 1999
[307] See Friedrich Knilli, Das Hörspiel. Mittel und Möglichkeiten eines totalen Schallspiels, Stuttgart (Kohlhammer) 1961

"Realisation" has been the technical term for signal (esp. time axis) manipulation in early electronic music production - different from the symbolic order of the written score. Both tape noise (the magnetic hiss) and vocal asemantics is rather missing in Samuel Beckett's Krapp's Last Tape script. The acoustic dimension of violence had escaped literature for long time: the shapeless "real" of battlefield noise which conquered the soldiers' ears without being expressable symbolically by language or writing. Therefore the acoustic event remained, in its extreme forms, a traumatic ongoing presence, an unarchivable memory. In Arnolt Bronnen's theatre play from 1924 about World War I experience, *Katalaunische Schlacht*, a gramophone becomes the protagonist on stage itself which haunts the human actors by a spectral, repeatable sound - literally retro-active in the psychoanalytic sense.[308]

Any approach that ties audibility to human performative practice only and not to operative technological media as such is restricting this dimension to evolutionary continuities and soft transformations rather than addressing the hard discontinuities introduced with the arrival of new media. While most of the prominent interpretations of media-enhanced dramas like Samuel Beckett's Krapp's Last Tape hold views about the inseparability of cultural practices and new media[309], the arrival of new media can not be reduced to discursive effects but actually induces epistemic choques. Culturally formated ears, "wrapped up in the Symbolic and Imaginary registers, can not hear how audio technologies expose the Real"[310]. It requires the *media*-archaeological ear such as spectrography to reveal such essentials.

In their technological essence, magnetic voice recordings induce a different kind of scientific analysis which is not limited to philology or musicology any more but researches the sub-semantic poetic articulation on the media-archaological level (spectral analysis with electronic measuring media), thus revealing evidence of a different (sub-poetic) kind. The human is not traumatically irritated by phonography any more once technological analysis reveals that human articulation it an artefact itself, resulting from bio-techniqes and a symbolical code called language.

Radiophonic Testimony (the Eichman Trial) and Media-Archaeological Analysis (the *Führer*'s Voice)

[308] See Helmut Lethen, "Knall an sich": Das Ohr als Einbruchtstelle des Traumas, in: Inka Mülder-Bach (Hg.), Modernität und Trauma.Beiträge zum Zeitenbruch des Ersten Weltkrieges, Wien (WUV) 2000, 192-210
[309] Brian Kane, Relays: Audiotape, Material Affordances, and Cultural Practice, in: Twentieth-Century Music, vol. 14, no. 1 (2017), 65–75 (73, note 24)
[310] Kane 2017: 73, referring to Friedrich A. Kittler, Gramophone, Film, Typewriter, Stanford, CA (Stanford University Press) 1999

Whereas *aura* as defined by Walter Benjamin depends on the impression of being uniquely "here and now", technological temp*oral*ity and specifically its sonic articulations culminate in a deferred and delayed presence, the electrified voice and its media-temp*aural*ity. Next to transcriptive "oral history", a techno-aural presence of the past takes shape.

As has been argued by Pinchevski and Liebes, the live radio transmissions of the Eichmann trial in 1961 "became inseparable from the memory of the trial itself [...]."[311] In terms of the electro-magnetic event, the authenticity of the media event, and the co-witnessing affect of radio voice transmission is preserved in its recording on magnetic tape. From that technological condition arises a unique option for time-shifted re-presencing traumatic testimony. While the affect of traumatic testimony disappears when recorded in alphabetic historiography, it is preserved in signal transduction.

A kind of acoustic memory shock has been the unexpected turning-up of a *mémoire involontaire*, a magnetic recording of Hitler's voice on a AEG tape, recorded by microphones once installed in the train waggon which carried the dictator and the Finnish General Field Marshall Carl Gustaf Emil Mannerheim on occasion of Hitler's visit in 1942, on occasion of Mannerheim's 75th birthday, at a train station near the airport of Immola in Finland. Eleven minutes were secretly recorded by Thor Damen, a sound engineer of the Finnish Broadcasting Company (Yleisradio) on June 4.

