[Wolfgang Ernst: SCRIPTS ON TECHNICAL MEDIA]

Text Block "MEDIA SCIENCE, TECHNO*LÓGOS* AND 'DEEP' MACHINE LEARNING (AI)"

[unpublished so far, roughly edited]

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- *Machine Learning / AI*

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Towards a Media Science:

(MIS-)UNDERSTANDING MEDIA WITH MCLUHAN

Message, massage: McLuhan's difference to Communication Studies

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

The message beyond McLuhan's grave is a critical awareness for media-induced phenomena acting upon humans in implicit ways. McLuhan has inspired neurological studies into mass media perception, that is: the awareness of subliminal processes induced by technical (mechanical and electronic) media such as later experimented by Herbert E. Krugmann's "Brain Wave Measures of Media Involvement"[1]. McLuhans seminal book *Understanding Media* originally did not result out of interest in media-epistemological theory right away, but originated more traditionally in communication studies. *Understanding Media* had been commissioned as an educational report to analyze the impact of watching television on school children. It was "absolutely McLuhan" to turn this study upside down, resulting in a most original analysis of the deep impact of media on human perception on the subliminal level. Understanding media is not about content, but the *message* and *massage* of the medium: the affective, neurological level, analogous to the figure/ground separation as developed in *Gestalt* psychology.

Expressing media theory: McLuhan the "man of letters"

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

The message of McLuhan's publications, even if their aesthetic content is typographically experimental, is still the alphabetic regime which is symbols, not signals. In that world, an encounter with his writings is not simply historical but refreshing. In its very consequence this asks for a radically archival reading and archivographical writing of such intellectual heritage - which is today The Herbert Marshall McLuhan Fonds, held in the Library and Archives of Canada (LAC) in Ottawa, signature MG 31, D

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

156. As such, "McLuhan" has never become post-literate, but stays "M-C-L-U-H-A-N". His two bodies, the mortal and the intellectual one, have resulted in a grave and in an archive. Only in the latter he has, in principle, become timeless, as long as is alphabetic letters can be identified and copied without loss.

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

Refreshing McLuhan: "Media ecology"

"Back to earth" is the dominant eco-discursive slogan in times of the recently declared anthropocene where the human impact is not marginal but essentially irritating geophysics. While this concern mainly concentrates on political activism, philosophy of technology assumes that it requires a deeper epistemic investigation to (literally) ground that challenge. The techno*lógos* approach rigorously traces the invasive - and revealing (Heidegger) relation of culture to nature back to its fundamental scene: the confrontation of *lógos* with matter as the essential techno-logical scene.

[From (agri-)cultural engineering to advanced technology, there is nothing counter-natural in technological culture: Every device consists of 100 % hardware. Still the in/formation of matter and energy makes a difference: nature reacting upon itself, but not chemically, rather reasonably. *Lógos* itself, though, is conceived neuro-biologically.]

Cultural knowledge has resulted in technologies which develop into autonomous systems. Marshall McLuhan has anticipated the current issues of "media ecology" not in terms of environmental damage, but in its cybernetic sense, with his diagnosis of the electric sphere becoming a second nature, a "noosphere" (a neologism adopted from Teilhard de Chardin which links to the current discourse on the "anthropocene" in the epistemological sense). In McLuhan's media ecology, "the medium is the message" as well: "Any understanding of social and cultural change is impossible without the knowledge of the way media work as

environments".[2] McLuhan's focus, though, is on "the phenomenology of media broadly defined through perception"[3], while the approach by radical media archaeology is distinct from such anthropocentrism. Its focus is rather on the inverse ecology of technical media, its micro-*invironment*. Media archaeology (in its "Berlin school" version) carries McLuhan beyond McLuhan who once demanded that "[t]he hidden aspects of the media are the things which should be taught" indeed, since "they have an irresistible force when invisible."[4]

But while being brilliant in the diagnosis of macro media infrastructures, McLuhan failed in investigating its micro-infrastructure ranging from the electronic circuitry and its symbolic coding to the seven layers of signal traffic *as* and *in* the Internet today. "When Sputnik went around the planet, nature disappeared [...] enclosed in a man-made environment."[5] So far McLuhan's diagnosis. The Sputnik chock in fact triggered the US-American counter-strategy of de-centralized communication structure resulting in the ARPA net indeed, prefiguring the Internet of today.

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

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

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2 Marshall McLuhan, the Medium is the Massage, New York / London (Penguin Books) 1967, 26
3 Michael Durroch / Janine Marchessault, Media as Extension and Environment, publication on occasion of the project *Feedback #1: Marshall McLuhan and the Arts*, Den Haag (West) 2017
4 Marshall McLuhan in a post-lecture Q & A session recorded by ABC Radio National Network on 27 June 1979 in Australia, from: youtu.be/a11DEFmoWCw?t=4m30s (as quoted in Gottlieb 2017)
5 Marshall McLuhan, The Planet as Art Form. Interview with David Frost, The American Broadcasting Corportation, 1972; marshallmcluhanspeaks.com/interview/1972-the-planet-as-art-form

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

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

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

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

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

Mis-Understanding Media: McLuhan's critique of Shannon

McLuhan's insistence on the ground / figure difference can be interpreted as the difference between the media-archaeological layering of media against their phenomenological (mass) media appearance on the level of interfaces and other surfaces.[7] This can be extended into the temporal domain, where frequency is the mathematical reversal of physical oscillations. High frequency carriers channels in tele-communication are being modulated by the varying low frequency articulations known to human perception as sound, music or speech, figuring or in-forming the basically *temporal* ground of transmission. Media archaeology is not only about spatial and topological grounds, but as well about the floating groundings: "Ground cannot be dealt with conceptually or abstractly: it is ceaselessly changing, dynamic, discontinous and heterogeneous, a mosaic of intervals and contours."[8]

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

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

McLuhans critical comment on Shannon's communication diagram is a desastrous simplification of its mathematical understanding. In his 1978 essay "The Brain and the Media. The 'Western' Hemisphere", McLuhan attributes the Shannon-Weaver model of communication to the

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7   Interfaces, though, may be treated different from traditional surfaces, since they represent a technical coupling.
8 Marshall McLuhan / Eric McLuhan, Laws of media. The new science, Toronto (University of Toronto Press) 1988, 63

predominantly left-hemispheric Gutenberg galaxy.[9] "The Shannon-Weaver model of communication [...] typifies left-brain lineal bias. It is a kind of pipeline model of a hardware container for software content. It [...] assumes that communication is a kind of literal *matching* rather than resonant *making*"[10] - which reveals McLuhan's kind of "analogue thinking" from the electronic media age (thus being closer to the analogue computer indeed). As has been expressed by a follower of McLuhan, the radio scholar Tony Schwartz: "Electronic media have been viewed merely as extensions of print, and therefore subject to the same grammar [...]. The patterned auditory and visual information on television or radio is not 'content'. Content is a print term [...] As stimuli, electronically mediated communication cannot be analyzed in the same way as print 'content'."[11]

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

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

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9 As quoted in: Peter Bexte, Cadillac und Gebetmatte. McLuhans TV-Gemälde, in: Derrick de Kerckhove / Martina Leeker / Kerstin Schmidt (eds), McLuhan neu lesen. Kritische Analysen zu Medien und Kultur im 21. Jahrhundert, Bielefeld (transcript) 2008, 323-337 (335)
10 Marshall McLuhan / Eric McLuhan 1988: 86
11 Tony Schwartz, The responsive chord, Garden City, New York (Anchor books) 1974, 19
12 Schwartz 1974: 24
13 See Stefan Heidenreich, FlipFlop. Digitale Datenströme und die Kultur des 21. Jahrhunderts, Munich / Vienna (Hanser) 2004

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

McLuhan's unease with media arts

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

Marshall McLuhan has not only been highly influential on New Media Art, but once declared artists being the radar antennas to the changes induced by new technologies himself.[15] Early 20th century artistic avant-gardes, like cubism, have been triggered by media technologies such as chronophotography indeed. But McLuhan's own experience in the recording studio for producing the experimental record *The Medium is the Massage* apparently left him intellectually untouched.[16] The philosopher of "acoustic space" as electrotechnical condition of media culture himself did not feel at home in the media arts. Even with Cera's triptych painting of a psychedelic TV at the front wall, art and science did not meet in the coach house of the Toronto University campus. McLuhan performed not as an artist, but as a true academic, with its predominant code of verbal and literary expression.

MEDIA STUDIES. Communication and Beyond

Medium end(s)

Media theoretical analysis starts with the very term *medium* itself. By definition, Greek *metaxy* (as defined by Aritotle in his *Physics*, book IV) and its Latin translation *medium* is the material channel of transmission, and technically located inbetween sender and receiver, data input and output. The act of analog signal transmission is temporally ephemeral,

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

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

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

almost "memoryless", while the data processing unit in computing already anticipates the output. In syllogistic reasoning, it is the "medium" term itself which has a functional existence, to vanish after the logical operation.

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

German "media theory" *avant la lettre*

In his *Grundlagen einer Philosophie der Technik* (1877), Ernst Kapp introduced the term "Organprojection"[18] - a remarkable anticipation of McLuhan's prosthesis-theory of media when finally comparing telegraphy networks to the human nervous system itself. Sigmund Freud's notion of the Unconscious (the "psychischer Apparat") somewhat anticipates the French Apparatus approach (Baudry on the cinematic *dispositif*). Furthermore, Walter Benjamin sees human perception shaped by the variant historic media conditions. Close to what Marshall McLuhan later termed "the medium is the message" he interprets film not in its content but rather as a setting like a physiological experimental laboratory: "Das Publikum fühlt sich in den Darsteller nur ein, indem es sich in den Apparat einfühlt. Es übernimmt also dessen Haltung: es testet." The dramaturgy of "choque" accommodates the audience on the perceptual level to the speed of modernity and time-critical moments. This phenomenon has been investigated further by Paul Virilio's "dromology" which (like Heinrich Heine in his famous thesis of the annihilation of time by the new transport vehicle railway around 1840) swallows spatial distance in favour of the temporal trajectory (tele-presence).

This diagnosis has been shared by Martin Heidegger's notion of annihilation of distance ("Ent/fernung") by radio and television. Heidegger's philosophy of technology is an epistemolgical rather than engineering view ("Das Wesen des Technischen ist nichts Technisches"). Heidegger, after his post-war prohibition of teaching at university, still

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

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

lingered as a ghost in the gang-ways of Freiburg university, inspiring a young generation of Friedrich Kittler, Norbert Bolz et al., while they were, at the same time, inspired by the neighbouring French (post--structuralists (Lacan, Foucault, Derrida).

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

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

Among the protagonists of "Kulturwissenschaft", Hartmut Böhme once defined the disciplinary matrix of "Kulturwissenschaft" in a way which claims to include (or absorbe) "Medienwissenschaft", arguing for a "interdisziplinäre Kulturwissenschaft mit offenen Augen für die Geschichte der technischen Welt"[19]. Wolfgang Frühwald rephrased this with a significant shift of emphasis (which has become the *credo* of the GfM in the meantime): a "*kulturwissenschaftlich orientierte Medienwissenschaft*"[20]. This perspective is critical. While cultural studies (including research on the technological impact) tend to reduce media to its discoursive effects rather than knowing media as technologies themselves (except a few scholars like Christian Kassung and others), media studies proper require a sound techno-mathematical and media-archaeological (-historical and -theoretical) knowledge and exercises how to develop epistemological questions out of that close knowledge.

The Different Meaning of "Communication" in Media Theory

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

For conventional print and broadcast "mass" media studies, communication logocentrically referred to the distribution of the spoken word. In terms of what appears on interfaces, communication media,

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19 Böhme 1989: 30
20 Wolfgang Frühwald, Geisteswissenschaften heute. Eine Denkschrift, Frankfurt/M. (Suhrkamp) 1991, 156

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

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

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

Shannon's *Mathematical Theory of Communication* (1948), as well as McLuhan's *Understanding Media* (1964), turned conventional communication studies upside down into emerging media studies proper by shifting attention from verbal, auditive or visual content to the techno-aesthetical message of media. The take-off of new German media theory,

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21 Norbert Wiener, 1942, The Extrapolation, Interpolation und Smoothing of Stationary Time Series with Engineering Application, typeskript dated February 1st, 1942, 3, in: National Archives and Records Administration, Record Group 227 (Office of Scientific Research and Development), College Park, Maryland (USA), MFR, DIV.7-313.1-M2 (Division 7 Report to the Services No. 19. MIT Research Project No. DIC-6037; OSRD No. 370, Massachusetts Institute of Technology); print version 1949 (M.I.T. Press); 3rd ed. 1964

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

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

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

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

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22 Kittler 1999: 5
23 Friedrich Kittler, Observations on Public Reception, in: Radio Rethink. Art, Sound and Transmission, ed. by Daine Augaitis / Dan Lander, Banff (Walter Phillips Gallery) 1994, 75-85 (75 f.)

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

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

TRANS- AND POST-URBAN COMMUNICATION

Telematic and / or urban space

Telephony from within buildings has long ago transcended the limits of intra-architectural communication, while not changing the architectural matter itself. Just ornamentally, a telephone may have been carved into the facade like in the Cincinnati and Suburban Telephone Company Building (Harry Hake, 1931).[26]

In both cases, in urban spaces and other territories, as well as in universal computing, architectures have sometimes been "rerouted" according to signal flows - even if what has affected theory and design, rarely evolved in practically new architectural territories. Architecture has been been relocated by media technologies more conceptually than factually. "The representation of the contemporary city is [...] no longer determined by a ceremonial opening of gates, by a ritual of processions and parades, nor by a succession of streets and avenues. From now on, urban architecture must deal with the advent of a 'technological space-time'. The access protocol of telematics replaces that of the doorway. The revolving door is succeeded by 'data banks', by new rites of passage of a technical culture masked by the immateriality of its components: its networks, highway systems and diverse reticulations whose threads are

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24   Subtitle of Bogost 2012

25   Weaver 1949 / 1963: 9

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

no longer woven into the space of a constructed fabric but into the sequences of an imperceptible planning of time in which the interface man / machine replaces the façades of buildings and the surfaces of ground on which they stand."[27] But doors and gates return from within such technologies itself, as media infrastructures.

Not to be confused: Material transport and signal transmission

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

While in urban and social politics, migration remains a matter of moving real people, data migration is of a different kind - unless both actions are short circuited and the gap between bodily and data migration closes, with forensic voice recognition algorithms applied to localize and identify refugees at another country's border - from location to addressability.[28] Such automated production of evidence is based on the spectrographic hard- and software tools which have previously been developed for scientific linguistic, phono-archival or ethno-musicological research.

To what degree do transport and passages of matter or bodies in urban space differ from coded or uncoded energy transmission? There is traffic passing through urban gates: moving bodies, bikes, automobiles. But there is a fundamental difference between physical transportation and the logistics of thermodynamic vehicles and material infrastructures such as streets, railway roads, architectural and urban gates, on the one hand, and transmission of signals according to the logics and protocols of data processing. Urban infrastructures might not be confused with the integrated circuitry of electronics (microchips) itself. Data compression by coding is even undoing delay of transfer with mathematical intelligence[29]; here it is rather information which is passing through gates, while the mobile device travel with their users. "Protocols", rather

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

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

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

than material hindrance, "are the immaterial groundwork of material infrastructures"[30].

"Locative media" vs. "urban space"

The modern metropolis has become adapted and wholly absorbed into global mobile communication standards, losing its specifiCITY; geophysical location (grounding) has been overshadowed (if not replaced, since real user bodies are still subject to physical being-there) by "locative media", which is: an address structure of global telecommunication sytems like UMTS. Urban space has become a momentary point of receiving and sending data from myriads of individual mobile devices, be it tourists or native citizens. Location is not fixed to a unique place any more, but becomes mobile itself. "[A]dresses guarantee the correlation of devices and positions, while at the same time assuring that devices can move from one place to the other without losing connectivity."[31] "The traditional division between the social and the techical becomes obsolete"[32]; "social media" converge with the media-archaeological *a priori* which is the technology of triangulation, developed for this purpose since the 1950s at Bell Labs and Motorola. Movement of the device through the space of the network assures its localization. Always already being part of a communication network, the devices can be monitored. "The distance of a device is constantly measured in relation to at least three radio towers"[33] - which means, beyond the imminent death of traditional analog radio, there is more "radio" than ever in communication media. Location-based services are offered by Google's Android and Apple's iOS, based upon the datasets of woldwide wifi networks. Thereby, the notion of "citizenship" is de-located.

On transmission as "bridging"

The conceptual difference, in media theory, between cultural techniques and technologies corresponds with the difference between material bridge constructions on the one hand, and transmission by electro-magnetic waves on the other. In Bertolt Brecht's *Lindberghflug*, as true media theatre in 1929, the airplane is an instanciation of material transportation, whereas radio wave transmission (the subject of Brecht's "Radio theory"[34]) has been "bridging" the distance between Europe and North America at the speed of light. While the material bridge is stable,

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

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

32   Sprenger 2018: 158

33   Sprenger 2018: 159

electro-magnetic bridging is vibrating itself in terms of high frequency resonance circuits, a repetitive temporal process. Material transportation implies delay in transmission (the actual transportation time), while immaterial radio transmission allows for "live" presence or the "mediated present" indeed.

Opening / Closing "Gates": Case Berlin

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

In the present media-cultural condition, a decisive difference endures between performative cultural techniques such as passages of bodies and vehicles through gates, and operative technologies such as signal flow between machines. "Code that runs on a machine is performative in a much stronger sense than that attributed to language. When language is said to be performative, the kinds of actions it 'performs' happen in the minds of humans, as when someone says 'I declare this legislative session open'" - or "open that wall", like US president Reagan during his Berlin visit in an address to Soviet Union president Gorbatchov. Even if such changes in minds might reach in behavioral effects, "the performative force of language is nonetheless tied to the external changes through complex chains of mediation. By contrast, code running in a digital computer causes changes in machine behaviour and, through networked ports and other interfaces, may initiate other changes, all implemented through transmission and execution of code."[35] Only as a superficial phenomenon, the urban "Berlin experience" still escapes such codings.

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

In 1948, at the outbreak of the "cold war" between East and West - a period which ended with the opening of the Berlin wall in 1989 indeed[36] -, Norbert Wiener defined a transsubstantiation in communication

34 See Bertolt Brecht, Der Rundfunk als Kommunikationsapparat, in: idem, Gesammelte Schriften, vol. 18, Frankfurt / M. (Suhrkamp) 1967, 127-134
35 N. Katherine Hayles, in: My Mother Was a Computer: Digital Subjects and Literary Texts, Chicago (University of Chicago Press) 2005, 50
36 For a transgressive reading of Berlin terrains and borders during Cold War in terms of electromagnetic radio spheres, see Alfredo Thiermann, Radio as Architecture: Notes toward the Redefintion of the Berlin Walls, in: gta papers 2 (2019) [ETH Zurich], 69-83

engineering: "Information is information, not matter or energy. No materialism which does not admit this can survive at the present day."[37] Socialist countries collapsed since their economy, for ideological reasons, anachronistically insisted on the priority of matter and energy.[38]

The technological infrastructure had already transcended or rather undermined the political or ideological divide of the cold war military "blocks": The Soviet empire implicitly collapsed with its economic decision for computing hardware to become compatible to IBM software standards in early 1970s.[39]

The Berlin wall has become a seductive but misleading metaphor for interrupted passage from the pre-information age. The new wall is the "firewall" for streaming data. The transition has not been that smooth as suggested in the notion of *Transubstantiating Transmission: Walls become Ports become Channels*[40], but rather a disruption, an originary bifurcation of two different regimes: the urban one and the micro-technological. Walls do not "become" ports but have been a precondition of binary computing (switching "gates") already.

Urban space is no "channel" of communication ("medium", in Shannon's terms), rather a sphere where channels in the more precise sense are being logically embedded and physically implemented. Sociological terminology might not be confused with the analysis of communication media condition; the "wall" metaphor might rather be addressed in cybernetic terms like "hindrance" (Shannon), logical "gates", and the binary "door" which allows for electric communication to flow exactly when it is closed (Lacan's definition of the "cybernetic door"[41]), contrary to the intuition of opening or closing the passage by check points at the Berlin wall.

"EARTHING" MEDIA. On the Material Modes of (Trans-)Global Technological Existence

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

The theme of the 6th Media Materialities Forum deals with "global" and "cosmic" issues: the earth, the world and the universe in a technological perspective. Different from so-called environmental humanities, this talk will focus on concretely "earthing" such global dimensions in a multiple media-technical sense. First of all, in electric engineering, electronic media require "earthing" like in early radio the apparatus has been "grounded" between heaven (antenna) and earth for the flow of electric current. Second, in terms of media science, there is the materialist imperative to "earth" the discourse about apparently virtual media cultures, down to AI, by reminding of its irreducible material grounds that reach from concrete microchip hardware over infrastructures of energy supply up to the mineral *rare-earth* elements. Finally, in a more cosmic perspective, it has been first optical, then computational media that generated trans-terrestrial "world pictures" (Heidegger), ranging from Galilei' telescope to contemporary "black hole" photography and "cosmic clocks".

a) (Trans-)Global Media Materialities:

Earthing Media

The media-archaeological approach in Media Science takes the "Material Media" forum title literally: It *understands media* (with McLuhan) not only as its variable textual or audiovisual content, but on a more fundamental, elementary and principal (*en arché*) level in its medium materiality as techno-logical *condition of possibility* (the Kantean, Foucauldean and Kittlerean *a priori*) for communication at all.

More materially, technological "earthing" as well concerns specific minerals that are required to produce high-electrical and electronic components at all.[42] This raises environmental challenges of electronic waste and recycling.[43]

x *demonstration object:* Silicon "Wafer" (MAF)

More technically, any power outlet and its related electric device is "earthed" or "grounded" for security.

Different from the general object-orientation at the "earth" as such in the current Anthropocene discourse, there is a more precise "earthing" or processual "grounding" (German "erden") in its double technical and philosophical sense. "Grounding" in engineering, simply put, "is a method

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42 https://en.wikipedia.org/wiki/Rare-earth_element, accessed 16 January 2025
43 See Jussi Parikka, A Geology of Media, Minneapolis / London (University of Minnesota Press) 2015

of providing a low-resistance path for electrical current to flow to the earth" to prevent unexpected voltage peaks or short circuits in electric devices.[44] On the other hand, there is "grounding" as a reminder, against speculative media philosophy, of its technical materiality.

[In an "elementary media" sense, earthing, in medicine, means a direct body contact with the earth to make possible a natural exchange with the dynamic electric charges and frequencies on the surface of the earth (like the so-called Schumann-resonances).[45]]

The earth itself is communicating as medium. Lightning and other events in the atmosphere and ionosphere generate a broad spectrum of electromagnetic waves (so-called Sferics) that become even audible as *ear-thing* to humans by short wave radio reception:

x MAF: *demonstration* ("Sokol" SW radio)

down to the Very Low Frequencies. Even the European and American power grid with 50 resp. 60 Hz have an impact, or the American and Russian submarine communications system (76 resp. 82 Hz).[46] This electromagnetism turns the globe into "acoustic space" in McLuhan's sense, literally extending into outer space as cosmic "radio" astronomy.

From Global Cultural Techniques to Cosmic Technologies

But let us differentiate between such "natural" media and media that have been appropriated (if not domesticated or tamed) by advanced cultural knowledge. What we call "technology" is a compound of material engineering and logical thought. The relationship between the earth and humanity has become "post-human" from the moment when cultural *techniques* have advanced into more autonomous *technologies*.

Diverse cultural techniques around global history differ from technologies *strictu sensu* that - until recently - have been a unique escalation of Western experimental thought and epistemology. This leaves us with the apparent oxymoron that technology is "local" (occidental) in terms of its genealogical context while at the same time claiming (and propagating) universal physical and logical laws. While Cultural Studies compare different cultures of technics, it is technology itself that makes the world "global".

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44 Web site AC-DC Electric, https://www.acdc-electric.com/what-is-electrical-grounding-why-its-important, accessed 20 January 2025
45 Web site https://sportaerztezeitung.com/rubriken/training/14510/grounding
46 https://de.wikipedia.org/wiki/Schumann-Resonanz, accessed 16 January 2025

Differentiating between "Earth" and "World" with Heidegger

Let us differentiates between the technical "world" and the material "earth". Agriculture is a transitive engineering of the earth, while technology extends to a more fundamental enframing of the earth as resource (the *Ge-stell*). For example, Heidegger criticizes the transformation of a river, by hydroelectric power stations, into a source of electric energy. This does not simply transform but transsubstantiates the earth into a technical circuit component. Different from more transient sailing on the sea, nowadays electric wind mills turn the wind into a sheer resource. Physical matter is considered as a passive medium that can be functionally transformed into an instrumental tool, such as the in/formation of silicon for the sake of computational microchips - whereas the "active matter" approach grants knowledge to the material agency itself.[47]

Heidegger differentiates between "world" as cultural environment, and "earth" in its material ontology. *Physis,* translated in Latin by *natura*, differs from *techné* in the Aristotelean sense.[48] *Physis* and *techné* are two ways of generation, such as self-growing plants vs. *human*-made artefacts like a vehicle. *Techné* though, in Heidegger's post-antique diagnosis, shall not be confused with the scientific and industrial *technologies* of mechanistic fabrication such as algorithmic procedures.

[*Techné* is a mode by which the *arché* of fabricated "Zeug" e. g., a wooden bed as carpentry, emanates from latency into *aletheia* . While such a fabrication occurs not by itself but still from within its material qualities, technology is rather external knowledge imposed upon matter. *Techné* depends on human agency that gouverns *arché* as "architecture"[49].]

The man-made artefact has its coming-into-being not in itself by nature, but is imposed by cultural knowledge that is negentropic in a counter-natural sense, even if embodied in 100 % natural substance. Is material and energetic nature transcending itself here as technology?

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47 See the Cluster of Excellence *Matters of Activity: Image Space Material* at Humboldt University of Berlin, https://www.matters-of-activity.de/en [accessed 24 November 2024].
48 Martin Heidegger, *Vom Wesen und Begriff der Physis. Aristoteles, Physik B, 1*, (1939, published originally in: Il Pensiero 3, 1958, 131-156 and 265-289, then in: GA 9, Wegmarken, FFM 1976
49 Stephan Zimmermann, "Heidegger über den Streit von Welt und Erde in der *Kunstwerk*-Abhandlung", in: Heidegger Studies, vol. 33 (2017), 199-230 (213), referring to Heidegger 1958 / 1976 (GA 9, 252)

Media Technologies and the "Anthropocene"

Humans are are not exclusively accountable for their actions in the Anthropocene any more. The techno*lógos* hypothesis rather grants agency to technology becoming autonomous.[50] While the debate about planetary cosmotechnics is mostly considered in terms of political *ethics*, a more post-humanist epistemology of cosmo*technologics* is rather about the understanding and unfolding of tec-knowledge as such.

[Is "AIsthetics" as radical unfolding of inner-technological knowledge impeded by ethical concerns - such as political philosophy since the Western age of Enlightenment, or cosmic harmony in the Asian tradition?]

With the current shift from software-based "virtuality" to environmental concerns, a more materialist research on media "grounds" this discourse. It insists that the relationship between humans and technical objects is not just instrumental, political, logical and moral, but material as well. That links environmental perspectives on global technology to eco-systems while at the same time not reducing this perspective to "nature" as such.

Materialist media theory deciphers the environ*mental* in de Chardin's and McLuhan's media-ecological sense. The environment becomes an *epistemic* issue of the entanglements of *lógos* with matter. Such a rethinking *of* and *by* media materialities is undermining the software / hardware, technology / matter dichotomy that has been dominant in occidental thought so far.

b) "Cosmopolitics" and the Planetarization of Technology:

The Cosmopolitics of Technical Reason: A Western Epistemic Imperialism, or a Self-Fulfilling Techno*lógos*?

Philosophers of technology since Ernst Kapp, Marshall McLuhan up to Bernard Stiegler have considered "cultural techniques" as an anthropological universal, understood as an exteriorization and liberation of organs and the neural mind itself. But technology is more than cultural engineering. It is even universal beyond the human. Here come Yuk Hui's antithesis: "[...] there is no one single technology, but rather multiple cosmotechnics."[51]

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50 See W. E., Techno*lógos* in Being. Radical Media Archaeology, and the Computational Machine (New York / London) 2021
51 Yuk Hui, Cosmotechnics as Cosmopolitics, in: e-flux journal # 86 (November 2018),

Hui conceives the word "cosmopolitics" in two different senses: as unilateral globalization and "ideological regime" on the one hand, and as a "politics of nature" in the increasing Anthropocene on the other hand. "Until now, so-called globalization has been [...] the universalization of particular epistemologies and the elevation, through techno-economic means, of a regional worldview to a putatively global metaphysics."[52] But technologies are no simple means for an imperialist Western ideology. It is rather the empire of tec-knowledge (QRT) itself that absorbs cultural differences epistemically from within, in the sense of a pure global technological reason.

In analogy to Kant's pursuit of a universal history as the "completion of a hidden plan of nature" (*Vollziehung eines verborgenen Plans der Natur*)[53], is there something like a scientific and technological aim to become global? It requires a media-"historical", that is: narrative teleology, though, to construct such a final state for technological reason to become self-conscious in the Hegelean sense.

[It does not evolve so by itself. Kant has been conscious of the necessity of such a narrative construct as a tool to achieve the reasonable imperative (while Hegel, one generation later, already presupposed a self-fulfilling reason: *Weltgeist*). Instead, now it is a technological reason: planetary computation that eliminates all regional techno-cultural differences. "The arrival of modern technology in non-European countries in recent centuries has created a transformation unthinkable to European observers." (Hui 2018)]

Hui instead suggests "a certain relativism as the condition of possibility for coexistence" (2018). But the *postmodern condition*, in Lyotard's sense, is not simply the global acknowledgment of different technical cultures. It is rather guessing incompatible alternatives to technology as such.

[Such alternatives are a dispute in sense of Heraklit's "contrarian harmony" (*palíntropos harmonía*, DK 22 B 51) / German "gegenstrebige

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https://www.e-flux.com/journal/86/161887/cosmotechnics-as-cosmopolitics, accessed 11 January 2025
52 Yuk Hui, Cosmotechnics as Cosmopolitics, in: e-flux journal # 86 (November 2018), https://www.e-flux.com/journal/86/161887/cosmotechnics-as-cosmopolitics, accessed 11 January 2025
53 Immanuel Kant, Idea for a Universal History with a Cosmopolitan Aim, in *Kant's Idea for a Universal History with a Cosmopolitan Aim: A Critical Guide*, eds. Amélie Oksenberg Rorty and James Schmidt (Cambridge: Cambridge University Press, 2009), as quoted in Hui 2018

Fügung"[54] and Lyotard's *The Differend* (in extension of Kant's *Streit der Fakultäten*).]

[In §3 "Cosmotechnics as Cosmopolitics", Hui replaces the logocentric metaphysics of "cosmology" by addressing this sphere more concretely by what he calls *cosmotechnics*, in tune with so-called Environmental humanities that "[...] employs humanistic questions about meaning, culture, values, ethics, and responsibilities" to address pressing ecological problems. They "aim to help bridge traditional divides between the sciences and the humanities, as well as between Western, Eastern, and Indigenous ways of relating to the natural world and the place of humans within it. The field also resists the traditional divide between "nature" and "culture [...]."[55]]

Hui continues the ethic bias from ancient Chinese philosophy: "the unification of the cosmos and the moral through technical activities, whether craft-making or art-making" (Hui 2018). But this rather refers to cultural engineering (German *Kulturtechnik*) than to advanced cosmotechnologies.

[Cosmotechnologics is of a different kind. Media ecology (in McLuhan's sense) is set apart from environmental concerns with the human as embedded in ecological systems.]

["[I]t is necessary to reopen the question of technology" indeed (Hui 2018). With his book *The Question Concerning Technology in China: An Essay in Cosmotechnics*, Hui responded to Heidegger's 1949 lecture "The Question Concerning Technology". But a close reading reveals that Heidegger was concerned with technics (German "Technik") rather than technology in its escalating sense.]

["[W]e must undo and redo the translations of *technē*, *physis*, and *metaphysika*." (Hui 2018). The techno*lógos* hypothesis, on the contrary, is rather endo- than metaphysical: the concrete union of *lógos* and matter as in/formation. Matter, though, is not "active" by itself. It requires cultural intelligence to become so.]

[Heidegger distinguishes between the ancient Greek notion of *technē*, as defined by the Pre-Socratics, notably the three "inceptual" (*anfängliche*) thinkers Parmenides, Heraclitus, and Anaximander, and modern technology (*moderne Technik*). "If the essence of *technē* is *poiesis*, or bringing forth (*Hervorbringen*), then modern technology, a product of

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54 See Jacob Taubes, Ad Carl Schmitt: Gegenstrebige Fügung, Berlin (Merve) 2011 (Internationaler Merve Diskurs: Perspektiven der Technokultur)
55 https://en.wikipedia.org/wiki/Environmental_humanities, accessed 23 January 2025

European modernity, no longer possesses the same essence as *technē* but is rather an "enframing" (*Gestell*) apparatus, in the sense that all beings become standing reserves (*Bestand*) for it." (Hui 2018) Neglecting techno-ethical concerns, Heidegger's diagnosis of the modernist "world-picture" ("Die Zeit des Weltbilds") reduces this transformation to the epistemic opposition between the Greek *technē* as poietic *Machenschaft* vs. a Cartesean notion of technics that is mathematically calculable.]

Has the communist revolution been China's ultimate path of joining with the techno-logical episteme beyond its traditional "cosmic" aesthetics of cultural techniques?[56] An answer to this process (*Vorgang*) is the techno*lógos* hypothesis: technological autoprogression. Is there a techno-logics that is inevitable even for China? Hui proposes the pre-modernist ethical and aesthetic Chinese unification of Qi and Dao as a third option: "the unification of the moral and the cosmic, since Chinese metaphysics is fundamentally a moral cosmology or a moral metaphysics" (Hui 2018). How does this relate to Dao as the "above forms," while Qi is what is "below forms" (Hui 2018)? Significantly, Hui in his the search for unity between technical instrumentality (Qi) and cosmic harmony (Dao) refers to examples from cultural technique rather than autonomous technology.

["[H]aving a good knife is not necessarily enough; it is more important to understand the Dao in the cow, so that one does not use the blade to cut through the bones and tendons, but rather to pass alongside them in order to enter into the gaps between them. Here, the literal meaning of "Dao"—"way" or "path"—meshes with its metaphysical sense." (Hui 2018)]

Against this background, Hui reads the tradition of technological thought in China "through the lens of the Qi-Dao episteme" (Hui 2018) with its respect for artisanship (*techné*) but mistrust of explicit technological inventions.[57] Is this wisdom still at work in China today, after its communist modernization? Different from the Taoist scepticism against reason and logic (Needham 1956: 580) and conviction that Tao is *in* natural things already[58], the technological approach is logocentric: an imposition of other-wordly form to actual matter. Contemporary China successfully is becoming more and more autonomous from Western

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56 "Wenn der Kommunismus in china an die Herrschaft kommen sollte, steht zu vermuten, daß erst auf diesem Wege china für die Technik »frei« wird. Was liegt in diesem Vorgang?" Martin Heidegger, *Anmerkungen I-V* (*Schwarze Hefte* 1942–48), ed. Peter Trawny (Frankfurt am Main: Klostermann, 2015), 441
57 See Joseph Needham, Science and Civilisation in China, Bd. 2: History of Scientific Thought, London / New York (Cambridge UP) 1956 [Reprint 1962], 124
58 Needham 1956: 123

technical supply by producing its own technological tools, ranging from electro-mobility with its batteries to powerful AI applications. But even the Chinese emancipation from dominant Western technological supply chains still continues the modernist language of engineering in terms of hard- and software, microchips and algorithms. The recent success of the Chinese AI model DeepSeek is no Taoist technique. A real emancipation would be the development of an alternative against the notion of technology itself, a kind of leap forward against the background of pre-communist Chinese "cosmotechnics".

[There is the "apparatus of biopolitics" (cfp) in Foucault's discourse analysis and Guattari's machine sense), and there are "existential media" (ranging among the proposed topics for this year's Media Materialities Forum) in the sense of John Durham Peters' "elementary media" and Siegert's *media archaeology* of the sea. But this remarkable term of "existential media" can - different from ecological humanities - as well be understood it in the radical techno-epistemic sense. Media are existentially techno-logical, that is: matter filtered through cultural knowledge.]

[It has been the liberation of scientific curiosity from the primacy of ethics, aesthetic intuition (Needham 1956: 579) and religious or power-political boundaries (German *Freiheit der Wissenschaft*) that academically (with the university as tentatively independent institution of knowledge and research) and in practical engineering enabled the emergence of what is modern technology in the artefactual and epistemic sense.]

Western Technology and / or Eastern thought?

In scientific cosmologies "human beings are constantly exploring beyond themselves" (cfp). In this era the organizers of this conference "see the potential of Eastern thought" (cfp), Is this an alternative to the Western technological approach where the human needs technical sensing and processing devices to be "liberated" from its anthropocentric modes of world perception? Are technological devices to explore the universe "phenomenotechnical" (Bachelard) tools in the Western tradition of science, vs. the more cosmo-aest(h)et(h)ic Asian approach? Will future media science become even more epistemically self-conscious "[i]n light of *these* [59]*philosophical inquiries*" (cfp)?

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59 6th *Media Materiality Forum* on "Digital Intelligence, Cosmotechnics, and Planetary Future", Tsinghua University (Future Media Lab, School of Journalism and Communication, Tsinghua University and Tsinghua University Science Museum), Beijing, March 29-30, 2025

The formulation in the "Call for Papers" of this 6th Media Materialities Forum, concerning the earth's inhabitants in a cosmic perspective, recalls Needham's plea (regarding not only ancient atomist and Newtonean science but more "organicist" quantum physics as well) for a complementary vision of Western mechanistic science and Asian philosophical wisdom with its spirit of associatedness[60] and "dynamic pattern" that can be culturally recognized since it is non-anthropocentrical indeed.[61] "How are the relationships between human beings, non-human organisms, technologies, inorganic matter and other actors woven and entwined?" (cfp) Needham himself, though, remains somewhat undecided in his use of the terms "technics" (such as cultural engineering) and "technology". Future media studies that are structured around these questions have to position themselves between two options: alternative technologies or alternatives to technology as such.

c) Cosmic Timing and Imaging:

The Cosmic Clock

With media-archaeological rigor, Yuk Hui's "cosmotechnical" philosophical approach may be *grounded* (or "earthed") in direct (transitive) consideration of its concrete mechanisms. Even if his 2018 essay includes, among other figures, a diagram of Su Song's (1020–1101) notorious clock tower. Its description ("The original design included an armillary sphere, a waterwheel, an escapement mechanism, and a chain drive", ibid.) does not specifically analyze the technological escalation of this clockwork: the consequences of the escapement against a different scientific epistemology in the West while Su Song's "Heavenly Clock" remained a unique marvel for the emperor's amusement[62] - just like Arthur Ganson's kinetic sculpture *Beholding the Big Bang* and Benjamin Heidergsberger's algorithmic piano composition *Pentatonic Permutations* today.

Against a cosmo-aesthetical harmony that is claimed for humanly fabricated timing mechanisms, the cosmos itself has become an active chronotechnology in the scientific sense of natural clocks:

Cosmo-technologically, the extremely stable rotation of so-called "pulsars" (spinning collapsed stars can become instrumentalized as most

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60 Needham 1956: 338 and 340
61 See Needham 1956: 374, on the natural philosophy of Wang Chhung) "incarnate in Man"
62 See W. E., "Is there a specific Chinese path of technology?", publication in Chinese translation, in: Global Journal of Media Studies [Tsinghua University, School of Journalism and Communication], vol. 10, no. 2 (April 2023), 196-210

accurate time-keepers, tracking their radio signals by observatories on earth. The exactitude of such cosmic fly-wheels are not ideal, though, since gravitational waves "pass over cosmic clocks and cause them to change"[63]. Such "slight irregularities in their spin have significantly reduced their usefulness as precision tools" (ibid).

In reverse, the Event Horizon Telescope (EHT) achieved the first direct image of the supermassive black hole M87 (the Messier black hole , published in April 2019). Instead of one super-large telescope it consists of an array distributed over six geographic sites, with the virtual telescope becoming as big as the earth. The "earth" itself becomes the hardware medium condition (and *Ge-stell* in Heidegger's critical sense) for the signal analysis of the cosmos. But even this will be transcended once such telescopes are relocated into "deep" space itself, by satellites.

The M87 "photograph" has been actually calculated as a function of time-critical data triangulated from different radio telescopes which were synchronized *via* their time-stamps. It required time-critical computation to smooth the delay of radio signals by clocking. Cosmology has become chronotechnical.

Global Perspectives Beyond the Telescope

Cosmogenic media as material bodies are not simply retroactive to those cosmological thoughts that they materialize, "just like the telescope is not retroactive to the discovery of planets - media are coextensive to the thoughts they 'allow.'"[64] Media cosmology "is an event, even a praxis - but of the media themselves" (ibid.).

"The earth and the cosmos have been transformed into a gigantic technological system", resulting in a "loss" (rather: liberation) of any metaphysical concept of the cosmos as "in the sense that we no longer perceive anything behind or beyond the perfection of science and technology." (Hui 2018) What is a vague general statement here needs to checked against its concrete technical objectifications: the telescope. Once "worlds beyond worlds" are "revealed by technology, nature ceases to be anthropomorphic" (ibid.).

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63 Entry "Cosmic clocks hold the key to the secrets of the Universe", web site of the University of Manchester *Manchester 1824*, https://www.manchester.ac.uk/about/news/cosmic-clocks-hold-the-key-to-the-secrets-of-the-universe/, accessed 24 January 2025
64 Bernd Herzogenrath "towards a practical aesthetics: thinking WITH" the matter, or even "medium", of aesthetics, in: Bernd Herzogenrath (ed.), Practical Aesthetics, London / New York / Oxford / New Delhi / Sydney (Bloomsbury Academic) 2021

It had been a decisive epistemic moment when Galileo Galilei directed the telescope, so far known as a military surveillance device, from earth to sky, as documented in his 1610 publication *Siedereius Nuncius*. The relation to the planets becomes *mediated*, as indicated in the title of the telescope as a communication device.[65] *Theoría* (mental contemplation) becomes interlaced with cosmical optics. In return, the telescope not only made aware of the human eye itself as a technical device, but made human perception aware of a cosmos that is generated by material techniques themselves, as media-active revelation (Heideggerean *aletheía*). Empirical "evidence" becomes literally (Latin *videre*) dependent on the reliability of the optical device. The human optical organs are not sufficient any more to investigate the universe.[66] Its intelligence becomes literally *cosmotechnical* instead.

The *Media Materiality* approach pays attention to such technical "earthing" of speculation. The philosophical "lense" on the cosmic dimension is metaphorically entangled with the lense as optical medium (and its double configuration in the telescope) itself. Any microscopic or telescopic visual perception has already been a technical "mediation" indeed; nowadays, though, *imaging* of events in the universe have become techno-logically computed such as the notorious first "photography" of a Black Hole. The telescopes in radio astronomy are not optical media any more but techno-sophisticated signal sensors. *Aisthesis*, that is: human sensual, empirical (such as optical) perception - now increasingly turns into *AIsthetics*.[67]

Global technologization is ranging from the electronic circuitry in microchips to the material and coding layers of signal traffic in the communication infrastructures today. This even extends to the cosmos. "When Sputnik went around the planet, nature disappeared [...] enclosed in a man-made environment."[68] So far McLuhan's epistemic diagnosis of the Anthropocene *avant la lettre*. In political reality, the Sputnik shock in fact triggered the US-American military counter-strategy of de-centralized communication structure resulting in the ARPA net indeed, prefiguring the Internet of today.

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65 See Joseph Vogl, Becoming-Media: Galileo's Telescope, in: Grey Room, vol. 29 (2007), 14-25
66 See Hans Blumenberg, Das Fernrohr und die Ohnmacht der Wahrheit, in: idem, Legitimität der Neuzeit, Frankfurt / M. (Suhrkamp) 1966
67 In allusion to the Glowing Globe festival conference title *AIsthEthics (artificial intelligence, aesthetics, ethics in art)*, October 17, 2024, University of Rijeka)
68 Marshall McLuhan, The Planet as Art Form. Interview with David Frost, The American Broadcasting Corporation (ABC), 1972, https//marshallmcluhanspeaks.com/interview/1972-the-planet-as-art-form, quoted after Gottlieb 2017

As it has been analyzed in Heidegger's notion of the Cartesian "world-picture", the cosmos itself has become technically mathematized. Beyond metaphysics, it is understood as a computational function (from Pythagoras to Zuse and the quantum physical theorem of the "computational universe").

The US-american science-fiction TV series *Devs* (a technothriller) features a mysterious AI-tec enterprise that is a "Laplacean demon", quantum-calculating the Universe. All of the sudden the cosmos gets inside the computational box.

Cosmos itself is increasingly cognized as "computational universe" in "deep" machine learning: dynamic "pattern" recognition in the Chinese notion of *Li* rather than a logocentric orientation at natural "laws".[69] Both comes together in neurophysiological and "artificial" signal processing, in its dialectics of binary information exchange while at the same time operating on the basis of neural weight summation.[70] At that moment, Needham envisioned a West-East synthesis of the organic and the mechanical.[71]

"New discoveries in the natural sciences thanks to the invention of the telescope and the microscope exposed human beings to magnitudes they could not previously comprehend" (Hui 2018). But astrophysical technology escalated even beyond the technical telescope, leading to a new relation with the entire spectrum and frequencies of nature that cannot be summarized by philosophical notions any more (Hegel's *Begriff*) but are delegated to the computational regime.

The traditional cosmoaesthetic human perspective is surpassed by a media "being". Such techno-mathematical processuality is "cosmic" no more (in the sense of philosophical harmony) but more "earthed" than ever, in the double material and intellectual sense of technology.

[Imaging M87: a "Black Hole" of Cosmic Imagination Indeed]

["From telescopes, rockets, and satellites to spacecraft, human beings are no longer just looking up at the 'vastness of the heaven and the infinity of the universe'[72]. Instead, we have broken through the limitations of the body and through various media and technologies have reshaped the relationship between the cosmos, the Earth, and the human. Although today the Earth remains the focus of the human condition, the

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69 See Needham 1956: 558
70 Needham 1956: 345, referencing Norbert Wiener's *Cybernetics* (1948)
71 Needham 1956: 583
72 From the preface to the *Pavilion of Prince Teng* by Wang Bo, written during the Tang dynasty, as quoted in the cfp

horizons of humankind are no longer limited by the land beneath our feet."[73]]

Comic imagination has replaced metaphysical aesthetics by computational, media-active *imaging* indeed. "By employing Very Long Baseline Interferometry (VLBI), the Event Horizon Telescope (EHT) achieved the first direct image of the supermassive black hole M87. It combined observations from multiple radio telescopes across the globe to attain exceptional angular resolution."[74] This is "globalization" in a tec-knowledge sense.

Published in April 2019, the image of the Messier black hole had been generated with data from an array of eight ground-based radio telescopes linked across six global locations through a process known as Very Long Baseline Interferometry (VLBI). The imaging process itself involved the use of advanced algorithms such as Regularized Maximum Likelihood (RML).

The image of M87*, featuring a luminous ring, "represents a paradigm shift in astrophotography, moving from the visual representation of the object to a computational simulation." (Giarrusso ibid.) The telescopic optical hardware is replaced by computational software. Media *theory* becomes operative indeed, when the synthetic image of a Black Hole "illustrates not merely the visible but a theoretical model [...], highlighting the convergence of the virtual and the actual in modern scientific inquiry. These images fundamentally
redefine the concept of photography itself."

Beyond the technical innovations of the EHT project, its broader epistemological implications deserve attention. The "cold" telescopic image of the cosmos is transformed into "hot" imaging by high-resolution technologies (high definition in McLuhan's sense).

But in a more radical insight, it is a different kind of cosmos-knowledge arising from within the machine that does not even require the notion of a (technical) image that is only a side-effect for human perception on the interface level. Interferometric visibility is a function of Fourier transform that turns signal measurements into "images". Vilém Flusser's notorious book title *Into the Universe of Technical Images*[75] turns upside down.

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73 From the "call for papers" to the 6th Media Materiality Forum, January 2025)
74 Francesco Giarrusso Redefining Photography: Virtual Visualizations and Epistemological Implications of the M87* Black Hole Images", lecture in the *Media in our sense* (*Medien, die wir meinen*) colloquy series at the Department of Media Science, Humboldt University of Berlin, May 15, 2024, "Abstract"
75 Minneapolis (University of Minnesota Press) 2011

A media-archaeology of the term "photography" itself reminds of its range that is wider than the human scope of visual perception: with Herschel terming "photography" for astronomical light measuring it captures the elecromagnetic spectrum (the visual spectrum of EM waves) and now even radio waves.

Such technological automation has dislocated cosmic "vision" from the human anthropocentrism to the machine.

This brings back Heidegger's understanding of technological *aletheia* as media-active archaeology of knowledge: Computational algorithms, extending / ranging beyond physical dimensions and anthropometric size and resulting in synthetic "images", are revealing new structures or dynamic patterns as a truth beyond the iconic indexical representation, resulting in a truly "artificial" intelligence of the cosmos as enlightenment.

The "photograph" of the M87 black hole in the universe is a diagrammatic simulation arising from computational techno*lógos* rather than from material *physis*. The image of the Messier black hole is rather circumscribing the Lacanean than the physical "real". It is literally grounded in real-number computing of radio-astronomic data, in a non-optical data "sublime". The image of M87 "is a visual representation of non-visual data (i. e., the visualization of radio waves)"[76], resulting in an epistemic gap between cosmic "vision" and "optical" events. "Operational images" (Harun Farocki) act algorithmically, as technological concretizations of Horst Bredekamp's notion of "Bildakt".

While the cognition of the universe becomes a function (an *imagination* or - with AI - even "hallucination") of the machine, cosmos is technologicaclly grounded more than ever. It is the unique task of media science to remind cultural studies dealing with cosmic aesthetics of its grounding in concrete technologies, counterbalancing speculative philosophy in favour of epistemic *earthing* by technological analysis. Any other kind of media science would lose its standing on a firm academic ground.

Technológos:

TRACING TECHNO*LÓGOS*

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76 Katherine Groo, "At the Gates of Hell: Indexical Pasts, Black Hole Futures" (presentation in colloquy "Media in our Sense", December 1, 2021), Abstract

Transitive media philosophy does not logocentrically identify the functional enactments of *lógos* in machines but interprets *lógos* itself as a mechanism that is cooriginally intertwined with matter - be it bodies or machines as "imachination"[77].

Definition, and understanding, of media as technology

By the neologism techno*lógos*, the encounters of reason and matter are identified as the central drama of analog and digital media as technologies – oscillating between "logified" matter, and the mechanized "mind".

"Radical" media archaeology is proposed as an approach for tracing techno*lógos*. This method addresses the core question concerning technology, understood as technical implementations of verbal, diagrammatic or mathematical *lógos* on the one hand ("analog" media), and technical "logification" of matter on the other ("digital" computing). Critical analysis of the technological condition requires the identification of core scenes in the encounters of technical reasoning and its temporal (electro-)physical materializations. A multitude of entanglements between reasoning *lógos* and technical matter and / or energy unfolds, mirroring the multiple articulations of techno*lógos* itself.

The difference between abstract computation and actual computing is decisive for defining present digital culture, ranging from topics like architecture between matter and informatization, over Digital Humanities research tools, to the challenges of "deep" machine learning in artificial intelligence. The technical implementation of software and "algorithmic thought" are a core issue for deciding if the conceptual neologism of techno*lógos* remains a heuristic or "abductive" (Charles S. Peirce) hypothesis, or turns out as an agency of its own.

The rigid media-archaeological method investigation of precisely located techno-logical events invites for a dialogue with the recent opening of media studies for deep geological, ecological, and infrastructural concerns. Future media analysis will go both ways, in parallel lines.

(Back-)Channels, and The *Lógos* of Technical Communication

Marshall McLuhan (1964) rather analysed the media technological message than its discursive "content" which he even dismissed as diverting critical attention. The historical economist Harold Innis focused on the *bias* of communication; its underlying orientation towards

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77 See media artist Tim Otto Roth's "imachination projects", https://www.imachination.net/next100/background.html

conquering either time (alias tradition) or space (alias telecommunication) is no metaphysical or social construction, but a function of its material or logistical techniques. But it is only with electronic media that communication transcends body-related cultural techniques to autonomous technologies.

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

By techno-logical necessity, Theodor W. Adorno's analysis of music in radio culture *Current of Music*, which stays close to the signal, once became incompatible with the rather sociological studies of the "Princeton Radio Research Project" directed by Lazarsfeld. The electromagnetic spectrum is made up of many kinds of waves most of which do not concern mass communication media. In "analog days", the limited of "radio" frequencies which can be squeezed in to a frequency band seemed to limit the expansion of communication media.[78] So-called *cognitive radio* (time hopping, or frequency hopping) has once been developed and patented by Hedy Lamarr and George Antheil for wireless submarine torpedo direction against possible interception or jamming of such "radio communication" by the enemy; the respective synchronization of the time-discrete hopping moments is based here on punched tapes known from music automata, especially composer Antheil's mechanism for the orchestration of 16 Player Pianos for the film sound of Ballet Mécanique in 1924) has been the answer, as well as asynchronous transfer. Digitisation radically multiplied channels for transmission, which implies a radical transformation in the ontology of communication: its mathematization and algorithmization.

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

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

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

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

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

This different bridging of distances by binary quantities results in a new quality: "The network became machine. No longer was the network a passive device, for repeater amplifiers actively added energy along the route. This change decoupled the wave that represented the conversation from its physical embodiment in the cable. [...] Electricity in the wires was now merely a carrier, separate from the message or signals it carried [...]. Now voices becomes signals [...]. The message was no longer the medium; now it was a signal that could be understood and manipulated on its own terms, detached from its physical embodiment."[79] Already Siemens' *regenerative repetitor* in electric telegraphy (the 19th

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

century Indo-European Telegraph Line) did not amplify with signals as well the noise, but clearly differentiates binary *digits*.

"Digital" information replaces the energetically continuous time-signal in favour of time-discrete pulses. Thereby the US-American Bell System which started with telephony "became not merely a set of voice channels but a generalized system capable of carrying any signal as a new currency: information"[80], transcending "communication" in the narrow human sense.

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

Communication is about signal circulation in coupled systems, be it man-man, man-machine, or machine-machine(s). The use of the term "communication" in Claude Shannons "Mathematical Theory of Communication" from 1948[81], relieves the notion from all semantic aspects. In that sense, a transmitter of radio waves "communicates" with the radio receiver, or computers communicate with each other in the Internet. Not the quality of information counts, but its quantitative measure, in the statistical sense. In information engineering, the word *communication* includes all kinds of procedures by which one human, or artificial, "mind" may affect another. This involves all kinds of human behaviour, for which Weaver lists written and oral speech, also music, the pictorial arts, the theatre, even the ballet. But "[i]n some connections it may be desirable to use a still broader definition of communication, namely, one which would include the procedures by means of which one mechanism (say automatic equipment to track an airplane and compute its probable future positions) affects another mechanism (say a guided missile chasing this airplane)."[82] Even without any human being involved, communication takes place.

Communication in Real-Time

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

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80 Mindell 2004: 107

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

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

sender) or it can be anticipated. For the latter case of influence on the signal production by the sender's assumptions about potential effects the term *feedforward* has also been suggested."[83] Its media archaeological primary scene has been the anti-aircraft prediction for ballistic weapons in Second World War and the Anti-Missile program in the Cold War, as developed in parallel lines by Norbert Wiener with Bigelow as applied time series analysis, and by Claude Shannon.[84] Shannon developed a model of techno-mathematical enemy aircraft movement anticipation, where the human factor (the pilot's intentional manoeuvers) is superseded and limited (corrupted) by the mechanical behaviour of the airplane and other physical parameters. In this model the real position of the enemy airplane at the temporal moment t is considered the "message", whereas registered deviations represent "noise".[85] Even miscommunication may turn out as productive from the perspective of technical communication engineering.

Between *lógos* and *techné*: Software Communication

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

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

The Insistence of "Humanities" in the "Digital"

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

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

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

To what degree do Media Studies still belong to the academic Humanities department? In the late Medieval kernel of what later became the academic university, the four "scientific arts", have been music, arithmetic, geometry and astronomy (the Quadrivium). Scientific *lógos* separated from human reasoning; the remaining three arts (the Trivium) constituted the "humanities" – grammar, logic, and rhetoric. In the Renaissance, the old Trivium became *Studia humanitatis*. With Digital Humanities, "science" and "humanities" fuse (or at least fold) into one, again. Humanist disciplines traditionally study subject matters to which the experimental method does not apply - "and instead mainly use the comparative method"[86]. With computational humanites, though, comparative research itself becomes *algorithmically experimental*.

"As humans and data machines become equal partners in cultural practice, social experience, and humanistic research, the humanities may no longer look like 'the humanities.'"[87] Digital post-Humanism is no more *Geisteswissenschaft* in Dilthey's sense. Still, Digital Humanities actually re-invents the informational aesthetics of cybernetics (Moles, Bense) - which is rather an up-dating than an exorcism of *Geisteswissenschaft*. In media theory there is a rather humanistic awareness (*Geistesgegenwart*) of algorithmic knowledge. It is not simply the quantitative increase of big data processing due to available computer storage and processing capacities (Moore's Law) which escalate in so-called digital culture, but its combination with a different quality of data processing: algorithmic programming as techno-logical, rather mathematical "intellectualising" in the double technical and philosophical sense of computational *intelligence*.

Once the harvesting of "big data" turns into epistemogenic operations, quantities of digitised cultural sources become qualitative *humanities*. "DH" methods require both critical and epistemological reflection as has been traditionally cultivated within old-fashioned humanities. But when in the field of the human-machine interface, human-centered design aims at "usability" in the visual aesthetics of screen design, this is a rather weak version of "Humanities of the Digital", even a misconception. "Humanities of the digital"[88] is not about re-humanising the digital world; on the contrary: "In order to reach true 'humanities of the digital', we - by a second-order observation – need to figure into our inquiries the human

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86 Entries "Liberal arts (education)" and "Humanities" in https://en.wikipedia.org/wiki, accessed August 7, 2017
87 Anne Burdick / Johanna Drucker / Peter Lunenfeld / Todd Presner / Jeffrey Schnapp, Digital_Humanities, Cambridge, MA (MIT Press) 2012, 105
88 As proposed, e. g., in the draft for the 13th International Conference on New Directions in the Humanities, 2015 special focus: From the Digital Humanities to a Humanities of the Digital, 17-19 June, 2015, University of British Columbia, Vancouver

misconception of the digital itself and reduce it out of the equation"[89], rediscovering the rigour and the tools from what was once the humanities in order to "get to the core of the digital itself, its 'Being' in the Heideggerian sense, its procedures, its time-critical operations that leave what was once called the human behind" (idem). German *Geisteswissenschaften* are what roughly translates into "Humanities", but German "Geist", as *lógos*, gets another meaning when understood by technology: "It can also denote a ghost" (van Treeck). What culture perceives as human-minded agency (the Hegelean *Geist*) "could be just the ghosts of the machines, the technical media we use" (van Treeck). Humanities of the digital are not philosophical analysis of subjective consciousness, but techno-mathematical *analytics* turned into true *sciences* of the spirit. Computing machinery, instead of being non-human, is rather discovered *within* the human: "While other species have technology, only humans, so far, compute. Thus digital technologies [...], can be brought under humanist modes of study."[90]

Tracing Techno*lógos*

A literal understanding of "technology" reveals that in this very term a specific *lógos* is a work. This approach identifies the core drama in contemporary media culture: the operative (sometimes incommensurable) encounters between the symbolic order and physical matter into which logics and codes have to be implemented in order to become operative as media. This entanglement becomes most expressive in digital computing as the technical realization of the abstract Turing machine.

The abstract algorithmic machine (Turing 1937) is no "noumenon" (a pure "object of an act of thought"[91]) in the earlier Kantean sense that remains simply intelligible / intellectual (as defined in § 3 of his 1770 dissertation De mundi sensibilis atque intelligibilis formae et principii), but its coming-into-being is operative diagrammatics ("scheme"), an algorithmic mechanism (reasoning) which can only unfold when embedded in / as matter, demanding to be actually processed - be it in the neural "mind", or as "paper machine" by pencil traces on squared support, or an electronic mechanism.

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

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

91 https://en.wikipedia.org/wiki/Noumenon, February 15, 2023

In order to avoid being trapped by the common anthropocentrism in the analysis of technics, media archaeology as a method allows for techno*lógos* to express itself, in an emancipation from both human "natural" language, and from conventional, body-related cultural techniques. In critical reference to Hegel, Simondon, and Heidegger's "Question concerning Technology" (and his notion of "enframing"), this focus is radically object- und process-oriented. The *eigensense* - and the *eigentime* - of technological knowledge is expressed (and can be traced) in concrete media-technical scenarios, such as the clocked timing mechanism, and the electronic television image.

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

[For McCulloch, a logical automaton, e. g., is seen as 'an "incarnation" of a kind of organic thinking-machine in the central nervous system"[92]. But different from a given physical or biological system, a technology, once it is deciphered with a theoretical concern, puts aside most non-rigorously describable elements of a natural system (notwithstanding 'noise').]

The relation between mind and body or matter, and the embodiment of *lógos* in actual flesh, have concerned philosophy, and religion for centuries. Rather than opposing the human to the machine (the "soul"- or "life"-oriented episteme of occidental metaphysics), media archaeology discovers the technical within the human itself - such as the coding by language as techno*lógos*, literally. The focus of Media Science is on techno*lógos*. Its investigation is not the human performative, body-related, but the technological, therefore: operative aspect of this fundamental theme. The daring hypothesis is anthropic: The physical world needed human culture to become aware of its implicit knowledge by techno-experimental technology. Instead of inserting the question concerning technology into social history or history of science (Science and Technology Studies), media archaeology radically cuts short this horizon, and focuses on the disruptive new qualities arising from the tight

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92 Gertrudis Van de Vijver, The Experimental Epistemology of Walter S. McCulloch. A Minimalistic Interpretation, in: New Perspectives on Cybernetics. Self-Organization, Autonomy and Connectionism, ed. by idem, Dordrecht (Springer) 1991), 105-112 (105, "Abstract")

coupling of matter and *lógos* in electro-physics and techno-mathematics. While cognitive neuroscience has developed the concept of the "embedded mind", operative reason (*lógos*), is understood as media in its strict techno-logical sense: as modulation and mastering of matter and energy by symbolically coded communication and control.

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

Concerning technology, the varying media constellations between *lógos* and matter do not simply result in infinite relativism. Such encounters rather ask for a more radical, non-dichotomic, archaeological understanding of media as technology. Mind and matter, in the case of technological things, are not clearly separate entities a priori, but co-originary intertwined. While "analog" technologies represent primarily logified matter, digital machinery rather tends towards logo-technification, as "objectivization of the mind" (in Hegel's terms) that do not remain philosophical speculation but become material epistemic tools for experimentation. Recent alternative approaches to computing allow for a material *arché-lógos*, unfolding a symbolical regime from within the physically real itself.

The Inductive Grounding of *Lógos* in Technical Matter

Media-archaeological analysis, even if it is close to the perspectives of speculative realism, more radically insists on the inductive grounding of lógos in technical matter in its concrete instantiations, and therefore limits itself to technologies in the sense of engineering and computing. Lofty philosophical deductions, with its rather liberal, extended and

generalized notion of a "machine-oriented ontology"[93], metonymically muse about the essence of machines, but rarely come close to their specificity as technology in detail. And so-called New Materialism, even it it comes close to the piezoelectric crystal as central technical agency in ultrasound imaging, just pretends to ground its epistemic argument in the concrete technical object. Instead, it frequently gets lost in discourse analysis, and "a feminist framework"[94] when it misses its media-epistemic difference to a loosely defined organic body. The thing (and media thinking) knowledge of a techno-logically informed material device such as the piezoelectric crystal, in its coupling to electronic circuitry, deserves to be granted an autonomous agency."

On Giuseppe Longo, *Le cauchemar de Prométhée. Les sciences et leurs limites*[95]

As it has been expressed by Alan Turing 1952 in his effort to mathematically explain the pattern generation in nonlinear biochemical morphogensis (discussed by Longo p. 177), the digital can only approximate (by Poincaré's equations, see p. 181) continuous diffusion and gradients in path-dependent processuality (somewhat colloquially coined "historical" by the author). Instead, concepts like "active matter" are discussed in science that require a different mode of analysis "back to earth" (if there can be a non-discrete "analysis" at all, since analysis, as seen with McLuhan, itself is an epistemic fruit of alphabetic notation). The renewed interest in *embodied* knowledge and *enactive* cognition (Clark / Chalmers 1998) goes along with Longo's rather anthropocentric ("nous, les humain", p. 232) criticism of the abstract Turing machine.

Maybe the categorical dichotomy between the discrete versus the continuous is a metaphysical misconception already, *en arché*. For Longo, just as in ancient Pythagorean mathematics already, "a *geometrical* meaning of the continuous rather than the algebra of the discrete" literally counts. Analog measuring here becomes incommensurable with discrete counting.

Longo almost hermeneutically understands "meaningful" organization against its mechanistic computational emulation. He insists that nature is not computable (p. 176) - an insight that has defined the limits of the Turing machine from the beginning. His monography rigorously (even sometimes biased and almost ideological) critiques the "discrete" as the

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93 L. R. Bryant, Onto-Cartography: An Ontology of Machines and Media, Edinburgh (Edinburgh University Press) 2014, 15
94 Karen Barad, Meeting the Universe Halfway. Quantum Physics and the Entanglement of Matter and Meaning, Durham / London (Duke University Press) 2007, 99
95 Paris (Presses Universitaires de France) 2023

"myth" of a universe that is calculable in terms of informational bits (p. 177). Longo objects the still prevalent numerical / computational approach to the physical and biological world (DNA genetics, as already described in Lily Kay's *Who Wrote the Book of Life? A History of the Genetic Code*, 1999). Qualified knowledge in information theory (Shannon) and algorithmics (Gödel, Turing et al.), combined with (meta-)mathematical and physical expertise, becomes productive in the discussion, differentiation and criticism of the common use of concepts like thermodynamic and / or informational neg/entropy (p. 235), epistemologically referring back to Maxwell's demon and Laplaean physics (p. 176).

Among many remarkable minor observations, this book points out the (non-)Greek concept of *a-logos* for the infinite / irrational (p. 24, p. 289 seq.), as a departure of the Pythagorean approach to a numerical (arithmetic) ratio of natural harmony prevailing in occidental history of science.

Longo's sympathy with the accidental alligns with recent computational criticism (like Beatrice Fazi's *Contintent Computation*) and classical chaos theory (René Thom). His deconstruction of the hardware / software divide (p. 278) as an *a priori* of digital computation (the discrete state machine) links with current debates in media theory (even if not noticing seminal media-archaeological writings like Friedrich Kittler's on that topic). With the author's insistence on the continuous which is missing in the "dehumanized" discrete computational approach, he himself misses to discuss the prevailing alternative that is analogue computing - both its techno-historical genealogy and its Renaissance in forms of entangled quantum computing. Longo's criticism of the discrete numerical and alphabetic approach to matter implicitly favours the subsymbolic signal against the sign (p. 111, p. 278). Any fundamental criticism of the discrete mathematical computational approach to the physical world[96] recalls this alternative to digital computing: *analog computing* that implicitly "counts" with the continuous. To express it somewhat paradoxically: the incalculable in matter (if not literally) "counts". In the concept of embodied computation "the physical realization of the computation or the physical effects of the computation" are not simply external or instrumental hardware, but "essential to the computation" itself[97].

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96 Giuseppe Longo, Quantifying the World and Its Webs: Mathematical Discrete vs Continua in Knowledge Construction, in: Theory, Culture & Society, vol. 36, issue 6 (November 2019)
97 B. J. MacLennan, Embodied computation: Applying the physics of computation to artificial morphogenesis, Parallel Processing Letters, vol. 22, issue 3 (2012)

CONCERNING THE TECHNO*LÓGOS* HYPOTHESIS

The techno*lógos* hypothesis tracks down the various encounters of computational reason and electro-physical are as the central drama of contemporary media technologies. "Radical" media archaeology, in that context, is a proper method for investigating the technical, and logical, (in)formations of machines.[98]

The techno*lógos* hypothesis invites to re-adjust ideas of Media Studies in favour of a Media Science. Such an understanding of technical "media" includes a concept of materiality that focuses on "non- human" agencies as well. The techno*lógos* hypothesis grounds media analysis radically in the technological apparatuses, relays, transistors, hard- and software, to precisely locate the scenes, operations and frictions where reasoning *lógos* and "informable" matter interfere.

Positioning the Techno*lógos* Hypothesis

There is an ongoing demand for philosophies of the "technological condition"[99]. But in many recent publications of media studies and cultural analysis concerning technology there has been a trend to move away from the "technical apriori" approach, in favour of its historical, social, and political contexts. Jussi Parikka's *Media Geology* and Durham Peters' *Marvellous Clouds* extend media analysis to cultural, discursive, and ecological systems and do not reduce them to their technical *a priori* any more. The techno*lógos* hypothesis takes the opposite turn, focusing even more rigidly on the inner-technical scene. Its aim is to derive sparks of knowledge and insight from within technology itself, momentarily suspended from discursive contextualization.[100]

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98 See Techno*lógos* in Being. Radical Media Archaeology and the Computational Machine, New York et al. (Bloomsbury Academic) 2021 (*Thinking Media* series, eds. Bernd Herzogenrath / Patricia Pisters). See as well W. E., There is no "Error" in Techno-Logics. A Radically Media-Archaeological Approach", in: Maria Korolkova / Timothy Barker (eds.), Miscommunications. Errors, Mistakes, Media, London et al. (Bloomsbury, "Thinking Media Series") 2021 (forthcoming)
99 See Yuk Hui, On The Existence of Digital Objects (University of Minnesota Press) 2016, and Ed Finn, What Algorithms Want. Imagination in the Age of Computing, Cambridge, Mass. / London (The MIT Press) 2017
100 For a comparable techno-materialist approach in contemporary debates on media theories and philosophies of technology, see Jussi Parikka, What is Media Archaeology?, Cambridge / Malden, MA (Polity Press) 2012, and idem, A Geology of Media, Minneapolis / London (University of Minnesota Press) 2015; further: Matthew Fuller, Media Ecologies. Materialist Energies in Art and Technoculture, Cambridge, Mass. / London (MIT Press) 2005

While Peters has been widening media theory to non-technical media.[101] *Technológos* with its techno-centrism decides for an inverse approach - meant not in an opposite, but complementary sense: "media understood both as natural and cultural"[102]. *Marvellous Clouds* extends the scope of media studies to cultural techniques and media ecology. Even if the "radical" media-archaeological techno*lógos* approach at first sight goes into the opposite direction, "digging" more into the technological things, both methods are seen as complementary (if not dialectic).

The analysis of *lógos* unfolding in matter / as machine, in a dialectic way (with the antithesis understood as complementary), radically grounds media analysis in the technological apparatuses, relays, transistors, hard- and software, to precisely locate the scenes, operations and frictions where reasoning *lógos* and informatisable matter interfere.[103]

Most recent media theories deal with computation, extending to so-called Artificial Intelligence. More speculative is the approach to the algorithmic software (what is called "soft thought"[104], as opposed to the close technological analysis in "radical" media archaeology. The techno*lógos* hypothesis has a decisive methodic (media archaeological) approach, while embracing a wider range of encounters between symbolic reason and matter, not limited to computation.

Estimation, Features and Method of the Techno*lógos* Hypothesis

"'Thought' [...] remains productively ambiguous within and beyond the humanities."[105] Thought, then, just like Turing's equation of the algorithm with the "machine" itself (Turing 1937), is both "the name for the act or an instance of thinking and the noun for what is in the mind" (Fazi ibid.). Just like thought is a function of a thinking process, computational - that is: (meta-)mathematical *lógos* - can not be detached from its technical implementation which is actual computing."[106] The neologism techno*lógos* is meant to emphasise "the material medium of computing –

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101 John Durham Peters, The Marvellous Clouds. Towards a Philosophy of Elementary Media, Chicago / London (University of Chicago Press) 2015
102 Peters 2015: 2
103 For another "radical" media archaeological analysis see Adrian Mackenzie, Wirelessness. Radical Empiricism in Network Cultures, Cambridge, Mass. / London (MIT Press) 2010, and idem, Machine Learners. Archaeology of a data practice, Cambridge, MA (The MIT Press) 2017
104 Luciana Parisi, Contagious Architecture. Computation, Aesthetics, and Space, M.I.T. Press 2013
105 Beatrice Fazi, Introduction: Algorithmic Thought, in: Theory, Culture & Society 2021, vol. 38 (7-8), 5-11 (8)

the materiality of the computational artefact that turns the abstract algorithm into a temporal event. This temporality is the condition of computing itself." Radical media archaeology is the method proposed to reveal, disclose, bring forth and analyse analyse such technological configurations and their effects. "If there is thinking in the algorithmic or if algorithms can be said to think, this capacity manifests via the execution and implementation of the techno-mathematical process that an algorithm is onto a material substratum." While this hypothesis reminds of the "embodied mind" thesis developed within cognitive science, the epistemic agency that the techno*lógos* hypothesis describes is rather situated within the technological processuality of an artefact, "not in its prosthetic association with a biological referent" (Fazi ibid.)

The techno*lógos* hypothesis, in its explicit *media-scientific* approach, aligns with the politics to advance media studies towards the "new sciences"[107].

The media-epistemological approach corresponds with Hanjo Berressem's extended research on "proper" media specificity such as technological *eigen*time[108], which is a central thread in the techno*lógos* hypothesis as well.

The intellectual framing of the "Thinking Media" book series of Bloomsbury Academic relates to the media-archaeological method most evidently in the premiere publication publication of the series *Media Matter* [109], with which the subject of "Media (In)Formations of Matter / as Machine" resonates already. Walter Seitter's "The Meta-Physics of Media"[110], in his grounding of the argument in the ancient Greek (Aristotelean) notion of "medium" as *to metaxy*, can be parallelized with the usage of *lógos* and *arché* in the techno*lógos*hypothesis. Chapter 2 in Herzogenrath's edited volume[111] displays a intellectual structure as the central question discussed in the techno*lógos* hypothesis: the encounters or even convergence of logical reasoning and actual matter in terms of "technology". This issue raises the question of the material embodiment

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106 Fazi 2021: 10, on W. E.'s article for this special TCS section *Algorithmic Thought*: "Existing in Discrete States: On the Techno-Aesthetics of Algorithmic Being-in-Time"
107 As it is expressed in the Web presentation of the Bloomsbury Academic "Thinking Media" book series
108 Hanjo Berressem, Eigenvalue. On the Gradual Contraction of Media in Movement / Contemplating Media in Art (Sound, Image, Sense) , London / New York (Bloomsbury Academic, "Thinking Media" series) 2018
109 Bernd Herzogenrath (ed.), Media Matter. The Materiality of Media, Matter as Medium, London / New York (Bloomsbury Academic) 2015
110 Chapter 1, in: Herzogenrath (ed.) 2015
111 Katerina Krtilova, Media Matter: Materiality and Performativity in Media Theory, in: Herzogenrath (ed.) 2015

of the symbolic mind. Herzogenrath's comments on Bill Morrison's film *Decasia* (2002)[112] unpack the different levels of temporality which materialises from film, ranging from its conceptual "time image" (Deleuze) down to the most material celluloid entropy. This resonates with the analysis of abstract computation vs. actual computing in the techno*lógos* hypothesis.

The insistence on media epistemology has a wider scope in the academic field, inviting to re-adjust the ideas of Media Studies *per se*. With Herzogenrath's *Media Matters* the techno*lógos* hypothesis shares the conviction that an extended understanding of "medium" needs to include a concept of materiality that focuses on "non-human" agencies as well. The book proposal fits into the "Thinking Media" series in a dialectic way (with the antithesis understood as complementary): While the current "Thinking Media" book series explicitly understands media in the context of cultural, discursive, and ecological systems and does not reduce them to their technical *a priori*, the techno*lógos* hypothesis on the other hand grounds media analysis radically in the technological apparatuses, relays, transistors, hard- and software, to precisely locate the scenes, operations and frictions where reasoning *lógos* and informatisable matter interfere.

The basic techno-materialist assumption is that phenomena like memory, perception, and thinking are not just given to humans, as an internal process that is purely mental, but there is always a material basis of mediation which links it to techno-logical reasoning itself. A genuine media philosophy worthy of its name cannot simply think and write *about* media but identifies the philosophical qualities and impacts from within each technology of media.

The techno*lógos* hypothesis, with its "radical" media-archaeological premise, wholeheartedly shares the "Thinking Media" series approach of cognitive technology, that is, to think through media, rather than simply about them. While media archaeology discovers the implicit "thinking" in techno-logical artefacts, with computing and algorithmic reasoning, such thinking becomes even explicit, culminating in the "deep learning" architectures of currently refreshed Artificial Intelligence, based on neural networks. From now on (as expressed in the "Thinking Media series"), media not only determine the present situation (as once notoriously defined by Friedrich Kittler), but in the meantime, have been unfolding and auto-executing from within.

Within an increasingly complex technological world, the techno*lógos* hypothesis offers to identify its core drama: the encounters on logical reason with the material real. "Radical" media archaeology is an adequate method of investigating such scenes in the contemporary

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112 In: Herzogenrath (ed.) 2015

media theatre with its current shift from classical to unconventional computing.

The varying encounters of reason and matter (a. k. a. "technology") is a global issue. In various academic disciplines, this is currently discussed under headings such as "technosphere" and "anthropocene". Implicitely and explicitly connecting to such discourses, the proposed book offers fresh arguments which can be integrated therein.

Radical Media Archaeology approaches technology in its own right, attempting to hint at the operative being of the machines that surround us. It uncovers the real drama of digital technology: how thought processes are institutionalised – hardcoded and hardwired – in matter. This method identifies current shifts in computing as answers to core problems of computation.

The entanglements of technical reason with informatisable matter occurs in two ways: its media theory, and its actual technical realisations. "Radical" media archaeology investigates the "grounding" of technical objects in actual matter, and to discover its principal sources of action. Academic analysis attempts to get as close as possible to understanding the unfoldings of technical matter. On the other hand, mathematical abstraction of computability has resulted in actual computing. As an implementation of symbolic reason into real matter, *lógos* has become technical itself.

[Different matters of implementing knowledge, though, make all the difference when it comes to its actual (mate)realization. Humanly "embodied" intelligence differs from intelligence that is "incarnated" in material media technologies. Biochemical signal processing can only conceptually (system-theoretically in the cybernetic sense, and information-theoretically in the computational sense) be equaled with technical in/formatization.]

While questions like the embodiment of the mind, or of *lógos* in actual flesh, have concerned philosophy and religion for centuries, the focus of this investigation is not on the human performance, but on the technological, operative aspect of this fundamental theme. Media archaeology radically focuses on the disruptive new qualities arising from the *tight coupling* of matter and *lógos* in electrophysics and technomathematics. Operative reason is understood, in this book, in its strict techno-logical sense: as a modulation and mastering of matter and energy through symbolically coded communication and control.

By a couple of precise case studies, "close technological" analysis ranges from mechanical, electronic, and computational procedures, up to current "deep" machine learning in Artificial Intelligence. Will *lógos* finally unfold from operative matter itself?

Thematic Synopsis of *TECHNOLÓGOS IN BEING. Radical Media Archaeology & the Computational Machine* (2021)

Going *medias in res*, "radical" media archaeology is the proper mode of analysis for the various encounters of reason (*lógos*) and matter (technical hardware) as the core drama of technological culture. Beyond the "question concerning technology" (Martin Heidegger), technology (deciphered in its composite sense) is more than simply a specification, or escalation, of previous practices of cultural engineering. It is an explicitly unnatural, negentropic regime of symbol manipulation impressed upon physical bodies and material (ranging from articulated language to traffic signs as "discourse" regulation). Once condensed into actual technologies, "experimental epistemology" becomes a controlled mode of culturally experiencing the physical world. Implicit technological knowledge deserves to be uncovered with technical and mathematical competence, and be articulated explicitly by the inquiring archaeo*lógos*.

Media archaeology is both a method media science, and a techno-logical practice. A more radical *understanding media* focuses on their technological and logotechnical existence - a thinking of media from within. Both terms *arché* and *lógos* are interpreted literally, as exemplified by the *lógos* of radio in its media infrastructural temporal logic. The thermionic tube turns out as central agency of electronic media. With an emphasis on the *lógos* of the machine, nonhuman communication by-passes the human-machine interface. This results in studies of techno-mathematical implementations as *dis*embodiment.

The "digital" literally turns out as the "hands" of *lógos*. Instead of being understood as inhuman, the machine can be discovered within the "human" itself. Media archaeology and cybernetics, beyond anthropocentrism, redefine the "hands on" approach to technical media, such as telegraphic handicraft, and other forms of signal *mani*pulation. Photography once liberated the image from the idiosyncrasies of the painterly hand by the *lógos* of the technical apparatus. A more "digital" case is typewriting as a decoupled relation of the hand to writing. *Lógos* becomes operative with the keyboard for coding. With *digitality* instead of the decimal "hand": fingers and numbers escalate into the binary code.

In the case of mechanically informed music from the past, human performance confronts technical operativity. Musical automata are opposed to the concept of so-called "historically informed music performance", with its focus on the human interpreter. Sonic analytics is a challenge to familiar histories of technology. The piano roll is presented as mechanisms for sonic time travelling. Sound-automatic invariance

results from Baroque music machines. Phonographical recording is opposed to the "musical" mechanism; phonographical analysis hereby challenges hermeneutic, logocentric interpretation.

Operative *lógos* irreducibly unfolds only when being (re-)enacted techno-logically, that is: as time object, for which it requires implementation in matter. Media archaeology and cybernetics redefine the "hands-on" approach to technical media, and other forms of signal manipulation, beyond anthropocentrism. The concept of the "media theatre" is proposed for such analysis. The research-artistic anatomy of Kittler's modular sound synthesizer from the early 1980s is a case study in identifying the *lógos* of a media machine. In reverse, re-enacting "logical" machines from the past results in the a-historic, co-originary experience of *lógos*. Such a symbolical re-enactment of machines is not simply technical (case YUGO car) but techno-mathematical (Babbage's "mechanical notation" for computational engines).

The technical logification of the optical images is computational *imaging* in the media-active sense. For analytic media studies which stay close to technology, the oxymoron of the analog television "picture element" is a case of logi*fiction*, whereas in actual digitization, the electronic image becomes logocentric again. The ultimate logification of the electronic image takes place with video compression, and computer graphics, replacing human visual perception by machine "vision". In image recognition by Artificial Intelligence, human perception returns from within the machine, as its techno*lógos*.

Media artefacts ask to be discretely addressed as "radical" media archaeology. In signal disturbance and breakdowns, the *alógos* of technical media is articulated as noise, respectively digital "artefacts". Digital sound compression is identified as "archaeologizing" the present. While vintage television recording itself has become a target of media-active archaeology in terms of signal restoration, digital video is interpreted as a logification of the electronic image. Digital data compression and microprocessor ageing are identified as "archaeologizing" the present. Can the so-called "post-digital" be interpreted as nostalgia for hardware materiality - and in what sense of archaeology? Towards a redefinition of the "material artefact", object-oriented programming shifts the focus on operativity rather than matter, especially in alliance with "processual" archaeology. The recent excavation of "E. T." cartridges, which may be compared to pre-historic archaeology proper, is a topic of computer (game) archaeology in its literal sense. Media-archaeological insight into malicious microprocessor ageing is in alliance with "forensic" media archivology, as exemplified by "reading" a computer ROM (Read Only Memory).

Radical media archaeology stays in close alliance with operative logo-technics (computing). Techno*lógos* arises from media-in-action: both the

matter of computation and the (with)in-human symbolic machine. The "human" gets redefined from the symbolic operations which take place within the so-called mind. A concrete mechanization of the calculating mind has been conceived in Karsakov's 1832 design of an intelligent machinery. Since *technológos* unfolds between materiality and the logical diagram, paper machines are identified as boundary objects. The calculating human turns out as a computational machine "it"self. Media archaeology concentrates on the scene where algorithmic reasoning (*alias* " computation") actually takes place. "Radical" media archaeology understands the computer in its double techno-mathematical meaning. Are the axiomatic limits of computability a challenge for actual computing? The opposition of the "analog" continuum *versus* "digital" discreteness turns out as a metaphysical dichotomy.

Time-discrete computing is an articulation of techno*lógos*. When former analogue "time-based" media operations transform into genuine time-discrete media tempor(e)alities, new challenges arise. Techno*lógos* in being, as time-discrete procedures, roots in the mechanical clock and the cinematographic mechanism, and escalates in actual *computing* (with) time.

Material media philology leads to a more radical understanding of software - a new kind of "love for *lógos*". Media philology is a sister method for media archaeology. What happens to "text" in the age of computer-based literacy? The message of computing is understood in the media philological sense. Machine philology, as critical software studies, deals with techno*lógos* in action. Among the various meanings which the notion of *lógos* has acquired in Western culture, the "word" and discursive "speech" range prominent. What differentiates media philology from the traditional "science of letters" is that it literally takes account of the alphanumeric code as well, which allows for *lógos* to unfold not only as philosophical "reason", but as algorithmic "ratio". The "literary" source code comment in computer programming is finally discussed as a genuinely media-archaeographical writing genre.

The experimental aproach to techno*lógos* is a form of "humanities of the digital". This reminds of archaeology proper in its leading role as "digital humanities" *avant la lettre* concerning the material cultural past. Counting by numbers, in digital culture, replaces the role of story-telling in previous cultures, by Markov chains. Even if Digital Humanities root in techno-mathematical analysis, there is still a necessity for questioning engineering and algorithmic practices in the "humanities" way. Such practices become productive when they activize archives which have been passive so far, in favour of a non-human, self-organising memory. "Hermeneutics" after Turing results in algorithmic experimentation.

Computing *for* and *as* architecture is about informatized matter in terms of information architecture and cybernetic aesthetics. Cultural techniques

like the closing and opening of doors and gates in domestic and urban space are tracked down to their *logification* as electronic flipflops in computing. Oscillating between the informatization of concrete buildings by imposing an architectural *lógos* on proper matter, digital textures emerge which ask for a radically media-archaeological analysis from within their technologies. The core drama to be identified is materially embedded *lógos* in algorithmicized architecture. The difference between abstract computation and materialized computing becomes apparent in the re-substantiation of code into matter (such as 3D-printing).

Is there no "memory" for techno*lógos*? Digital storage takes place below the "memory" metaphor, and actually returns in / as "machine learning". It replaces the sociological or cultural "memory" concept by the techno-analytic one. In technological understanding, there is no "memory" in computing, rather discrete storage states. Not yet "memory" (or "memory" no more), intermediary storage, and delay lines, suspend the emphatic memory discourse. But when the neuronal memory ensemble is reformulated in techno-mathematical terms, "memory"-determined probabilites take over (Markov chains). Human and / or nonhuman sorting of images by association clash in Legrady's media art installation *Pockets full of Memories*. There is a return of the "memory" agency in Artificial Intelligence as anthropomorphization of the machine. Concrete instantiations of adaptive visual memory machines, such as Rosenblatt's "Photoperceptron", and the self-organizing map, oscillate between neuroscience and techno*lógos*.