While Hitler rarely allowed himself to be photographed, filmed or phono-recorded in private situations, all of the sudden, the secret media archive lets him speak in a private tone. "The voice on the tape is low-pitched and somewhat hoarse, with sentences rambling, and breaking off repeatedly into pauses for thought."[312]

This invites for spectrographic signal analysis. There are archival pauses in the historical sense (the event) and as techno-archival event as well:

"The recording was suddenly cut off. Hitler’s security men spotted the cords coming out of the window. They raised a fuss, threatening Damen

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[311] Amit Pinchevski and Tamar Liebes, Severed Voices: Radio and the Mediation of Trauma in the Eichmann Trial , in: Public Culture 22:2 (2010), 265-291 (267)
[312] Kirsikka Moring, Conversation secretly recorded in Finland helped German actor prepare for Hitler role, In: Helsingin Sanomat International Web-Edition, http://www.hs.fi/english/article/1076153999513, accessed March 19, 2013. First published in print: Helsingin Sanomat, September 15, 2004. For a YouTube-reproduction of the document, see: "Hitler 'Talking' To Finnish Field Marshall Mannerheim", http://www.youtube.com/watch?v=t_Xf3l7RjBk; accessed March 19, 2013

with a gesture suggesting cutting off the throat. According to Vihonen, the security men demanded that the tape be immediately destroyed, but Yleisradio was allowed to keep the reel, after promising to keep it in a sealed container. One of the tapes ended up in the hands of the head of the state censors' office Kustaa Vilkuna, and he later gave it to Yleisradio in 1957. The second tape was kept by Damen himself, who died in 1965. It was found in 1992 by his son Henrik Damen, hidden away in his father's garage."

A copy of the tape was sent to the Institute of Military History of the German Armed Forces. A study of the tape's authenticity was made in the acoustics laboratory of the German Central Criminal Police. But paradoxically, it is exactly such signal analysis in quest of the authentic voice which reveals the monstrosity (in Fact: the Sirenic sonicity) of the human voice when it becomes analysed (and resynthesised) as a techno-physical event.

The American sound artist Seth Cluett once coined the term "temporal dissonance" for such irritations. "Dissonance" in itself is of a sonic-temporal nature (different from simple "dislocation"). Sonic asynchronicities create irritations in the human sense of time (different pace / temporalities / speed).

Stefan Gfrörer from German BKA (Kriminaltechnik) identified Hitler's voice by comparison with officially recorded Hitler public speeches. Forensic technology is truly media-archaeological analysis.

Not only the human is speaking from tape - it is the recording technology itself as well. Gfrörer "compared the speech to a talk Hitler had just previously held and which was recorded by using exactly the same system as in Finland, and the analysis proved that it was Hitler talking."[313]

Hitler's personal assistant who had been present during the train journey could not recognise the recorded voice as specifically Hitler's one when listening to the recording long time after - a difference between neuronal and electronic memory. The stored recording of Hitler's conversation with Mannerheim during lunch at the train journey breaks of when suddenly music can be heard - the previous recording of the (radio) tape. The authentification of the recorded voice as Hitler's (which is symbolically rendering a name as meta-data to an audio signal) itself is a media-archaeological act, based not on human memory (Hitler's former assistant) but on stectography, with signal-detecting and signal-analysing electronics and measuring instruments. What flashes out, is the physically "real" of acoustics. Different from Roland Barthes'

[313] http://www.ww2f.com/topic/1497-the-conversation-between-mannerheim-and-hitler; accessed March 19, 2013

definition of the photographic *punctum*, the signal here is a dynamic one, revealing its evidence only when moving forward, a kind of "punctum-in-becoming" like the cathode ray which creates the impression of an electronic image which in fact consists of nothing but Bergsonean time of duration.[314]

This reminds of the gramophone recording of Heinrich Himmler's "secret" speech to SS men on the *Endlösung*. Film director Romoald Karmaker has turned this record into a "documentary" film, with Himmler's speech not being articulated from the original recording in the archive, but alternatively being read by the actor Zapatka.