The varying constellations between symbolical *lógos* and technically informed matter / energy cannot be forced into a coherent system. Neither can such entanglements be reduced to a metaphysical dichotomy. Techno*lógos* emerges from, and with, material operativity *a priori*, and is dynamically redefined by every concrete technology. In a radical understanding of media as techno*lógos* in being, against "black boxing", media archaeology answers to the challenge of speculative techno-(mate)realism, and reinterprets the role of technology within the so-called "Anthropocene". The technological (in)formations of matter *as* machine remain the essential drama of the present media condition.

Concerning *Technológos in Being. Radical Media Archaeology & the Computational Machine* (2021)

Even if the title suggests that the media-analytic focus is on computation, the book is starting with, and including, "analog" media techniques as well, like the mechanical Welte recording piano, or the digital restoration of first electromechanical television recordings (John Logie Baird's *Phonovision* "grammophone" records), as represented in devices for video disc recording in the MAF.

"You understand computation as a reasoning, embedded and conditioned by the machine itself."[113] This is a non-anthropocentric point of view indeed. While Alan Turing's seminal paper from 1936 (published 1937) "On Computable Numbers" starts with the image of a mechanism which can emulate all the operations a human performs during a mathematical calculation with paper, pencil and eraser, radical media archaeology turns this vantage point around, assuming that once calculating, a human is in a (turing-)machine state. In this premise, mechanical computation is not simply a techno-logical escalation of ancient cultural techniques of hand-based calculation and writing, but rather subjects a human to its own logics - while still requiring some kind of "embodiment" (or implementation) to become processual (and not simply an algorithmic symbol chain).

The encounters of computational reason and electro-physical matter are tracked down as the central drama of cultural technologies. "Radical" media archaeology is proposed and defined as a proper method for investigating the technical, and logical, (in)formations of machines."

Within an increasingly complex technological world, the techno*lógos* hypothesis offers to identify the core drama of contemporary media technologies: the encounters of logical reason with the material real - or, in more grammatological expression, the "matteReal".

The key method of "radical" media archaeology approaches technology in its own right, attempting to hint at the operative being of the machines that surround us. It uncovers the real drama of digital technology: how thought processes are institutionalised – hardcoded and hardwired – in matter.

While questions like the embodiment of the mind, or of *lógos* in actual flesh, have concerned philosophy and religion for centuries, the focus of this investigation is not on the human performance, but on the technological, operative aspect of this fundamental theme. Media archaeology radically focuses on the disruptive new qualities arising from the *tight coupling* of matter and *lógos* in electrophysics and technomathematics. Operative reason is understood, in this book, in its strict techno-logical sense: as a modulation and mastering of matter and energy through symbolically coded communication and control.

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113 Suggestion for discussion by cand. Ph.D. Robert Bobnic, University of Ljubljana, June 16, 2021, following the online-presentation by W. E., Against the "Dead Media" Metaphor, "live-"streamed from the Media-Archaeological Fundus at Humboldt University, Berlin for the *Digital Dish* series, organized by Ljudmila Art And Science Laboratory (Ljubljana), 17th of June, 2021

By a couple of precise case studies, this technological analysis ranges from mechanical, electronic, and computational procedures, up to current "deep" machine learning in Artificial Intelligence. Will *lógos* finally unfold from operative matter itself?

The techno*lógos* hypothesis invites to re-adjust current ideas of Media Studies towards a more analytic Media Science, in terms of "radical" media archaeology. Since an extended understanding of media, beyond McLuhan, needs to include a concept of materiality that focuses on 'non-human' agencies as well.

Radically (in the literal sense), down to the *arché* of techno-logical roots, the techno*lógos* hypothesis "grounds media analysis radically in the technological apparatuses, relays, transistors, hard- and software, to precisely locate the scenes, operations and frictions where reasoning logos and 'informable' matter interfere"[114], asking: What kind of "intelligence" occurs in that very precise entanglement, and to what degree is it autonomous from the external "social" or other cultural forces? Gilbert Simondon's combined philosophical and precise analysis of the evolution of technical objects is based on the hypothesis that technology unfolds according to its own laws "and that customer demand has no paramount influence upon the evolution of technical systems. [...] Simondon never intended to optimize the engineer's tasks from an economic point of view and, in fact, his conception of technical progress can be considered as independent from the capitalistic trend of innovation."[115]

The techno*lógos* hypothesis "offers a contrarian vision for media studies that circumvents two of the major streams of the field over the past decades: the ecocritical expansion of the media concept and the politically engaged cultural studies approach that asks about what affordances media yield to people"[116]. Instead the focus is "on the material logics and artifacts by which thought is rendered concrete and hardware is rendered intelligent", involving knowledge of different kinds of technical machines and their basis in mathematics. Such a radically

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114 Book jacket text of *Technológos in Being.Radical Media Archaeology & the Computational Machine* (2021), https://www.bloomsbury.com/uk/technologos-in-being-9781501362293, accessed June 17, 2021
115 Vincent Bontems, Gilbert Simondon's Genetic "Mecanology" and the understanding of laws of technical evolution, in: Techné 13:1 Winter 2009, "Abstract", https://scholar.lib.vt.edu/ejournals/SPT/v13n1/pdf/bontems.pdf, Zugriff 30. Mai 2021
116 John Durham Peters, Professor of English and of Film and Media Studies, Yale University", on book jacket of W. E., *Technológos in Being* (2021)

media-archaeological approach "is bracingly hardcore as opposed to sentimental" (ibid.).

The analytic focus of radical media archaeology is on the *arché* of media, locating and thinking the primary scenes of technology media from within its technologies. Idealistically *dis*embodied *lógos* becomes re-embodied by - or in - its techno-mathematical implementations. It is only from within (and not in diagrammatic advance) that both the *arché* and the *lógos* of electronic media unfold.

Relieving the signal from human subjectivity (starting with photography as "self-inscriptive" optics), the radical media-analytic approach goes beyond anthropocentrism. Mechanical typewriting has already decoupled the human relation of the hand to writing, when *lógos* Encounters the machine interfaced by the discretizing alphanumeric keyboard. Whereas cultural techniques have been bound to the whole human "hand", with digital media, discrete fingers and numbers are at work (the "Tom Thumb") - while themselves being cybernetically governed, and controlled, by the algorithms and circuitry from within the electronic devices.[117]

Where human performance meets (or confronts) technical operation, the resulting interaction and co-agency tends to be perceived anthropocentrically. While manual experimentation of time with machines is frequently subjected to the historical discourse., a different kind of temporal articulation emerges from reenactments of techno*lógos* itself. Just like the former Jugoslavean YUGO car can be reconstructed from the modules of its detailed manual, Charles Babbage's computational Difference Engine no. 2 (surviving as a mid-19th century design only) has been symbolically reenactment of machines in the present (Science Museum, London).

Is there a *lógos* within technical images? The (techno-)logification of the image is an oxymoron, as it is expressed in the technical term of the "picture element" for pre-digital TV engineering? While analog video imaging and the *alógos* of Video Noise have been escaping the control of the symbolical to a large extent, with computer graphics, human vision shifts to genuine "machine vision". Digital sound compression is archaeologizing the present already. With the digital RestAURAtion of vintage television recordings, *imaging* becomes both an object, and the agency of media archaeology, just like the (re-)reading out code from a corrupted (or user-protected) ROM results in really "forensic" media archivology. Is the "post-digital" return to haptic materiality a nostalgia already? The real archaeological "excavation" of the once (for economic

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117 See Stefan Münker, on "Däumlinge" (and Serres' related essay), in: Moritz Hiller / Stefan Höltgen (Hg.), Archäographien. Aspekte einer Radikalen Medienarchäologie, Berlin (Schwabe Verlag) 2019

failure) buried cartridges from the Atari "E. T." video game, in the desert of New Mexico, becomes a true topic of computer (game) *media* archaeology, when the focus is not on its material evidence only, but bceomes an investigation of its code. Restoring the game by disassembling the original code is giving the cultural archaeology performance a media-archaeological, "digital" turn. As a new kind of "love for *lógos*", material media philology aims at a more radical understanding of software. "Digital Humanities" practice is turned upside down as media-archaeological "humanities of the digital".

Once abstractly coded algorithms are technically implemented as "software", the operative encounters of *lógos* and matter reveals the unexpected, and sometimes incomputable, behaviour of code. In the age of computer-based literacy, software is "text" no more, leaving the conventional human-centered *lógos* to the marginal literary code comment.

Techno*lógos* emerges from the matter of computation itself. In that media-theatrical drama, symbolical computation comes close to the material world. Algorithmic reasoning can never be pure, but actually (and necessarily) takes place in, and as, techno-mathematical computing. The symbolical machine (such as Karsakov's paper machines) is not external, as mechanization of the calculating mind, but occurs within the human already. Such machine operations re-define the "human" from within. When being in the calculating state, a human is a computational machine "it"self.

A most "concrete" encounter of matter and informational *lógos* occurs with(in) architecture and its increasing cybernetization. Can the architecturally embedded *lógos* be separated from Platonically "autonomous" algorithmic thought at all? What has been a cultural technique before, the opening resp. closing of "gates", has become the flipflop circuit within digital microprocessor "architectures". The (re?)substantiation of code into matter results in 3D printing technology.

Digital data and code storage deconstructs the cultural "memory" metaphor. Intermediary storage, and technical delay lines, are not yet memory, or "memory" no more at all. Digital techno*lógos* knows "memory" only in quotation marks, from a technological view.

Even neural human memory can be reformulated, and therefore emulated, in technical terms - down to the Return of the "memory" metaphor in Artificial Intelligence, and the media-archaeological prototype of machine learning (Rosenblatt's Perceptron). A media-theatrical scene of the clash between human and / or non-human sorting of images by association unfolds in Legrady's *Pockets full of Memories* installation. In media-active *archivology*, digital archives become self-organizing by themselves.

Against a certain metaphysical bias in statistical AI, media archaeology radically reminds of its techno-mathematical ground. The neural net approach dislocates the familiar algorithmic approach to intelligence. But how "Deep" is Machine Learning?

Automatic "content" retrieval and algorithmic data identification reduce all semantics to syntax and numerical weighting. There is no "hermeneutics" after Shannon, and the algorithmic experimentation and experience of text and speech reveal a *lógos* of a non-human kind.

There is a certain anthropomorphic allure suggested by machine "learning". But in the moment when the human voice itself is revealed by, and as, techno*lógos*, a different kind of articulation occurs.

In a radically machine-oriented approach (both electric hardware, and symbolic code), an *arché-lógos* is technically revealed from the structured *melos*[118] and (algo-)rhythmics[119] of matter & energy itself. In times of increased "virtualization" of media knowledge on the one hand, and within the Anthropocene condition on the other, the question concerning techno*lógos* literally "matters" (a verbalization preferred by Karen Barad) - in favour of a techno-logically renewed media materialism.

Techno*lógos* in Being: A thought experiment

Technológos in Being is about a thought experiment in philosophy of technology (or media theory), and about actual technological experimentation itself (the Signal Laboratory). Sometimes, a book gets written when informal thoughts require to be articulated by the symbolical machine (be it the printed word in the Gutenberg era, or electronic textuality). In the case of *Technológos in Being*, technology itself - whose knowledge is implicitly embedded in (in-)formatized matter and energy (that is: analogue and digital) - asked for a textual formulation, since inner-technical operations depend on the human investigative mind to be expressed as explicit knowledge. A latent subject matter is not always simply preceding its verbal formulation or

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118 This technical term for the "melodic" element in music is originally derived from ancient Greek *melea* in the plural, signifying corporeal limbs. See Rainer Bayreuther, Der Sound gottes. Kirchenmusik neu denken, Munich (claudius) 2021, 59 seq.
119 See the neographism coined by 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

vice versa (words becoming flesh), but its expressive argument, and enunciation, co-evolves in the entanglement of engineered matter and logical mind (*techné* and *lógos*). In this way, *Technológos in Being*, as a media-scientific train of thoughts in the format of a material publication, is an agency of research itself.

The core question is simple: What if the very term "technology" is not simply understood as an umbrella word for the science and studies of cultural techniques, but is understood in its face value: as the kinds of *lógos* which emerge with(in) techniques? The technological argument is not an exclusive privilege of the human mind, but evolves in technologies themselves: from "analogue" machines to the most logical operations of computing. At the borders of Artificial Intelligence from Machine Learning, *Technológos in Being* grants the gift of knowledge to the machinery itself, therefore understanding the book series title, for which it has generously been accepted, literally: *Thinking Media* (eds. Bernd Herzogenrath and Patricia Pisters).

Techniques are logical and mathematical reason (*lógos*) unfolding in matter as machine, in a two-fold existence as logified matter and technified mind. As an investigation of operative encounters between *lógos* and matter, *Technológos in Being* oscillates between a heuristic hypothesis (or daring assumption), and its positive assumption as an operative given. The techno*lógos* hypothesis is not answered, but left as a question. The book is rather tracing an inherent technical knowledge in the contact zones between the (mate-)real and the symbolic regime, than presupposing it as a given ontology.

This investigation does not proceed by story-telling but by applying detailed technological case studies. The method proposed for such an investigation is "radical" media archaeology, which does not historically unearth dead media or neglected media-philosophical arguments, but aims to create sparks of techno-knowledge (techno*lógos*) from within the most intimate encounter with the proper characteristics of technical operations themselves. It is therefore conceived rather as media *science* than as media *studies*, more akin to the symbol for the mathematical square root which is "√", to archaeographically indicate the "radical" media archaeological method which is proposed, in the text, to investigate techno*lógos* in computing

Among other aspects in the Techno*lógos* volume, Deep Machine Learning is figuring. Its core question if there is a techno-logical reason of its own increasingly relates to the currently updated discourse about Artificial Intelligence - in order to put it in a less anthropocentric perspective.

Furthermore, the techno*lógos* hypothesis aligns with the emergent field of so-called "unconventional computing", granting in-formatized (different from self-"active") matter the capacity to calculate

autonomously. Materially embedded technicity, (hardware), once mirrored in the investigative mind (software), reveals a kind of autonomy which can neither be reduced to conventional cultural techniques, nor to an absolute posthuman regime. The book therefore refuses to make a theoretical (observational) separation between the (human) mind and technological devices as its object of investigation, and aligns with recent debates about the entanglements of matter and mind (from Gilbert Simondon to Karen Barad). But in a truly media-scientific sense, it does so by staying as close as possible to the analysis of the mechanisms of the machine. Through "abductive" (Charles S. Peirce) or "phenomenotechnical" (Gaston Bachelard) analysis, materialized technological self-knowledge is allowed to reveal itself "in being" (in execution), while at the same time being dependent on the human word to be expressed.

The verbal conjunction "and" in the sub-title of the book ("Radical Media Archaeology & the Computational Machine") has been replaced by the typographical "&", since such entanglements are a recurrent argument in the techno*lógos* hypothesis. The core issue of the techno*lógos* hypothesis, which is the co-originary entanglement of logical structure with matter, can be non-discursively expressed by a hard-wired diagram: experimental electronic circuitry from the Signal Laboratory of Humboldt University Berlin (Institute of Musicology and Media Science).

[Hard-Wired-Circuitry.jpg; Photo: Jochen Viehoff]

While logocentrism still treats such an artefacts as the material implementation of the symbolic order in technical materiality, the techno*lógos* hypothesis - here in alliance with speculative philosophy - turns the relation between body and spirit upside down.

CUNNING TECHNOLOGICAL REASON, AND THE PANDEMIC CRISIS

Does techno*lógos* remain a mere heuristic, hypothesis, or does it turn out as an actual being? Maybe the dramatically accelerating digitization of social (tele-)presence, and the accompanying algorithmization of cultural knowledge, triggered by the current viral COVID-19 pandemic as a cunning form of genetically encoded intelligence, is this answer already.

In a more epistemic approach that avoids mere medical analogies[120], the media-theoretical side-effects of the current pandemic (especially the new "communication philosophy" of mRNA vaccines) may be considered. It is tempting to assume "abductively" (Peirce) that the COVID-19 virus is an invention (or "trick" - old Greek *mechané* -, or Hegelean "outwit of

120 See the forthcoming special issue "Pharmacologies of Media" of the online journal Media Theory, edited by Yigit Soncul and Scott Wark

reason") of techno*lógos* to boost the digitization of (tele-)presence, and to algorithmicize cultural knowledge.

The Technical Languages of Video Conferencing

First of all, children acquire local parental languages; "secondary" languages are learned in school, as "foreign" languages. Notably ubiquitous English as *lingua franca* is a verbal equivalent to global technological communication infrastructure itself. The dominant "communication" engineering language is (still) English (Shannon et al.), especially in computational science, and computer programming code.

The contemporary form of communication, its techno-logical condition (in its double sense), is "online" communication, which has been drastically accelerated by the pandemic SarsCoV-2 crisis. Hereby, academic discourse is subjected not only to English as *lingua franca*, but to the technical language (*lógos*) of digital video conferencing already. Participants of discourse are rather technically (inter-)connected by electric and logistic circuitry, than in a traditional *dia-lógos*. The frictions in the technical preparation for a video conference demonstrate that there is mis-communication on the material media level first, before any academic controversy may arise at all.

MEDIA ARCHAEOLOGY AND TECHNO-LOGICAL TIME. A Transcultural Concept? Case Study China

With a comparative focus on Western thought and Chinese techniques, the question arises to what degree the concept of technology is a universal phenomenon, or to what degree does it rather depend on transcultural knowledge transfer. Is "radical" media archaeology, as a method of media scientific inquiry, affected by such cultural variances at all?

The paradigm of "cultural diversities" (in Science and Technology Studies, and media-archaeological "variantology"[121]) is contrasted with the universalist hypothesis of techno-logical equiprimordiality. More specifically, the techno-analytic focus will be on chronotechnics, with the medieval Chinese "Heavenly Clockwork" as a precise case study. This advanced time-keeping mechanism in China has been a dis/covery in its many senses. The technical analysis of its escapement clocking mechanism is connected to the claim that any inter-cultural discussion concerning "time & technology", and comparative media archaeology as

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121 Chen (Joseph) Cheng-Yih, Cultural Diversities. Complementarity in Opposites, in: Zielinski / Fürlus (eds.), Variantology vol. 3 / 2008: 153-190 (153)

such, requires a precise "grounding" from within technology itself.

From discussing the language(s) and politics of *techné*, the analysis extends towards an "archaeography", concerning the interrelation between divergent writing systems and techno-logical thought (esp. computation).

At first glance, "media archaeology" (be it "variantology" or "radical" media archaeology), to a certain extent, appears as a Eurocentric concept. The application of Heidegger's "Question concerning technique", and Needham's comparative history of sciences in East and West, are already a media-archaeological instrusion into the "inner affairs" of Chinese culture. By a shift of perspective the humanitarian claim that there are political, economic, and strategic concerns which cannot be limited to an intra-national agenda but demand inter-national discourse, will be deferred to the question if there is something like a universal techno*lógos* as such.

The "cosmopoietic" unification of Dao and Qi (Yuk Hui) will be contrasted with a genuine notion of technology, resulting in a media-archaeological "declaration of independence" of techno*lógos*.

Introducing "Radical" Media-Archaeological Analysis:

Introducing "Media Archaeology"

Several scholars (notably Erkki Huhtamo, and Siegfried Zielinski) have applied the term "media archaeology" to the investigation of technical artefacts from the past which either predetermine, still co-determine, or even escaped the current narratives of media culture. Such research has been methodologically inspired by Michel Foucault's discourse analysis *Archaeology of Knowledge*,[122] and his *Order of Things. An Archaeology of the Human Sciences* [123], and has literally (though implicitly) been preceded by works such as C. W. Ceram's *Archaeology of Cinema*[124].

Different from the concept of cultural techniques which are still body-related chains of technical operations, a more radical, technology-prone media archaeology grants the agency of the machine an autonomy of its own right. In its "archaeological" (time-layered) rather than narrative (linear) approach, historical media archaeology is closer to the

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122 Michel Foucault, Archaeology of Knowledge and the Discourse on Language [FO 1969], transl. A. M. Sheridan-Smith, New York (Pantheon Books) 1972

123 Michel Foucault, The Order of Things. An Archaeology of the Human Sciences [FO 1966], Oxford / New York (Routledge) 1989

124 C. W. Ceram, Archaelogy of Cinema, translated by Richard Winston, London (Thames & Hudson) 1965

epistemology of science (in the French tradition of Bachelard and Canguilhem), than to classical humanities. But different from Science and Technology Studies, radical media archaeology does not always already interpret technical evidence through the lense of its contingent social, or economical, in general: "historical" circumstances. It grants the techno-logical condition (that is: both technical materiality, and logical knowledge) a condition of its own.

At this point, the fundamental difference between radical media archaeology, which abducts a techno-logical intelligence of its own, and Joseph Needham's rather socio-cultural approach to science and technology emerges. "The great stumbling block here for the internalist school [...] is the central question of historical causation. Scenting economic" - or techno-logical - "determinism under every formulation," - of techno*lógos*, literally - "they insist that the scientific revolution [...] cannot have been derivative from some other social movement [...] they do not like to admit that scientists have bodies, eat, drink, and live social lives among their fellowmen."[125] This raises the question to what degree academic life depends on the actual *symposion*, and cannot be reduced to merely digitized videoconferencing (as it happened during the pandemic university "lockdown" crisis in 2020 / 21). For Needham, "science is fundamentally entwined with society"[126]. This epistemologically extends the insistence of materialist "Berlin School" media-science on hardware archaeology - against the reductionalism of mere Software Studies - to the fundamental question to what degree knowledge is literally *embodied*., and entangled with matter.

[The media-archaeological approach comes close to the analytic operation which philosopher Edmund Husserl once termed "epoché": a phenomenological reduction of experience to what he calls a 'sphere of ownness.'"[127] Techno*lógos* is such a sphere of technological knowledge of its own. In order to investigate the essence of technology, accordingly, one has to distinguish between the human act of technical consciousness and the phenomena at which it is "intended" (Husserl). "Knowledge of essences would only be possible by "bracketing" all assumptions about the existence of an external world. This procedure he called 'epoché'."[128]]

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125 Joseph Needham et al., Science and civilisation in China, vol. 7: The Social Background, Part 2: General Conclusions and Reflections, London (Cambridge University Press) 2004, 3
126 Aaron Grinter, The Grand Tradition. Revisiting the Work of Joseph Needham to Address Ethnocentrism in Contemporary Philosophy and Socienty, in: Cosmos and History. The Journal of Natural and Social Philosophy, vol. 14, no. 3 (2018), 297-320 (301)
127 Entry "Edmund Husserl", Wikipedia, referring to Husserl's *Ideen* from 1913, https://en.wikipedia.org/wiki/Edmund_Husserl, accessed May 11, 2021
128 Wikipedia ibid.

But different from somewhat anthropocentric media phenomenology, media archaeology takes the non-discursive agencies of media culture into account, such as the arrangement of keys on a typewriter. Different from classical archaeology as academic discipline, techno-mathematical media archaeology not only encompasses material artefacts, but the analysis of their logical programming as well (media philology). The focus on hardware goes along with close, even "forensic" media analysis (Matthew Kirschenbaum[129]). Media archaeology refers to both a method and an object group of research. It cannot be reduced to one coherent school[130], but different branches have developed in the meantime: the "Dead Media" approach (Bruce Sterling), historical media archaeology (Friedrich Kittler), cultural (*tópos*-oriented) media archaeology (Erkki Huhtamo), "prospective" media archaeology and "variantology" (Siegfried Zielinski). In a second generation, this has been extended, notably by Jussi Parikka, to media-ecological issues concerned with electronic waste, energy consumption of digital media, and the "Anthropocene".[131] Closer to the technological investigation stay "computer archaeology"[132], "radical" media archaeology, and the experimental writing of such evidence as "archaeography"[133].

While media archaeology, in different academic and artistic practices, is very often non-critically reduced to a label of retro-aesthetical nostalgia for obsolete technology like Sterling's "dead media project", or simply understood in a historicist sense (like "steampunk" in literary fiction, and narrative compute game design), the "Berlin school" of Media Science actually insists - at least in principle - on the imperative of (re-)enacting technical beings: in terms of electronic hard- and computational software "close to the machine" (which requires "hacking", the opening of the Black Box both as electronic matter, and as software) but as well in terms of conceptual media theory..

Media archaeology can neither be reduced to a mere "tinkering" practice, nor to a mere concept. In its investigative and mathematical sense, media archaeology is "radically" grounding in technical analysis (hard- and software) on the one hand, and philosophically "questioning" technology on the other, with its techno*lógos* hypothesis. This is a core criterium concerning the applicability of media archaeology as a research method to the case of Chinese technical culture.

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129 Matthew Kirschenbaum, Mechanisms. New Media and the Forensic Imagination, Cambridge, MA (The MIT Press) 2008
130 As emphasized in the introduction to Huhtamo / Parikka 2011
131 See Jussi Parikka, A Geology of Media, Minneapolis / London (University of Minnesota Press) 2015
132 A book series co-edited by Stefan Höltgen
133 See Hiller / Höltgen (eds.) 2019

Introducing the technológos hypothesis

According to the techno*lógos* hypothesis, the actual media-philosophical question is posed by technology itself, and media archaeology is elaborating answers to that challenge. Therefore a literally "radical" grounding of analysis *within* the machine is required, in a comparison between Chinese, and Western, core elements of technical objects.

[For radical media archaeology, "grounding" analysis is non-metaphorically understood here, but in its precise electronic engineering sense, where "ground or earth is the reference point in an electrical circuit from which voltages are measured, a common return path for electric current, or a direct physical connection to the earth."[134]]

Apparently, late medieval Europe, and China, invented similar techniques independently, without direct cultural translation, rather by techno-logical necessity, which - according to the "techno*lógos*" hypothesis - is a corollary of inner-technical logics itself. The media-archaeological concept of unfolding technological knowledge is opposed to the concept of technical historicism, which is based on the model of inter-cultural knowledge exchange. Any technology is predominantly a function of natural (physical) and mathematical (logic) "laws of thought" (Boole), rather than of circumstantial political, social, discursive, or economic environments.

"Variantology" vs. "Radical" Media Archaeology

The more "liberal" branch of media archaeology is rediscovering interesting histories of machines, and their recurrent *topoi* (Erkki Huhtamo) in cultural discourse, "but may not have thought about those in such starkly material terms" such as committed proponents of radical media archaeology.[135] Against radical techno-centrism, Siegfried Zielinski, actually moved away from the "media archaeology" which has been triggered by himself to a certain degree, to a more inter-cultural "variantology".

This shift has been echoed by philosophers and historians of science in Chinas as well, such as Chen Cheng-Yih: Technical diversities "produced a rich global variation among early civilisations"[136]. But the epistemic core question here remains - different from the humanities' focus on historicity: Are such technical diversities due to cultural difference, or

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134 Entry "Ground", Wikipedia, https://en.wikipedia.org/wiki/Ground_(electricity), accessed May 11, 2021
135 Electronic communication Peter McMurray, 16 January 2020
136 Chen Cheng-Yih 2008: 153

according to laws which are inherent *within* technology itself?

A more rigorous "variantology" therefore asks whether different cultural contexts actually result in significant modifications of technologies. Regarding techno-knowledge and its actual media infrastructures, Euro-American ("occidental") modernity is still imperialistic, that is: globally dominant - wainting for the moment when Chinese engineering - beyond advanced 5G communication lines, and Artificial Intelligence - will result in technologies which are genuinely different, or not even "technologies" any more.

In terms of "modernization", it has still been Western standard technology and sciences which objectively equalized cultural otherness, by its textual and media technical taxonomy, communication and control. If the theory and practice, sending and reception of electromagnetic waves, for example, would not be universally applied, radio broadcasting would not function on the scale of the "global village" (McLuhan). World-wide technology, in its governing hard- and software, is still specifically "Western", even when, for example, the information technology standard for the encoding, representation, and handling of text expressed in most of the world's computational writing systems is extended from the traditional 7 bit American Standard Code for Information Interchange (ASCII) to the "Unicode" character set[137]. Or are the laws of techno-knowledge, by autopoietic necessity, rather universal by themselves?

In terms of a more discourse-oriented interpretation of variant technical development in different cultures, "[t]o grasp the co-constitution of material and discursive production, we must approach the world as historical."[138] But media archaeology is non-historicistic in its research concerning the entanglement of technical materiality and cultural knowledge (*lógos*). At this point, the techno*lógos* hypothesis of radical media archaeology[139] departs from both the socio-economic approach of Science and Technology Studies, and the rather "speculative" realism of object-oriented ontology. Technological media are not speculative things, but they actually co-exist on the material (*techné*) and the logical level.

[The Non-Historistic Approach to Technology (with Simondon)]

Ranging from Martin Heidegger to late Bernard Stiegler, there has been an increasing number of research and publications on the question of how "time" relates to "technology". Against the rich background of

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137 See entry "Unicode", Wikipedia, https://en.wikipedia.org/wiki/Unicode, accessed May 11, 2021
138 BuYun Chen, Needham, Matter, Form, and Us, in: Isis, vol. 110, no. 1 (2019), 122-128 (128)
139 See Ernst, Techno*lógos* in Being, forthcoming 2021

Chinese cultural techniques, the core issue is whether both "time" and "technology" need to be discussed in alternative ways, or if there is a techno-logical invariance which insists across the various cultures. The discussion of co-original technical inventions in the Eastern and Western world has been stimulated by Joseph Needham's seminal research on the comparative history of science.[140] According to the techno*lógos* hypothesis (as proposed in this argumentation), machine time deserves to be epistemologically taken seriously in its own terms, which - in the end - suspends both the materiality of physical technics and its symbolical encoding from the relativities of cultural historicism, and its various media practices. Such an autonomous technical genealogy has been prominently pronounced by Gilbert Simondon's philosophy of technics.[141]

The "Deep Time" approach to sciences, and technologies, already presupposes a common temporal reference, whereas media archaeology follows a rather inductive, multiple times (Aristoxeons: *chronoi*) concept of autonomous techno-logical development, in acordance with Simondon: "[H]is analysis of technical progress is based on the hypothesis that technology has its own laws and that customer demand has no paramount influence upon the evolution of technical systems."[142]

According to Simondon, "technical evolution obeys first and foremost the necessity of solving internal problems" - autopoietically - "and that the user or the consumer's demand have no paramount influence upon this evolution."[143]

The concretization process in the evolution of the electronic tube (which is presented as a photographic gallery in the appendix to Simondon 1958) "is no blind or random process, nor is it subject to the caprice of external factors. Technical systems have, from the beginning, intrinsic potentialities."[144] In Simondon's own terms: "If technical objects evolve towards a limited number of specific types, that is in virtue of an internal

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140 See Colin A. Ronan, The Shorter Science and Civilisation in China. An abdrigement of Joseph Needham's original text, vol. 1, Cambridge UP 1978. For a criticism of Needham's approach, see Chen Cheng-Yih, Early Chinese Works in Natural Science, Hongkong UP 1996
141 Gilbert Simondon, On the Mode of Existence of Technical Objects [FO 1958], transl. Cecile Malaspina / John Rogove, Minneapolis, MN (Univocal Press) 2017
142 Vincent Bontems, Gilbert Simondon's Genetic "Mecanology" and the understanding of laws of technical evolution, in: Techné 13:1 Winter 2009, "Abstract"
[https://scholar.lib.vt.edu/ejournals/SPT/v13n1/pdf/bontems.pdf, accessed May 1, 2021]
143 Bontems 2009: 2
144 Bontems 2009: 4

necessity and not on the strength of economical influences nor practical demands."[145]

But Simondon's "technical object" is not (yet) a technology in the information engineering sense: as entanglement of real matter (mateReality), and symbolic *lógos*. As long as cultural techniques still adhere to a "cosmic" unity with nature, they do not escalate into the kind of dialectic antithesis which defines technology in Marx' emphatic sense:

"Nature builds no machines, no locomotives, railways, electric telegraphs [...] These are products of human industry; natural material transformed into organs of the human will over nature, or of human participation in nature. They are organs of the human brain, created by the human hand; the power of knowledge objectified"[146] in the Hegelean sense. But this is Artificial Intelligence not yet. Only with the techno*lógos* hypothesis, a media-epistemic "synthesis" may emerge.

The crucial question arises from the literal deciphering of the very term "technology" here: Does it simply refer to the science of technics, or - more emphatically - to the expression of a logics of its own?

The narrative, historiographic enframing of technical objects hides its inner historicity (or tempoReality) like media consumer design hides its real techno-logical essence (notably in computing devices such as the Smartphone where the machine disappeared behind the interface to 100 %). "The external appearance and design are a sort of social and cultural 'super-historicity' without any real technical meaning."[147] Against cultural media historicism, according to Simondon, "[r]ecurrent transformations between the levels give information about the 'logic' of the progress and suggest that a law exists."[148]

A Scientific Approach to the East / West Technology Comparison: Needham's "Titration"

In a comparative technological analysis, media archaeology is closer to analytical science than to narrative historiography of inter-cultural tradition, or transfer, in the humanities. It is no "typo" that Joseph Needham, initially a research biochemist for the Royal Society, and already holding a chair in biochemistry at Cambridge University by the time he started researching Chinese traditions[149], in one of his book titles,

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145 Gilbert Simondon, Du mode d'existence des objets techniques, Paris (Aubier) 1958 (1989), 24
146 Karl Marx, Grundrisse, Harmondsworth (Penguin) 1973, 706
147 Bontems 2009: 7
148 As paraphrased by Bontems 2009: 7
149 See Aaron Grinter, The Grand Titration: Revisiting the Work of Joseph

calls his comparative history of science and technology *The Grand Titration* rather than "Tradition" (1969). While many scholars consider Needham's "titration" rather as a metaphor, media archaeology takes this method more seriously, as a scientific (rather than historical) approach to comparative "culture & technology" studies, and knowledge transfer ecology.

[As a professionally trained biologist and chemist[150], Needham has been especially aware that the modern European knowledge of "affinity" between chemical elements may have derived from more ancient Chinese treatises.[151] His methodic "titration" approach in the West-East comparison concerning science becomes its proper object of analysis here. This reminds of a novel by Johann Wolfgang von Goethe, published in 1809, *Die Wahlverwandtschaften*, translated into English under the title Elective Affinities, which describes the *oiko-nómos* of inter-human relationships in terms of a chemical laboratory experiment. The invitation, by the protagonist couple, to Ottilie and the Captain Otto to share living in their mansion near Weimar "is described as an 'experiment', as it indeed is. The house and its surrounding gardens are described as 'a chemical retort in which the human elements are brought together for the reader to observe the resulting reaction'. As if in a chemical reaction, each of the spouses experiences a strong new attraction, which is reciprocated."[152]]

In order to answer the question why "modern science, as opposed to ancient and medieval science", only developed in the Western world, Needham insists: "Nothing but a careful analysis, a veritable titration of the cultures of East and West will eventually answer this question."[153] As a rather unconventional media-theoretical method and kind of analogue computing, this approach is closer to "experimental epistemology" in science[154] than to any history of ideas. Titration (also known as titrimetry) is a "laboratory method of volumetric analysis to determine the

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Needham to address Enthocentrism in Contemporary Philosophy and Society, in: Cosmos and History: The Journal of Natural and Social Philosophy, vol. 14, no. 3, 2018, 297-320 (298)
150 Needham 1993: 43
151 Needham 1993: 40
152 https://en.wikipedia.org/wiki/Elective_Affinities, accessed November 15, 2021, referring to Peter D. Smith, Elective Affinities (2001). "Archived 2006-06-15 at the Wayback Machine. Abstract from the article that appears in Prometheus 04" (note 2)
153 Needham 1993: 30
154 Warren S. McCulloch, A Historical Introduction to the Postulational Foundations of Experimental Epistemology, in: F. S. C. Northrop / Helen H. Livingstron (eds), Cross-Cultural Understanding: Epistemology in Anthropology, New York (Harper & Row) 1964, 180-193

concentration of an identified analyte (a substance to be analyzed)"[155] - not by analogy (such as in model building by analog computing), but by the actual reaction with another reagent, termed the "titrator". What is measured in such an operation is *not* historical knowledge interchange but an autonomous process, the degree of "technicity" in a given culture (in Gilbert Simondon's sense) - in terms of another culture's standard of what defines "technology" (at all).

Comparative Chronopoetics:

Chrono(techno)logy, in its double sense

The analysis of technical evidence from the past divides into two complementary families of media archaeology: the "historical" and the "radical" version. Zielinski, as an imaginative media historian, sets technical evidence in an sound archival context, and all media archaeology is as well media "archivology" indeed. Then there is Huhtamo's media-historical concept of recurrent technical "topoi". Finally, "radical" media archaeology claims a totally different, ahistoric tempor(e)ality for technologies as such. This becomes most concrete when the object of research itself is a "time piece": the escapement mechanism of the mechanical clock.

French philosopher and sinologue François Jullien argues that there has been no concept of linear time in China but only *shi*, which means 'occasions' or 'moments'."[156] The media-archaeological question is therefore twofold: Is there a different tempor(e)ality of technology in China, and are its time-techniques themselves of a different kind?

[The translational difficulties to find equivalents, in the Chinese language, to technical terms and neologisms like "time-critical" media, and media "tempor(e)ality", is not simply due to interlinguistic differences, but a symptom of a different techno-culture itself. Two aesthetics of time are semantically confronting each other here - with the "Eastern" one rather philosophical and ethical, the "Western" one rather technological. But in case expressions like "time-criticality" are not understood in its discursive but technological meaning, the inner-technical event, in itself, is non-ambivalent in its signal operativity across the cultures: It means moments, or instantiations, of time that are decisive for electronic processes to succeed - like the tricky synchronization of television lines between sender and receiver, or the "algorhythmic"[157] orchestration of data cycles within computing. The

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155 https://en.wikipedia.org/wiki/Titration, accessed April 28., 2021
156 Hui 2018: 210
157 Shintaro Miyazaki, Algorhythmics. Understanding Micro-Temporality in Computational Cultures, *online* in: Computational Culture, Issue 2 /

temporeal - in allusion to Jacques Lacan - is already challenging the symbolic order.]

On the one hand, in historiographical respects, a couple of technical inventions in China, such as the escapement-driven clock, have actually preceded their occidental counter-parts. But as it has already been remarked in Martin Heidegger's critique of "vulgar" clock time[158], such a chronology already presupposes a world-wide standard historical time itself, against the local autonomy of a cultural "proper time" (*eigenzeit*).[159]

For Needham, the rise of "modern" science - which (according to Heidegger) is intertwined with the rise of modern technology - is bound to names like Galileo Galilei. To what degree is the pendulum clock, with all its practical applications, "a simple consequence of a scientific discovery"[160]? Galilei's experiments with the free pendulum have been purely knowledge-driven, and epistemogenic in that sense: "The measurement of the pendulum's time of oscillation has no meaning other than in a scientific problematic, when it is a question of comparing the duration of precise phenomena" (Stengers ibid.). The pendulum is therefore not the time keeping mechanism necessary for *applied* calculation in the governmental or other sense.

Most of the inventions where Chinas seems to have been "in advance" of Europe but remained singular, and did not trigger a chain of techno-logical evolution.[161] If it is not driven by the love for knowledge for knowledge's sake (the proud academic tradition), it remains bound to governmental, bureaucratic pragmatism. Cultural techniques are "applied science", while a more experimental approach happens for the love of knowledge sake, in the sense of Presocratic Greek natural philosophy where *techné* means an emistemology of its own right, a true (philo-)techno*lógos*.

Among the advanced technical Chinese inventions in comparison to

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2012; http://computationalculture.net/algorhythmics-understanding-micro-temporality-in-computational-cultures
158 Martin Heidegger, Sein und Zeit [1927], Tübingen (Niemeyer), 11th ed. 1967, § 80 "Die besorgte Zeit und die Innerzeitigkeit", 411-420 (esp. 415)
159 See W. E., Die Herausforderung lokaler Zeitkulturen durch Chronotechniken (mit einem Akzent auf Takt vs. Rhythmus), in: Patrick Eisenlohr / Stefan Kramer / Andreas Langenohl (eds.), Parallaxen moderner Zeitlichkeit [Ästhetische Eigenzeiten, Band 22], Hannover (Wehrhahn) 2021, 165-184
160 Stengers 1997: 185
161 See Richard E. Nisbett, The Geography of Thought. How Asians and Westerners Think Differently ... and Why, New York (Free Press) 2003

Europe, Needham explicitly discusses the media-epistemic core element in the mechanical clock, "the invention of an escapement, namely a mechanical means of slowing down the revolution of a set of wheels so that it would keep time with humanity's primary clock, the apparent diurnal revolution of the heavens"[162]. Different from other cultural techniques, "that Chinese practice was not [...] purely empirical. The successful erection of the great clocktower of Su Sung at Khaifêng in A.D. 1088 was preceded by the elaborationof a special theoretical treatise by his assistant Han Kung-Lien, which worke dout the trains of gears and general mechanism from first principles" (ibid.) - *en arché*. But it is the juncture of such an escapement mechanism with a consistent mathematization in early modern Europe which apparently has been missing, to a certain decisive degree, in China.

Chronotechno/logy, in its double sense, is not only related to a material mechanism like the escapement, but to an analytic, mathematical concept of time keeping as well. Here we see, most concretely, the contrast in the views of time and space, "as exemplified by the Greek finite crystalline universe and the Chinese infinite empty-space universe"[163]. An infinite universe does not trigger a purely mechanical concept like the celestial clock, nor the computational model of the Turing machine.

[What kind of cultural techniques is related to the concept of time in ancient China, and how did media technologies - in the escalating sense - change such concepts in modernity? According to Needham, the category of time has never been absent in China[164], but has been dominated by historical consciousness.[165] With genealogical chronology and history as the queen of sciences in China, the emergence of „mathematization" as driving force in modern science (Heidegger's "Zeit des Weltbildes"[166]) has been hindered.[167]]

It has been exactly the Chinese theosophy of "cosmotechnics" which prevented, in Daoism, the evolution of a mathematized natural science. Consequently, the order of nature (*kosmos*) has not been perceived in terms of mathematical laws, but as *li* (rules of destiny).[168] There is a

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162 Needham 1993: 35
163 Cheng-Yih 2008: 113
164 Joseph Needham,"Time and Eastern Man", in: idem 1969: 218–298 (219)
165 Needham 1969: 234
166 Martin Heidegger, The Age of the World Picture, in: idem, The Question Concerning Technology and Other Essays, New York, NY (Garland) 1977, 115-154
167 Needham 1969: 242
168 Joseph Needham,"Human Law and the Law of Nature" [*1951], in: idem 1969: 299–330 (323 seq.)

"negative techno*lógos*" connected to scholar Yuk Hui's celebration of Chinese "cosmotechnics". As has been remarked by a reviewer of Needham's *Grand Titration*, the Chinese set of mind rather adopts to "nature", instead of subjecting it to neg-entropical knowledge and its objectification in terms of technologies.[169] The ethics of "cosmotechnics" is a hindrance against radical abstraction into the non-metaphysically operative symbolical machine (which Husser lamented in his *Krisis* work).

Francois Jullien has argued that Chinese culture, for many reasons, has not aimed at a concept of "absolute time", as it is known from European philosophy and Newtonean science, in favour of a semantic temporal plurality like "the instant", and "duration", instead. Such heterochronic concepts, in a surprising way, more precisely short-circuit to what actually happens *within* time-critical technologies, such as the precise escapement mechanism to "digitize" time. Therefore, a core question is to what degree the genesis of technological objects in China has been - and still is - related to the Chinese notion of "time". Has their been, in the Chinese cultural tradition, an incommensurability between its time philosophy, and its operative time technologies? In its precaution not to get lost in lofty philosophical speculations on "time", media archaeology radically seeks insight, for that epistemic question, by grounding its analysis in the close technical inspection, and inductive knowledge, from *within* the technological mechanisms themselves. Let us therefore shift such an analysis from East to West, and "back" again.

The controversial invention of the escapement-driven clock mechanism in Benedictine monasteries has been decisive, since late medieval Europe, for the development of a chrono-technical notion of equidistant, quantized temporal units, intervals called "seconds", resulting in a "digitization" of the notion of time itself.[170] In comparison, a huge water-driven mechanism at the Chinese imperial court in the year 1092 has been provided with a kind of "stop-and-go" mechanism; on the background of this evidence, Needham discussed whether there has been a direct technological link between the European escapement mechanism, and this Chinese invention, on the basis of cultural knowledge transmission - or whether both cultures, independently, came to isomorphous solutions for similar problems by techno-logical (rather than techno-historical) necessity. Media archaeology seeks to identify this momentum in the rigid sense of co-originality ("Gleichursprünglichkeit" in

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169 "Vielleicht sollte die chinesische Geisteshaltung, die Natur nicht zu bekämpfen, sondern sich ihr anzupassen, als einer der entscheidenden Faktoren für das Ausbleiben der neueren Wissenschaft und Technik besonders vermerkt werden." Liu Mau-Tsai, in: NOAG 111 (1972), 63-65 (64), https://www.oag.uni-hamburg.de/noag-archiv/noag-111-1972/rez-3.pdf, Zugriff 6. Mai 2021
170 As discussed in Gerhard Dohrn-van Rossum, History of the Hour, Chicago (University of Chicago Press) 1996

German language, a term frequently used by philosopher Martin Heidegger). This technological "origin" can by no means be reduced to the beginning in the "historical" sense, but seeks to identify the *arché*, a beginning as "command"[171], or "call-to-knowledge" in the ancient Greek sense. This *arché*, not by coincidence, is the core element in the very term media archaeology itself.

"Heavenly Clockwork"

Fig: Reconstruction sketch of the escapement mechanism of the "Heavenly Libra", in: Dohrn-van Rossum 1992: 86, Fig. 18

When the missionaries of the Jesuit order introduced mechanical clocks in Japan and China at the end of 16th century, self-beating clocks were admired as marvels of European invention, when compared to rather imperfect local water clocks. But there had been a complex water clock in medieval China before, the "Heavenly Libra" for both driving astronomical mechanisms and dividing the day into 100 quantities by an escapement mechanism indeed. In the era of Western-Easter direct contact in early modernity, though, Chinese culture itself seems to have practically forgotten its own advanced water clock technique. Such knowledge only resided in archival latency, in remotely accessible texts.[172]

In his 1927 provocative text with the title "Radio - An Antediluvian Invention?", Bertolt Brecht recalls "an old story in which the superiority of Western culture is supposed to be made clear to a Chinese man. He says, 'What have you got?' They reply, 'Railways, automobiles, telephones.' 'I am sorry to have to tell you,' replies the Chinese man politely, 'that those are things we have already forgotten'"[173].

Is the Chinese concept of technology itself "time"-reversed? The "prehistoric", here, is not a term for times preceding historical (writing) cultures, but in a media-archaeological sense denotes an anachronism in the strong sense- just as Walter Benjamin defined "antiquity" as an immediately discontinued present. Techno-logical tempoReality is structural rather than "historic". The temporal qualification "ancient" is indeed "not used by Chinese and Western historians in the same way.

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171 As reminded by Jacques Derrida, Archive fever, xxx
172 Dohr-van Rossum 1992, 84 ff. subchap. "Die 'Himmlische Waage' [the "heavenly libra", 84 seq.
173 As quoted in: Zielinski / Fürlus (eds.) 2008: Introduction (14). The short text appears in vol. 18 of Brecht's Gesammelte Werke (Schriften zur Literatur und Kunst I.) (Frankfurt, 1967) pp. 119 ff; for an English translation of the text see: Brecht on Film and Radio, ed. Marc Silberman (London, 2000), 37

Chinese historians refer to the time before the Opium Wars of 1840 as 'ancient', whereas for Western historians the period before the fifth century, when the Roman Empire withered away, is 'ancient'."[174]

This reminds of the flip-side of hardware-oriented media archaeology, which is media archivology. When Joseph Needham published the first volume of his Science and Civilization in China, in 1954, he described the mechanical clock as the last genuinely European invention which has been imported to China.[175] A few years later this argument revolved, after the rediscovery of medieval reports on a complex clockwork mechanism in China - in text form, not as actual mechanical artefact.[176] "The fact that relatively little written evidence concerning these technical details has come down to us springs from social factors which prevented the publication of the records which the higher artisans certainly kept."[177] Less than the excavation metaphor which is frequently associated with "media archaeology", it is rather about uncovering the archive (with l'*archive*, though, in the Foucaultean sense, comprising the material machine as well).

The escapement clock mechanism is decisive since is embodies the escalation from cultural (chrono-)technique to an autonomous time technology. Is the *techné* of the escapement mechanism equipped with a *lógos* of its own (instead of an external application, or incorporation by cultural knowledge)? According to Needham, the relationship between matter (energy) and form (organization) is "a reciprocal one, in which matter, possessing a logic of its own, sought an appropriate form or 'level of organization'."[178] Such a logic of its own has its immediate consequences. Against the intransparency of porcelain in China, the predominance of glass in Europe induced lens-based, dioptrical media for projection and inspection, as a technical invitation from its very materiality.

When the levels of organization, in turn, correspond to the scale of matter, this requires a larger system theory of organization, rather than analysis which dissolves systems into a collection of particles in the Western atomistic tradition of science. Against the Aristotelian view that form was an imposition on matter[179], respectively "in-formation" (in Flusser's wording). Needham's argument is inherently techno-logical: "something had happened to matter that made it inconceivable to

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174 Nianzu 2008: 117, note 1
175 Cambridge 1954, 243
176 Joseph Needham / Ling Wang / D. J. de Solla Price, Heavenly Clockwork. The Great Astronomical Clocks of Medieval China, Cambridge (Cambridge University Press) 2008 [2nd ed. Cambridge 1986]
177 Needham 1993: 36
178 Chen 2019: 124
179 Chen 2019: 124

separate it from form"[180].

The crucial question, between history of science, and media archaeology, is its agency: Does human research lead to such a discovery, or is there rather, in parallel, technology re-inventing itself - just as the late medieval monastic clock escapement mechanism in Europe evolved independent from the Chinese "heavenly libra"? In the privileging of continuities by historiography, the Chinese clock mechanism is immediately contextualized as a "missing link" in the chain of technical evolution, between the ancient water clock, and the late medieval mechanical clock in Europe.[181] In media-archaeological perspective, though, there is rather an isolated technical autopoiesis, as a more universal phenomenon. This "time piece" mechanisms is not even necessarily directed at time measurement, and probably rather a misappropriation, or "abuse", of another model mechanism.

"[W]hile the invention of the wheel is a technical tendency, whether or not wheels will have spokes is a matter of technical fact." / "While a technical *tendency* is necessary, technical *facts* are accidental: as Leroi-Gourhan writes, they result from the 'encounter of the tendency and thousands of coincidences of the milieu'."[182]

The great astronomical clock, once constructed from 1092 onwards for the Chinese court, has been an assemblage of diverse timing indications, from astronomical time down to acoustically indicated quarter hours of the day, all driven by a central water wheel with distinct movable scoops which were all counter-balanced. Here we come to the media-epistemically decisive mechanism. Its precise technical identification is a core media-archaeological "hermeneutic" competence - "radically" knowledge-oriented investigation, as technical analysis. All of the sudden, a mechanism - instead of simply transforming energy - communicates "information" (in Stengers' sense). "Time", in fact, is movement reformulated into information.

In the Chinese "heavenly clock" case, an "analog" flow of water supplied the movable scoops from a storage tank, until they flipped and triggered a mechanism which prevented the wheel from driven backwards. This "stop-and-go-movement"[183] allowed for time-discrete "clocking" in the

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180 Joseph Needham, Matter, Form, Evolution, and Us, in: World Review (1941), 15; rpt. in: Their Changing World, ed. J. R. M. Brumwell, London (Routledge, 1944), pp. 27–37 (30 seq.)
181 Joseph Needham, The Missing Link in Horological History: A Chinese Contribution [1958], in: idem, Clerks and Craftmen in China and the West, Cambridge 1970, 203-238
182 Hui 2016: 8, quoting André Leroi-Gourhan, L'homme et la Matière, Paris (Albin Michel) 1973, 27
183 Dohrn-van Rossum 1992: 88

material and symbolic sense and implemented a true "escapement" mechanism, but fundamentally differs, in principle (in media-*arché*) from the oscillating foliot escapement of the European Middle Ages - which D. Landes therefore described as splendid "dead end"[184]. Against a radical escalation into the abstract "machine", the "heavenly libra" maintains a "cosmotechnical" relation to the natural water flow as the proverbial analogy to the "flow of time" (in Heraclitus' Presocratic sense of *panta rhei*).

What has been the case, in the East-West comparison of such clock escapement mechanism, is rather two instanciations of co-evolution. Needham and Price still insist on a historical model of cultural knowledge transmission of this mechanism from China, via the Arabic world, to the West, as "stimulus diffusion"[185] for the improvement of such an escapement. But such a cultural knowledge diffusion - different from Needham's "chemical" epistemology - remains speculative. There is rather an equiprimordial co-evolution of time-delayed, but equally targetted technical knowledge ambitions.[186] In the European monastic case, this was less bound the "heaven" (astronomical modelling, with all its religious and ethic discursive implications), but rather pragmatically to the cultural-technical ritual of prayer itself: a clock mechanism for waking up monks for regular prayer in the night, that is: in the absence of any sun dial (therefore "clock", from French *cloche*). Only accidentally it turned out (rather by internal knowledge from within technology, as implicit techno*lógos*) that the repetitive mechanisms for the alarm clock could be (mis-)used for indicating the hour as well, in a techno-metonymical shift of emphasis towards different interfaces (the clock dial).[187]

["Grounding" the Inter-Cultural Question concerning Time: A Comparative Media Archaeology of the Escapement Mechanism]

For the media-archaeological approach, it is mandatory to start its analysis from the existent technologies themselves. Only a "close reading" of the material technical detail, or symbolical code, brings media-epistemic equivalences, vs. cultural differences, into view - its "anonymous history"[188], including the hypothesis of a techno*lógos* according to which there are independent, parallel lineages of thinking

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184 David S. Landes, Revolution in Time. Clocks and the Making of the Modern World, London / Cambridge, Mass. (xxx) 1983, 17 ff.
185 As quoted in Dohrn-van Rossum 1992: 88
186 Dohrn-van Rossum 1992: 88
187 Dohrn-van Rossum 1992: 102
188 In the sense of Sigfried Giedion, Mechanization takes Command. A Contribution to Anonymous History, New York (Oxford University Press) 1948

media, which occur in widely spatially, or temporally, separated cultures of the globe.

One of the few moments when Hui does not simply philosophize about technology in China but mentions a precise technology, is the media-archaeological anamnesis of the escapement-driven clock work.

Associated with media archaeology, different from conventional media history in terms of Cultural Studies, is another concept of the relation between techno/logics, and "time".

There is a different tempor(e)ality for media archaeology in China. Jullien notes, for the pre-modern Chinese understanding of time, that "the movement of the seasons is taken as a first principle, is fundamentally idfferent form that of the [geometrical / numerical: mathematical] Aristotelian tradition, which is based on a conception of time as [counting] movement from one point to another" = Hui 2016: 211. One this *analysis* becomes mechanical *synthesis*, the proverbial clock mechanism derives. But no the other way around: a contingent mechanism does not necessary results in an epistemic shift, as longs as it internal techno*lógos* is not understood by human use. According to Jullien, the abstract concept of "time" has remained absent in China ("out of - historical - time" itself, ana-chronistic): "although one can find ways of recording dates and years" - annalistic rather than narrative -, "the perception and understanding of time remained closely attached to concrete events rather than abstract time"[189]. Positively formulated, this is a rather media-archaeological attitude: not subjecting a mechanism to *lógos*, but induced *vice versa*. The mechanism itself does not know "time".[190]

Ironically, even with the "absence" of a genuinely *scientific* technological thinking in China - as discussed in Joseph Needham's monumental analysis of the question why modern science and technology did not (e)merge in China[191]-, the Chinese were "pioneers in clockmaking: Zhang Heng (78-139) succeeded in using water to rotate an armillary sphere, and the polymath Su Song (1020-1101) constructed one of the first clocks in the world, the 'Water-powered Armillary & Celestial Tower' (1088).[192] Su's mechanism, though, was abondoned 1214 "due to the difficulty of transportation during the move of the capital [...], and no one else could understand the documents drafted by him in order to rebuild

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189 Jullien, as paraphrased by Hui 2016: 210, note 18
190 See W. E., Does "Time" Make Sense to Media?, forthcoming in: Natasha Lushetich / Iain Campbell (eds.), Distributed Perception: Resonances and Axiologies, London / New York (Routledge) 2021
191 See Hui 2016: 167
192 Hui 2016: 210 seq., note 18, referring to Needham / Wang / de Solla Price 2008, 7

it"[193]. In parallel, Chinese "explosion" diagrams of Western machines reveal no analytic technological sense.[194]

"[...] the question we should reflect here is that of whether the existence of calendarity implies a conceptual 'elaboration' of time?"[195] For Aristotle, time itself becomes the function of movement; its essential quantification (as "analog-to-digital-conversion", concerning the apparent "flow of time") is a cultural technique of counting[196]: "[...] time is a number, not by which we number, but rather as a thing numbered, and this is always different when eyarlier or later; for the nows are different."[197]

The spatio-temporal interval, the "between" (to metaxy / Latin *medium*), here literally "counts". "But, as Jullien shows, this [geometrical] notion of time as interval only reached China in the nineteenth century, following the adaption of the Japanese translation of time as 'between-moments' - *jikan* in Japanese and *shijian* in Chinese."[198]

So far theory. But only when such a cognitive diagram is actually implemend in / as machine and becomes media-time (the clockwork), a different kind of temporality emanates: frictions, dissipations, entropy.[199] In order to grasp such non-perceptional sensibilities, radical media archaeology as a form of "posthuman cultural studies"[200], rather takes the point of view (*theoría*) of the machine itself. In their introduction to *Critical Terms for Media Studies* (Chicago 2010), the editors W. J. T. Mitchell and Mark B. N. Hansen take the title of Marshall McLuhans seminal *Understanding Media* (1964) at face value: Current cultural analysis requires a media-active understanding from the perspective of technologies themselves.

Chinese cultural understanding of "time" rather adhered to the astronomical orientation, which is "analog" time, different from machine-abstracted "digital" time. In such a view (shared in ancient Greece as well, apart from the philosophical "atomists" like Demokrit), there is no

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193 Hui 211: note 18
194 See Bruno Latour, Drawing Things together, in: Michael Lynch / Stevel Woolgar (eds.), Representation in Scientific Practice, Cambridge, Mass. (MIT Press) 1990, 19-68
195 Hui 2016: 211, note 18
196 See Siegert, xxx, in: Hiller / Höltgen (eds.) 2019
197 Aristotle, Physics, 220b5-12, cited [by Hui 2016: 211, note 19] in: D. Bostock, Space, Time, Matter, and Form. Essays on Aristotle's Physics, Oxford (Oxford UP) 2006, 141
198 Hui 2016: 212
199 See Stengers 1997
200 Geoffrey Winthrop-Young, Cultural Studies and German Media Theory, in: Gary Hall / Clare Birchall (eds), New Cultural Studies, Edinburgh (Edinburgh University Press) 2006, 88-104 (100)

"ticking" clock, but the rather "circular", continuous movement of planets.

The Chinese equivalent to ancient Greek *kósmos* (or Latin universe) is non-atomic; it is rather comparable to the "chronotope" in literary studies (Michail Bakhtin): as Yu (space) Zou (time), where Zou "is etymologically related to the wheel of a wagon, from whose circular movement time takes its figurative metaphor", in astronomical terms.

But with Christian Huyghen's introduction of zycloids into the pendulum clock mechanism in Europe, time became autonomous: isochronic. It is from such close analysis of the critical technological elements that media-archaeological insight arises.

Inspired by the blockchain company Solana's claim of the water clock as an analogy of the central feature of its network architecture (a "clock before consensus" in its Proof of History protocol)[201], Stamatia Portanova actually relates the recent Chinese interest in blockchain techno-economy (which chronotechnically based on "time stamps") with the Hellenistic Greek clepsydra invented by Ctesibius on the one hand, and somewhat asymetrically with time consciousness as developed in ancient China, down to Su Song's Heavenly Clockwork with its escapement mechanism.[202] "The functioning of the clock tower will thus give us the possibility to closely analyze a technical o bject [...] that could be sonsidered as a blockchain ancestor [...] of physical and cultural processes."[203] The crucial question still remains, if such technological intelligence (in its double sense, with China's "social score" system) should be deciphered as a result of cultural-historical formation, or be granted a techno-chrono-logics, or tempor(e)ality, of its own, when epistemic insight is "abductively"[204] derived from close technical analysis of, e. g., the escapement mechanism which, in the case of Su Song's clockwork, actually converts "analog" (water-)flow time into time-discrete "digital" counting, while maintaining the phenomenal illusion of a steady continuous, circular motion on the in its double sense level of the armillary sphere which served as the predominant "interface" of the clock

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201 Solana, Proof of History Explained by a Water Clock. A useful analogy for understanding Solana's network architecture, in: Medium (entry June 27, 2018), https://medium.com/solana-labs/proof-of-history-explained-by-a-water-clock-e682183417b8, accessed September 1st, 2021
202 See Stamatia Portanova, Whose Time Is It? Asocial Robots, Syncolonialism, and Artificial Chronological Intelligence, London (Sternberg Press) 2021, 56-68
203 Portanova 2021: 57
204 On that method of thought, see Charles S. Peirce, Lecture VII. Pragmatism and Abduction, in: Collected Papers of Charles S. Peirce, ed. by Charles Hartshorne / Paul Weiss, Cambridge, MA (Harvard UP) 1974, 112-131

tower in Kaifeng. Time-continuous *integration* of a passage of time (like in analog computing, here: time-"counting"), as in the case of the clepydra, here categorically differs from the time-discretization operated by the escapement mechanism in Su Song's, or late medieval European, clockworks.

Ethical Control vs. Media-Archaeological Liberation of Chronotechnics

Contrary to the media-archaeological techno*lógos* hypothesis[205], Yuk Hui aims at "opening the question of technics not as a universal techno-logy [sic], but as a question of different cosmotechnics"[206] with its media-environmental concern, "giving priority to the moral and the ethical"[207] as a return to / of pre-modern Chinese philosophy of technique.

As a cultural concept, the notion of technique in China refers to the classic book Yi Jing. Different from the Western concept since Greek antiquity (and criticized by Heidegger as an "oblivion" of being), ancient China regards technology as low, and rather emphasizes moral and ethical questions concerning the relationship of human beings to nature. It is such "cosmotechnics" (Hui) that prevented China from inventing the autonomization of machines from nature (matter and energy), such as the thermionic tube for electronics (in difference to mere electricity), or the digital computer in terms of the Turing machine.

Science and Technology Studies try to explain the difference between Eastern and Western evolution of technology by an emphasis on its embededdness in various historical, and socio-economic or -political contexts. Why can it then be that computing and communication engineering, as developed in the West, ultimately succeeded in China with its fundamentally different cultural and scientific history? The answer[208] lies in the radical de-contextualization of both technologies.

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205 See W. E., Techno*lógos* in Being. Radical Media Archaeology and the Computational Machine, New York et al. (Bloomsbury Academic) 2021 (*Thinking Media* series, eds. Bernd Herzogenrath / Patricia Pisters), forthcoming
206 Hui 2016: 289
207 Hui 2016: 290
208 As it has been suggested by David Friedrich M. A., in a discussion following following the online-presentations by W. E., Against the "Dead Media" metaphor. "Objectified" and Processual Media Analysis in the Media-Archaeological Fundus, and "Radical" Media Archaeology as its Research Method, from the Media Archeaological Fundus, Humboldt University, Berlin, in the *Digital Dish* series, organized by Ljudmila Art And Science Laboratory, and Projekt Atol Institute (Ljubljana), 17th of June, 2021

The Turing machine is ultimately powesrful by its radical procedural "stupidity" (Lacan's "alphabêtise"), and information theory by its no less radical distance to any questions of semantical meaning in signal transfer.

While the escapement mechanism of the medieval Chinese clock tower has been such an autonomization in machine terms, it did not emancipate from its referencing back to natural astronomy as the ultima time measuring quality. It is the will to know (Nietzsche), as epistemic desire, which divides true technology from merely "applied" cultural techniques.

[Media archaeology in the "Berlin School of Media Science" tradition insists on rooting any philosophy of technology in precise case studies resp. technical analysis. Whereas Jullien (and Hui), in their studies on the Chinese concept of "time", remain mostly philosophical, media archaeological grounds analysis in the actual timekeeping device where the media "time" (philosophical) question becomes its own topic: the escapement-driven clock. Media archaeology insists on an archaeographical description of the technical device in its materiality and its operativity.]

["From ancient times - that is, from the deep time of Chinese knowledge culture - knowledge concerning calculation of the passage of time, from day to night and light to dark, was not dubbed heliology or heliologics, but was known as gnomonics. The name comes from the gnomon, a perpendicular rod that was driven into the ground or a many metres-tall obelisk, which then cast a shadow upon the even plane around it showing the passage of the hours. The gnomon is the artificial agent positioned between the natural light of the sun and the abstract measurement result that can be read off the graduation: the shadow rod functioned as the medium in gnomonic projection."[209] But then - according to Needham - this did not result in the kind of analytical geometry which characterizes Cartesian modern science. The "analogy" between measuring device and nature remained direct, not indirect like in analog computing where the common denominator is the respective mathematical analysis of both agencies: natural movement on the one hand, and the technical device on the other.]

So what is "heavenly", even metaphysical, about such clockworks? Nothing, in media-archaeological terms. It is rather by precise reference to astronomy (driving the armillary). But then, the decisive media-archaeological discontinuity (Foucault's emphasis in his *Archaeology of Knowledge*) is the emancipation of the time-basing mechanism from the "heavenly" planet circulation, to be more exact (Huyghens).

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209 Siegfried Zielinski & Eckhard Fürlus, Introduction: Ars brevis umbrae et lucis, in: idem (eds.), Variantology 3 / 2008, 7-14 (11)

The crucial media-archaeological question is this: Does the autonomization of "time" from nature result from an intertwining of social, economic, governmental, and technical processes (the STS approach), or rather follow its own internal "technical reason" (techno*lógos*)?

["Right from the start, the introduction of mechanical devices for measuring time had posed the problem of the relationship between astronomical time and clock time. The first mechanical clocks, as is also the case with the sundials that have remained from antiquity, are not timekeepers but ways of representing and marking the course of the sun. The base unit was the diurnal period, divided into twelve hours of equal length, which involves a variation in the length of the hour according to the time of year. Thus, the first clocks were not subjected to any constraint pertaining to precision and regularity; on the contrary, the mechanism had to provide for a variability in the speed of the clock hands so that they could be adjusted to the variation in the length of the 'temporary hours.'"[210]]

[If "train time" - as proposed by Belgian astronomer Adolphe Quételet - "can be deduced from the longitudinal position of the point and its average solar time"[211], this analysis is closer to analogue computing indeed.]

[The "Politics" of Media Archeology, and Technical Micro-Analysis:]

The Language(s), Writing and Politics of *Techné*

Different "languages" of science:

The historian of Chinese science Chen Cheng-Yih, for comparison between Chinese and Western technical thought, identifies a contrast in the "languages" of knowledge.[212] Does this difference in language extend to the techno*lógos* itself?

The unique decisive difference "modern science" made to both ancient and medieval science in Europe, and to the Chinese scientific tradition, since the time of Galileo in the late Renaissance, has been "the

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210 Isabelle Stengers (mit Didier Gille), Time and Representation, in: dies., Power and Invention. Situating Science, Minneapolis / London (University of Minnesota Press) 1997, 177-212 (179)
211 Stengers 1997: 181
212 Chen (Joseph) Cheng-Yih, Cultural Diversities. Complementarity in Opposites, in: Zielinski / Fürlus (eds.), Variantology vol. 3 / 2008: 153-190 (153)

application of mathematical hypotheses to Nature, the full understanding and use of the experimental method, [...] and the acceptance of the mechanical model of reality"[213] - different from all "organic", or holistic, intertwinement of science and nature. Only thereby operative mathematics, the symbolical machine (and finally, computing) could emerge, while the dominance of two fundamental forces like Yin and Yang, remained an allegorical oscillation unless analyzed like a (co-)sine function in Fourier analysis - which Needham calls East / West "the wave-particle antithesis"[214], apparently inspired by quantum physics. Only mathematical operations, as *characteristica universalis* (Leibniz), could be inter-nationally communicated. Only from its "fusion with mathematics"[215] natural science, as operative knowledge, has been suspended from its symbolical cultural semantics. The fusion of technics with logics resulted in technology as such - a fusion which, even though China had a long-developed algebraic mathematics, did not coincide with engineering[216], as long as the Chinese aversion against atomism prevented scientific *analysis* (which McLuhan understood as a function of the ancient Greek alphabetic writing system itself). In spite of its marvellous single and advanced technical achievements, "the *philosophia perennis* of China was an organic materialism", preventing the "mechanical view of the world"[217].

In that sense, with an application to China, Hui quotes Heidegger. Just like in Heidegger's diagnosis of "The Time of the World Picture", the mathematization of science in early modern Europe has divorced the question of technology from its original Greek understanding of *techné* as nature (*physis*), technological modernity, "[i]n the case of China, the *Qi-Dao* unity has been completely shattered"[218]. Against Science & Technology Studies ("Needham's argument centres on both social and philosophical factors"[219]), "[t]his is "not only a socio-political question, but fundamentally an ontological one"[220]. Needham quotes from Master Lü's Spring and Autumn Annals (around 240 B.C.) on the working methods of the Tao of Heaven: "This may be called the untaught teaching, and the worldless edict."[221] Follows Needham's comment on such *archai* "which no one had ever issued or even put into words" (kind of implicit techno*lógos*): "Such a conception is truly sublime" (ibid.).

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213 Needham 1993: 31
214 Needham 1993: 35
215 Needham 1993: 31
216 Needham 1993: 32 f.
217 Needham 1993: 34
218 Hui 2016: 241
219 Hui 2016: 168
220 Hui 2016: 241
221 As quoted in Needham 1969: 324 (his tr.)

"The Unification of Dao and Qi" (Hui) vs. Technology

"There are innumerable observations of metal melting and lacquer ware remaining unscorched when struck by lightning; thus people acquired their first knowledge about conductors and insulators."[222]

"Radio" has been discovered before it was "invented"[223] at different places, according to similar electro-physical laws in combination with their experimental, playful human approach: "The Chinese discovered static electric attraction and that many kinds of materials become electrically charged when rubbed: also that there is a flash and a noise when they discharge."[224]

How does heavenly lightning relate to electronics, that is: electricity (as energy) becoming technology? "[T]he unification of Dao and Qi"[225] actually prevents such an escalation. The flashes and flows of electrons within a thermionic tube is a "Promethean fire" of a new kind.

In Chinese Daoism, "technique must be compatible with *Dao* in order to attain its highest standard"[226], resulting in "[I]n its modern sense *Qi* means 'tool', 'utensil', or more generally, 'technical object'"[227], while *Dao* stands for the supreme order of beings.

On the genesis of the compass in ancient China, for example, Nianzu remarks: "In ancient China the attracting and repelling forces of magnetism and the polarity of magnets were known. This article highlights the knowledge of Liu An […], King of Huainan in the Han Dynasty, and his followers about magnetism, especially the fact that they were the first to succeed in producing magnetic bars. Further, there are many stories about magic and conjuring tricks that employed magnetism."[228] But did such knowledge ever emancipate from the cosmic theology or philosophy (like European "natural philosophy" of Schelling, Hegel on electricity), vs. a truly analytic science? "In history, for a long time people thought that thunder and lightning were expressions of the mood of the gods. Most philosophers and thinkers explained their causes with the Qi of the Yin and Yang. The philosopher Wang Chong of the Han Dynasty was the first to put forward the idea that thunder and lightning consist of fire. […]" - which at first sight looks comparable to Presocratic observations (Empedocles). " But in Daoism, "this philosophy of nature

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222 Nianzu 117
223 As expressed by xxx, in: xxx
224 Dai Nianzu, Electricity, Magnetism, and Culture in Ancient China, in: Zielinski / Fürlus (eds.) Variantology vol. 3, 2008: 117-151 (117)
225 Hui 2016: 65
226 Hui 2016: 65
227 Hui ibid., referring to Laozi
228 Nianzu 2008: 117

did not indulge in speculations on the basic material elements of the world, as was the case with Thales, Anaximander, Empedocles, and others, but rather treated of an organic or synthetic form of life"[229] - which preferred environmental harmony to rigid analysis (as induced by the alphabetic elementarization of human speech - the "technologization" of the word, with Walter Ong[230]).

Towards an Archaeography: Writing, and Techno-Logical Thought

Printing with block letters had been invented in China centuries before it occurred in Europe. The difference to the Gutenberg book print lies in a different technical logic, with its focus in the identical reproducibility of its single movable lead letters by the negative mold of the hand casting instrument. Identical text reproduction in fact is a critical condition for knowledge circulation concerning both the text, and its scientific illustrations.[231]

According to McLuhan, the phonetic alphabet in ancient Greece privileged elementary, analytic thinking in science, privileging the epistemology of an abstract symbolical mechanism, in contrast to the iconogram in China. In ancient Greece, the radical elementarization of oral speech by the vocal alphabet already privileged an atomic scientific approach to physical articulation.[232] As a decisive step for the emergence of what Needham calls "modern science", mechanical reproduction replaced the human idiosyncrasies of writing by hand - while historian Carlo Ginzburg points to "the striking case of China, where the invention of printing did not cut the ties between literary text and handwriting."[233] Has this actually been due to the pictographic characteristics of Chinese characters themselves, preventing a more functional concept of symbol manipulation techniques?[234]

As a "language" function of the Western alphabetic principle and the

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229 Hui 2016: 64
230 Walter Ong, Orality and Literacy. The Technologizing of the Word, London (Methuen) 1982
231 For the Western case, see Elizabeth L. Eisenstein, The Printing Press as an Agent of Change, Cambridge / London 1979], Vienna (Springer) 1997
232 See as well J. Goody / J. Watt, The Consequences of Literacy, in: Comparative Studies in Society and History, vol. V (1962-63), 304-45
233 Carlo Ginzburg, Clues: Roots of a Scientific Paradigm, in: Theory and Society, Vol. 7, No. 3 (May, 1979), pp. 273-288 (275)
234 See Thomas Francis Carter, The Invention of Printing in China and its spread westwards [*1925], 2nd ed. 1955. See as well Thomas S. Mullaney, The Chinese Typewriter. A History, London / Cambridge, MA. (MIT Press) 2017

Chinese logographic principle, Chen Cheng-Yih identifies a "contrast in their logic, as exemplified by the formal Aristotelian syllogism and the pragmatic Mohist [natural philosophy] model thinking. We see the contrast in their mathematical proofs, as exemplified by the Greek axiomatic deductive proof and the Chinese derivative proof."[235]

Needham, though, rejects "the thesis that pictographic writing hindered the advancement of science in China; [...] it enables the same expression with much greater brevity"[236].

Lacking singular characters for vocals, Chinese writing is not phonocentric. Is Cheng-Yih's approach logocentric, in contast to a more elementary analysis (the symbol-operating machine) as a function of the *vocal* alphabet in the Western epistemology[237]? "The notation invented to express technical and quantitative concepts in fields such as mathematics and sciences, is basically a type of language. The current notation adopted in mathematics [...] is a system composed mainly of symbols, signs, marks, as well as characters. As a language, such a notational system is logographic in nature. The pronunciation of the symbols in such a notational system can be readily adapted to the pronunciation of the spoken language of the user or the reader."[238]

["In a written language, a logogram or logograph is a written character that represents a word or morpheme. Chinese characters [...] are generally logograms, as are many hieroglyphic and cuneiform characters. [...] All known logographies have some phonetic component, generally based on the rebus principle. Alphabets and syllabaries are distinct from logographies in that they use individual written characters to represent sounds directly. Such characters are called phonograms in linguistics. Unlike logograms, phonograms do not have any inherent meaning."[239]]

Is media archaeology itself a function of its elementary writing system? While media archaeology is radically analytic concerning technologies and therefore not burdened by the hermeneutic quest for meaning, while relating such evidence to epistemic questions at the same time,

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235 Chen (Joseph) Cheng-Yih, Cultural Diversities. Complementarity in Opposites, in: Zielinski / Fürlus (eds.), Variantology vol. 3 / 2008: 153-190 (153). For a translations of the traditional texts, see Angus Charles Graham, Later Mohist Logic, Ethics and Science, Hong Kong 1978
236 Hui 2018: 168, referring to Needham, The Grand Titration 1969 / 2005: 38
237 See W. E. / Friedrich Kittler (eds.), Die Geburt des Vokalalphabets aus dem Geist der Poesie. Schrift - Ton - Zahl im Medienverbund, Munich (Fink) 2006 (series "Kulturtechnik", vol. 5)
238 Cheng-Yih 2008: 163
239 Wikipedia, entry "Logogram", https://en.wikipedia.org/wiki/Logogram, accessed May 1st, 2021

"cosmotechnics" relates technical phenomena to ethical concerns - logographic rather than archaeographic.

"We see the contrast in their views of building elements of the world, as exemplified by the Greek view that the world is made of atomos [atoms]" - related to the cultural technique of alphabetic writing as analytic (McLuhan) as background to counting time by numbers "and the Chinese view that the world is made of qi [energy]. Such contrast in approaches and views arising from cultural diversities were often found to be complementary."[240]

Interpolation: Chinese Writing Characters, and / or Information Technology"

What are the limits of logographic writing concerning the transition from cultural techniques to technology? "Entering complex characters can be cumbersome on electronic devices due to a practical limitation in the number of input keys"[241], that is: the literal *writing machine* / typewriter.

[There exist various input methods for entering Chinese logograms, "either by breaking them up into their constituent parts such as with the Cangjie and Wubi methods of typing Chinese, or using phonetic systems such as Bopomofo or Pinyin where the word is entered as pronounced and then selected from a list of logograms matching it. While the former method is (linearly) faster, it is more difficult to learn. With the Chinese alphabet system however, the strokes forming the logogram are typed as they are normally written, and the corresponding logogram is then entered."[242]]

Due to the number of glyphs in Chinese logograms, "in programming and computing in general, more memory is needed to store each grapheme, as the character set is larger. As a comparison, ISO 8859 requires only one byte for each grapheme, while the Basic Multilingual Plane encoded in UTF-8 requires up to three bytes. On the other hand, English words, for example, average five characters and a space per word and thus need six bytes for every word. Since many logograms contain more than one grapheme, it is not clear which is more memory-efficient. Variable-width encodings allow a unified character encoding standard such as Unicode to use only the bytes necessary to represent a character, reducing the

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240 Cheng-Yih 2008: 113
241 Wikipedia, entry "Logogram", https://en.wikipedia.org/wiki/Logogram, accessed May 1st, 2021, subchap. "Characters in information technology"
242 Wikipedia, entry "Logogram", https://en.wikipedia.org/wiki/Logogram, accessed May 1st, 2021, subchap. "Characters in information technology"

overhead that results merging large character sets with smaller ones."[243]

Concerning Computation

In mathematics, for not only representing quantitative mathematical concepts and relations, but actually technically executing algorithms and derivations, "operative notation" (Sybille Krämer), as familiar since Western antiquity, "uses written symbols to compose equations for expressing mathematical thoughts"[244], and to and to execute them on paper, and / or as machine (Turing 1937).

This arithmetic approach is linked to the Aristotelean concept of "time" as numerical measurement of movement in terms of "before", and "after"- in fact a "digitization" of the (supposed) flow of time, culminating in Alan Turing's advice, for digital computing:: "treat time as discrete."[245]

[While there has been an "analog-to-digital converter" in China in "the standard method of converting rotary to rectilinear motion"[246], together with "that apparatus so complex as that of the water-wheel linkwork escapement clocks"[247] - which Needham does not media-epistmologically cross-related, though -, such a "digitzation" of movement did not results in the theory of binary information units neg-entropically derived from physical thermodynamics, as in the case of Claude Shannon's *Mathematical Theory of Communication*. *Kho hsüeh*, the traditional and current Chinese term for science, still remains "classification knowledge"[248]. As well, the quantization of movement in the mentioned Chinese clockwork did not coincide with a "preoccupation with quantitative measurement which is one of the most essential hallmarks of true science"[249] but has been hindered by a rather organicistic perception of approaching "nature" in Chinese philosophy. "Actually the invention of clockwork was directly connected with the very absense of planetary models in Chinese thinking"[250], but this autonomy of "timing" did not redefine the Chinese concept of "time" itself.]

Yang Xiong's (53 B.C. to 18 A.D.) writing *Tai-xuan-jing* actually proposed the ternary counting system against the binary one. Via his

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243 Wikipedia, entry "Logogram", https://en.wikipedia.org/wiki/Logogram, accessed May 1st, 2021, subchap. "Characters in information technology"
244 Cheng-Yih 2008: 166
245 Alan Turing, State of the Art, xxx
246 Needham 1993: 43
247 Needham 1993: 42
248 Needham 1993: 40
249 Needham 1993: 41
250 Needham 1993: 41

correspondence with Jesuit missionaries, China's binary and ternary counting system in mathematics and computing became known to German polymath Gottfried Wilhelm Leibniz, inspiring his dyadic calculations in zeros and ones, and his design for a binary computing machinery. Still, even Leibniz remained imprisoned within a theological enframing (*Ge-stell*) to justify such operations in a "cosmotechnical" harmony (Hui), like the paper machine (Ars Magna) of Raimundus Llullus. European scholasticism, and Chinese philosophy, can be adequated indeed: "[T]he Neo-Confucian school in the / eleventh, twelfth and thirteenth centuries A. D. achieved a wonderful philosophical synthesis strangely parallel in time with the scholastic synthesis of Europe."[251] Needham defends this position against the *topos* that Chinese culture emphasised practice and hence ignored theory - "which is evidently incorrect then we consider that Neo-Confuciasnism in China achieved speculative metaphysical thoughts at least as great as its mediaeval European counterparts"[252].

According to Needham, instead of a mechanical word view, Chinese thought has been, philosophically, "an organic materialism"[253]. Is this a techno-logical "lack"?

"[...] the original mode of cosmotechnics, is bifurcated into technis and religions, in which the latter retain an equilibrium with the former"[254]. But for techno*lógos*, this "bifurcation" is primordial.

Needham's core concern is truly techno*lógos* instead of simple technical progress in China when compared to the West.

According to Needham's cultural analysis, bureaucratic feudalism of scholar-gentry in China's T'ang and Sung era favouring „the growth of natural knowledge and its *application to technology for human benefit*", especially astronomy, applied mathematics and engineering projects the sense of cultural techniques, but hinders the emergence of capitalism[255] - which is entangled with the escalation from techniques to genuine technologies. Different from Max Weber's social analysis (his "protestant mind" hypothesis) of emergent capitalism in early modern Europe relating to technology, media archaeology rather asks for its media-epistemic conditions.

[Karl Marx' so-called "Machine Fragment" focuses on "fixed capital" instead of knowledge for its own epstemic sake. According to Marx, "fixed captial absorbs knowledge not in order to produce more knowledge, but

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251 Needham 1993: 36
252 Hui 2016: 168
253 Needham, The Great Titration, 21, as quoted by Hui
254 Hui 2016: 20
255 Needham 1969: 196 f.

in order to produce an ever-greater quantity of physical goods as the bearer of an ever-greater magnitude of surplus-value."[256]]

Even Charles Babbage and Karl Marx, with his fixation on "fixed capital", adhered, with their machine notion, to economic functionality - against the admittance of wholeheartedly meaningless symbol operation for algorithmic reasons (the Turing machine). The "symbol" becomes machine in the operative sense - no "symbolic" dimension any more in the sense of cultural semiotics and hermeneutics, as it can be studied in the case of philosopher Leibniz' *Dyadik* where the binary symbols are still discursively related to a theological order like *ying* and *yang* in China, but operatively emancipate into an autonomous mechanism for computation.

This grounds, or "radically" enracinates, in actual writing techniques.

In his text *Quid sit idea* Leibniz declares that his model of a machine, which operates with characters ("characteres exprimunt numeros"), expresses the machine itself – just like Babbage's "mechanical notation" allows to enact the actual machine already on the level of an operative diagram. The Turing machine, though, is not programmable, for its operation, by logographic characters.

Concerning a Comparative Approach to Technology in China:

Media Archaeology of Technics in China: a Dis-covery

[The remarkable construction of the escapement-driven clock in medieval China has obviously been falling into oblivion in China itself, so it appeared anew as a Western import since the times of Jesuit missionaries.]

Since the 19th century, the technical implementation of Western modernity in Chinese culture has overlayed its previous cultural techniques. When media-archaeological understanding dis-covers China's technical past and explores its resources, this is not cultural conservativism against the communist modernization, but a more fundamental media-epistemic issue. The "many puzzles and differences from the West, especially Europe"[257] challenge the Western concept of technology itself.

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256 Martin Spence, Marx against Marx: A Critical Reading of the Fragment on Ma-chines, in: tripleC17(2) 2019, http://www.triple-c.at, 327-339: 331, subchapter "3. General Intellect"
257 Electronic communication to the author, by Haijiang Tang, School of Journalism and Information Communication, Huazhong University of Science and Technology (HUST), China, 16 January 2020

[Yuk Hui's essay in Chinese "cosmotechnics"[258] has been written, to a large degree, in the absence of concrete technological analysis, such as the clock drive mechanism mentioned marginally when discussing Joseph Needham's comparative history of science. Explicitly inspired by Bernard Stiegler, the relation of technology and time, with a focus on China, figures centrally in Hui's analysis. This question relates to philospher Martin Heidegger's critique of "vulgar" clock time indeed.]

[Heidegger's critique of modern technology starts with its relation to Western metaphysics. "[T]he conception that there is only one - originally Greek - type of technics has been an obstacle to any original critical thinking of technology in modern Chinese thought."[259] Hui is rather imagining a specifically Chinese philosophy of technology, against which the media-archaeological techno*lógos* hypothesis radically insists: While cultural technics may have been locally specific, technologies, in their abstract technical reason and practical behaviour, are *non*-humanly, maybe even *non*-culturally, universal.

[In accordance with Needham, Hui asks: "Why was technics never thematized in Chinese thought? *Why has time never been a real question for Chinese philosophy?* How was the traditional concept of Qi transformed in its relation to Dao as China welcomed technological modernity and westernization?"[260] Most surveys of the major concepts of traditional Chinese thinking concerning technology remain historical, though, instead of a radical Sino-techno-epistemology, and even Hui's guiding question "how Chinese thought might today contribute to a renewed, cosmotechnical questioning of globalized technics" (ibid.) does not really dare to address the techno-ideological break which occurred, against this rich tradition, with the communist regime.]

[Media Archaeology: a Eurocentric concept?]

Any media archaeology of technology in China, when it is articulated from a scholar in the Western tradition, has to be tested against Joseph Needham's monumental investigation of the Chinese scientific tradition. Still, Needham oscillates, somewhat undecidedly, between an epistemological and socio-economic approach to his core question why "modern science" developed in the Western world only.[261]

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258 Yuk Hui, The Question Concerning Technology in China. An Essay in Cosmotechnics, Falmouth (Urbanomic) 2016
259 Yuk Hui's web page "Digital Milieu", http://digitalmilieu.net/?p=1114, accessed 3 February, 2020, referring to Hui 2016
260 Digital Milieu, op. cit.
261 Joseph Needham, Poverties and Triumphs of the Chinese Scientific Tradition, in: Sandra Harding (ed.), The "Radical" Economy of Sciences. Toward a Democratic Future, Bloomington, Ind. (Indiana University Press)

[Many technical adventions have been made in China in advance, when compared to the Western tradition. But as it is indicated by recurrent temporal signifiers like "in advance"[262], Needham, argues on the basis of comparative *history* of science when he supposes a global history which allows for a comparative time-table of scientific development at all - while philosopher Immanuel Kant had still be aware that the claim of a "global history" is rather an "imperative of reason" than a given evidence. This is in accordance with Needham's rather enlightened final claim: "Modern universal science, yes; Western science, no!"[263] (somewhat conterbalanced, though, by his almost Rankean technological historicism: whatever happened in diverse civilizations "is entirely worth studying for its own sake"[264]).]