Negative sound as traumatic interval: silence as form of sonic witnessing

With sound recording in digital high fidelity (due to lossless signal reproduction according to the Nyquist / Shannon sampling theorem), the traditional tight coupling (at court and in legal discourse) of indexical phonographical real presence and witnessing is being undermined.

Arnold Dreyblatt's "memory opera" performance, reading printed names by actual voices, once reimplemented the symbolical rigid signifiers into real living bodies by human re-presencing (different from re-play by phonographic apparatuses) - like the "sonic memorial" of September 11 attack on World Trade Towers 2001, by US Public Radio.[315]

A Compact Disc by Jonty Semper, edited September 6, 2001 (shortly before the attack on the New York World Trade Towers on September 11, 2001: see "radio memorial") allows for the re-play of the recording of "The one minute silence from the funeral of Diana, Princess of Wales" which on September 6, 1997, was broadcasted *in memoriam* Lady Diana on radio and TV.[316]

But just as for the recorded silences in the video-testimonies at the Yale Fortunoff Archive such silence is no articulation of trauma any more but by the very act of recording already the transformation of real into symbolic silence which thereby becomes accessible to the historiographical imaginary.

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[314] See Bergson, Matter and Memory, on "vibrations", and Maurizio Lazzarato, Videophilosophie, Berlin (b-books) 2002

[315] See the audio project *Kenotaphion*, www.kenotaphion.org

[316] See Claudia Benthien, Die *vanitas* der Stimme. Verstummen und Schweigen in bildender Kunst, Literatur, Theater und Ritual, in: Kolesch / Krämer (eds.) 2006: 237-268 (262)

Wheresas traumatic silence escapes recording, the repeatability of recording itself creates a trauma of another kind by its very technological virtue: an irritation of logocentristic "presence". Silence recorded on magnetic tape though makes silence accessible as processual *durée* (in the Bergsonean sense) by its very necessity of a electro-magnetic and motor driven motion.

Interruptions may then be taken as kind of negative presence effects insofar as hereby "the nonhermeneutic [...] punctuates the hermeneutic [...]."[317] The equivalent to spatial, material or visual absence is negative sonicity: silence. In trauma studies, pauses and interruptions in recorded speech count as symptoms - symptoms which can better be identified by ultra-sensible and DSP measuring media than by human psychoanalysts. But from the media-archaeological point of view (the "ears" of the recording apparatus), speech and pauses are equally forms of signals. Frequently interview quotes and diary material are anonymized, and "[a] series of dots ... indicates a pause in speech."[318] The *real* involuntary memory (in Lacan's sense) is *arché*-logique (no speech / *lógos*), but articulation by silence. In algorithmic techno-memory practice, there is a "Silence finder" tool in the audio-editing software Audacity which automatically, that is: algorithmically, taggs intentional and non-intentional pauses in speech or sound files. The present text will dis-continue at that point.

Digitizing the Dialogue: Zoom Video Conferencing

Any academic talk that is taking place online is already a concrete scene of "digitizing" both the lecturer, and the audience. With the participants and hosts joining on Zoom, there is a cybernetic feedback channel to ask questions, parallel to a livestream *via* YouTube for a more general public. Video conferencing, in a media-technical sense, literally transduces (transforms) cultural communication.

With Zoom, electronic media are flipping from a mere "extension" of artistic and academic practice to technology in the sense of Heidegger's *Ge-stell* (enframing). A Zoom teleconference is no dialogue any more, but a technical communication coupling, literally technical *lógos* defining the condition of communication, with no counter-action by human corporealities any more. Against the auditive, and visual design of the Zoom setting, the human dialogue becomes "antiquated" already, a pure "remediation", or simple "content" (McLuhan) of an obsolete cultural technique to the new technical formation - as it has already been suggested in the title of Günther Anders' books *Obsolescence of Man*,

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[317] Amit Pinchevski, Levinas as media theorist, in: xxx

[318] Ben Anderson, Recorded music and practices of remembering, in: Social and Cultural Geography, vol. 5, No. 1, March 2004, 3-19 (18)

facing television.