While the historical civilization in China, when compared to Western antiquity and its "dark ages", regarding techniques had been "in advance of Europe media archaeology" (ibid.), a "scientific revolution" did not occur. Needham, as a *historian* of science, has a tendency to look for diachronic continuities, and inter-cultural knowledge transfer. Indeed, when it is deciphered *literally*, even the "discontinuity" between West and East which opened as a gap since the late European renaissance consists, in its majority of letters still consists of "-continuity".[265] Media archaeology, though, in the tradition of Foucault's *Archaeology of Knowledge* (1969), rather identifies discontinuities not only in the chronological, but techno-epistemic sense as well.

Media archaeology is rooted in close technical analysis. Can it be applied to cultural techniques in China, if "in China, technics in the sense we understand it today - or at least as it is defined by certain European philosophers - never existed"[266]?

Media philosopher Yuk Hui makes an explicit "distinction between the use of the words technics, *techné*, and technology: *technics* refers to the general category of all forms of making and practive" - in the sense of cultural engineering; "*techné* refers to the Greek conception of it, which Heidegger understood as *poiesis* or bringing forth; and *technology* refers to a radical turn which took place during European modernity, and developed in the direction of ever-increasing automation, leading

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1993, 30-46 (31). Originally included in: idem, The Grand Titration: Science and Society in East and West, London (Allen & Unwin) 1969, 14–54
262 Needham 1993: 30
263 Needham 1993: 45
264 Needham 1993: 44
265 This literal reading has been inpired by Walter Seitter, Vienna
266 Hui 2016: 9

consequently to what Heidegger calls the *Gestell*"[267]. Can technological Eurocentrism, in contrast to China's belated / revolutionary modernization, be located in this "age of the world picture"?[268]

But a translation error occurs here: Heidegger's term "Technik" (in the German original), is mistaken for "technology".

[Heidegger here differs from Karl Marx' so-called »Maschinenfragment« which explicitly expresses the "technological application of natural sciences"[269]]

Eurocentricity or Western-centrism is "a worldview that is centered on Western civilization or a biased view that favors it over non-Western civilizations."[270] The conceptual scope of "Eurocentrism" varies: "from the entire Western world to just the continent of Europe or even more narrowly, to Western Europe" (ibid.). When the term is applied historically, it may be used in reference to German "Abendland": the "Occidental" Western societies of Europe and North America. When the term is applied to the history of science and technology, Joseph Needham's question concerning technology in China, in comparison to the Western world, comes into discussion.[271] But when deciphered media-archaeologically, a rather autonomous temporal epistemology arises.

Does it require, in the sense of Yuk Hui's "cosmotechnical" modification of Martin Heidegger's *Question Concerning Technology*, a techno-philosophically specific adoption to Chinese culture?

[Hui's monography fundamentally aims at "opening the question of technics not as a universal techno-logy, but as a question of different cosmotechnics"[272].]

In order to become "free" (liberated) *to* technology, media analysis requires to be suspended - at least momentarily - from immediately

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267 Hui 2016: 4, note 3
268 Martin Heidegger, The Age of the World Picture, in: idem, The Question Concerning Technology and Other Essays, New York, NY (Garland) 1977, 115-154
269 Marx 1973: 700 For the GO: "technologische Anwendung der Naturwissenschaften" indeed, in: idem, Grundrisse der Kritik der Politischen Ökonomie (Oktober 1857 bis Mai 1858) -the -; page numbering following MEW vol. 42, notebook VI "Das Kapitel vom Kapital", pp. 590 seq. (596)
270 As defined in the online encyclopedia Wikipedia, entry "Eurocentrism", https://en.wikipedia.org/wiki/Eurocentrism, accessed April 28, 2021
271 Joseph Needham, Science and Civilization in China, vol. 1 (1954)
272 Hui 2016: 289

reading material evidence in historical, cultural, or social "context" - thereby subjecting the technical object to textual narrative. Instead, along with Foucault's "Introduction" to his *Archaeology of Knowledge*[273], the "document" becomes "monument" again, accessible for a more distanced *ekphrasis* (archaeography).

[Isabel Stengers, in her analysis on the technical mechanism of timing and its discursive representations as "time", oscillates between both poles: close analysis from within the machine on the one hand, and cultural studies on the other.]

In order to define "modern science", and to compare the Chinese scientific heritage with what occurred with "the Galilean break-through", Needham advises "to distinguish more clearly between science and technology"[274]. In spite of all the marvellous cultural techniques in which Chinese civilization has advanced, it never escalated to technology in Heidegger's sense of the "Modern World Picture". But according to the radical media archaeological premise, techno*lógos* can never be missing. It is only its specific realizations and configurations which are dependent on the historical contingencies of social and economic contexts. That is what, between the lines, Needham seems wanting to express for the Chinese case: Techno*lógos* has always been around in that culture, knocking at human will for knowledge, but in different kinds of techno-logical articulations by human words, or machines.

Cultural techniques[275], and "[...] an artisanal technical culture existed in China, and [...] it was in many respects advanced *in comparison to the same period* [WE] in Europe"[276]. In accordance with Needham's comparative history of science, "there was indeed a technical spirit in ancient China"[277], but this is not (yet?) technology. In media-epistemic terms, this makes all the difference. When the body-related tool becomes an automaton, a techno-logical escalation takes place. "It is the aim of this book to show that it is not only necessary to seek alternatives"[278] - that is, alternative technologies in the sense of Zielinski's book series

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273 Michel Foucault, The Archaeology of Knowledge and the Discourse on Language, transl. from French by A. M. Sheridan Smith, New York (Pantheon Books) 1972
274 Needham 1993: 43
275 See Bernhard Siegert, Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real, transl. Geoffrey Winthrop-Young, New York (Fordham University Press) 2014
276 Hui 2016: 167
277 Hui 2016: 168, referring to: Joseph Needham, The Grand Titration. Science and Society in East and West, Routledge 2005 [*Toronto, University of Toronto Press, 1969]
278 Hui 2016: 289

Variantology[279] which ends with an epistemic recognition of global diversity -, but to consider alternatives to the notion of technology itself.

["Cultural Diversities" vs. Techno-Logical Equiprimordiality]

Different from cultural historicism, media archaeology identifies a rather autonomous economy of techno-logics in cultural development and in the logistics of knowledge exchange, due to its respective operative media. Radical media archaeology even questions their respective concept of technology as such. Cultural techniques have been flourishing in China for millennia. But "is there truly "technological thought in China?"[280]

The historiography of sciences, in its narrative bias, tends to privilege, generally, the inter-cultural knowledge exchange and transfer model. Media archaeology, in its mathematical meaning, rather prefers the correlation procedure, where two distinct data (time) series may reveal weak similarities, but do not yet prove a strong causal inter-cultural relationship.

Against the "globalization" concept of Cultural Studies, concerning "[t]he 'sciences', like technology and like the technical schools", Heidegger remarks: "An international thinking does not exist, only the universal thinking, coming from one source", equiprimordially - like the physical laws with its natural constants, and autonomous techno-logistics.

[German *Technik* has been mistranslated into English "technology" here; in the German original, Heidegger's phrasing is: "'Wissenschaften' sind, wie die Technik und als Techniken, notwendig international."]

[But then, Heidegger still seeks to locate such media thinking, searching for an *arché*. "Dieses aber ist, um nahe am Ursprung bleiben zu können, notwendig ein geschickliches [sic] Wohnen in einziger Heimat und einzigem Volk", since: "das jeweilig einzige geschickliche Heimattum der Bodenständigkeit ist die Verwurzelung, die allein das Wachstum in das Universale gewährt"[281] - a "radical" media-(un)archaeological oxymoron.]

The crucial ontological question arises: Is techno-logics, as techno*lógos*,

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279 2005 seq.; see esp. Variantology 3. On Deep Time Relations of Arts, Sciences and Technologies In China and Elsewhere, edited by Siegfried Zielinski and Eckhard Fürlus (in cooperation with Nadine Minkwitz), 2008
280 Hui 2016: 7
281 Martin Heidegger, Gesamtausgabe, vol. 97, Anmerkungen I-V (Schwarze Hefte 1942-1948, ed. Peter Trawny), Frankfurt / M. (Klostermann) 2015, 59 seq., entry "Denken und Dichten"

"something detachable from its cultural source"[282], or - by its very necessity of material, and energetic, processual embodiment to come into being - always already temporally, and spatially, localized?

Heidegger's "one source", though, is not *völkisch*, but rather techno-logical, as temporally, and geographically, recurrent techno*lógos*: "technical inventions which [...] became incorporated, *whether or not by re-invention*, into the corpus of modern technology"[283]. Needham here remains somewhat undecided concerning the question whether techno(logical)-knowledge is transferred through historical channels, or capillaries, of communication, or rather co-originary in the sense of the techno*lógos* hypothesis.

Since Needham writes a history, rather than archaeology, of science, he still privileges the model of inter-cultural - and sometimes "belated" knowledge transfer[284] against the concept of originary independent "re-inventions", even though "we do not know the way-stations through which it came"[285]. "[I]n spite of China's isolations and inhibitions" - the Great Wall -, "a great deal more mathematical influence came out of that culture than went in" (Needham ibid.). Once more, in terms of "diffusion", the chemical model governs Needham's approach. This transfer is techno-logical in its literal double sense: either it is concrete technical objects themselves that cross cultures and are copied, or further developed, or it is an idea, the technical *lógos*, which is transferred in terms of "stimulus diffusion", without any specific technical detail, such as the windmill, which has been invented in its horizontal version in Persia and extended to China in late medieval times, but emerged in Europe in vertikal form from the beginning in 13th century. Needham's approach admits that the inter-cultural transfer of implicit technical thing-knowledge follows a different logic than its expressive verbal, or textual description, which is dependent on either bureaucratic, or epistemologic, recording aesthetics.

"The astonishing thing is that these discoveries" - concerning the formal logical system by the Greek philosophers, and "the possibility of finding out causal relationships by systematic experiment (at the Renaissance)" - "were made at all"[286]: emanating *from within* techno*lógos*, so to say. All the difference it makes is the "rational conception of the cosmos as an orderly whole working by laws discoverable in thought"[287] - where *lógos*

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282 Hui 2016: 5
283 Needham 1993: 44; italics W. E.
284 On "delayed transfer", cp. Jack Goody, The Logic of Writing and the Organization of Society, Cambridge et al. (Cambridge UP) 1986
285 Needham 1993: 39
286 Albert Einstein, letter to J. E. Switzer in 1953, as quoted in Needham 1993: 38
287 Gillispie, as quoted in Needham 1993: 38

both as ratio, and as though, coincide, resulting in a material artifact like "the anti-Kythera computing machine" from the Hellenistic times[288]. In the Western scientific tradition, both such a material mechanism, and its abstract concept (Turing 1937), coincided to true techno/logy, against more conventional, practive-related cultural techniques: "But no Oriental civilization graduated beyond techniques or thaumaturgy ["Wundertätigkeit"] to curiosity about things in general."[289] Western civilization "has produced not merely a high intellectual grasp of science but also a high scientific technology. By this is meant something distinct from the background noise of the low technology that all civilizations and societies have evolved as part of their daily life."[290]

Media Archaeology, and a Different Concept of Technological "Time"

[Media archaeology claims a knowledge-oriented, even "chronopoietic" analysis of media temporalities.[291] Its core assumption is that the essence of technological artefacts not only unfolds *in* cultural time (known as history), but *as* time-critical processes itself. By their twofold time-based and *timing* mechanisms, technological media are understood as a tempor(e)ality of their own. Media-archaeological analysis therefore ranges from internal, micro-temporal signal transduction and data processing, over its relation to the human "inner sense" of time (Husserl's *Phenomenology*), up to the "anachronistic" relation of technological action (the "tempoReal") to symbolically ordered historiographcal time at all. Media archaeology is therefore not a philosophy, but deals with actual signals in technical matter, ranging from past to present times.]

Exactly because the media-archaeological method of investigating media technologies has been somewhat "Eurocentristic" so far, it invites, in the context of Chinese culture, to rethink - or truly "translate" - its paradigms stemming from Occidental techno-logical culture since Greek antiquity. Media archaeology raises the question if - in an almost Platonic sense - technical media and their capacity of cognitive and operational reenactment exist in an ahistorical tempor(e)ality - and to what degree their techno-logical being is modulated by historically contingent cultural differentiations. To a certain degree, pre-modern Chinese cultural

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288 Needham 1993: 40
289 Gillispie, as quoted in Needham 1993: 38
290 D. J. de Solla Price, Science since Babylon, New Haven, Conn. 1961, as quoted in Needham 1993: 37
291 See W. E., Chronopoetics. The Temporal Being and Operativity of Technological Media, transl. by Anthony Enns, London / New York (Rowman & Littlefield) 2016. Translation into Chinese forthcoming with Fudan University Press

techniques obviously relate to alternative concept of times (in the plural), or rather: timings (in a processual understanding).

The method of media archaeology addresses such questions as analytic research, and archaeography is its mode of writing which stays close to the technological artefact itself. Protagonists like Erkki Huhtamo and Siegfried Zielinski's research project *Variantology* have already paved the way for a more global media-archaeological perspective, which goes beyond the Eurocentric or "Western" and extends to the techno-cultural achievements in China. One step further, "radical" media archaeology not only discards conventional narratives of "history of technology" but seeks to liberate the theory of media temporality from technological anthropocentrism. This even arrives at the critical point where the plausibility of "time" as a category for understanding media is questioned at all.

IS THERE A SPECIFICALLY CHINESE PATH OF TECHNOLOGY?

This paper[292] ("whose central European bias is unfortunate, but unavoidable"[293]) comes from the fields of media theory, and philosophy of technology. While the philosopher of technology Yuk Hui has already published a seminal study on questions concerning technology in China[294], the following answers will be of a slightly different kind.

"A New and Uniquely Chinese Path to Modernization"?

Is the relation of technology in ancient and contemporary China a continuous, or radically discontinuous one? In October 2021 the Chinese Academy of Social Sciences organized its conference in Beijing under the theme of "A New and Uniquely Chinese Path to Modernization." The very term "modernization", as known from sociological discourse, is frequently related to processes like industrialization for the epoque of the 19th century, and post-industrialization for the 20th with its technological bias. According to McLuhan's diagnosis, traditionally non-industrial areas like China never had such a nineteenth century, and has entered the twentieth century in a non-linear leap.[295] Has there been, instead of a

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292 Published in Chinese translation in: Global Journal of Media Studies, vol. 10, no. 2 (April 2023), 196-210
293 Friedrich Kittler, Universities: Wet, Hard, Soft, and Harder, in: Critical Inquiry, vol. 31, no 1 (Autumn 2004), 244-255 (244)
294 Yuk Hui, The Question Concerning Technology in China. An Essay in Cosmotechnics, Falmouth (Urbanomic) 2016
295 Marshall McLuhan in: War and Peace in the Global Village 128, as quoted in the forthcoming Master thesis by Yen-Chen Chang, Technophysis: A Media-archaeological Investigation of Technology and

smooth transformation, a rather abrupt replacement of a traditional philosophy of techniques, by a radically Westernized global technology?

But what has been missing in that 19th century - just like in the Arabic culture which as well had been so much advanced in medieval times - is not only industrialization in the economic sense, but the emergence of meta-mathematics as well, in its epistemic sense, which - in Europe - derives back to the Renaissance and Baroque favour of free play of signs (Descartes, Leibniz, down to Condillac). In combination with the enlightenment turn towards pure reason (Kant), this resulted in modes of technical reasoning, in a techno*lógos*. which, until today, became world-wide dominant with no real respect to cultural differences.

The theory of modernization is tightly coupled to philosophical enlightenment, and rationalization. For European cultural history in comparison with other parts of the world, and China specially, historian of science Joseph Needham has answered to the question of "modernization" specifically. China has achieved many of its technical inventions even prior to Europe, but such inventions frequently remained rather singular, without a lasting impact on society and knowledge, whereas in Europe, at least since the age of Enlightenment, some key inventions, which have been known in China already, triggered a whole technological revolution. They obviously "resonated" with philosophy and society in a specific way. Needham derives technological modernization from a truly scientific epistemology, as a prerequisite to transform cultural techniques (German *Kulturtechniken*) into true technologies. This is closely related to an academic enframing which allows and even invited for unconditional freedom of thought experiments.

The argument will unfold in three steps:

1) First an artifact-based reconsideration of the technical culture in China prior to the People's Republic, in comparision to the West.

2) What follows then are thoughts on the historicist "uniqueness" of civilizations in respect to their techno-logical paths, against the hypothesis of a more universal techno*lógos*.

3) Finally, a few questions are addressed to Chinese media theory, concerning technological independence.

Intercultural Exchange of Technical Knowledge, vs. Equiprimordial Techno*lógos*

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Concerning technical knowledge, pre-communist "ancient" Chinese culture, for thousands of years, it has been among the most advanced cultures in a global perspective. This directly relates to the theme of this year's conference, which is civilization exchange from multi-disciplinary perspectives. From the point of view of media theory and philosophy of technology, the fundamental question arises whether technological expertise arises and circulates on the basis of inter-cultural knowledge transmission (which is the approach of cultural history, Science and Technology Studies, Cultural Studies, and traditional German *Kulturwissenschaft*). But this model cannot explain how mathematical operators and concepts like the "zero" could independently arise in Middle America (in the Maya culture) and in the Indo-Arabic sphere, or how elementary techno-epistemic units like the escapement mechanism for time-discrete, almost "digital" clockworks emerged in medieval Europe and in China rather independently, without any (positively traceable) direct inter-cultural knowledge transmission. Against this historicist approach, radical media theory proposes the techno*lógos* hypothesis, claiming that technical or logical knowledge autonomously arises from within technological action itself, once it is granted to unfold in an atmosphere of experimentation of technical knowledge unlimited by philosophical, ethical, or ideological constraints.

Epistemological "Titration" vs. Inter-Cultural Tradition

While media *studies*, and the history of technology approach, privilege a model of direct inter-cultural exchange of technical knowledge, media *science* actually applies a different, rather media-archaeographical[296] than media-historiographical method of approach that is *scientific* in itself, such as Needham's comparative "titration" between civilizations.

The Humanities privilege a hermeneutic inter-subjective, historicist approach which assumes a inter-cultural transfer of such knowledge. In contrast, a more scientific approach - as proposed by the expert on ancient Chinese techniques, Joseph Needham under the chemical method of "titration" - allows for a less anthopo- and culturocentric approach, allowing for the hypothesis of a non-human genealogy of technical knowledge (or techno*lógos*).

Needham's method for a comparative analysis of the evolution of modern science in China and the West is in accordance with the methodic claims of media *science* rather than with discourse analysis in cultural studies. Needham's approach is not built on the historiographical model of scientific and technical knowledge interchanges between East and West by direct cultural communication, but he rather creates an epistemic knowledge laboratory (in Hans-Jörg Rheinberger's sense) in

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296 See Höltgen / Hiller (eds.), Archäographien, xxx

what he describes as a "veritable titration"[297]. Needham employed the "metaphor" (BuYun Chen) of volumetric analysis to describe his comparative approach to Eastern and Western cultures. Titration is "a method of chemical analysis whereby the concentration of a given chemical solution (the titrand) is determined by the slow addition of another solution of a known concentration and volume (the titrant) until the reaction neutralizes and results in a color change [...]. His analytical procedure was thus to '"titrate" the great civilizations against one another, to find out and give credit where credit is due', and, in so doing, to 'analyse the various constituents, social or intellectual, of the great civilizations, to see why one combination could far excel in medieval times while another could catch up later on and bring modern science into existence'."[298]

Departing from Cosmotechniques: Timing Technologies in Comparison

The theme of this year's International Academic Forum 2022 in Beijing is *Civilizations Amid Profound Changes: China and the World"*. One parameter for measuring such change, and exchange, between civilizations in a comparative way, is the role and self-understanding (technology) of its cultural techniques. For such a measurement (or "titration" in Joseph Needham's sense), precise media-archaeological case studies are required.

Different from the notion of technology which traditionally signifies the academic discipline of technique, the aforementioned techno*lógos* hypothesis takes the notion of "technology" literally, asking for the kinds of knowledge (*lógos*) which arise from within technical processes themselves.

This brings the argumentat, for a notorious example, back to the escapement mechanism in early devices for time-keeping. In its double emergence both in So Sung's so-called Heavenly Clockwork and its Western counterparts this mechanism seems to have arisen form the technological unconscious rather than from a intentional chain of human inventions, and inter-cultural knowledge exchange.

For representatives of the "Berlin school" of media science, the focus is on this technological aspect, with an application of the media-archaeological method of inquiry. This method, with its emphasis on a

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297 Needham 1998: 30
298 BuYun Chen, Needham, Matter, Form, and Us, in: Isis, vol. 110, no. 1 (2019), 122-128 (122 seq.), referring to: Joseph Needham,The Grand Titration: Science and Society in East and West, London (Allen & Unwin) 1969, 11 seq.

"close reading" of technical devices, prevents the discussion on technological "modernization", and cultural comparison, from becoming too speculative.

The mechanical clockwork which is controlled by an escapement mechanism has been fundamental for epistemic notions and practices of time-discrete clocking, and technically (re-)produced periodic oscillations which are paradigmatic of most analog signal processing devices (including digital data synchronization) until today.

From a media-archaeological perspective, Su Song's clockwork from medieval China is less noteworthy for its for its user- or observer-oriented interface but for its essential media-epistemic "thing" (in accordance with Rheinberger). Its escapement mechanism has become the basis of binary mechanics, and discrete oscillation, and therefore implements a real "media atom" (Chang's term). Such a "media atom" is less a function of inter-cultural discourse but a rather autonomous "teknowledge" element, as known from the concept of "memes" for technical evolution.[299]

Such a mechanism is familiar from Su Song's "Heavenly Clockwork", which has been constructed as a water-powered armillary and celestial tower' at the end of the 11th century, in Kaifeng.

[Fig: Reconstruction sketch of the escapement mechanism of the "Heavenly Libra", in: Dohrn-van Rossum 1992: 86, Fig. 18; USB "Intenso": Himmlische-Waage-Rossum-1992-86.pdf]

The escapement mechanism is essential for the achievement of time-discrete counting, even if on the interface level, the time indication seems to progress linearly. The final focus of a digital re-animation of Su Song's Hevenly Clockwork is on the escapement stops and levers indeed. All of the sudden, this horological device re(oc)curs from within the medium of its digital replica itself, which is: the discrete clocking of digital computing, with its unit of measurement "clocks per instruction" (CPI).

From a direct techno-analytic comparison of Su Song's Heavenly C'lockwork with its Western counterpart, the anonomyous invention of the escapement mechanism in late-medieval Benedictine monasteries[300], a couple of media-epistemic insights, and questions, derive.

While previous calendars and astrolabs, both in the ancient European and Chinese tradition, had rather been kind of "analogue computers" in

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299 See Susan Blackmore, The Meme Machine, Oxford 1999
300 See Gerhard Dohrn-van Rossum, History of the Hour, Chicago (University of Chicago Press) 1996

relation to cosmic planetary revolutions[301], the time-discrete escapement mechanism allowed for a different, "digital" computation of time. But such a technical experiment becomes culturally decisive only when it triggers, or resonates, with a discourse which allows to treat the apparent "flow" of time" as discrete - as once literally expressed in Alan Turing's report on "The State of the Art"[302] of early digital computing in the West. Only when symbol manipulation, both as mathematical operation, or as a hardware mechanism, is radically abstracted from any religious, philosophical, ethical, or ideological constraints (such as Leibniz' "dyadic" interpretation of the Chinese Ying and Yang symbolism, and the trigrams in the Book of Changes), computation becomes truly techno-logically operative, as it resulted in Turing's algorithmic mechanism. (as struggled by Leibniz, and achieved by Turing), it becomes truly techno-logically operative.

Martin Heidegger, in his "Question Concerning Technology"[303], refers to the hydroelectric power station and barrage, which technically interrupts a poetic *leitmotiv* in German Romantic poetry (such as Hölderlin), the river Rhine. Even if the economic content of such a mechanism is apparantly a "green" technology for energy generation and therefore "cosmotechnique" in its current sense, the actual media message is the transformation of fluent water into a cybernetically controlled mechanism - just like the analog-to-digital converter in computing turns energy and matter itself into "information" (Norbert Wiener) measured by its binary units ("bits").

To refer this back to Su Song's escapement mechanism, which is an analog-to-digital-converter indeed. His Astronomical Clock Tower, created in 1089 A. D., has also been known as "Cosmic Engine"[304], and has been thereby still adhering to "cosmotechnics" (in colleague Hui's sense).

But the "cosmotechnical" idiosyncrasies in both Western, and Chinese philosophy of technology, have radically been absorbed (if not dialectically elevated) by algorithmic computation. According to Marshall McLuhan, the digital "computer has made possible our satellites which

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301 See Nathan Sivin, Cosmos and Computation in Early Chinese Mathematical Astronomy (1969)
302 Alan Turing, The State of the Art. Lecture to the London Mathematical Society on 20th February 1947, in: B. E. Carpenter / R. W. Doran (eds.), A. M. Turing's ACE Report of 1946 and Other Papers, Cambridge, Mass., et al. (The Massachusetts Institute of Technology) 1986, 106-124
303 Martin Heidegger, The Question concerning Technology [GO 1949], in: idem, Basic Writings, ed. David Farrell Krell, New York (Harper and Row) 1977, 287-317
304 "Su Song's Astronomical Clock Tower", https://vimeo.com/43772707

have put a man-made environment around the planet, ending 'nature ' in the older sense".[305]

"Digitizing" Time: The Escapement Mechanism

While a mechanical museum can produce mechanical replicas of Su Song's Heavenly Clockwork, only an algorithmic animation actually reveals the techno-epistemic relevance of the escapement mechanism which turns the very metaphor of the "flow" of time in the ancient Chinese time philosophy into a saw-tooth signal processing, thereby discretizing "time" as such into countable units.

The literally *decisi*ve water container filling as the core escapement mechanism in Su Song's clockwork is finally shown in the digital version. Originally aired on an "Ancient Discoveries" episode from the History Channel TV series, a shorter and edited animated replica of Su Song's Astronomical Clock Tower can be seen *online*. While everything else in this animation is based on Photoshop, LightWave and Fusion, "there's also a tiny RealFlow moment at the end"[306]. All of a sudden, this digital "animation" is not redemptive media archaeology in the sense of "dead media" (Sterling) any more, but a techno-mathematical archaeology of the present, with digital computing itself as the actual archaeologist of knowledge. RealFlow as "a fluid and dynamics simulation tool for the 3D and visual effects industry, developed by Next Limit Technologies in Madrid [...] uses particle based simulations"[307]. Does the RealFlow animation of Su Song's Clockwork even more perfidiously subject an alternative past technique to the Western episteme of computational and mathematical logics, as an effect of the elementary analysis induced by the Greek alphabet? By this digital animation, the Western model of computation and mechanical calculation is actually imposed on the Chinese "Heavenly Clock", thereby depriving - or liberating - the mechanism of all its cultural-discursive "cosmotechnical" enframing.

Even further, RealFlow technology embodies the mightiness of the Shannon / Nyquist sampling theoreme which claims to emulate the "analogue" by the "digital". While Henri Bergson, and Martin Heidegger, have criticized chronophotography, and the mechanical clockwork, as a false, "vulgar" notion of time against a really temporal *durée* or *Geschick*, it is operative techno-mathematics nowadays which allows to capture the "flow" of time in discrete calculation, kind of a dialectic synthesis beyond the apparent oxymoron of "the digital analogue" beyond its dialectical divide. Is this kind of techno-scientific approach a "universal" knowledge

305 Marshall McLuhan in: War and Peace in the Global Village, xxx, 36
306 "Su Song's Astronomical Clock Tower", https://vimeo.com/43772707
307 https://en.wikipedia.org/wiki/RealFlow, accessed February 23, 2022

where local cultural traditions,, and autonomous civilizations, do not make a difference any more?

Media-Archaeological Thoughts on Su Song's "Heavenly Clock"

On top of Su Song's Clock Tower, a human-oriented "interface" displayed an "analog" armillary. Only by opening the black box from insid, it becomes clear that this apparently continuous flow of planetary movements are the function of a discrete automation, and escape-driven with jack-wheels - a different kind of usage of "flowing" water, just like digitization turns staedy processes (like voltage change) into binary steps. In the case of Su Song's escapement mechanism, it takes around 15 seconds to fill one jack; this hydro-mechanical escapement mechanism itself seems to have been invented by Buddhist monks in the 8th century already. Did this finally reach Europe in 14th century in a process of intercultural knowledge transfer, or did both version arise autonomously (with notable difference in the actual realization of such escapements indeed)?

The historicist concept of cultural transfer between East and West s here contrasted with the more media-archaeological notion of equiprimordial inventions.

Su Song's clock tower, in its more limited sense, has been "a huge instrument on astronomy"[308]. But it is in effect a more hidden mechanism in its core which is "thought as one of the most important scientific and technological achievement of ancient China" (ibid.). To what degree does this mechanism go beyond familiar cultural techniques, in favour of an truly autonomous technology? And to what degree has Su Song's mechanism already been "scientific", according to its different definition by Needham for Western science (Galileo Galilei)?

A minimized replica of Su Song's Heavenly Clockwork at Kaifeng, on the basis of Song's detailled description in a book from 1092, has been constructed both at the Historical Museum in Beijing, and in the London Science Museum. The museum frame, as operative media theatre, allows for a direct comparison. Has the Song mechanism been equiprimordial when compared with to the Western Benedictine escapement which has arisen anonymously, thereby indicating that there is rather an inner-technical logics which induces such solutions in whatever cultural context sooner or later, as a subcultural "tecknowledge" rather than being dependent on direct intercultural transmission in the form of textually recorded knowledge. Techno*lógos* does not depend on the written word.

Related to precise case studies such as the escapement mechanism, with

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308 Commentary to https://vimeo.com/43772707

a comparative focus on Western thought and Chinese techniques, the question arises to what degree the concept of technology (to be differentiated from more archaic cultural engineering[309]), and to what degree such a specific mechanism like the "escapement" is a phenomenon arising from universal endotechnical knowledge experimentation as such, or does it rather depend on material, and symbolic transcultural knowledge transfer? The paradigm of "cultural diversities" (in Science and Technology Studies, and media-archaeological "variantology"[310]) is therefore contrasted with the hypothesis of techno-logical equiprimordiality.

An Inspiration from China, and its Transformation into Western Technical Reasoning: Leibniz' "Dyadics"

Another notorious case is Leibniz' binary ("dyadic") number system (0 / 1), diagrammatically even designed by the polymath as a digital mechanism for computing, which has more directly been inspired by Chinese notions of Ying and Yang, by the Book of Changes. This occurrence seems to support the knowledge transfer model against the hypothesis of a co-originary techno*lógos*.

The knowledge of "operative writing" (Sybille Krämer) such as the Chinese trigrams, in the form of a picutre of 64 hexagrams, had been sent to Leibniz on the 4th of November 1701 by Jesuit missionary Joachim Bouvet[311], and actually inspired his experiments with the binary number system. Leibniz' own handwriting of a series of 0/1 calculations already in 1697 resulted in his remark "tabula ita stabit"[312]. In a gift to the Count of Braunschweig, Leibniz' designed a medaillon which explicitly relates the binary numbers to a religious notion of God creating the world ("one") from nothing ("zero").

While such binary calculation has still been a cultural technique, since it depended on the human hand to be bodily performed, the same mechanism later became fully technological with the operative design of programmable computers.

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309 See the special issue on *Cultural Techniques* by the journal: Theory, Culture & Society, vol. 30, no. 6 (2013), edited by Jussi Parikka and Geoffrey Winthrop-Young
310 See Siegfried Zielinski / David Link (eds.), Variantology 2. On Deep Time Relations of Arts, Sciences and Technologies, Cologne (Walther König) 2006
311 See G. W. Leibniz, Der Briefwechsel mit den Jesuiten in China, 2006, 375 f.
312 As preserved in the Leibniz-Archiv Hannover

[Cosmotechnologics in its radically media-archaeological understanding (case Leibniz)]

The concept of a binary number system that is reduced to the ciphers "zero" and "one", e. g., has explicitly been recognized by philosopher Gottfried Wilhelm Leibniz, in his correspondence (1697-1702) with the Jesuit missionary Bouvet in China, as an equivalence to a non-Western cultural knowledge: the Chinese book *I Ching* ("Book of Changes") with its core eight trigrams (each containing 2^3 possible combinations[313]) as an "administrative" matrix or "filing-system" (Needham 1956: 337) and their ethical and cosmoaesthetic connotations. How can there be an independent discovery of an equal knowledge, against all trans-cultural differences? While the *I Ching* contains binary arithmetics rather *un*consiously, Leibniz turned this into a conscious mechanism.[314] Leibniz had developed his *De Progressione Dyadica* in 1679 already but published it only in 1703, while his *De Arte Combinatoria* (published 1666) had been explicitly stimulated by the ideographic nature of Chinese characters.[315] So it is the symbolic machinery itself, below humanist intention, that makes such a logics operate. It took Cartesean thought (as criticized by Heidegger as mathematical "world-picture" indeed) though to trigger such a medium awareness.

Leibniz himself has declared a theological interpretation of the dyadic system, with God as the creator of everything from nothing.[316] But this seems like an exterior discursive disguise of the Cartesean mathematical radicalism and atheism.[317] The dyadic system rather revealed the inner-(techno-)logical truth of symbol manipulation and processing below any semantic content as a techno-logical, autopoietic "world" of its own. The Chinese "cosmotechnical" impulse (in Hui's sense) has thereby been transformed into a cold mechanisms. After the West had adhered to the micro- / macrocosmos analogies itself in ancient, medieval and early modern times[318], it has been this "cold gaze" of science, in its declaration of independence against ethic, aesthetic, theological or governmental claims, that resulted in a veritable techno-logical media epistemics of its own. This even allowed for Leibniz to turn this symbolic mechanism into a material machine. His symbolic design of a binary computer has been materially engineered by the Heinz Nixdorf computer museum in Paderborn.

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313 See Fig. 41: Segregation table of symbols in the Book of Changes, from 12th centurs, in Needham 1956
314 Joseph Needham, Science and Civilisation in China, Bd. 2: History of Scientific Thought, London / New York (Cambridge UP) 1956 [Reprint 1962], 343
315 Needham 1956: 479
316 See Needham 1956: 341, note d)
317 See Needham 1956: 498
318 See Michel Foucault, The Order of Things, chap. on "Similarities"

Enforcing the Western Alphabet Upon Chinese Characters: The Chinese Typewriter

Can such new technologies, as developed in the West, be reconciliated with ancient Chinese, traditional techniques of communication, transport, and production? Will there, once the nuances in Chinese language are not subjected any more to a logocentric notion of machine engineering, arise a different, more differential techno*lógos*?

For the highly complicated mechanical Chinese Typewriter (invented in 1916), the Chinese transliteration systems zhùyīn (officially adopted in 1918 by the ROC) and pinyin (since 1958 in the PRC) have been created, in the hope of a quick adaptation to the Western QWERTY keyboard.[319] The IBM "Electronic Chinese Typewriter", in its mechanical symbol transformations, appears similar to the German Enigma. Still, this mechanism did not result in a Chinese equivalent to the Turingmachine. What does this non-occurrence articulate (in a kind of negative techno*lógos*)?

The "first Chinese" digital computer, introduced in 1958, has not been specifically Chinese in its technological architecture at all. This is not a question on forking paths, but a more fundamental discontinuity between media-archaeological layers of technologies. Will there, instead of violently adopting complex Chinese characters to the Western typewriter mechanism, arise a different kind of Turing machine once the mechanism is developed from within Chinese writing itself, and will symbol operations replaced by a more "calligraphic" approach to computation?

Media-Archaeological Analysis of Technology, and the (A)Political

Media Archaeology has sometimes been accused of being somewhat apolitical, with its rigid focus on technical epistemology.[320] But in a deeper sense, the interrelation appears.

The theosophical entanglement of "cosmos" and natural science, which has been so drastically separated after Pre-Socratic Greek philosophy in old Europe, and more technically in the early modern European age, is returning from behind, in the current "anthropocene" concern with global warming. But while Hui's "cosmotechnics", as a philosophical theory, remains "an elaborately developed question, and nothing else"[321], a more

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319 Master thesis Chang, Abstract
320 See Jussi Parikka, What is Media Archaeology?, Cambridge / Malden, MA (Polity Press) 2012
321 In the sense of Gilles Deleuze's definition of philosophy, in: idem.,

material media archaeology gives this question a cutting edge, literally "grounding", or "earthing" this concern. such is Jussi Parikka's investigations into the geopolitics of trading with rare earths as constitutive "elements" in semi-conducting micro-processors.[322]

Needham, for sure, does not share the techno*lógos* hypothesis, when he criticizes certain scholars for maintaining that "all scientific developments in non-European civilizations were really nothing but technology"[323] - as if technology could be separated from the techno-episteme which is both material experimentation and its mathematical abstraction.

Related to the media-archaeological techno*lógos* hypothesis is the politically more delicate question to what degree technical reason, in its coupling to techno*lógos*, is autonomous in the media-archaeological sense. Is the "freedom" of techno-mathematical thought a function of experimenting with the machine, or rather related to its "social" context? Heinrich Hertz' detection of electro-magnetic "resonance" between an oscillator (sender) on the one side, and its inductive coil (receiver) at the other, in a darkened lecture hall of Technical University in Karlsruhe around 1880, has been a rather auto(techno)poietic diagram, independent from its contingent political regime. "Media" communication, in the strict media-archaeological sense, is the immediate signal event, and only for a second order observation becomes a question of "mass media". For such techno-knowledge to take place, and for techno*lógos* to become explicit, it rather requires the institutions of academic research. As an *epoché* (in Husserl's sense), such a framework allows for a - at least temporary - suspension from the political, administrative, economic, and other demands of developing immediate functional applications of knowledge,. For such an independence of research, a concrete dispositive named "university" is required.

That brings up the question if radical media archaeology is "apolitical". How free is scholarly research to question technology, and to return to alternative approaches towards cultural information of matter and energy? Is this freedom a political question, demanding for freedom of thought in the liberal sense, or is such a freedom of technological though as well a question of its epistemology - as discussed by Michel Foucault? Foucault himself, more directly, addressed the "techniques of power", and the "cybernetics of governmentality" (which is a verbal pleonasm, of course). As is demonstrated in Wolfgang Hagen's recent book which

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Empricism and Subjectivity. An Essay on Hume's Theory of Human Nature, New York (Columbia UP) 1991, 106
322 Jussi Parikka, A Geology of Media, Minneapolis / London (University of Minnesota Press) 2015
323 Needham 1993: 36

opens the "black box" of smartphone photography[324], the usage of technology is not simply a "social media" question in terms of discourse and political content (such as democracy vs. censorship), but there is a micro-political level of freedom in technological usage as well.

"[S]cience is only possible in a democratic medium. [...] Democracy might therefore almost in a sense be termed that practice of which science it the theory."[325] If media archaeology is political, than it is related to the question to what degree the "ancient Greek heritage" of the scientific and technological episteme has been related to democracy (in the narrow sense) or to the "freedom of thought" (against theocracy or authoritarian regimes). "The hard trial will begin when the instruments of power created by the West come fully into the hands of men not of the West, formed in cultures and religions which leave them quite devoid of the Western sense of some ultimate responsibility to man in history. [...] Men of other traditions can and do appropriate *our* science and technology, but not our history or values. And what will the day hold when China wields ["ausüben"] the bomb?"[326]

This coincides with one of Needham's concluding remarks: "Let us take pride enough in the undeniable historical fact that *modern* science was born in Europe and only in Europe, but let us not claim thereby a perpetual patent thereon."[327]

Needham sharply criticizes Gillispie for his Western intellectual imperialism. But nothing can be more Eurocentric than Needham's own claim for global knowledge circulation which is a direct product of Western enlightenment philosophy.

Freeing the Spirit for Thought Experiments, and the Difference it Makes for Experimental Technology

For cultural techniques, and technical knowledge ("teknowledge") to become a truly techno-logical *science* , both theoretical research and practical experimentation requires to be liberated from any binding into idiological, aesthetic, or religious discourses. Even the environmental concern is such a restrictive bias. The Chinese notion of "cosmotechnics" (Hui) has been familiar to Western thinking as well since Greek antiquity (with "natural philosophy" such as Heraklit's). But then - as it has been criticized by Heidegger - the early modern paradigm of science, attached

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324 Wolfgang Hagen, Neudasein. Essays zur sozialen Epistemologie der Smartphone-Fotografie, Berlin (Kulturverlag Kadmos) 2021
325 Needham 1969: 145
326 C. C. Gillespie, The Edge of Objectivity. An Essay in the History of Scientific Ideas, Princeton, N. J. 1960, as quoted in Needham 1993: 45
327 Needham 1993: 45 (1969: 54)

to names like René Descates and Galileo Galilei, has been going beyond. For the Western scientific and technological paradigm, both as theory and as practice, the "freedom of thought experiments" has been vital. For the technological achivements which have been triggered by the mathematical calculations and laboratory techniques as practiced by figures like von Helmholtz, Maxwell, and Hertz in 19th century Europe, the condition of free thought experimentation, as condition of possibility (*a priori*) for truly technological development, has been provided by the the autonomous academic dispositive (Heidegger's *Ge-stell*).

With Leibniz' development of the binary number system in its Chinese inspiration, or the escapement mechanism for time pieces such as Su Song's Heavenly Clockwork, or other technical and mathematical cases where China has advanced its Western counterpart in many respects, the question remains: Why did such technical configurations trigger high-technological devices in the West, while in China, such instanciations remained splendid, but isolated?

An answer may be the technical device in its function as "epistemic thing"[328]. G. W. F. Leibniz rather (re-)"interpreted" the Chinese Ying-Yang[329], in ways which fundamentally differ from its meaning in Chinese cultural aesthetics, and cosmic philosophy. Is it the pure desire, and academic and social allowance, of "thought experiments" without any philosophical, theological, or ideological restrictions, which finally led to Alan Turing's non-semantical, non-cultural algorithmic mechanism called the Turing machine which become the basis for universal computation until today? The condition of possibility for such a machine to arise has been a long genealogy and practice of inquiry into logical calculi for their own sake, a non-instrumental play of logical reasoning, scriptural signs, operative diagrams, and mathematical oparators (from Leibniz over Hilbert to Turing and others). Just like Heinrich Hertz' research into the physical nature of electro-magnetic waves which unintentionally gave birth to "radio" technologies until the Wireless LANs of today, it has been therefore the "culture-free" play of symbols, and the materialized "thought experiments" in the laboratory, which have been at the core, and *arché* (both beginning and principle) of globally dominant communication and knowledge technologies until today.

The Communist revolution in China, and a different attitute to technological "modernization"

The so-called the Self-Strengthening Movement (1861-1895) a.k.a. Western Affairs Movement after ancient China's defeat in both Opium

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328 A term borrowed from the historian of science Hans-Jörg Rheinberger, xxx
329 A proposal by Stefan Höltgen, Dept. of Media Science, HU Berlin

Wars against the British and the French Empire (1839-1860) has triggered the first wave of technological "modernization" in China, and there has been an escalation of Western technologization in China induced by the Communist revolution. As discussed in Yuk Hui's monography, did this apparent discontinuity change China's traditional attitude to technology, away from ancient notions of "cosmotechnics", towards a more material, mechanical, and techno-mathematical approach? "Even up until now, China is still immensely influenced by these Westernisation movements and the modern European techno-science."[330]

Heidegger's "question concerning technology" seems to adhere much closer to the ancient Chinese culture and its "cosmotechnical" philosophy (Yuk Hui), than to its "up-dating", or "modernization", in the era following the political revolution. "If communism in China should come to rule, then one can assume that only in this way does China become 'free'" - liberated not *from*, but - "for technology" [GO "Technik"]. What is this process?"[331] All the difference between technique, and technology. In terms of media archaeology, the rupture between ancient cultural techniques which have been comparatively "advanced" against the West, but then - in its "imperial bureaucracy"[332] - endured more or less without any further evolution, occurred with the Communist era "and the coming into being of capitalism" (Needham ibid.) which redefined China's approach to technology. But while for Needham, it is still that "both mind and science are themselves products of the social level"[333] in the sense of Science and Technology Studies[334], the techno*lógos* hypothesis checks such evidence against the possibility of technological *autopoiesis*.

Towards Technological Autonomy?

Relating the International Academic Forum 2022 under the theme *Civilizations Amid Profound Changes: China and the World,* media theory directs attention to the brute fact that Western communication and knowledge technologies, like the sphere of electro-magnetic waves, and

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330 Yen-Chen Chang, planned master thesis: Technophysis: A Media-archaeological Investigation of Technology and Nature from Antiquity to the Present in China, abstract of presentation within the advanced student research colloquy "Media in our sense", January 26, 2022, Media Theatre, HU Berlin)
331 Martin Heidegger, as quoted in Hui 2016: 6, from: idem, Schwarze Hefte 1942-1948, Anmerkungen I_V = GA 97, Frankfurt / Main (Klostermann) 2015, 441
332 Needham 1969: 152
333 Needham 1969: 153
334 "[...] questions which only a sociology of science can answer": Needham 1969: 224

digital computing, have become universally dominant since the 20th century (latest). In that sense, almost all cultures around the globe have been subjected to such universal technical infrastructures. "Modernization" did not result in a multitude of autonomous technological practices, but in a radical standardizations both in terms of technical hardware and of software. While cultural, political, philosophical and ideological differences remain, according to Marshall McLuhan's seminal thesis, international technologies have turned the earth into a "global village".

Regarding precise technologies like electronic communication media (starting with telegraphy, advancing over radio waves, up to present-day computing and artificial intelligence), we should not simply compare "China and the World" with regard to China's ancient technical culture, but rather ask to what degree the People's Republic of China has already been involved, even absorbed, *within* a technological "world" which is still dominated by the occidental technological episteme.

Concerning media technology, the question arises: are *Civilizations Amid Profound Changes*, with respect to diverging technologies as well? It will be a decisive moment, even "singularity" (in a difference sense than Kurzweill's usage of that term from physics[335]), when - at some region of the earth - all of a sudden a kind of technology will arise which essentially differs from the inherited Western paradigm. Even more radically, this may be articulated as an alternative to the very notion of "technology" itself.

There are already indications of the desire of such a re-formulation of the philosophy of technology, under the pressure of the "Anthropocene" and imminent climate change. Yuk Hui from Hongkong University has declared a "cosmotechnics" which will reconciliate respect for nature with the technological imperative. Interestingly, he refers to ancient Chinese philosophy of technique with its tradition of Daoism ("cosmotechniques") and the notion of Qi (instrumentality), to be rediscovered. Will this ancient approach, in spite of its intermediary "modernization" in terms of Western technologies, reoccur and results in a unique "Chinese" path of technological post-modernization?

The traditional "cosmic" approach has been interpreting the relation between technology and environment (German *Umwelt*) in metaphysical terms. It takes a radical "technophysical" turn (Chang) to maintain such a claim within a strictly scientific technological culture. Technophysis, different from ancient cosmotechnics, emanates from within natural materealities (not meta-realities), and becomes freed from the ideological, or ethical, binding into the symbolical regime of cosmic order.

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335 Ray Kurzweil, The Singularity is Near: When Humans Transcend Biology, New York (Viking) 2005

In order not to be lost in lofty speculations, media archaeology proposes to discuss such issues with reference to precise technical case studies - such as the "analogue computer" as an alternative to digital computing not only in the instrumental sense, but in epistemological terms as well, when mathematics is no longer a cognitive model imposed upon the real world, but it is derived from within the physical world itself: computing with matter. In that sense, future quantum computing will be a re-entry of the paradigm of analog computing, even if still dominated by the "digital" information model.

Linear Technological "Modernization" vs. Non-Linear "Path Dependence"

Modernization theory asks: To what degree does the technological infrastructure "control the limits of human and cultural interaction.[336] New technologies are a major factor of social change indeed, in terms of "any significant alteration over time in behaviour patterns and cultural values and norms" (ibid.). This technological viewpoint is reminiscent of McLuhan's "laws of media" indeed. According to modernization theory, however, "new technologies do not change societies by itself. Rather, it is the *response* to technology that causes change. Frequently, technology is recognized but not put to use for a very long time [...]" (ibid.) - which calls to attention the prominent, but rather singular case of the medieval Chinese timing technology, Su Song's "Heavenly Clockwork".

Against the familiar comparative "history of technology" approach, this calls for a non-linear archaeology of technological development. Accordingly, classical modernization theory drastically differs from the so-called "path dependency" theory in economics, social sciences, and technology studies. In terms of Science and Technology Studies (STS) with its focus on the "social construction of technology", the question arises whether there is still such a thing like a specific Chinese path of (and to) technology indeed.

A path dependence media theory assumes that the technological decisions presented to a given culture are dependent on previous decisions or experiences made in the past. In that sense, technical standard and communication media patterns are not based on current conditions, such as the rather abrupt modernization in China, but are still influenced by a sequence of past attitudes to technique "each leading to a distinct outcome"[337].

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336 Wikipedia, entry "Modernization Theory", https://en.wikipedia.org/wiki/Modernization_theory, accessed February 23, 2022

Will there be a future Declaration of Techno-Logical Independence? Towards a Post-Technological "Singularity"

The media-archaeological attention to the temporal emergence of technical artefacts, for sure, is not restricted to unearthing relevant knowledge from the past. It is rather determined to analyse the technical, and computational, "archive of the present", extending to future media technologies as well, such as "deep" machine learning - especially against the background of path-breaking activities on that field in China.

So-called "globalization", apart from its economic, political and social aspects, can be defined as the technological integration of cultures, especially through (communication) technologies as non-human agency

Such agencies operate cross-cultural. Does the rich, "deep" background of technical knowledge in ancient cultures such as China make a difference here, or are such differences equalized against the techno-logical rupture induced by truly techno-scientific thinking (Needham's argument)? Or will this "deep" background, in a kind of media-archaeological recursion, return, resulting in a significant modification of the "Western" technological episteme itself?

This argumentation therefore ends with a speculative thought. It will be a disruptive moment - fallen "out of history" - when non-Western cultures not only echo any more, or simply accelerate, technologies that have been basically invented and developed in European and occidental thought, but substantially modify them - or may even replace the very notion of "technology" itself, in unexpected ways.

In that context, it may be an advantage that ancient China has rather restrained from a transcendent, abstract concept of linear "time" (as developed by Hegel's Philosophy of History), and has preserved a rich variance of temporal semantics in its cultural practices, due to its "cosmotechnical" philosophy (Yuk Hui), and the technical characteristics of Chinese writing and language itself. Under such conditions, techno*lógos* might, in this media-theoretical speculation, reveal an "alien" tempor(e)ality.

In the contemporary world condition, the technologies that have been developed in the "West" are still enduring to dominate globally. It will be a crucial moment indeed when a non-European culture, such as the rich Chinese one, starts to develop truly alternative technologies (as it now happens with Artificial Intelligence).

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337 https://en.wikipedia.org/wiki/Path_dependence, accessed February 23, 2022

In March 2021, Chinese "People's Congress" in Beijing, has expressed the governmental ambition for technological autonomy against the Western world - but is still adhering to the Occidental episteme and standards of technology, such as the technical paradigms of computation. A more fundamental autonomy might not only retrospectively resume ancient China's environmental, and ethical "cosmotechnique" (Yuk Hui). More radically, it would result in an alternative to the concept of "technology" itself.

CHRONOPOETICS IN THE CHINESE CONTEXT

Chronopoetics[338] claims a technological, knowledge-oriented analysis of media temporalities. Its core assumption is that the essence of media only unfolds *in* - or *as* - "time". By their time-based and timing mechanisms, technological media are identified as a enriching cultural reality by a temporal *cosmos* of their own. Such an analysis ranges from internal, micro-temporal signal and data processing over its relation to human temporal perception up to the question of how media relate to "historical" time at all. Such an approach is therefore not a philosophy of media history, but deals with signals in technical matter, ranging from past to present times.

It is difficult indeed to find equivalents, in the Chinese language, to challenging terms and neologisms like the "time-critical", and "tempor(e)ality". Maybe two philosophies of time are semantically confronting each other here. But in case expressions like the "time-critical" are not understood in its discursive but technological meaning, the inner-technical event, in itself, is non-ambivalent in its signal operativity across the cultures: It means moments, or instantiations, of time that are decisive for electronic processes to succeed, like the tricky synchronization of television lines between sender and receiver, or the rhythmic orchestration of data cycles within computing.

It has been a rather unforeseen coincidence that the question about the temporal being and operativity of technological media gained a new momentum by the sudden increase of "digitized" time-critical telecommunication triggered by a non-computational virus during the Corona pandemic. With the semi-automatic tracing of chains of contamination, time-critical data processing has become a vital factor in the containment of the pandemic Corona virus since the end of 2019. The necessity to "slow down" the dissemination of the virus is familiar to

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338 W. E., Chronopoetics. The Temporal Being and Operativity of Technological Media, transl. by Anthony Enns, London / New York (Rowman & Littlefield) 2016

media theory from intentional signal delay lines in technical terms. The temporeal - in allusion to Jacques Lacan - is already challenging the symbolic order.

The *Chronopoetics* approach to technological cultures so far has been somewhat "Eurocentristic". This invites to rethink - and thereby truly "translate" - the arguments for other techno-logical cultures. The question is raised if - in an almost Platonic sense - technical media and their capacity of cognitive and operational reenactment exist in an ahistorical tempor(e)ality, or to what degree their being is modulated by historically contingent cultural differentiations. Marshall McLuhan's teacher Harold Innis, in his research on the "bias" of communication, differentiates space-based and time-based communication media to explain the different characters of empires in cultural history (touching China only marginally, though). To a certain degree, pre-modern Chinese cultural techniques obviously related to alternative concept of times (in the plural), or rather: timings (in a processual understanding).

A proper mode to address such questions is the method of media archaeology as analytic research, and archaeography as its way of writing. Protagonists like Erkki Huhtamo and Siegfried Zielinski's *Variantology* have already paved the way for a more global media-archaeological perspective, which goes beyond the Eurocentric or "Western" and extends to the techno-cultural achievements in China. A more "radical" media archaeology not only discards conventional narratives of "history of technology" but seeks to liberate the theory of media temporality from technological anthropocentrism. This even arrives at the critical point where the plausibility of "time" as a category for understanding media is in question at all.

Ranging from Martin Heidegger to late Bernard Stiegler and recently Yuk Hui, there has been an increasing number of research and publications on the question of how "time" relates to "technology". Against the rich background of Chinese cultural techniques, the core issue is whether both "time" and "technology" need to be discussed in alternative ways, or if there is a chronopoetical invariance, and techno-logics, which insists across the various cultures. The discussion of equiprimordial technical inventions in the Eastern and Western world has been stimulated by Joseph Needham's seminal research on the comparative history of science. Machine time deserves to be epistemologically taken seriously in its own terms, which - in the end - suspends both the materiality of physical technics and its symbolical encoding from the relativities of cultural historicism, and its various media practices.

What kind of cultural techniques constructed the concept of time in ancient China, and how did media technologies - in the escalating sense - change such concepts in modernity? French scholar Francois Jullien has argued that Chinese culture, for many reasons, has not aimed at a

concept of "absolute time", as it is known from European science and philosophy, in favour of a semantic temporal plurality like "the instant", and "duration". Such heterochronic concepts, in a surprising way, more precisely short-circuit to what actually happens *within* time-critical technologies. Therefore, a core question is to what degree the genesis of technological objects in China has been - and still is - related to the Chinese notion of "time". Has their been, in the Chinese cultural tradition, an incommensurability between its time philosophy, and its operative time technologies? In its precaution not to get lost in lofty philosophical speculations on "time", media archaeology radically seeks insight into such epistemic questions by the close inspection, and inductive knowledge, from *within* the technological mechanisms themselves. A notorious example, in the context of media chronopoetics, is the mechanism of the escapement-driven clock, which has been decisive, in late medieval Europe, for the development of a chrono-technical notion of equidistant, quantized time units ("seconds"). As discussed in Gerhard Dohrn-van Rossum's *History of the Hour*, a huge water-driven mechanism at the Chinese imperial court in the year 1092 has been provided with a kind of "stop-and-go" mechanism; on the background of this evidence, Needham asked whether there has been a direct technological link between the European escapement mechanism, and this Chinese invention, on the basis of cultural knowledge transmission - or whether both cultures, independently, came to isomorphous solutions for similar problems by techno-logical (rather than techno-historical) necessity. Media archaeology seeks to identify this momentum in the rigid sense of co-originality, its *arché* ("Gleichursprünglichkeit" in German language, with reference to Heidegger).

For such an *arché*ological approach, it is mandatory to start the analysis of media chronopoetics from the existent technologies themselves. Only such a "close reading" of the technical detail, or symbolical code, brings media-epistemic equivalences, or cultural differences, into view. Its "anonymous history" (to borrow Siegfried Giedion's term) extends to the hypothesis of a techno*lógos* according to which there are independently parallel lineages of thinking media, which occur in widely spatially and temporally separated cultures of the globe.

The media-archaeological attention to the temporal poetics of technical artefacts, for sure, is not restricted to unearthing relevant knowledge from the past. It is rather determined to analyse the technical, and computational, "archive of the present", and extends to future media technologies as well. An additional chapter on the impact of artificial intelligence, and "deep" machine learning, on the conventional notion of tempor(e)ality, remains to be written - especially against the background of a path-breaking activity on that field in China. To finalize with a speculative thought: It will be a disruptive moment - fallen "out of history" - when non-Western cultures not only echo any more, or simply accelerate, technologies that have been basically invented and

developed in European and occidental thought, but substantially modify them, or may even replace the very notion of "technology" itself, in unexpected ways. In that context, it may be an advantage that ancient China has rather restrained from a transcendent, abstract concept of linear "time", and preserved a rich variance of temporal semantics in its cultural practices, due to its "cosmotechnical" philosophy (Yuk Hui), and the technique characteristics of Chinese writing itself. Under such conditions, techno*lógos* might, in this media-theoretical speculation, reveal its proper tempor(e)ality.

Machine Learning / AI:

MACHINES LIKE US? Phenomenological vs. Innertechnological Analysis of Artificial Intelligence

De-centering media anthropology

Human-machine interfacing, down to "deep" machine learning, and cognitive robotics, in a subject- or society-centered perspective, increasingly results in "humanzing" the abstract machine (aka "computing"). From a non-anthropocentric perspective, though, the same procedures can be interpreted (with Turing, Lacan, Kittler) in a reverse sense: Machines - starting with articulate language as techno-logizing of young humans - actually elicit the "machinic" within the so-called human "it"self (rather than himself / herself). The culturally and philosophically familiar man / machine dichotomy (in Occidental though, at least), and the "baroque narcissism" (Kawanami-Breu) in the Cartesian man / automaton confrontation, is thereby suspended.

What if the apparently "human" dimension is being redefined, by cultural experimentation *with* or rather *within* technology, as machinic already (*en arché*)? This would lead to a different kind of archaeology of (tec-)knowledge, where man is not its exclusive agency in the world.

In order not to get lost in phenomenology or "speculative" ontologies, such questions need to be discussed in terms of radical endo-machinic analysis.[339]

While, e. g., artificial neuronal nets are conceptually modelled upon the human brain activities, in a "close reading", their actual technical implementation (embedding / "embodiment" / implementation) radically differ in their materiality and energetics, and results in an emerging techno-logics (of not "singularity") of their own.

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339 See David A. Mindell, Between Human and Machine. Feedback, Control, and Computing before Cybernetics, Baltimore / London (Johns Hopkins University Press) 2004 [1st ed. 2002]

Recent technologies are reminding of the machine (Lacan's / Kittler's "World of the Symbolic") within the human itself. Articulate language, and alphabetic writing, have already defined "humanism" as techno-logical cultural form. The techno-logically induced future of living will result in a deconstruction of the conventional concept of "life" itself, in favour of cellular automata.

A core scenario is still Turing's seminal publication "On Computable Numbers" from 1936 / 37, starting with its dramatic hypothesis: Man, in the moment of symbolic calculation (even with pencil on paper), is in a symbolical "machine" state already. In computational science, notably, Turing (the subject) himself vanished into the "turingmachine", while in non-technical discourse, the ghost of Turing keeps returning in literary, and cinematographical, narratives (McEwan's *Machines like Us*, or the *Enigma* film).

Even the technical, cybernetic, and science fiction concept of "humanoids" (Stanislav Lem's legacy) is still affirming anthropocentrism in machine culture. Finally, "deep" Machine Learning" aims at emulating the human mind / affect complex. A more radical non-symmetric aesthetics accentuates the systemic difference already on the interface level, displaying and enhancing the frictions which occur in the coupling of both systems.

AI can only simulate or imitate (Turing 1950), but not "emulate" human intelligence; emulated by computing can only another discretely coded Turing machine, no real world being. Computers still "have no significant sensory or manipulative contact with the real world but operative only in an abstract environment of numbers and operations on numbers"[340]. But in actual *computing* (instead of abstract computation), such numbers and operations are part of a highly material environment of electronic architectures. Can *big data* training in machine learning only approximate this real world - or, up to Leibniz' *limes* sense, become equivalent to the world itself? Logos here is no ontological category, but becomes material and energetic (even thermodynamically), that is: operative as "propositional logic - understood as an apparatus that determines what is the case and what is not"[341], culminating in digital computing that consciously excludes the "time of non-reality" (Norbert Wiener) that actually occur between binary states.

When tightly - not simply symbolically (cognition), but in terms of a "bio-adaptor" (Oswald Wiener) - coupled to techno-logical machinery, man is

340 Shannon 1953: 1236

341 Bernhard Siegert, Coding as Cultural Techniques: On the Emergence of the Digital from Writing AC, in: Grey Room, no. 70 (Winter 2018), 6-23 (8)

losing its exclusive position as "reasoning" agency, which has logo-centrically been defined as his *differentia specifica* against other forms of being (the Aristotelean "Wesensunterstellung"[342]).

As analyzed in Charles Babbage's *Economy of Factory,* the worker is becoming part of *automaton* itself; Karl Marx' "Machine Fragment" moved this thought experiment to its borderline. Machines no longer a linear externalization of man (Kapp / McLuhan) or - in terms of Taylorism - man's alienation (Marx), but his own mental / cognitive mirror-image (Lacan). Instead of an alienation, technology rather brings-forth (Heidegger) the machinic within man itself: as "alien" epistemology (in accordance with Ian Bogost).

Machine-learning algorithms

In cybernetics and behaviourism, the category of "learning", which has previously been ascribed to humans exclusively, have increasingly been applied to non-organic agencies as well.[343] The common denominator is the neuronal learning algorithm as its core mechanism, understood not simply as formal mathematical procedure. It is the physiological embodiment vs. its technological implementation which makes the difference between man and machine intelligence. Media-archaeological analysis of actual Machine Learning takes caution not be seduced by the neuroscientific "embodiment" model. "Deep" learning has been inspired by neuroscience indeed - but is this a justified scientific analogy, or simply the (re-)entry of anthropocentrism into the computational machine? Media-archaeological criticism of A/ / ML concentrates on the divergent modes of neuro-biological vs. technological "embodiment" of intelligence (or ratio) is crucial indeed. Against the inherited Cartesianism, the body is no simply extension of the brain, nor is actual AI computing a mere implementation of the "spirit" (Hegel) of software. Matter / energy, and reason, are rather primordially intertwined in / as technology. Even with the all-or-none law of nervous action, this functional resemblance of neurons to our binary relays, vacuum tubes or transistors in technical computing only extends to an emulation (with "emulation" being restricted to the Universal Turing Machine). Machine

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342 Entry "Genus proximum et differentia specifica", https://de.wikipedia.org/wiki/Genus_proximum_et_differentia_specifica, accessed November 15, 2022
343 As discussed in Sebastian Kawanami-Breu's impulse lecture "Behaviorism at Electronic Speed. Lerndispositive von Ebbinghaus bis Rosenblatt": Sebastian Kawanami-Breu and Stefan Höltgen, Artificial Neural Nets and Learning Algorithms, combined lectures November 25, 2020, on occasion of the research colloqy Media in our Sense (*Medien, die wir meinen*) at the Department of Media Science, Humboldt University, Media Theatre

intelligence is different *en arché*. In the field of visual pattern recognition, Frank Rosenblatt's Perceptron materialized an electronically hard-wired algorithm which is symbol processing - while the body does not. "[T]he goal is to find aspects of dynamical systems that can be interpreted as symbolic processing"[344], that is: "digital", though essentially, it remains "analogue", without an internal clock as required for the Turing machine. Rosenblatt's *Principles of Neurodynamics* has been declared an explicit "Theory of Brain Mechanisms (subtitle 1961) as a machine model, not as wetware.

Since 19th century laboratory experimentation of human psycho-physiological capacities (von Helmholtz, Ebbinghaus, Semon), "learning" has been implicitly algorithmicized (even "algorhythmicized", with Miyazaki). With Norbert Wiener's (et al.) publication Behaviour, Purpose, Teleology (1943), such a fundamel lerning algorithm has become explicit, as controlled by negative feed-back. "Teleological behaviour" became synonymous with negative feed-back which is recurring (or re-invented) in today's Deep Machine Learning "backpropagation".

Rosenblatt's Perceptron has been foremeost an electronic brain model, "not an invention for pattern recognition"[345] - in fact a materialization of cybernetic and experimental anthropo*de*centrism, reminding of the essentially "machinic" within the human itself. It has been no metaphysical "spirit" but the techno-logics of concrete electronic elements like the binary electro-magnetic relay (Shannon), or the flipflop vacuum tube circuitry which, in its epoch, induced such "brain" models of thought as positist experimentation. So-called androids are media-archaeologically "grounding" (in the electro-engineering sense) any speculative anthropology in experimentable science, thereby turning *lógos* into *operations*. Algorithmic technologies (a.k.a. "machines") thereby become epistemic toys.[346] Even the rat is thereby recognized as a problem-solving device (Shannon's "Theseus" labyrinth).

Locating the intelligence machine

Clark Hull designed "psychic machines" in the 1930s. Lacan refers to this model, but dismisses the quotation marks - just like Sigmund Freud described the "psychischer Apparat" not as metaphor.

The human mind / brain has increasingbly been modelled in algorithmic terms. The software of Artificial Intelligence itself, though, is merely a symbolization of hardware storage. Artificial Neuronal Nets are concretely

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344 Pfeifer / Bongard 2007: 355
345 Rosenblatt 1961, viii
346 See Hans-Jörg Rheinberger, Das "epistemische Ding" und seine technischen Bedingungen, xxx, 70 f.

localizable and "grounded" in computer memory.[347] An early artificial neuronal net algorithm for pattern recognition has been implemented in the high-level programming language BASIC. A "neuron network associative memory" (John Walker's "BrainSim" on a vintage Commodore 64 home computer) has been able to recognize letters and numbers "done in less than 250 lines of BASIC". This approach is now reenactable with an emulator of the COMMODORE 64 computing decive.

The "neuronal tissue", in the animal and as machine, rather performs rather filter functions.[348] But the cybernetical Black Box model tends to overlook the differences in human-machine analogies. The term "friction" can therefore be borrowed from mechanics, but now be applied in a techno-epistemic sense. Any media-philological code discussion is matched by its media-archaeological hardware analysis.

The precise grounding of fuzzy terms like "neuro mediality" or "neuro-aesthetics" (re-)turns such an analysis of phenomenological superstructures to its proper techno-logical basis: measuring, sensing and *imaging* media as condition of possibility of such research fields.

"Machines like Us" (McEwan)? Media Phenomenology vs. Inherent Techno*lógos*

When epistemologist of cybernetics Gotthard Günther asked: "Can Mechanical Brains Have Consciousness?" in the first place, this question was originally published in the periodical Startling Stories.[349] Another of Günther's reflextions concerning the same question has originally been a commentary to Isaac Asimov's novel *I, the robot*.[350] According to Asimov himself, Gunther "maintained [that] when Old World civilization was transplanted to the New World, a distortion was introduced and one of the ways in which this distortion was evidenced was by the peculiar

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347 As discussed in Stefan Höltgen's impulse lecture "70 dim f1%(42),f2%(42),m%(42,42): Behaviorism at Electronic Speed. Lerndispositive von Ebbinghaus bis Rosenblatt", during Sebastian Kawanami-Breu and Stefan Höltgen, Artificial Neural Nets and Learning Algorithms, combined lectures November 25, 2020, on occasion of the research colloqy Media in our Sense (*Medien, die wir meinen*) at the Department of Media Science, Humboldt University, Media Theatre
348 As suggested by Shintaro Miyazaki, Junior Professor for Digital Media / Computation at the Dept. of Media Science at Humboldt University, Berlin
349 vol. 29, no.1, New York 1953, 110-116
350 Gotthard Günther, Das Bewußtsein der Maschinen. Eine Metaphysik der Kybernetik, Krefeld / Baden-Baden (Agis), 2nd ed. 1963, Supplement IV Die "zweite" Maschine, 179-203 [originally commentary to Isaac Asimov, Ich, der Roboter, Düsseldorf / Bad Salzig 1952, 219-242

American invention of science fiction, which was not to be confused with earlier European ventures in the field (i. e., Jules Vernes)"[351]. Is it the cybernetic paradigm itself which has created all that difference, down to movies like *Ex Machina* (GB 2015)?[352]

Günther's insistence on the distinction between Archimedan machine / mechanics, and the "second" machine is analytically vital.[353] Ian McEwan's novel *Machines like Us* (Cape) 2019 is "set in the 1980s in an alternative history timeline in which the UK lost the Falklands War, Alan Turing is still alive, and the Internet, social media, and self-driving cars already exist" - resonating with Gibson's / Sterling's "steam punk" novel *The Difference Machine*. "The story" - *humanzing* again - "revolves around an android named Adam and its/his relationship with its/his owners, Charlie and Miranda, which involves the formation of a love triangle."[354] This echoes early insights from classical information aesthetics. "We are presently facing [...] a revolution of automation, [...] of symbiosis with machines [...], a 'secret revolution' in the sense that those who are part of it - all of us - were unaware that it was going on."[355]

Nowadays, the former subject / object dichotomy, with its man / machine separation, is replaced by a more dialectic (Hegel / Günther) or "diffractive" (Karen Barad) inter-relation between both the organic and the electro-technical cognitive system.

The symbolic is not simply "materialized" or "embodied" in hard- or wetware any more, but in this technical entanglement induced by cultural knowledge, a different (maybe even "diffractive") kind of *lógos* emerges (with "emergence" taken in its scientific, not transcendental definition).

Some questions concerning AI / ML[356]

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351 Isaac Asimov, Memory Yet Green (1979), 605, as quoted in: entry "Gotthard Günther", https://www.wikiwand.com/en/Gotthard_Günther, Zugriff 24. November 2021

352 Screen play / director: Alex Garland

353 Andreas Broeckmann, Machine Art in the Twentieth Century, Cambridge, MA / London (The MIT Press) 2016, 19

354 https://en.wikipedia.org/wiki/Machines_Like_Me, accessed November 22, 2021

355 Abraham A. Moles, Introduction to the colloquy Computers and Visual Research,Center for Culture and Information, August 3-4, 1968, Zagreb, in: Margit Rosen (ed.), A Little-Known Story about a Movement, a Magazine, and the Computer's Arrival in Arts. New Tendencies and Bit International, 1961-1973, Karlsruhe (ZKM) / Cambridge, Mass. (MIT) 2011, 263-266 (264)

356 Formulated by Robert Bobnic, as discussed on Sunday, October 8, 2024, at Maribor computer arts festival (MFRU), Slovenia

As long as Deep Machine Learning, trained by social media data and cultural image banks, are adapted to human values (which are not universally given like logical or physical laws, but episteme-dependent[357]), they remain oriented at "human" society. Genuinely *artificial* intelligence lets a non-social intelligence emerge instead.

Sociocentrism can "limit the performance and the potentiality of AI systems" (Bobnic) indeed. AI becomes epistemogenic once it is not simply liberated "from" an anthropocentric notion of intelligence (neuroscience) but liberated "to"wards true artificiality, that is: acknowledigng its technical "other phenomenology" (Ian Bogost 2012) as *techknowledge*, different from a purely instrumental use of AI / ML as pragmatic tool in everyday applications. This lets techno*lógos* be articulated through epistemogenic tinkering respectively "media arts".

But the general attitude of human culture towards techno*lógos* remains ambivalent. "Is there a human narcissism at work and, in a way, a hostility towards autonomous forms of technology?" (Bobnic).

According to the "laws of media"(McLuhan) in history (or their recurrent "*topoi*", with media archaeologist Erkki Huhtamo), new technologies first look like "insulting" cultural narcissism, resulting in social and econimic fears - but with (at the same time) an irreducible fascination to play with such potentialities beyond human control. Automata in the baroque (Descartes) and in fiction (androids, artificial voices from von Kempelen's machine) have been arising horror and fascination at the same time - now extending from bodies (robitics) to the operations of the mind itself. Turing starts his article from 1937 on what later became labelled as the Turing machine (a. k. a. digital computer) already in his introduction pointed out that a human, when performing a numerical calculation, is in a machine state which can as well be operated by an artificial mechanism. But the freedom of such thought experiments is the core of academic research and philosophical speculation, and the arts unfold in the sphere of such unlimited experimentation.

When ever humans are afraid of an arising external technological challenge, they try to turn them down into instrumental tools. The essence of techno-logical challenge has a rather psychoanalytic sense: Humans are afraid of being reminded, by technologies, of the "machine" whithin the human *its*elf (the Freudean "id"), by discovering that his / her own nonconscious affects happen "faster than thought" like in electronics. Human "subjectivity" is now challenged by AI-modelling (the original cybernetic impulse) which reveals the neural cognitive mechanism within humans themselves.

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357 According to Foucault's discourse analysis and September 2023 Ars Electronica (Linz) theme *Who ownes the Truth?*

Instead of focusing on the data capture "bias" by machine learning algorithms, it might make sense "to grant algorithms the right to learn and to optimise the conditions for machine learning, just as for humans" (Bobnic). According to Turing (again), the reasoning human acts "algorithmically" already. Computer chip design has already been changing from human engineering to automated machine diagrams.

But a core challenge arises: To what extend can media archaeology still "offer insights into the materiality of AI in the form of abstract machine learning systems?" (Bobnic). In particular, media archaeology proposes a hands-on approach to media materiality and technologos in the form of computation emancipated from the human brain. "How to approach AI with a hands-on approach?" (Bobnic). There is still "no software" in AI / ML, in the strict techno-materialist sense. But its driving ratio is mathematics enacted as techno*lógos*. Therefore "radical" media archaeology has always emphasizes its double nature as material *and* mathematical analysis of the techno-logical *arché* as the double-bound essence and governing rules (or conditions of possibility of articulation) of digital computing.

The core focus of the techno*lógos* hypothesis is on the operational principles (*archai*) of technology, i. e. the logical diagrams and schematics *once they are* (and only unfolding then) technically (materially and energetically) implemented. It is about extracting insights into the workings of techno*lógos* from within the technologies themselves. "When the media become computational and algorithmic, it is about insights into the workings of computation" (Bobnic) - but not reduced to abstract computation, but as actual *computing*, which is the implemented ("embodied") mathematics as software and / or diagram.

Can techno*lógos* be "archived" in the conventional sense at all, or does it escape - like the Lacanean *real* - all historiographical textualization (language) and codification? The technological events and breakthroughs from the last decades that have been "most relevant for understanding computation" (Bobnic) can only archaeographically be registered.

"[...] in general, media archaeology is still on the margins of approaches within the field of the various disciplines dealing with technoculture" (Bobnic). But radical media archaeology has an alternative approach to "understanding technologically generated and modulated culture" (idem) - exacly by dismissing hermeneutics ("understanding") and mere "modulation" role of technologies. Techno*lógos* is an epistemic signal in itself.

The "societal" STS orientation is a hindrance for understanding the techno*lógos* of computational culture. Radical Media Archaeology proposes a readically knowledge-oriented approach instead: its research

as entanglement of "logical" thinking (reasoning) and material "tinkering" (informatized matter / energy). The MFRU workshop "Gentle but Noisy", on October 7th, 2023, located at Cultural Incubator, Maribor (for "8 to 14 years"), let children "build their very own portable electronic acoustic device, by simply using wood, screws, a few electrical elements, a metre of wire, and a battery"[358]. But AI agents (e. g. large language models currently at the forefront that paradoxically dismiss the conventional language-orientation at all, in favour of a radical random approach) can not be reduced to electrified logics (the circuit) alone any more. The term computation might become obsolete itself, sinse NLP systems approach speech "as a disorganized complexity, a stochastic and non-linear process with multiple variables at play, which statistics is capable of reducing to the most likely organized complexity and then to the most likely simpler problems at stake.[359] But what starts with noise in Generative Adversarial Nets, is still not "anarchic". When shapes are successively filtered, in subtractive "imagogenesis" (Faldalen), from Pink Noise, is the "icon" already inherent?

The computer, as real electronic artefact, actually does not care whether signals, once converted to "data", are of linguistic or visual or acoustic or other phenomenal character. Such phenomenal categories are replaced by data *formats* - the logical equivalent to the physical *medium* (Heidenreich). Still, such formats need physical hardware to be enacted at all. Form is not is not simply imposed on unorganized matter (hylé) as symbolic determination from outside itself, but primpordially "afforded" by its mateRealization.

Not only thermodynamic physics (the hardware), but computation itself deficient, according to the metamathematical incompleteness theorem (Kurt Gödel).[360] While any computational "art" is already a function of algorithmic reasoning, the "art of computing" (rather than is increasingly responsible to remind of, and to investigate, the non-computable on the one hand, and to "liberate" AI to non-instrumental use as knowledge-generating laboratory (experimental epistemology, with Warren McCulloch).

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358 https://www.mfru.org/events/gentle-but-noisy-8-14-years (accessed October 7, 2023)
359 See Ulrik Ekman, The Complexity of Coding Conversational Agents, preprint on web site ResearchGate, https://www.researchgate.net/publication/329584795_The_Complexity_of_Coding_Conversational_Agents (version received April 2019). A shorter version has been published in: Nanna Bonde Thylstrup and others (eds), Uncertain Archives. Critical Keywords for Big Data, Cambridge, Mass. / London (MIT Press) 2021, chap. 8 "Conversational Agents"
360 See M. Beatrice Fazi, Contingent Computation: Abstraction, Experience, and Indeterminacy in Computational Aesthetics, London (Rowman & Littlefield) 2018

Computation itself is changing from imperative programming (algorithmic control) to calculating (with) probabilistic, Markov Chain-based random instead of Cartesean certainties. This coincides with the metadata-free paradigm shift, in untrained machine learning, towards subsymbolic signal processing. The familiar task-specific coding of algorithms is left behind in favour of the development of "deeply" structured neural networks that generate their output directly from big data training sets (Ekman 2019). The CNNs are increasingly doing so by not simply processing data intransitively upon brute matter (silicon), but subsymbolically by signal transduction from within technically organized matter.

Artificial Techno-Poiesis

Humans may learn exactly from errors in their "dialogue" with intellectualized machines. Human-Machine-Interaction (HMI) *turns* (German "Kehre") into Machine-Human-Interaction, with an emphasis on the tecNOlogical (Dörfling) articulations from within the machine itself: a dia(techno)logue indeed.

True machine learning, with an emphasis on the "machine", is not biased by the human brain model any more. It will rather be future non-classical computers among themselves which truly "recognize" (the other meaning of "intelligence") how knowledge arises, in artificial neural nets, from patterns in the combination of big data and high-frequency computing. Raymond Queneau, in his rather mechanical "cut-up" poetry paper machine from 1961 *Cent mille milliards de poèmes*, chose as its initial slogan an insight from Alan Turing: "Seule une machine peut apprécier une sonnet écrit par une autre machine"[361], such as: "Der Respekt ist die Wiederholung des Radikalen und sein Ende."[362]

Different from AI, that aims at mimicking human intelligence by probabilistic reasoning / computation, Link explicitly allows the contingencies of his semantic web-based combinatorial machine to be expressed in their idiosyncasies.[363]

[Remarkably Link, in the book title, still insists on his human author name against the literary hallucinations of his computer program "Poetry Machine" - what in informatics is known as "Human-in-the-Loop" (HITL)[364].

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361 See Siegfried Zielinski, Nachwort: "Poesie-Erreger", in: David Link, Pandaemonium, Berlin (Matthes & Seitz / Rohstoff) 2024, 297-317(308)
362 Link 2024: 5
363 See Link 2024: 293, with explicit reference to Sigmund Freud and Ferdinand de Saussure
364 See David Link, Pandaemonium algorithmisch, in: Link 2024: 293-295

His program therefore privileges sens-carrying expressions that his "associative" machine extracts from the Internet once the mechanism has been triggered by a human input (295).]

["*Pandaemonium* is first and foremost a place of no place, a space of madness and unreason, the realm in which demons, all the horror, the abjects feast on the bowels and excess of the present. *Pandaemonium* is, above all, as David Link proves with the help of his generative software »Poetry Machine«[365], a place of possibility, of unexpected pleasure and happy coincidence, where it is not the human being who sees himself in the computer-generated product, but rather where it becomes clear what happens when algorithms are finally allowed to turn and develop free of effectiveness, finiteness and determinism: fed with literary works, articles from daily newspapers, song and information theory texts [such as Claude Shannon], a program behaves here that does not aim for control and predictability, but rather, without ever concealing its technical character, like a fantastic, fanatical fever dream, allows one to participate in the birth of poetry from the spirit of the machine."[366]]

Only then will the techno-logical medium message of AI be self-fulfilled. *Understanding media*, in "deep" machine learning, becomes media-active, liberated *from* human intelligence *to* of an intelligence of its own.

BIOLOGY VS. TECHNO*LÓGOS*. Chemical Morphogenesis and / or the Computational Regime

[Abstract]

The divergence between "The Intentionality of Matter" respectively biological morphogenesis on the one hand, and techno-logical reasoning of "algebraic patterns" (in Ada Lovelace's sense) is a media-epistemic fundamental issue. To what degree does autopoietic material intentionality differ from technical in/formatization of matter? Is the latter an activation of a latent (inherent) *lógos* or is it imposing an external reason upon thermodynamic physics? Computational morphogensis (since Turing 1951) arises from already (pre-)in/formed matter and symbolic character strings, that is: from material hardware circuitry and

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(293)

365 See David Link, Poesiemaschine / Maschinenpoesie. Zur Frühgeschichte computerisierter Texterzeugung und generativer Systeme, Munich 2007

366 https://alpha60.de/art/pandaemonium, July 3, 2024. For an "AI" predecessor of Link's Pandaemonium see Oliver G. Selfridge, Pandemonium: A Paradigm for Learning, Session 3, Paper 6, in: D. V. Blake / A. M. Uttley (edss), Proceedings of the Symposium on Mechanisation of Thought Processes, London, 1959, 511-531

its software code. Are such emerging patterns rather immanent in its training data banks, as preformation? On the other hand, is there a morphogenetical bio*lógos*, or does continuous, "transient"[367] biochemical diffusion as pattern fabric(ation) differ categorically from discrete techno*lógos* as mechanization and conceptual ABCtraction? Is mathematics (co-)originary to the emergence of patterns, down to AI and "deep" machine learning, or are artificial neural nets simply their analytic modelling? The techno-logical generation or recognition of patterns ("intelligence" in the military sense) logocentrically differs from patterns that emerge within physical and organic matter. This investigation insists on the operative divergence between bio- and technomorphosis. Different from entropic irreversibility in real physics, AI is capable of a reverse morphogensis such as refiguring an image from background noise. Maybe the identification of "patterns" is logocentric already. Does the category of "form" already "bio-morphize" statistical modelling and its computation? Once AI is not reduced to a human-oriented tool but conceived as an epistemic toy, it allows for such media philosophical questions of a "transcendental cybernetics" (Gotthard Günther). The following arguments will not add further scientific evidence on the chemical basis of morphogenesis (for which humanities respect and envy scientific research) but rather invite to ask appropriate media-philosophical questions concerning that phenomenon.

A. The Technológos Approach:

Morphogenesis as a Form of Unconventional Computing

Any fundamental criticism of the discrete mathematical computational approach to the physical world[368] recalls an alternative to digital computing: *analog computing* that implicitly "counts" with the continuous. Donald O. Hebb's theorem, as it has been formulated in his *The Organization of Behavior* in 1949 (New York: Wiley) just when the first digital computers effectively took off, defines "learning" as iterative enhancement of the strengh of synaptic links between neurons. This is in the engineering tradition of analog computing indeed.[369] There is an original bifurcation of the computational (mathematically symbolic) vs. the sub-symbolic, "embodied" computing approch to machine learning. In

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367 See, e. g., Matthew A. Oberhardt et al., Harnessing the landscape of microbial culture media to predict new organism-media pairings , in: Nature Communications 6/1 (October 2015)

368 Giuseppe Longo, Quantifying the World and Its Webs: Mathematical Discrete vs Continua in Knowledge Construction, in: Theory, Culture & Socienty, vol. 36, issue 6 (November 2019)

369 As emphasized in Günther Görz / Josef Schneeberger / Ute Schmid, Handbuch der Künstlichen Intelligenz, Munich (Oldenbourg) 5th rev. ed. 2014, 11

the latter concept, "the physical realization of the computation or the physical effects of the computation" are no simple hardware means to achieve an otherwise purely logical effect, but "essential to the computation" itself[370]. Its artificial morphogenesis specification "applies the embodied computation principles of embryological development to coordinate massive swarms of microscopic agents to assemble complex physical structures."[371]

To go one step further: Is the biochemical phenomenon of morphogenesis itself a form of unconventional (analog) computing? And is this relation between matter and form transitive? Turing's 1952 mathematical model describes the transition from a homogenic initial state to an organized final state. Fourier analysis and partial differential equations are the mathematical tools for modelling dynamic processes in rather logical than nonlinear terms. Is the ambition of such a mathematical analysis here a simple modelling, or does it suggest an originary computing from within biochemical matter itself?

Turing significantly uses the term "mechanism" (derived from his definition of the algorithm in 1937) in the abstract of his 1952 text. It is exactly this mathematical mechanism of analysis which Bergson opposed to *elan vital*. A mathematical approximation (as *historia rera gestarum*) might not be confused with the morphogenetic event (*res gesta*) itself. Which core agency causes the variations and identities in morphogenesis? Is a morphogen a signal communicating pattern generation which can be abstracted into a computable symbol? All of the sudden, morphogensis turns the "extended mind" model of cognitive science[372] upside down: It is biochemical matter itself that, as morphogensis, extends to reason. But it still requires a human mind (respectively cultural knowledge) to become identified as information, or intelligence.

In the symbolical concept of morphogenesis (as "Turing-Mechanism"), a previously homogenic system starts to sub-divide, making "informative" differentiations. The creation of order from noise includes spontaneous nonlinear local random events indeed. A kind of "Oracle machine" (Turing again) dynamically generates patterns. Just as it is modelled in artificial image synthesis by generative adversarial neural nets (GANs) *via* self-

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370 B. J. MacLennan, Embodied computation: Applying the physics of computation to artificial morphogenesis, Parallel Processing Letters, vol. 22, issue 3 (2012)

371 Bruce MacLennan, A philosophical path, in: Andrew Adamatzky et al., East-West paths to unconventional computing, to appear in: Progress in Biophysics and Molecular Biology (2017), 54-58 (57)

372 Andy Clark / David Chalmers, The Extended Mind, in: Analysis, vol. 58, no. 1 (1998), 7-19

organization, biological tissue can generate organ(izational) patterns as order from background noise without external reference.[373]

There are patterns of matter, organic patterns, and patterns of information. This triad critically recalls Norbert Wiener's seminal dictum in *Cybernetics* from 1948, stating that "information is information, not matter nor energy". Informational patterns (the discrete mathematical numerical regime) are conceptually (even media-ontologically) different from physically continuous organic matter and energy. Physically and bio-chemically "active" or even "intentional" mattering (like in the hypothesis of a plant cognition) seems opposed to another kind of matters of activity: techno-logically in/formed ("activated") matter. Or is such a categorical dichotomy itself already metaphysics? Is the "continuous" itself is a dialectic counter-thesis of the "digital" itself? Once a mathematical bio*lógos* is assumed, it can be applied as techno*lógos*. Such a mathematical analyse re-turns in concrete numerical simulations that are able to approximate the geometries of natural patterns.

Data strings such as the number "pi" tend to generate patterns as order from chaotic and random processes, once they are algebraically formulated as a sequential function by the discrete machine. As soon as physical or bio-chemcial signals are digitally processed as "data", they have already become translated into the symbolic regime of computing, by analog-to-digital "sampling". But for a non-mathematizable kind of input, Turing's PhD thesis has introduced a hypothetical "Oracle machine". In a 1948 report Turing even suggested the thought experiment of an hypothetical "unorganized machine" that is still a discrete (therefore computable) mechanism, though (like a FPGA in present computing hardware).

So-called "Turing dynamics", although symbolical, approaches the biochemical real of continuous processuality. Digital *computation* here emulates natural analog *computing* itself. But a biochemical neuron can only reductively be simulated by analog electric circuitry.[374]

Computation and / or Computing Morphogenesis with Turing

To what degree can the rather transcendental notion of "emergency" in Machine Learning be addressed in terms of morphogenesis and so-called Turing patterns? Nonlinear dynamics is at work here, as chaotic systems from which patterns emerge. What is its primary *biológos*? The agencies that are at work before patterns finally become apparent as phenotype

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373 Manceau 2022: 48
374 See F. F. Hiltz, Analog Computer Simulation of a Neural Element, in: IRE Transactions on Bio-Medical Electronics (Januar 1962), 12-19

are hardly known.[375] Does the computational machine relate to such "Turing mechanisms" in biochemical morphogenesis? Computable numbers (Turing 1937) differ from elementary bio-chemistry indeed. Turing's defined the algorithm as purely symbolic machinery. But for applied mathematics, in the strictly defined sense of operative diagrammatics, there is no matter-free mathematical operation. This requires a proper *material machine* concept.

When "a homogeneous one-morphogen system undergoes random disturbances without diffusion for a period, and then diffusion without disturbance"[376], such a process becomes "very convenient for computation" (ibid.). Figure 2 in Turing's text demonstrates such a pattern, "obtained in a few hours by manual [sic] computation" (ibid.).

Turing's rather marginal discussion of the role of the technical computer simply as device for speeding up his complicated time-consuming mathematical derivations of morphogenesis is remarkable. Turing actually does *not* co-originally compare the bio-chemical "mechanism" to his concept of an universal algorithmic machine, while still adhering to the computer-epistemic premise: Whatever can be analyzed mathematically can be turned from the "analog" into discrete symbols can, in reverse, be synthesized computationally.

Is there continuous dynamics or rather a deterministic machine at work in biochemical morphogenesis? "The purpose of this paper is to discuss a possible mechanism by which the genes of a zygote may determine the anatomical structure of the resulting organism."[377] A finite automaton is supposed to be hiding behind, or being embodied in, "a number of chemical substances (morphogens) diffusing through a mass of tissue of given geometrical form and reacting together within it"[378]. To what degree is Turing's "theory of morphogenesis"[379] interested in, or concerned with, the *actual* bio-chemical embodiment, that is: the matereality of such a mathematical modeling? Turing has been aware that the description of the system in terms of the concentrations in the various cells can be "only an approximation"[380]. "In practice, though, "[...] the presence of irregularities, including statistical fluctuations in the numbers of molecules undergoing the various reactions, will, if the system has an appropriate kind of instability, result in this homegeneity disappearing"[381]. This morphogenetic "drift" seems explainable "with only

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375 Turing 1952: 50
376 Turing 1952: 59
377 Turing 1952: Abstract
378 Turing 1952: 40
379 Turing 1952: 41
380 Turing 1952: 41
381 Turing 52: 42

very simple mathematics"[382]. But Turing's argument is not purely mathematical, it is physical as well. Turing's analysis is adaptive to the (mate)real event and not brutely imposed from above as an ideal modeling. "[T]emperatures giving rise to these functions would settle the matter finally"[383] - while considering *matter* here in its literal sense. This reminds of Turing's ACE project concern for temperature variances in mercury delay lines for temporary data storage by dynamic reiteration (RAM).

But this approach, Turing adds, "would be difficult and somewhat out of the spirit of the present inquiry. Instead, it is proposed merely to mention imaginary reactions which give rise to the required functions by the law of mass action" (ibid.). The "reactions here described are by no means those which are most likely to give rise to instability in nature"[384]. For Turing's mathematical expression, "it makes a media-epistemic difference indeed "whether on a theoretical or experimental basis"[385]. Is there a self-expression of logos *from* matter, or is such a reason only symbolically imposed on the real? The binary computer is never simply "symbolic", not even if expressed by pencil on paper.[386] It is so only if reduced to mathematical formalism ignoring the material respectively energetic in-between or "forbidden zone"[387] that occurs between binary switching states. The engineering definition of "information" is consciously missing the tempo*real* "time of non-reality" (Norbert Wiener). But morphogenesis cannot be reduced to the merely "symbolical machine" (as defined by Sybille Krämer), just as the Turing Machine can only compute *computable* numbers, vs. the contingencies that are included in a hypothetical "Oracle Machine"[388].

Pattern Engineering vs. Autopoietic Emergency: Techno- or Bio*(a)lógos*?

Ancient Greek philosophy does not know a negation of *lógos*; even material reasoning occurs *anà lógon* here (which means the "analogue" in a literal understeanding). The term *álogos* is rarely featuring (such as

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382 Turing 1952: 43
383 Turing 1952: 43
384 Turing 1952: 43
385 Turing 1952: 46
386 See footnote 5 in Turing 1937
387 Bigelow at the New York Macy Conferences on cybernetics, as quoted in Jörg Pflüger, Wo die Quantität in Qualität umschlägt. Notizen zum Verhältnis von Analogem und Digitalem, in: Martin Warnke / Wolfgang Coy / G. C. Tholen (Hg.), Hyperkult II. Zur Ortsbestimmung analoger und digitaler Medien, Bielefeld 2005, 27-94
388 Dissertation Turing 1938: Systems of Logic Based on Ordinals). See Andrew Hodges, Alan Turing. Enigma, New York 1983, chap. 7

in the New Testament), oscillating between the unreasonable ("without reason") and the non-represented ("without speech").[389]

Do Turing patterns follow a bio*lógos* in equivalence to technology? While patterns arising from computational mathematics still follow the logocentric mind, cellular patterns act autopoietically. In between operates the contemporary concept of "deep" machine learning.

Turing's excursion in the field of theoretical biology itself addresses the logocentrism of its mathematical approach. He cautions and declares any algebraic model of chemical morphogenesis, right from the beginning, a "falsification"[390]. What is the epitemic price of transforming "analog" matter (the physical world) into an algorithmic mechanism of computability (symbolizing physics as the regime of real numbers)? Is *counting* morphogenetically *a priori* to the concept of numbers?[391] The Pythagorean understanding of *pragmateía ton anà lógon* differs from subsequent algebraics as merely formal computation as it has been practiced by al-Khwarizmi.[392]

Turing's text on the chemical basis of morphogenesis assumes that pairs of chemical morphogens, through "reaction-diffusion", spread through a tissue, and in interaction with one another produce patterns. The discretizing (rather than "analogue") approach of (the) Turing (machine) is *sampling* momentary "states" of the biochemical system and stochastically describes how such a state determined from the state a moment very shortly before"[393]. This model amounts to "a physical theory" (ibid.) of Markov chains.

B. The Musicality of Morphogenesis:

The *mousiké* of Morphogenesis

The phenomenon of embryonic gastrulation appears almost "musical" in the ancient Greek sense[394], that is: unfolding in harmonic ratios or "standing waves" (Turing 1952). This phenomenon is known, in musical composition, as *patterning* - a spatially (harmonic) or temporally

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389 See the Greek-English Concordance for ἄλογος, https://www.billmounce.com/greek-dictionary/alogos, accessed November 28, 2023

390 Turing 1952: 37

391 See Bernhard Siegert, Zählen. Archäographie einer Kulturtechnik, in: Moritz Hiller / Stefan Höltgen (eds.), Archäographien. Aspekte einer Radikalen Medienarchäologie, Berlin (Schwabe) 2019, 265-380

392 Lohmann 1970: 111

393 Turing 1952: 37

394 See Lohmann, Mousiké und Logos, 1970

(rhythmical) repetitive motive or structure. Identical repetition would be scalar in the numerical, countable, discrete sense. Especially Minimal Music, on the other hand, knows a differential shift in such patterns ("phasing"[395]).

In biochemical morphogenesis, diffusible substances interact with one another, and produce spatially periodic wave-like patterns. In combination with the model of evolutionary "resonance"[396], such pattern formation corresponds with the epistemic message of the electromagnetic wave regime indeed, as kind of a "natural radio".

But in order to explain the micro-chemical decisions for such harmonic discriminations, Turing's model (like the "Oracle machine" in his PhD thesis from 1938) has to admit the intrusion of the real (noise) as primary generation of oscillation in matter at all, once its resonance frequency is addressed by nonlinear disruption, as defined for the emergence of oscillations in vacuum electron tubes.[397] The challenge to mathematical analysis is to master such nonlinear dynamics, by translating random events into the pseudo-random discreteness. In computer games, actual random can only be infused to digital computing by an external physical source: not mathematicall, rather by coupling the discrete data machinery with a stochastic real world signal infusion. Still Turing, the mathematician, when focusing on "the breakdown of homogeneity"[398], is trying to bring the problem "within the range of what is capable of being treated mathematically" (ibid.), until finally such equations "have now been converted into a quite manageable"- in fact: mechanizable - "form"[399].

"Random disturbing influences"[400] are irruptions of the real into symbolic operations: "Strictly speaking one should consider such influences to be continuously at work. This would make the mathematical treatment considerably more difficult" indeed (ibid.). The media-archaeological answer to this challenge is analog computing. Turing significantly remarks that "[t]his principle is familiar in radio, and is fundamental to the theory of the superregenerative receiver"[401].

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395 See entry "Pattern (Musik)", https://de.wikipedia.org/wiki/Pattern_(Musik), accessed March 18, 2024
396 See Rupert Sheldrake, The Presence of the Past. A theory of evolution, New York (Time Book) 1988
397 See Heinrich Barkhausen, Einführung in die Schwingungslehre nebst Anwendungen auf mechanische und elektrische Schwingungen [1932], 6th ed. Leipzig (Hirzel) 1958
398 Turing 1952: 46
399 Turing 1952: 48
400 Turing 1952: 49
401 Turing 1952: 57

The "physical significance" of algebraic equations - a transitive relation between the symbolic and the real - remain unclear. "The disturbances near the time when the instability is zero are the only ones which have any appreciable ultimate effect"[402].This kind of "catastrophic instability"[403] is - in the sense of René Thom[404] - the cause of nonlinear "emergence".

"Most of an organism [...] is developing / from one pattern to another", but to "follow this more general process mathematically"[405] would not extend to "any very embracing *theory* of such processes [...]. It might be possible, however, to treat a few particular cases in detail with the aid of a digital computer. [...] It might even be possible to take the mechanical aspects of the problem into account as well as the chemical."[406]

"[T]he Analytic Engine weaves algebraic patterns just as the Jacquard-loom weaves flowers and leaves", Ada Lovelace once proclaimed.[407] Can flowers, in reverse, be symbolically approximated, or is an even more equiprimordial analysis required, like in Turing's mathematical concern with morphogenesis?

Turing intended non-linear equations to be used for a "morphogen theory of phyllotaxis" in a later paper (ibid.), that is: concerning the emergence of regular order and fractal patterns in plants. Can we expects a posthumous "letter" *from* Turing in that anarchival sense? For the description of how patterns in nature, such as stripes and spirals, arise from a homogeneous, uniform state, the so-called reaction–diffusion theory of morphogenesis has become a basic model in theoretical biology. With such Turing patterns, the proper name "Turing" itself has become a pattern of textual strings.

Can there be a non-(bio-)logocentric scientific study of "life" phenomena?

Turing is aware that his mathematical treatment of morphogenesis is an "imaginary biological system" that might be "of some help in interpreting

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402 Turing 1952: 57
403 Turing 1952: 59
404 René Thom, Mathematical Models of Morphogenesis, Chichester (Ellis Horwood), 1983
405 Turing 1952: 71 seq.
406 Turing 1952: 72
407 Augusta Ada, Countess of Lovelace Sketch of the Analytical Engine Invented by Charles Babbage, by L. F. Menabrea [...], with notes upon the Memoir by the Translator, in: Taylor's Scientific Memoirs 3 / 1843, as quoted in Morrison / Morrison 1961: 252

real biological forms"[408]. Biological "forms", in that sense, radically differ from techno-logified (in/formatized / pre-formed) matter.

An epistemological momentum of reaction-diffusion systems is that "although they represent nonlinear partial differential equations, there are often possibilities for an analytical treatment"[409]. "Turing hypothesized that the resulting wavelike patterns are the chemical basis of morphogenesis"[410] - analogous to the techno*lógos* hypothesis, while at the same time differing with its vibrational approach. With Fourier analysis, though, the computational logos of repetitive wave forms (be it heat, or sonic) is revealed.

Is the geometric "pattern" concept, in theoretical biology, a rather spatial, cosmo-logical aesthetisation of what is only temporary distribution of elements (or rhythm) in fluctuation such as fractals or repetitive deformations in hydrodynamics?[411]

Is mathematical analysis a model imposed upon the world, or is the world actually calculating itself mathematically? Leibniz claimed that when listening to breaking waves at the seashore he could actually participate, via the auditory channel, in patterns calculating themselves as differential equations (*nesciens*); Norbert Wiener later felt challenged, as a mathematician (the title of his autobiography), to calculate the curls of innumerous waves on the surface of Hudson River when looking out of his office window at M. I. T. in Boston.

"[A] uniform population of cells can form regularly patterned aggregates that depend on the mechanical properties of the cells themselves and the rigidity of the surrounding extra-cellular environment", similar to macrophysical wave-like (implicitly "sonic") wind patterns formed in sand. Concerning such implicit sonicity, it involves a sophisticated frequency Fourier analysis, in order to distinguish between random sound fluctuations, white noise, and true information with meaningful pattern.[412]

So-called Turing patterns "may also be responsible for the formation of human fingerprints"[413]. The mathematical diffusion model "provides an

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408 Turing 1952: 72
409 https://en.wikipedia.org/wiki/The_Chemical_Basis_of_Morphogenesis, accessed November 20, 2023
410 https://en.wikipedia.org/wiki/Turing_pattern
411 See Marie Manceau, Mathetmatik des Federkleids, in: Spektrum der Wissenschaft 9.22, 44-54 (46), spektrum.de/artikel/2040262
412 Wolfgang Heckl, Fossil Voices in: Durability and Chance. The Science, Responsibility and Cost of Sustaining Cultural Heritage, ed. W. E. Krumbein et al., London (John) 1994, 292-298 (293)
413 https://en.wikipedia.org/wiki/Turing_pattern

answer to the fundamental question of morphogenesis: 'how is spatial information generated in organisms?'" (ibid.)

The (Algo)Rhythm of Morphogenesis: Standing Waves

Is there a bio-logical difference between chemical morphogenesis and other systems starting with spherical symmetry and changing "according to the laws of electricity and magnetism"[414], with smallest disturbances of equilibrium resulting in decisive nonlinear deviations?

Just as it has been identified in Heinrich Barkhausen's *Schwingungslehre*[415], it requires an external impulse (as disturbance) for an oscillation within an electronic vacuum tube to arise: "The situation is very similar to that which arises in connexion with electrical oscillators"[416], and "it is not obvious how the oscillation begins" (ibid.). "[T]here are random disturbances always present in the circuit. Any disturbance whose frequency is the natural frequency of the oscillator will tend to set it going" (ibid.).

[In Alvin Lucier's magnetophone-based "operative" performance *I am Sitting in a Room* (1969) the magnetic tape-based "loops" of recording of his voice, its replay, and its re-recording, finally make the room itself articulate itself in its noisy patterns.]

Standing waves are the time-critical equivalent to visual "patterns" indeed. If visual (morphogenetic) patterns are a periodic distribution of elements within a system, its analogy is the musical rhythm in the time domain - a kind of non-discrete *analógos*. Spatial periodicity is analogous to temporal rhythms. Can Miyazaki's notion of "algorhythmics" lead back to the Turing maschine, just like the theory of fractals arrived at an algorithm for apparently contingent "natürliche Muster (hier: Periodizitäten)"?[417] But an algorithm can only approximate the "dirty" rhythms in natural matter.

Turing 1952 assumes the morphogenetic pattern as a dynamic result of stationary waves. Such standing oscillations in time created by the superposition of traveling waves, "whose peak amplitude profile does not move in space"[418], have been first described scientifically by Michael Faraday in 1831. His attention to standing waves on the surface of a

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414 Turing 1952: 41
415 Heinrich Barkhausen, Einführung in die Schwingungslehre nebst Anwendungen auf mechanische und elektrische Schwingungen [1932], 6th ed. Leipzig (Hirzel) 1958
416 Turing 1952: 42
417 Electronic communication by Stefan Höltgen, August 24, 2022
418 https://en.wikipedia.org/wiki/Standing_wave, November 25,2023

liquid in a vibrating container has obviously already been triggered by the electromagnetic media episteme.

[Faraday's phenomenological observations have been mathematically reformulated by Maxwell's equations - anticipating Turing's approach to the phenomena of morphogenesis.]

In the archaeology of knowledge, Faraday's experiments have been induced by the vibrating string as epistemogenic media event. As with the Pythagorean monochord, "[t]he most common cause of standing waves is the phenomenon of resonance, in which standing waves occur inside a resonator due to interference between waves reflected back and forth at the resonator's resonant frequency." (Wikipedia ibid.).

Morphogenetic patterns in space thus become a time function linking *lógos* and *mousiké* from within the vibrational event that is "tuned" (Heidegger's *Stimmung*) in harmonic ratios according to ancient Greek understanding. Pythagoras' insight did not derive from mental deduction but inductive experimentation with the vibrating string on the monochord.[419] Ancient Greek philosophical inquiry assumed a "musical" *lógos* that arises from *physis* as "cosmic" order (*harmonía*) itself.

[Goto's binary Parametron computer, in Japan, actually used this electrophysical phenomenon of the resonating circuit with phase shift for implicitly "sonic" digital computation.]

Such *lógos* is not imposed on matter by cultural knowledge engineering but matter / energy is ana/logic already, as suggested in Turing's mathematical analysis of morphogenesis.

Spherical symmetry - a key term in Turing 1952 to describe an organism supposed "to be shaped like a sphere, with all parts radiating equally around a center point[420] - lets the Pythagorean critical "Gretchen question" return. Is the (biochemical) world essentially structured mathematically (logically) already from within, so that its implicit *lógos* can be elicited by technical reasoning, or is mathematics only the reductive modelling of an essentially more complex reality? Instead an *impure mathematics* may be assumed and instantiated techno-logically.

"Patterns of Information" and / or Temporal Patterns (Rhythm, Acoustics)

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419 See Johannes Lohmann, Die griechische Musik als mathematische Form [1957], in: Musiké und Logos, Stuttgart (Musikwissenschaftliche Verlags-Gesellschaft) 1970, 17-26
420 https://study.com/academy/lesson/spherical-symmetry-definition-biology-animals.html

The expression "patterns of information" privileges the Shannon / Weaver approach, while its media-archaeological grounding rather focuses on its technological ma(t)teRealities.

Information theory defines "information" as "a probability function with no dimensions, no materiality, and no necessary connection with meaning. It is a pattern, not a presence"[421]. McLuhan makes a similar point about scale: "For the 'message' of a medium or technology is the change of scale or pace or pattern that it introduces into human affairs."[422] Electronic communication - such as radio transmission, or the TV image - consists of a time-critical patterning of information.[423] But ma(t)te*really* any informational unit relates to a physical signal (electricity).

In his emphasis on "acoustic space" as the nonlinear, simultaneous, synchronous experience of using electronic, McLuhan pays respect to the auditory sense that is "particularly adapted to perceptual anticipation in the detection of time patterns [...]."[424]

But McLuhan's notion of media as pattern formation still refer to human culture. A less anthropocentric analysis (the techno*lógos* hypothesis) discovers a latent knowledge (logos) from within techniques, which still depends, though, on human investigation, Kantean insight and epistemic experimentalisation to become explicit.

In electronic communication engineering, there is a time dimension for patterns already. Information theory here deals with "the study of messages, and their transmission, whether these messages be sequences of dots and dashes as in the Morse code or the teletypewriter, or sound-wave patterns as in the telephone or phonograph, or patterns representing visual images as in telephoto service and television. In all [...] the message to be transmitted is represented as some sort of array

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421 Sara R. Yazdani, Photography in Flux. art, media, and ecologies in the works of Wolfgang Tillmans, dissertation (draft) for the degree of philosophiae doctor (PhD), University of Oslo (version 2018); final title: Self-Sufficient Images: Art, Media and Ecologies in the work of Wolfgang Tillmans (April 2019)
422 Marshall McLuhan, Understanding Media. The Extensions of Man [1964], Cambridge (MIT Press) 1994, 8
423 Schwartz 1974: 23
424 J. D. North, Application of Communication Theory to the Human Operator, 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, 372-389 (386)

of measurable quantities distributed in time."[425] Here, "[t]he patterned auditory and visual information on television or radio is not 'content'. Content is a print term, subject to the truth-falsity issue. [...] As stimuli, electronically mediated communication cannot be analyzed in the same way as print 'content'."[426]

But pattern generation (morphogensis) differs from (algorithmic) pattern recognition.

TECHNOMORPHOSIS

[Preliminary Anecdote: Addressing Turing Discretely]

Let us start with a literal reading of Turing's 1952 text as alphanumeric machinery of diagrammatic reasoning. With media-epistemic eyes, this deciphering will focus on the technological momentum, such as the application of actual computing to Turing's computational equations.

The German translation of a selection of Alan Turing's writings, named Intelligence Service[427], does not include, but lists, in its additional bibliography of Turing's writings, an article on biochemical morphogenesis. At first glance it is hardly believable that this is the same Turing well known for his exercises in vintage computing. But then, what does this mean: the same Turing? The reader is not confronted with an embodied scholar, but with written or printed texts and mathematical calculations. Issues like "computable numbers" (1937) or "Computing Machinery and Intelligence" (1950) and finally mathematical models of biochemical morphogenesis (1952) all turn out as epiphenomena of metamathematical computability. A thinking reason, as an agency, hereby exits not as "author" mind, but as strings of letters in Foucault's sense of *l'archive* as condition of possibilities of enunciation. This it is well expressed by the very naming of "The Turing Digital Archive"[428] online.

A nonhistoricist approach addresses "Turing" in a more "machinic" way. Thereby the biographical transformations are suspended in a different, temporal regime. History of ideas expresses the transformations of

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425 Norbert Wiener, 1942, The Extrapolation, Interpolation und Smoothing of Stationary Time Series with Engineering Application, typoscript dated 1st February, 1942, 3: National Archives and Records Administration, Record Group 227 (Office of Scientific Research and Development), College Park, Maryland (USA), MFR, DIV.7-313.1-M2
426 Schwartz 1974: 19
427 Edited by Bernhard Dotzler / Friedrich Kittler, Berlin (Brinkmann & Bose) 1987
428 https://turingarchive.kings.cam.ac.uk

"Turing as engineer" like this: "Early Turing with Hilbert to Godel algorithms and making them into engineered and engineering machines. Late Turing engineering the organic from the physical and via Poincarés equations."[429] But at that point, techno*lógos* rather asks back: "And what is the mechanical?" (Lash ibid.)

In the archival Turing collection at King's College in Cambridge, among other manuscripts (that is: "paper machines") on experimental computing, I rather accidentally found myself amidst a sequence of paper drafts on the morphogenesis subject indeed. It was obviously "the same Turing" in terms of a writing mechanism. My reading of Turing 1952[430] will therefore be rather archival, that is: deciphering such thoughts as what they are: an operative sequence of alphabetic, alphanumerical and diagrammatic characters, closer to the turing machine - written with minuscule "t" rather than with the uppercase "T" which already biographically assumes a text-transcendent living reference. The limit of computability - addressed in Turing-texts from 1937, 1950 and 1952 alike - is equivalent of alphabetic writing that - as symbolic order - misses the "analogue" recording of contingencies (a. k. a. "life"), even in spite of ancient Greek's grammo-phonic effort to capture embodied *lógos* (the vocal signal) by means of discrete letters for single vowels of articulated speech.[431] Andrew Hodges tried to (re-)anthropomorphize Turing by narrative means. But in terms of *ars combinatoria*, Turing-as-archive (records) *is* a rotational Enigma writing machine. Any mental dialogue with Turing can only be *literally* computational. *Persona*, from Latin, after all means "mask". Therefore, an "imitation game", in Turing's sense, will be performed with Turing *as text* itself. A mechanistic view of "life" here confronts the vitalist interpretation of the machine itself.

As it is expressed by Giuseppe Longo in his letter (!) to Turing, Turing has been "able to 'immerse himself' into the phenomena on which he works."[432] This actually transforms the author from *him* to *it*. "Turing makes himself a 'human computer', he lives the dramatic quest for an undetectable imitation of a man, a woman, a machine." (Longo ibid.).

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429 Electronic commununcatin Scott Lash, January 16, 2024
430 A. M. Turing, The Chemical Basis of Morphogenesis, in: Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, vol. 237, no. 641 (Aug. 14, 1952), 37-72, subsequently abbreviated as "T52: xx"
431 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, Munich (Fink) 2006, 299-314
432 Giuseppe Longo, Letter to Turing (June 7, 2018), in: Theory, Culture & Society, vol. 30, issue 6 (November 2019), "Abstract", https://doi.org/10.1177/0263276418769733

[In a 1948 report Turing suggested that the infant human cortex was an "unorganised machine"[433], thereby anticipating the conceptual artificial neural nets. But that is exactly what differentiates a biochemical and -electric rhizome from "artificial", that is: technologically controlled networks: There is no "unorganized" machine, just like "pseudo random" in discrete computation.]

But the very term "machine" is misleading when it comes to discrete computation. Here, the metaphor of the thermodynamic engine semantically lags behind. The symbolical Turing machine did not result from a mathematization of an actual calculating-machine such as the textile weaving punched-card programmable Jacquard loom, but from a metamathematical mechanization of mathematics itself, as mechanical procedure. This separates the theoretical models of Artificial Intelligence from the Cartesian animal-as-machine. In a strong understanding of techno*lógos*, the Turing machine does not "just mimic the behaviour of the human computer" (Turing 1950: 438), but it is co-originary to its intellectual capacities. This involves two kinds of patterns: biochemical morphogenesis as the subject of Turing's paper on the one hand, and the deciphering of the alphabetic Turing text (its letters as symbols, sequences and rhythms) as patterns of a reasoning *lógos* (mis-)named "Turing".

"*Active Matter*" *vs. Technológos:*

Biologically "Active Matter" and / or Techno*lógos*

In accordance with a more "ecofeminist" redefinition of science, matter is less seen as passive resource to be exploited or in-formed than "as active subject"[434]. To what extend does bio*lógos*, once conceived as "active matter" differ from techno*lógos* as technically activated matter?

There is no techno*lógos* from within brute matter / energy. It can only emerge from already informed "hardware" - kind of recursive "preformatism" in the technical engineering sense. At Berlin Humboldt University, the research project Symbolic Material changes perspective from an (apparently) passive notion of materiality (Shannon's 1948 definition of the communication channel as "merely the medium") in favour of active matter able to generate symbolic processes from its own

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433 See entry "Unorganized machine", https://en.wikipedia.org/wiki/Unorganized_machine, accessed January 19, 2024
434 Donna Haraway, Situated Knowledges. The Science Question in Feminism and the Privilege of Partial Perspective, in: Feminist Studies, 14/3 (1988), 575-599 (593)

infrastructure.[435] Is this conceptual "active matter" - in accordance with the techno*lógos* hypothesis[436] - a fiction of "abductive" reasoning (in Peirce's sense), or is it matter itself that lures out reason in / as cultural (that is: symbolic) knowledge? Is biochemical matter (subject of "the study of chemical processes within and relating to living organisms"[437]) enabled to generate forms of symbolization (not just signals), which might be understood in terms of techno-logical circuitry, as experimentally performed with the biggest one-cess organism on the world, the slime mold ("Schleimpilz") by experimental computer scientist Andrew Adamatzky? The traditional border lines separating "nature" from "culture" are blurred by notions like "medianature" (Jussi Parikka) and "biological computing" (Adamatzky) that signals a return to analog (continuous) computing as it has been conceptually identified with the goal-oriented behaviour of the slime mould. Or is there a fundamental difference between the bio- and the techno-logical regimes? "[H]ere was an organism capable of concurrently processing input from millions of membrane-bound and intracellular receptors, yet we were utilising it as a mere variable resistor (albeit one that would crawl slowly over a circuit board)."[438]

Graphene as an allotrope (a structurally different form of the same element) of carbon - consists of a single layer of atoms arranged in a hexagonal lattice nanostructure.[439] When graphene itself becomes semiconductive microchip hardware for digital computing ("which be controlled to conduct or insulate electricity at will"[440]), it is not such matter itself, but its in-formation that becomes technologically "active". There is no autopoietic emergence of the symbolic here in the biochemical morphogenesis sense (Turing 1952).

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435 "die in der Lage ist, aus ihrer inneren Struktur heraus symbolische Prozesse hervorzurufen":
https://de.wikipedia.org/wiki/Exzellenzcluster_Matters_of_Activity._Image_Space_Material
436 W. E., Techno*lógos* in Being. Radical Media Archaeology & the Computational Machine, New York et al. (Bloomsbury Academic) 2021 (Thinking Media series, eds. Bernd Herzogenrath / Patricia Pisters); paperback edition 2022
437 https://en.wikipedia.org/wiki/Biochemistry, accessed January 3, 2024
438 Richard Mayne, Union of mind and body, in: Andrew Adamatzky et al., East-West paths to unconventional computing, forthcoming in: Progress in Biophysics and Molecular Biology (2017), accessed August 2017 ["accepted Manuscript"], 38-41 (39)
439 https://en.wikipedia.org/wiki/Graphene, accessed January 5, 2024
440 Web site New Scientist, entry (4 January 2024) Matthew Sparkes "First working graphene semiconductor could lead to faster computers", https://www.newscientist.com/article/2410612-first-working-graphene-semiconductor-could-lead-to-faster-computers (accessed January 6, 2024)

The role of computer programming changed from the moment when software started to design new circuitry as agency by itself. Logification of matter literally converges with communication engineering when its concrete medium channel is encoded, that is: when concrete matter gets in morphogenetic motion.[441] Unlike shape grammar-based modelling of the growth heterogenous assemblages like biological cells or cultural cities, software "organisms" have been developed to model the self-regulation of physical dynamics that can not be reduced to a pre-existing preformative logic. Their operational mode is rather driven by the uncertainty of material input as physically embodied contingencies and entropic indeterminism.[442] While the computational machine is still initially triggered by source code scripts, an artificial neural net still transcends the rule-governed approach. Hardware not only becomes algorithmicized, but software thought itself is challenged by interacting with matter. This ceaselessly results in reparametering the script in recent "deep" machine learning. "[T]he most discrete data such as the chemical emissions" (New-Territories/R&Sie(n) 2006-2009) - if "discrete" at all - embody a different kind of *lógos* that is not "implicit" to matter but "implicated"[443] by technological in/formation. Any kind of reasoning still needs a material mechanism to concretize and to unfold in material being, beyond the logocentric autonomy of its source code. Such realizations of the symbolic regime exclusively result from actual operations in the subsymbolic sphere. Media-archaeological analysis (both technical and mathematical) therefore shifts its emphasis from *lógos* to *techné*. Artificial forms of "intelligence" or even "life" have been lacking to reflect their underlying physical infrastructure so far.[444] Just like in Turing's mathematical analysis of morphogenesis, a "more abstract vision [...] from a Riemannian perspective of unfolding [...] shows that the structure" - even of the Internet - "is not predefined [...] but rather grows from the inside-out, unfolding space(s) and time(s)" (ibid.). Such topological unfolding always occurs from material infrastructure to make logical reasoning possible in the first place at all, be it as calculus operated with pencil on paper, or as electrified software. Technical *lógos* in being (*tó on*) does not exist in metaphysical abstraction (the Platonic "ideas"), but only in its operative material (re-)entries. After all, any cultural kind of symbolic code grew from 100 % physical evolution.

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441 The project workshop Terramorphosis I ("The Intentionality of Matter") has been held at the Lisbon Architecture Triennale in October 2022

442 See Luciana Parisi / Stamatia Portanova, Soft thought (in architecture and choreography), in: Computational Culture, 1 (November 2011). Available online: http://computationalculture.net/article/soft-thought (accessed 5 February 2020)

443 "Implicated knowledge" is a term by Ferenc Mérei, Lacan's translator (a notice by Monika Perenyei, Budapest)

444 See Marincic 2019: 122

Critical reason takes place in biochemical and bioelectric neural matter that is externalized into symbol operations to become "abstract" / mechanical metalanguage self-reflection (techno-logical reasoning).

Code is a symbolically contracted rule that arbitrarily refers each symbol of an alphabet to another symbol (or string of symbols) in another set - such as the Morse code relates alphabetic letters to a sequence of short and long signals and pauses.[445] To what degree is the "genetic code" as well such a cultural convention as it is already inherent in bio"logical" matter?

["The classification of the ontogeneses would allow us to pluralize logic using a valid foundation of plurality. As for the axiomatization of the knowledge of preindividual being, it cannot be contained within a pre-existing logic, because no norm, no system that is detached from its contents can be defined: only the individuation of thought can, by realizing itself, accompany the individuation of beings that are different from thought itself."[446]]

Giuseppe Longo addresses this issue in his "Letter to Turing" (dated 16th January 2018): "Here, in contrast to your discrete-state machine, you grasp the role of the continuum, of the interplay between non-linear dynamics and physical measurement, which is always an interval, always approximate."[447] Did Turing identify, in morphogenesis, a "the continuous reshaping and the genesis of forms in a 'hardware' without 'software"[448], that fundamentally differs from the "symbolic machinery" of discrete computation, for which Turing insisted: "It is an essential property of the mechanical systems which we have called 'discrete-state machines' that this phenomenon does not occur. Even when we consider the actual physical machines instead of the idealised machines, reasonably accurate knowledge of the state at one moment yields reasonably accurate knowledge any number of steps later."[449]

Are mathematical computability and bio-chemical morphogenesis incommensurable like geometry and arithmetics in Pythagorean Greece? Discontinuation, though, has not been imposed by arithmetics upon the machine, but arose from the theory of (time-discrete) kinematics in physical science itself.[450]

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445 https://de.wikipedia.org/wiki/Code, accessed November 20, 2023
446 Simondon 2009: 13
447 Giuseppe Longo, Letter to Alan Turing, in: Theory, Culture & Society, thematic issue "Transversal Posthumanities", edited by M. Fuller / R. Braidotti, 2018, DOI: 10.1177/0263276418769733
448 Longo 2018, Absatz "Knowing how the be within phenomena"
449 Alan Turing, Computing machinery and intelligence, in: Mind (1950), 440

[Patterns of Knowledge Tradition: Symbolic materiality and / or cultural memetics]

The research project Symbolic Material at Humboldt University of Berlin mutually investigates the material foundations of symbolic processes and the symbolic dimensions of matter[451]. Traditional dichotomies like body / mind, active / passive, material–symbolic may be rethought "variantologically" (Zielinski) or as multiple reason (Simondon) indeed. Still, the TL-hypothesis is of a different kind. Resulting from cultural knowledge on the one hand, but existing as physical artefact on the other, technology embodies subcultural knowledge as well. The desire to discover a logical "language" of physical nature, which transcends the limits of human knowledge, is inherent to analytic knowledge culture. Lacking here is media theory and philosophy of technology. Matter is not already in itself "symbolizing".

But reformulated in terms of an "abductive" hypothesis (Peirce), the concept of "symbolic material" reminds of the "memes" (Dawkins) as transfer of evolutionary concepts to cultural techniques and their heritage in times of communication media:

According to the model of techno-cultural "memetics", cultural knowledge is transmitted by gene-like entities called "memes" which can be either an idea, belief or belief system, or pattern of behavior that spreads throughout a culture either diachronically by cultural inheritance (as by parents to children) or contemporary by cultural acquisition. Such pervasive thought patterns replicate themselves via rather unconscious communication means or media, kind of a parasitic code or contageous mental "virus" (such as language in Burrough's understanding). In so-called social media, memes denote "an idea that is spread from blog to blog; an internet information generator, especially of random or contentless information"[452].

Such "memes" replicate by circulation between human brains, or by human mediation such as copy machines (Blackmore 1999). In parallel to this hypothesis, there are patterns that replicate not only through, but *as*

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450 See Franz Reuleaux, Theoretische Kinematik. Grundzüge einer Theorie des Maschinenwesens, Braunschweig (Vieweg) 1875, and Peter Berz, Uhrwerk und Zeitgetriebe, in: Georg Christoph Tholen et al. (eds.), Zeitreise. Bilder, Maschinen, Strategien, Rätsel, Basel / Frankfurt (Stroemfeld / Roter Stern) 1993, 171-188
451 "die materiellen Grundlagen symbolischer Prozesse in Wechselwirkung mit symbolischen Dimensionen von Materialien": https://de.wikipedia.org/wiki/Exzellenzcluster_Matters_of_Activity._Image_Space_Material
452 http://www.urbandictionary.com/define.php?term=meme

technological devices, propagating themselves. Recent "deep" machine learning comes close to such a technical auto-replication of knowledge.

[Matter and Form (with Aristotle and Thompson)]

Is biochemistry (or "life") opposed to the mechanisable? Such a Cartesean comparison of the living animal to the machine has been criticized as metaphorical. Georges Canguilhem's paper "Machine and Organism", written in 1946/47, defines organic life itself as the model of the living-machine.[453]

Aristotle, in his rather logocentric enquiry of "becoming", knows a dichotomy between (female) stuff or matter (*hýlē*) and (male) form (*morphḗ*) - such as the potential sculptural form that resides as latent potentiality in a physical marble block.

D'Arcy Wentworth Thompson, in his seminal *Growth and Form* from 1917 (Cambridge UP) has applied mathematics to biology. Thompson, though, focused on the analogy between biological forms and physical mechanics - just like any simulation of morphogenesis by an electric analog (computing) circuit is reductive. An analog circuit may be able to functionally reproduce some of the known electrical characteristics of biological morphogenesis, but excludes its more intricate chemical micro-reactions, just like in neuron simulation "secretion at the terminals of a neuron of the so-called transmitter substance. The artificial neuron does not perform useful work in this sense. Therefore, the electrical characteristics alone are considered."[454]

Thompson's paradigmatic forms were load-bearing structures: technical bridges and animal bones alike, where an engineering logics is co-originarily at work both in culture and nature. This hypothesis comes close to the heuristic theorem of so-called "memes" that, in analogy to genes in evolutionary biology, are cultural units of implicit knowledge inheritance.[455]

The *Terramorphosis* Approach

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453 See O. Fiant, Canguilhem and the Machine Metaphor in Life Sciences. History of Science and Philosophy of Biology at the Service of Science, in: Transversal. International Journal for the Historiography of Science, vol.4 (2018), 149–162 (158)

454 F. F. Hiltz, Analog Computer Simulation of a Neural Element, in: IRE Transactions on Bio-Medical Electronics (January 1962), 12-19, "Summary", footnote 1 (12)

455 See Susan Blackmore, The Meme Machine, Oxford 1999

In analogy to the media-archaeological insistence on software *as* hardware[456], the "terramorphosis" approach claims a critique of the neoplatonistic concept of form. Mind is not above but entangled with matter.[457] (In-)Formation is not assumed as mindful consciousness upon matter or energy, and valued "ontologically prior" to physical reality"[458], but assuming *nous* (when translated as thought, intelligence, or intellect) from within the physical realm / earth (Latin *terra*) itself, literally *grounding* (terminus technicus in engineering, German *Erdung*) logos.

A media-epistemic crucial question is whether the confrontation or clash between the symbolic regime (such as writing programming code) and its techno-material realization as actual computing is absolute, or rather gradual. The frictions that occur in their intertwinement are symptoms of "transduction" (in Simondon's sense).

Locating the Primary Scenes of Technomorphosis

In analogy to Turing's model of biochemical morphogenesis, technomorphosis as it unfolds in technical media is assumed to be an epistemic engine that drives transformations by redefining itself.

In morphogenesis, self-expressing patterns arise from biokinetic movements. But it takes symbolical analysis as the mathematical operation without which no understanding of morphogenesis seems possible. One the other hand, each of its actual biochemical operations still take place in 100 % "analogue" materiality and/or energy. While in information aesthetics, it is its logical (in)formation which negentropically turns a physical signal into a technical sign (Bense 1965: 218), the Pythagorean bio*lógos* hypothesis - against the caveats in Turing 1952 - discovers such signification from within matter itself. The relation between mathematics and bio-engineering becomes transitive in direct interaction. Is the relation between a diagrammatic flow or a mathematical model chart, and its physical materealization, only abstract, or existentially concrete? In such a confrontation ("encounter"), the symbolical regime becomes vulnerable to physical noise. In terms of bio*lógos*, there is no absolute dichotomy between the "material-free" abstract formula or algorithmic script, and its brute chemical configuration. There is a intimate entanglement instead (in the sense of Barad 2007). Its extreme technical formulation is analogue electronic

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456 Friedrich Kittler, There is No Software, in: Stanford Literary Review vol. 9, no. 1 (Spring 1992), 81-90

457 Karen Barad, Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter, in: Corinna Bath (ed.), Materialität Denken, Bielefeld (transcript) 2005, 187-216

458 Web site Stanford Encycplopedia of Philosophy, entry "Neoplatonism" (January 2016), https://plato.stanford.edu/entries/neoplatonism

computing which literally calculates with the physical qualities of matter and energy, such as potentiometers and voltage, itself. "If you leave out the part of engineers who write little structures on silicon you see one part of matter calculating the rest of matter."[459] Mathematical reasoning here finds its equivalent in an electrophysical or biochemical operation.

Discrete Operationality vs. Continuous (In)Formation?

Can Turing's excursion into theoretical biology be link with Kittler's "There is no Software" theorem, as argued by Giuseppe Long in his "Letter to Turing", working out the distinction and opposition between the discrete (Turing's Discrete State Machine) and the continuous?

In his 1952 piece on "The Chemical Basis of Morphogenesis", Turing looks at the development of patterns or shapes in biological organisms where systems of chemicals are reacting with one another *diffusing* across space. Such a process is addressed as "unconventional" computing nowadays. Can such implicit analogue computing (at least) be approximated by discrete mathematics? A contemporary techno-logical analogy to bio-chemical morphogensis is the diffusion model in "deep" machine learning, but the difference insists: Any "diffusion" in artificial neural nets occurs already in discrete states, numerically countable, and therefore merely *pseudo*-randomly. Even the mathematical approach addressing this event in terms of "real numbers" can only be a symbolical approximation to real bio-chemistry - unless, below the macrophysical world, the quantum event itself is addressed.

Turing 1936/37 defined all that is computable by a discrete-state-machine, while "[a]n example of what is non-computable in real numbers would be a number line onto which a needle with an infinitely fine point is dropped"[460]. Does the apparent "continuous" make the bio-logical difference to discrete computing such as artificial neural nets?

The morphogenetic growing of patterns as order from disorder is acting negentropically and therefore "informational" in Shannon's sense.

[It is a thin line that separates the hypothesis of a negentropic material intentionality, or form-generating *lógos* (respectively *physis*, with Aristotle) in biological matter (Turing 1952), from the "negentropic" imprint of cultural knowledge / mind *upon* matter. Negentropy as such is a problematic concept, since there is always a re-entry of energy (Landauer's physicist principle).]

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459 Friedrich Kittler, xxx, in: Gane and Sale 2007: 324
460 Friedrich Kittler, The Finiteness of Algorithms, transmediale / journal, November 9, 2017; https://transmediale.de/content/the-finiteness-of-algorithms

How can patterns emerge from biochemical wetware (protein) continuously without having been discretely programmed? A piano player, in his man-machine coupling, techno-logically enacts, e. g., the score of Franz Liszt's 2nd Concert, as external code. In his body, though, the bio-logical DNA is the informational code which bio-cybernetically governs inheritance on the molecular level and tends to "control 'the body' which is high in energy"[461] respectively entropy. Is morphogenesis an alternative oxymoron of of "analog code"?

Maybe the categorical dichotomy between the discrete versus the continuous is a metaphysical misconception already, *en arché*. For Longo, just as in ancient Pythagorean mathematics already, "a *geometrical* meaning of the continuous rather than the algebra of the discrete" literally counts. Analog measuring here becomes incommensurable with discrete counting.[462] Even in the heroic epoch of cybernetic reasoning, the brain - as in von Neumann's publication - has not been reduced to a discrete state algorithmic machine, but instead considered as an digital / analog hybrid, where the electro-chemical-physical activity of a neuron varies in its membrane potential governing the "time of non-reality" (Wiener) between inactivity and discharge ("firing"). While for Wiener "the neurons, the atoms of the nervous complex of our body, do their work under much the same conditions as vacuum tubes"[463], von Neumann rather accentuates the difference between the biological and the electroic (artificial) neuron.

Turing "makes us see the continuous deformations of a material action/reaction/*diffusion dynamics of hardware with no software*"[464], thereby bridging his analysis of nonlinearity in biological dynamics to today's neural nets. Still, such an analysis literally remains algebraic mathematics as *tertium comparationis* between the discrete and the continuous, between the numerical and the functional.

["Transductive" ontogenesis (Simondon)]

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461 https://en.wikipedia.org/wiki/AGIL_paradigm, accessed November 24, 2023, referring to Talcott Parsons, The Social System, London (Routledge & Kegan Paul) 1970
462 See Jörg Pflüger, Wo die Quantität in Qualität umschlägt, in: M. Warnke / W. Coy / G. Chr. Tholen (eds.), HyperKult II: Zur Ortsbestimmung analoger und digitaler Medien, Bielefeld (Transcript) 2005, 27-94
463 Norbert Wiener, Cybernetics or Control and Communication in the Animal and the Machine, reiusse of the 1961 second edition, Cambridge, Mass. (MIT Press) 2019, 60
464 Longo 2018, "Abstract"

Can *lógos* make matter "think" by its (in)formatization, that is, by engineering and computing? The "thing knowledge"[465] and media thinking of a techno-logically informed material device such as the piezoelectric crystal, in its coupling to electronic circuitry, deserves to be granted an autonomous agency.

According to the "anthropic principle", the physical world needed human culture to become techno-logically aware of its implicit knowledge by scientific reasoning and experimentation. Is there a different, non-cultural *lógos* which is revealed from matter itself, like the crystal structure of silicon as the very material basis of current electronic computing, allowing to calculate with nature on its elementary level? "Silicon is nature calculating itself", Kittler once exclaimed.[466] This co-naturality undoes the familiar culture / nature dualism.

In what is described as morphogenesis, two substances interact at different pace and mutual interaction as activator or inhibitor, "crystallizing" into a so-called Turing Structure.[467] The phenomenon of crystallization deconstructs the Aristotelean hylemorphistic dichotomy of passive matter vs. active in-formation[468], Simondon argues concerning ontogenetic "individuation" in the micro-physical domain, "which is molecular" - discrete - "and not molar"[469]. The individualizing morphogenetic activity that is at work with the crystal being formed "is not the meeting of pre-existing form and matter that exist as previously constituted, separate terms" in the Aristotelean sense, "but a resolution springing from a metastable system that is filled with potentials: form, matter and energy pre-exist in the system. Neither form nor matter suffices" (ibid.). Simondon rather identifies an equiprimordiality: "The true principle of individuation is mediation [...]" (Simondon ibid.) - but not in the sense of techno*lógos* that is of a different epistemo- (rather than onto-)logical kind. That is why Simondon's transfer of evolutionary concepts to "technical objects"[470] leads to misunderstanding (if not

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465 Davis Baird, Thing Knowledge. A Philosophy of Scientific Instruments, Berkeley / Los Angeles / London (University of California Press) 2004
466 In: Gane and Sale 2007: 324
467 Manceau 2022: 47
468 See Gilbert Simondon, The Position of the Problem of Ontogenesis, transl. Gregory Flanders [French Orig. 1954-58] in: Parrhesia, vol. 7 (2009), 4-16 (an advance publication from the English translation of Gilbert Simondon's L'individuation psychique
et collective, U of Minnesota P.). See as well Léa Perraudin, Augmenting the Material Reality of Computing, in: Exhibition catalogue *Extended Reality*, Kultur-, Sozial- und Bildungswissenschaftlichen Fakultät at Humboldt University Berlin (September 2021), 16-23 (19)
469 Simondon 2009: 7
470 Gilbert Simondon, Du Mode d'Existence des Objets Techniques, Paris (Aubier) 1958 [On the Mode of Existence of Technical Objects, transl.

confusion) that the author himself can hardly prevent: "[I]n relation to classical culture, the notion of form must be saved from the reductive manner the notion was used in the hylomorphic schema; and a second time, in order to save information as signification from the technological theory of information in modern culture, with its experience of transmission through a channel."[471]

"Matterphorical" has been the title of a special issue of the Theory & Event Journal.[472] Can "information" be less oriented at mechanistic communication engineering and rather be identified in matter and organisms revealing some kind of rational intentionality themselves? "Life" itself then becomes a mere metaphor for information. But it still takes human reasoning to make such intentionality logically explicit. In concentional philosophy, there can be no consciousness, intentionality, or reason in matter itself, only as matter informed by cultural knowledge. Cultural knowledge has engineered and modulated matter & energy into forms, as technical in/formation - which then, in return, is enabled to develop kind of intentionality of its own once matter is not simply in-formed but becomes computable in terms of information theory (Shannon).

Simondon stays close to Turing's mixing mathematical investigations on bio-chemical morphogenesis with knowledge from engineering.[473] "The transductive operation" - understood here in analogy to converting "signals from other physical waveforms to electric current or voltage waveforms, which then are processed, transmitted as electromagnetic waves, received and converted by another transducer to final form"[474] "is an individuation in progress; it can, in the physical domain, occur in the simplest manner in the form of a progressive iteration"[475] - or pattern as "the systematic conditions of individuation, the internal resonance" (ibid.). "The notion of form must be replaced by that of information, which presupposes the existence of a system in a state of metastable equilibrium that can individuate itself; information, unlike form, is never a unique term, but the signification that springs from a disparation."[476]

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Cecile Malaspina / John Rogove, Minneapolis, MN (Univocal Press) 2017]
471 Simondon 2009: 12
472 vol. 24, no. 1 (January 2021); see
https://readingmatters.princeton.edu/matterphorical
473 Alan Turing, The chemical basis of morphogenesis, in: Phil. Trans. R. Soc. London B 237 (1952), 37–72; reprint in: The Collected Works of A. M. Turing: Morphogenesis, hg. v. P. T. Saunders, Amsterdam (North-Holland) 1992
474 https://en.wikipedia.org/wiki/Signal_processing, accessed December 28, 2023
475 Simondon 2009: 11
476 Simondon 2009: 12

Attention - here as well Simondon distances his evolutinary approach from communication engineering: "The notion of form [...] deserves to be replaced with that of information. In doing so, the notion of information must never be reduced to signals or to the supports or carriers of information in a message, as the technological theory of information tends to do, a theory that was initially abstracted from transmission technologies."[477] Therefore "[t]he pure notion of form must [...] be saved two times from an all too summary technical paradigmatism" (ibid.).

Artificial Intelligence in terms of Analog Computing

A radical, that is: close reading of what actually occurs within the circuitry of "hidden" or "deep" machine learning "layers" (itself an archaeological metaphor) reveals that electronic computing has so far modelled the biological brain neuronal tissue by artificial "neurons" that are themselves of a complete different physical nature (such as the thermionic tube). This difference has frequently been pointed out by von Neumann.[478] The cybernetic equation of the "binary" signal propagation mode between nerve cells with digital computing[479] actually disregarded the actual differences in concrete action. The pulse-based electronic model missed the continuous biochemical portion of nervous activity in the human brain. A new type of technological transistors, though, that is: ion-gated transistors (IGTs) that replace the familiar MOSFET are actually compatible with biological signal propagation since they share the same materiality, with the semi-conductive matter not being artificially n- or p-dotted silicon crystals any more, but electrolyts (anions and kations like in body cells) in a polymer grid. Though still acting basically in the bipolar mode, their characteristics rather return to "analog" computing - a media-archaeological figure of technical time. This results in a more energy-efficient and real-time signal processing. Finally, Synaptic Transistors, as neuromorphic technical elements (such as the Memristor as well) allow to approximate the parallel signal propagation otherwise excluded by the von Neumann architecture of computing. Actual bioneural synapses "have a practically unimited number of possible states - not just 'on' or 'off'."[480] The mathematical approximation (by calculating with real numbers) becomes equivalent to the biological

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477 Simondon 2009: 12

478 John von Neumann, Computer and the Brain, New Haven / London (Yale University Press) 1958

479 See Warren McCulloch / Walter Pitts, A Logical Calculus of the Ideas Immanent in Nervous Activity, in: Bulletin of Mathematical Biophysics 5 (1943), 115-133, and Norbert Wiener, Computing Machines and the Nervous System, in: idem, Cybernetics or control and communication in the animal and the machine, Cambridge, Mass. (M.I.T. Press), 2nd ed. 1962 [*1948], 116-132

480 Jian Shi, as quoted in xxx

neural net. If such engineering innovations are understood not simply in a biotechnical but in a media-epistemological sense as well, this leads to a closure of the gap that has so far fundamentally separated strictly sequential digital signal processing (in so-called von Neumann architecture of computing) from hybrid analog-digital biological communication.

Neural Patterns:

Initial Questions

A challenge of the "Explainable Artificial Intelligence" (XAI) approach, so far, has been the explainability of pattern emergence from big data. Is pattern recognition in AI replacing the inherited Cartesean certainty? In order to avoid metaphysical connotations, speculative realism needs to be replaced by techno-analytics. "Emergence" becomes a function of pre-programmed (even hard-wired) logical gates (artificial neurons) in combination with unpredictable *big data* as kind of dynamic logos - a different kind of "syllogism".or "collecting".

When statistical probabilities, in artificial neural nets, replace particular identities, the so-called "analogue" returns within digital computing itself - if not on the material level, then in the digital signal processing sense. Analog signals concern "differences of magnitude, frequency, distribution, pattern, organization, and the like", while in linguistic structuralism (de Saussure), "[d]igital differences are those such as can be coded into distinctions and oppositions, and for this, there must be discrete elements with well-defined boundaries."[481] That is what differentiates computational media from a Deleuzean media theory (or Goethean "morphology") of ceaseless "becoming"[482]. To what degree does the discrete character of the signifier relate to (or even follow from) its continuous material "substratum" itself (ibid.)?

Even the smallest informational unit, the "bit" as measurement of binary decision probabilities, is always already "dirty" with material or energetic essence - even if simply inscribed with a pencil on paper. In other words: Does "information" not just take place as mathematical logics that is externally imposed on physical matter as computer hardware (in the form of logical gates), but rather arise from within matter and energy itself - just like Pythagoras assumed integer numbers as structurally inherent in the physical world? And with respect to Turing's mathematical reasoning of the phenomenon of biochemical morphogensis: There is a

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481 Anthony Wilden, System and Structure, Essays in Communication and Exchange, 2. Auf. London 1980, 189
482 See Joseph Vogl, Becoming-Media: Galileo's Telescope, in: Grey Room, vol. 29 (2007), 14-25

difference between apparently "logical" acting of naturally given materialities, and techno-logically pre-in/formed matter / energy. Different from the "diffusive" biological morphogensis approach, the outdated "preformation" theory in embryology comes closer to technical engineering that concerns already pre-(in-)formed matter / energy. In between acts Waddington's concept of epigenetics.

When a catalyst, in the chemical sphere of morphogenesis, also produces an inhibitor, this comes close to interaction (inhibition and excitation) among biological or artificial (technical) neuronal nets indeed. But algebraic mechanisms modelling biochemical processing[483] differ from their technical implementation as electrical analogs[484], just like symbolic notation differs from actual circuitry (which Peirce's first "electric diagram" of logical reasoning ignored. Biochemical processing becomes a *mechanism* Turing's term 1952) only by mathematical notation which renders them apt for computational modelling.

Can there be "logics" - such as form and pattern - arising from bio-chemical morphogensis and not exclusively from already reasonably (that is: by cultural knowledge) structured physics?

The physicist approach to natural phenomena "encompasses the interactions of matter and energy at all [...] time scales in the physical universe"[485], while engineering involves cultural knowledge in/formed on physics, as literal techno-logy (technological devices) such as logical gates in electronic computing.

Neuroscientific vs. Techno-Logical Pattern Recognition

Are morphogenetic chemical processes becoming *technomorphosis* in AI / ML "diffusion" models? A fundamental difference is biotic ("wetware") *embodiment* vs. its electro-physical techno-logical *implementation*. Will the term "technique" be reserved for such *reasoned* operation, vs. bio-chemical performance? The difference will remain between cellular autopoiesis vs. technologically in/formed matter. How can form arise from unstructured matter / energy? Do patterns develop from an unformed, equally distributed original matter "through a sequence of

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483 Like R. FitzHugh, Mathematical models of threshold phenomena in the nerve membrance, in: Bull. Math. Biophys., vol 17 (1955), 257-278, or A. S. Householder / H. D. Landahl, Mathematical Biophysics of the Central Nervous System, Bloomington, Ill. (Principia Press) 1945
484 Such as L. D. Harmon, Artificial neuron, in: Science, vol. 129 (1959), 962 seq. See as well Patrick Kangas, The role of passive electrical analogs in H. T. Odum's systems thinking, in: Ecological Modelling 178 (2004) 101–106
485 https://en.wikipedia.org/wiki/Physicist, accessed November 22, 2023

steps in which cells differentiate and organs form"[486] - that is: in discrete sequences like cellular automata (Conway's "Game of Life") or from Reinforcement Learning in Artificial Intelligence?

By massive big data training "deep" machine learning is capable of revealing - or presupposing - latent patterns in data clouds that have been unknown to human intelligence so far. AI-generated images finally dissimulate the dataset from which they have been trained as input. The precise bifurcations from data input to the iconic output, though, become lost in a labyrinth of pattern-recognizing layers.

Can pattern generation, in artificial neural nets, be explained by "analysis", that is (just like the effect of the discrete alphabet upon continuous speech) be reduced to smallest units like the artificial neuron (von Neumann) and thus be materially identified in electric circuitry - or rather in mathematical modelling as "method for linearly approximating nonlinear behavior"?[487] Radical media archaeology encompasses both regimes.

Fig.: Operative diagram of an artificial neuron (in the Lectron kit)

Fig.: Rosenblatt's Perceptron (circuit diagram)

Is the analytical, alphabet-induced (McLuhan) approach already a failure against a materially stochastic approach? What emerges as patterns is more than the sum of its elements. This surplus enacts Markovean mathematics to become computable form.

The techno-logical generation and / or recognition of patterns ("intelligence" in the military sense) logocentrically differs from patterns emergent within physical and / or organic matter.

Synthetic morphogenesis comes close to apparently self-(re)programming algorithms in "deep" machine learning that analytically arrive at pattern recognition from big data in a non-anthropocentric sense: neither as visual nor auditive perception, but as mathematical *formula*/tion.

Frank Rosenblatt's Perceptron from the 1960s has still been an experimental escalation of cybernetic anthropology: "first and foremost a brain model, not an invention for pattern recognition"[488]. The latter is

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486 https://en.wikipedia.org/wiki/Epigenesis_(biology), accessed November 22, 2023
487 See F. F. Hiltz, Analog Computer Simulation of a Neural Element, in: IRE Transactions on Bio-Medical Electronics (January 1962), 12-19 (12), "Summary"
488 Rosenblatt 1961: VIII

better realized in technologies liberated (and liberating) from the human model, such as by filtering as functions of a mathematical matrix.[489]

Analytic vs. synthetic image patterns in "deep" machine learning

Signal-processing systems such as artificial neural nets for image recognition operate different from the conventional panoptical regime. "Dataveillance" does not concentrate on specific items, but on data patterns and clustering. Similarity-based sorting of digitized objects by self-organizing maps does not operate with scalar values, but with vectors. Such subsymbolic expressions are "not symbolic but pattern-like"[490]

The analytic reverse of synthetic morphogenesis *is* pattern recognition. Once images and sounds have become digitally calculable, they can be subject to pattern-recognition algorithms, such as in so-called cultural analytics.[491] The notion of „pattern", after all, is derived from Latin pater - but it is no patri-archival order any more, rather a matrix. Such procedures media-actively "excavate" and generate unexpected statements and perspectives from an audio-visual archive that can, for the first time, organize itself not just according to tagging by verbal meta-data but according to its own "weights" - kind of morphogenetic visual memory in its own medium.

[In one of the modalities of George Legrady's "database art" installation Pockets Full of Memories, Cell_Bin, images of very day items captured from "social media" are placed on a black screen, and an algorithm randomly distributes them. The ephemera of everyday life are thereby assembled (*con-lectio* in a literal sense) in a rather associative than rigid way, and combined with a cognitive influence by user metadata tagging. A transarchival regime is at work here. Space is left in between to be successively filled by incoming photographies. This loosely coupled patterns seem to evolve dynamically. "Images that you wouldn't think belong together somehow link up, leading the viewer down strange [...] pathways."[492] But this "somehow" is no enigma but a function of

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489 See Shintaro Miyazaki, The Strange Kinship of Algorithmic Filtering with Audio Filtering. A Critical (Media)-Theory of Filters and Extraction, typescript 2020

490 Timo Honkela / Juha Winter, Simulating Language Learning in Community of Agents Using Self-Organizing Maps, Helsinki University of Technology, Publications in Computer and Information Science, Report A71, December 15, 2003, *online*

491 Lev Manovich, How to Compare One Million Images?, in: Understanding Digital Humanities, edited by David M. Berry, Basingstoke (Palgrave Macmillan) 2012, 249-278

metadata and automatic shape detection. Such patterns are only pseudo-random.]

[For one of the earliest relics from cybernetic media art in the context of the New Tendencies, Zagreb, see Vladimir Bonačić's "Dynamic Object" no. GF.E16S (1969), a random number generator (Galois Field) for light patterns:

Fig.: Photo: Miro Cimerman]

In media-active reconnaissance some kind of images do not appear in the viewer's retina or mind, there are patterns that can be understood to contain their own hidden "knowledge". Effective computation in massive deep machine learning is able to detect patterns even where humans are no longer able to observe or recognize them, just as with the search for implicit patterns in the irrational number "pi" (π) that appears in many formulas across mathematics and physics. "[I]t cannot be expressed exactly as a ratio of two integers, although fractions such as are commonly used to approximate it. Consequently, its decimal representation never ends, nor enters a permanently repeating pattern."[493]

[Natural neural networks are no closed world of programmed data but they are affected by their environment for their cognitive processing. This can be mathematically matched in terms of stochastics (probability and predictability). Information engineering in Natural Language Processing therefore operates with Bayesian logic.]

In artificial neural networks for "deep" machine learning, AI image synthesis as well starts with uncorrelated white Gaussean noise filtering shapes: a different kind of morphogenesis, in analogy to "subtractive" synthesis in Indian "drone" music and electroacoustics. By *denoising* from so-called *latent space*, random is getting transformed into *gestalt*, kind of morpho*regenesis*.

[Processed with the "eyes of the machine", *imaging* - in its media-active sense - is rather about pattern recognition instead of iconology. Perception from the side of AI concentrates on patterns, forms, rhythms: the meta-mathematical *lógos* and *mousiké* of dynamic data processing. For moving image sequences, AI tools like VideoFusion (Google Colab) are not "video" any more at all, but sequences of data synthesis.]

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492 Comment by George Fifield (Boston Cyberarts Inc.), "Can you see me now?", in: The Boston Globe, http://www.wellesley.edu/DavisMuseum/exhibitions/exhibitions_celltango.html, accessed August 2010
493 https://en.wikipedia.org/wiki/Pi, accessed November 20, 2023

The programming environment StabeDiffusion for AI image synthesis is based on the thermodynamic diffusion model, as it has been developed in statistical physics by Garvin E. Crooks for microscopically reversible Markovian systems. By stochastic processes the model is even allowing to "negentropically" restore, step-wise (in discrete time), the original state from disorder back to order[494] - kind of micro-"explainable" AI.[495]

[Within artificial neural nets, the *gestalt* theory ground / figure difference (which has been so decisive for McLuhan's media theory) dissolves.]

[Mathematical stochastics (comprising probability theory and statistics) is "the mathematical modelling of random phenomena and the calculation of probabilities"[496].]

Technomorphogenesis is a way of filtering "information from data (data mining)"[497]. Different from imperative algorithmic computation, a simple "method for generating an endless succession of [...] fractal patterns"[498] is by "iterating simple maps and ordinary differential equations with coefficients chosen automatically by the computer" (ibid.). But it is only by experimental techno-phenomenology (Gaston Bachelard's "phenomenotechniques") or "experimental epistemology" (Warren McCulloch) that actual patterns perceivably arise from probabilities - similar to Mandelbrot images which revealed the phenomenon of recursive self-similarity only by fast computer imaging.[499]

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494 See Sohl-Dickstein et al., Deep Unsupervised Learning using Nonequlibrium Thermodynamics, in: arXiv.org. 2015, unter: https://arxiv.org/abs/1503.03585
495 An argument in the forthcoming Master thesis by Raphael Tostlebe, Die Dramaturgie KI-generierter Videos - Zwischen Anthropozentrismus und Technológos, Department of Media Science, Humboldt University Berlin (2024)
496 "Stochastics and statistics", web site University Bremen, https://www.uni-bremen.de/en/fb3/research/mathematics/research-profiles/stochastics-and-statistics (accessed November 23, 2023)
497 Entry "Stochastics: Probability Theory & Statistics", web site Department of Mathematics, Technical University of Munich, https://www.ma.tum.de/en/research/research-fields/stochastic-probability-statistics.html, accessed November 24, 2023
498 Julien C., Sprott, Strange Attractors: Creating Patterns in Chaos, http://sprott.physics.wisc.edu/sa.htm, accessed 25 March. 2019
499 See Friedrich Kittler, Computergraphik. Eine halbtechnische Einführung, www.aesthetik.hu-berlin.de/medien/texte.php

[Visual pattern-recognizing by artificial neural nets became prominent with Rosenblatt's "Perceptron" in 1957[500], with electric circuits (logical gates) modelling alphabetic characters.]

The general idea behind ML is operative morphogenesis indeed: An organized layering of nonlinear processing units extracts patterns from unlabelled data, progressing from lower to high level feature extractions which transform into cognitive abstractions. But in its actual technical realization - operative unfoldings of *lógos* in informed matter / energy, that is: as machine - the model quits its similarity with neural image processing within the human brain.

The cybernetic black box model tends to overlook the differences that occur between both "systems" in animal-machine analogies. Just like the "brain model" approach of AI, once computationally enacted, is neglecting the frictions that arise once diagrammatic concepts are actually (electro-)physically implemented, epistemic and actual gaps open between bio-chemical kinetics and its mathematical modelling.

"Like physics, electronic engineering is a science whose primary object is signals, the physical materiality of signs"[501] - while computational mathematics reduces this to its informational value in Wiener's sense of supsense from matter and energy.

Machine knowledge (techno*lógos*) emerges from big data patterns when they are processed (in a new form of data *legein*) in layers of artificial neural nets *not in spite*, *but because* they are techno-logically non-human in their connective circuitry. They are *technical* neural networks more precisely than vaguely "artificial". Morphogenetic "emergency" is no metaphysical quality here, but becomes a mathematically - and therefore computable - measure for degree of complexity that has been Turing's 1952 ambition - while Gordon Pask's "organical computers" from 1960, growing patterns as kind of electro-chemical analogue counter pieces to the discrete Turing machine.[502]

Turing's 1952 approach is not actually *simulating* biochemical morphogenesis, but functionally *emulates* it with his mathematical equations. Biochemical reactions and discrete computing cannot be mapped upon each other, they are literally "incommensurable"[503]. Even

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500 Frank Rosenblatt, The Perceptron. A Perceiving and Recognizing Automaton, Cornell Aeronautical Laboratory Report No. 85-450-1, January 1957, Buffalo, N. Y.
501 Bernhard Siegert, Cacography or Communication? Cultural Techniques in German Media Studies, 40
502 See Seiffarth (ed.) 2022: 146
503 As proposed by Beatrice Fazi at TCS-Research Workshop "Algorithmic Thought / Digital Power", March 18, 2019, at SAGE Publications, London

the "black box" relation between input / output in creative AI text, speech or image synthesis, as long as this in-between is mathematically modelled such as in Turing's morphogenesis analytics, remains within the symbolic regime.

There is a hermeneutic specter still active in the assumption of "intentional matter" (the *Technomorphosis I* workshop theme). A new metaphysics is lurking behind the hermeneutic "hidden layers" rhetoric. A statistical Hidden Markov Model *assumes* the system being modelled "to be a Markov process with unobservable ('hidden') states"[504]. The outcomes of an observable process Y are 'functions of the outcomes of X in a known way. "Since X cannot be observed directly, the goal is to learn about X by observing Y." (ibid.) This applies to pattern recognition such as speech, handwriting and bioinformatics. From the Markovean dialectics of pattern and randomness structures unfold.

In analogy to the XAI question, the question arises where exactly to locate pattern formation in morphogenesis: on its biochemical, or mathematical level? The bio*lógos* here confronts the techno*lógos* of morphogensis.

In the field of visual pattern recognition, Frank Rosenblatt's Perceptron materialized an electronically hard-wired algorithm which is symbol processing - while the body does not. "[T]he goal is to find aspects of dynamical systems that can be interpreted as symbolic processing"[505], that is: "digital", though essentially, it remains "analogue", without an internal clock as it is required for the signal-discretizing Turing machine. Rosenblatt's *Principles of Neurodynamics* has been declared an explicit "Theory of Brain Mechanisms (subtitle 1961) as a machine model, not as wetware. Media-archaeological criticism concentrates on the divergent modes of neurobiological stuff vs. technological "embodiments" of morphogensis models.

[The mathematical approach to morphogenesis in its bio*de*centrism suggests an essentially "mechanism" within the living cell itself. It has been no metaphysical "spirit" neither cellular protein but the techno-logics of concrete electronic elements like the binary electro-magnetic relay (Shannon), or the flipflop vacuum tube circuitry which, in its epoch, induced such models of thought. In that sense, artificial neural nets are not even "neural" but straightforward techno-logical.]

THE TECHNO*LÓGOS* OF "DEEP" MACHINE LEARNING

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504 https://en.wikipedia.org/wiki/Hidden_Markov_model, accessed August 15, 2023
505 Pfeifer / Bongard 2007: 355

"Embodied" intelligence? Neuroscientific vs. media-archaeological analysis of AI / ML

Today, enactive Artificial Intelligence (AI) and "deep" Machine Learning (ML) practices challenge the Cartesean dichotomy between internal and external operations of the mind. Rolf Pfeifer's and Josh Bongard's anthropocentric analysis of *How the Body Shapes the Way We Think* (MIT Press 2007) may alternatively be extended to the difference it makes for intelligence once it is not "embodied" (the "enactivism" approach in cognitive science), but computationally "implemented" both materially and symbolically - therefore truly becoming *artificial* in the technological sense.

Unlike the cognitivistic view of intelligence, which is algorithm-based, the embodied approach envisions the intelligent artifacts as more than just a computer program; it has a body, and it behaves and performs tasks in the real world. But the difference between human and "artificial" AI is between performative and operative intelligence.

Even if they are neuroscientifically inspired, AI and ML "are not only a model of biological intelligence, but a form of intelligence in its own right"[506], in their concrete material and energetic embedding, and in their time-critical situations.

[AI itself still demands human collectives to become realized as technology. But although engineered by human knowledge, a *non*-human intelligence can be recognized in the articulations of advanced technologies. This is the "message" of technology even below the superficial manifestations of so-called Artificial Intelligence.]

Operative unfoldings of *lógos* in informed matter / energy, that is: as machine

Most concepts and techniques of "AI" are still anthropocentric, in their orientation at the human notion of intelligence[507] and considered as its mere "augmentation". Media-archaeological analysis rather argues for a non-anthropocentric understanding of current Artificial Intelligence and "deep" machine learning. Most emphatic "artificial intelligence" can be down-formulated to machine learning, which is self-correcting relational data bank cross-analytics and not "deep" at all in any metaphysical

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506 Bongard / Grand 2007: 18

507 Sybille Krämer, Vom Mythos "Künstliche Intelligenz" zum Mythos "Künstliche Kommunikation", oder: ist eine nicht-anthropomorphe Beschreibung von Internet -Interaktionen möglich?, in: Stefan Münker / Alexander Roesler (eds.). Mythos Internet, Frankfurt (Suhrkamp) 2001, 83-107

sense. In engineering terms, it is rather flat, and can be located as circuit boards in host computers. Beyond the imperative programming approach, machine intelligence claims knowledge (*lógos*) which emerges from big data patterns when they are processed (a new form of *legein*) in layers of artificial neural nets not in spite, but because they are techno-logically non-human in their connective circuitry. Scientifically speaking, "emergency" here is no metaphysical quality, but becomes a mathematical - and therefore computable - measure for degree of complexity.

With the differentiation between "explainable" (scientific) and "interpretable" (humanities) AI, the ancient art of hermeneutics returns; but then, even hermeneutics has been a cultural technique which might easily be trained to machines). The human mind, with its cognitive bias to derive meaning from where meaning might not be existent at all, gets displaced by "non-interpretable" AI. The so-called "hidden layers" of artificial neural nets, even if they are precisely defined in computer science, seduce to be read as trivial metaphor, linked to philological hermeneutics rather than to rigid techno-logical analysis. AI / ML, though, do not ask to be "understood" in term of humanities, but to explained media-scientifically.

The general idea behind "deep" ML is operative hermeneutics indeed - a concretization of what Heidegger once identified as "revealing" techno*lógos*. An organized layering of non-linear processing units extracts patterns *from unlabeled data*, progressing from lower to high level feature extractions which transform into cognitive abstractions. Its core operation of backpropagation is well known from cybernetics: Each successive layer uses the output from the previous one as input.

At the same time, the classic von Neumann-architecture of digital computing is still the operational theatre for most AI applications. Is there an evolution or rupture, "from" the algorithmic Turing-machine "to" statistical AI, from the logical reasoning of Boolean algebra as it is incorporated into the ALU of micro-processors, to a rather different epistemology of stochastics with its pro-active predictions (derived from WWII cybernetics and its Anti-Aircraft Predictors), Markov chains, and probabilites, breaking the borderline between truth and "fake"? Retracing Rosenblatt's 1958 "Perceptron", radical media archaeology seeks to ground the metaphysics of apparently unexplainable "deep" learning in precisely identifiable hardware operations, locating *lógos* in / as matter again. Against the metaphysical risk, media archaeological analysis opens the "black box". It reminds of the anthropocentric allure hiding, more than ever, behind machine "learning" which extends to a kind of computational sociology. Human-centred machine perception epistemologically flips when it reminds man of the machine-like technics of his / her own cognition. The human is excluded when not supervised by humans any more, in adversarial machine-to-machine learning.

As such, AI / ML may be regarded not as a "tool" in the instrumental sense, but as an epistemogenic toy (Spiel"zeug"). It is structurally equivalent to music, which is no direct externalization of inner subjectivity[508] but its objectified (symbol-manipulated) diagram (in Peirce's sense). Electronic circuitry, different from the neural brain itself, allows for experimentation in a controlled way and lets techno-logics be co-articulated.

AI knows no subjectivity, not even an "alien" one. Therefore the radical media-archaeological ambition is to find a non-anthropomorphizing language to describe it as a mechanism, which is expressed in rather mathematical approximations of machine functions - such as machine "vision" is not detecting shapes but pixel dependencies.

Tracking the techno-mathematical event within techno*lógos*, cybernetic reasoning (Gotthard Günther) replaces the Cartesean dichotomy between mind and matter respectively body. The central issue of transcendental philosophy (such as Immanuel Kant's) has been the human as reflective system of its environment. This system gets objectified by cybernetic t(h)ink(er)ing.[509]

In that sense, AI / ML is not only a new sort of "objectivation of the mind" in G. W. F. Hegel's sense, but an alternative form of techno-logical reasoning that is granted a techno*lógos* of its own.

By tinkering with AI, the human discovers the mind as machinic itself (in Lacan's and Turing's sense) - just like the CAPTCHA procedure for identifying human users "online" (which literally "completely automatically tells computers and humans apart") rather elucidates the mechanism *within* human the psyche, or intelligence. Already in the Baroque obsession with self-acting automata (Descartes *L'Homme*), the techno-logical device mirrors the machine within the human.

By experimental objectivations such as AI / ML, a human being does not directly experience the mechanism or machinery of his mind, because of its different material implementation when there is not biological embodiment but electronic circuitry with its different, reprogrammable connectivity. It is from that difference that unforeseen artefacts arise, which are no "errors" but become indicators of another "intellect".

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508 See Georg Wilhelm Friedrich Hegel, Ästhetik, vol. 2, Berlin / Weimar 1976
509 As it is expressed by Gotthard Günther, Lebenslinien der Subjektivität. Kybernetische Reflexionen, ed. Bernhard Mitterauer / Klaus Sander, Compact Disc Cologne (supposé) 2000

ON THE BORDERS OF EXPLAINABILITY? Against hidden metaphysics in the discourse about "deep" machine learning

Part I: THE TECHNO*LÓGOS* OF "AI"

As an actor of cultural change, Artificial Intelligence (AI) and "deep" Machine Learning (ML) have entered the scene of the media-cultural theatre. To what degree can the content-generative mechanisms of massive data processing *via* artificial neuronal nets still be kept transparent and explainable? This concerns not only academic inquiry, but media-artistic research as well, whose critical task is not to obscure complex technologies by visual, acoustic or haptic metaphors, but to find unconventional ways of making their "black box" transparent.

Is AI / ML not yet "understandable" as long it is still in progress? According to Foucault's *Archaeology of Knowledge*, the "archive of the present" is impossible to understand; it can only be periodized and archivized once it recedes to the margins of the present, becoming past.

But "artificial intelligence" has been induced already since two and a half thousands years ago. The Greek elementary vocal alphabet, the Indo-Arabic cultural technique of counting by discrete numbers, and finally algorithmic procedures not simply extended human reasoning but fundamentally re-defined its performances in favour of abstract symbolic operations. In professional and every day life, to a big extend human perception is confronted with alphabetic, alphanumeric and numerical symbols which, although being embodied in all kinds of physical signals, are immediately de*coded* in terms of discrete information units. Neural cognition it thereby already conditioned - or "massaged" (McLuhan) to operate in (pseudo-)computing modes - as already described by Turing (1937) for human mathematical operations as "paper machines".

Concerning a periodization of AI, the "cold" winter of AI after an enthusiatic take-off, in the 1980s, has been due to ideological dead-ends of the cybernetic episteme, and due to the lack of computational power and "big data" affordance. More efficient mathematical models are nowadays entangled with the power of massively parallel processors and the statistics supplied, by data banks, for training in Machine Learning.

So-called "deep" machine learning, with its "emergent" properties and irritating artefacts, seems to escape the conventional tools of analysis. Is the choice of metaphysical terminology such as "depth" and "emergency" simply a semantic cultural lag against the accelerating speed of AI technologies, or is this the symptom of a more fundamental challenge, and epistemological irritation, of the traditional mind / matter dichotomy? Media archaeology, instead of assuming "ghosts" in such machines, rather tracks AI's techno*lógos*. It radically insists on opening

the black box of AI in a non-anthropocentric approach, by identifying the diagrammatic reasoning that intrinsically arises from within the techno-mathematic mechanism and circuitry itself.

AI and ML are not a simple escalation but rather the finalization (in the Hegelean sense) of classical computing. Is thereby even the "period" of *computer* art coming to an end? There is a new paradigm arising from artificial neuronal nets which rather induce a renaissance of "analog" computing - even if they are still disguised in "digital" standard microelectronic technology? In the sphere of synthetic texts, sounds and images emanating from AI toys like ChatGPT or Stable Diffusion, should there be, for the sake of rigid analysis, instead of hardware-centrism or critical code studies - a shift of emphasis, a focus on the techno-mathematical layers which are at work in between hard- and software?

Media-sociological vs. technological analysis of AI / ML

A non-anthropocentric analysis of AI and Machine Learning stays consciously suspended or "bracketed" from the social, or ethical concerns at least for a moment (Husserl's *epoché*), and rather investigates *teknowledge* from within - and among - machines. Most discursive expectations or promises ignore the elementary mathematical operations of AI technologies which itself operates upon already (in-)formatized matter & energy. While Kate Crawford's *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence*[510] brings "critical reflections on artificial intelligence back down to earth" in the discourse-analytical sense, media-archaeological analysis is literally "grounding" AI / ML in its concrete techno-mathematical *matteRealizations*. Such mechanizations are not simply derived applications but primary conditions of AI's coming-into-existence, eliciting the implicit intelligence of technically in-formed matter and energy. "[...] to really intervene politically one should also intervene in the design of the technologies themselves."[511]

Certain micro-political features may be materially (hardware) and logically (software) incorporated in the current design of technologies. This sociocentric view of AI as tool though, in the tradition of the French apparatus theory, is media-archaeologically contrasted by identifying technological *eigenintelligence* that escapes even the implicit ideological impulse. Cultural analysis and Science and Technology Studies critically deal with the underlying "ethics" in machine learning, such as its gender or race "bias" that is inscribed already in the algorithms of the operational system and the data sets for the training of Machine Learning. Radical media archaeology, on the other side, rather focuses

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[510] Harvard (Yale UP) 2021
[511] Electronic communication by Francesco Striano, May 24, 2023; see as well his article https://dzine.deditore.com/it/anarchia

on the epistemogenic momentum of such technological configurations themselves. "Bias", after all, is a term from electric engineering, meaning the *operating point* - "a dc voltage or current about which the instantaneous value might vary"[512]. Radical media archaeology identifies such a bias within the artificial neural net itself, rather than in its external cultural discourse.

But there is a sudden "dialectical synthesis" of technical analysis *versus* media sociology, once big data, derived from "social media" platforms, are used for training AI to mimick human behaviour patterns by sheer massive imitation. ML is turning the term "social media" upside turn, algorithmically transforming technically "mediated" telecommunication between humans into a big data source to be processed upon artificial neural nets.

Opening the "black box" of AI / ML

Composer Richard Wagner has become famous for a technical *camouflage*. In his design for a festival hall at Bayreuth, he introduced the orchestra pit in a deeper layer of the architectural ground - to acousmatically hide to the audience the visually distracting technical production of the sound.[513] Just as in contemporary loudspeaker culture, the music emerges like a sonic specter (and literally: spectrally) from a mythical abyss. Against a similar metaphysics of sublime dissimulation in current products of machine learning, a dismantling and opening of the black box of its "deep" layers is critically required, to achieve a sound understanding of "artificial intelligence" both in terms of neural net electronics and its underlying mathematics that departs from so far brain modelling in favour of a genuine techno*lógos*. But where can that condition of possibility be located exactly - in its brute matter, in its software, or in the "big data" which are processed? Different from conventional algorithmic reasoning, signal processing gets replaced by stochastics and becomes filtering from noise, an application of the Hidden Markov Chain model,.

While the cybernetic paradigm stays with the black box model, media archaeology resists a mere aesthetic metaphorization (such as computer-graphical visualization) of AI / ML procedures. To what degree is it possible to techno-logically infer from an comparative analysis of the input / ouput relation the essence and operativity of AI's "black box"?

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512 http://electronics.stackexchange.com/questions/66958/what-does-the-term-bias-mean, accessed 15th June 2016
513 See Friedrich Kittler, Weltatem. Über Wagners Medientechnologie, in: Diskursanalysen, vol. I: Medien, edited by Friedrich A. Kittler / Manfred Schneider / Samuel Weber, Opladen (Westdeutscher Verlag) 1987, 94–107

White box attacks on layered (convolutional) Neural Nets (CNNs) reveal their backpropagating errors. But the internal ML mechanism is not reducible to algorithms any more, since its output generation (be it text, music, or images) stems from the combination of software with big data and thereby results in unpredictable emergent phenomena. Artificial neural networks are still powered by huge differential equations. But unlike classical computing and statistics, a rather stochastic model replaces the logical approach.

AI / ML under a time lens

Even if most actual computations performed by AI are not visible to the human user, rigid media philology looks for ways to make such algorithmic procedures transparent: its operative, literally techno-logical diagram. Is there something like a "debugger" for the aberrant data path decisions in convolutional artificial neural nets? In his keynote lecture to the 11th World Computer Congress in 1989, Donald E. Knuth challenged his audience by suggesting a thorough analysis of everything a computer does during one second of computation.[514] Can the techno*lógos* of AI in actual being - instead of reducing it to the protocol of symbolic program changes - be identified by slowing down and enlarging its elementary material actions? Ralf Baecker's light and sound installation *Floating Codes* at the Ars Electronica Festival 2022 in Linz explored "the inner workings and hidden aesthetics of artificial neural networks" by concretizing "the fundamental buildings blocks of machine learning systems"[515] in the form of 250 custom-made artificial neurons. Their idiosyncasies made it evident to the human observer that media-art/ificial techno*lógos* is no derivation of the mind but developing an alternative"intelligence" of its own.

According to Leibniz' monadology, perception itself cannot be explained, and therefore not be simulated, by mechanics. Entering such a "Perceptron" (*avant la lettre*), one would perceive just moving elementary units, but they do not assemble (*legein*) to something which comes close to a cognitive figure in human perception.[516] Nowadays, though, ANNs enact exactly such a mechanism. But for the system to achieve this, it still requires a translation of real world signals as it is well known from robotics *via* sensors and the A/D converter. It still requires a

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514 See the entry "Knuth's Challenge", https://www.gaxun.net/commentary/knuth-challenge, accessed August 29, 2023
515 Carsten Seiffarth (ed.), Ralf Baecker.Cybernetic Imaginaries, Berlin (Distanz) 2022, 158
516 Gottfried Wilhelm Leibniz, Lehr-Sätze über die Monadologie, Jena / Frankfurt / Leipzig (Meyer) 1720, as quoted in Seiffarth (ed.) 2022: 41

translation of the real into the symbolical regime to make it operative intelligence.

Computing hardware, though, can not self-reflect its own activities other than by emulating the mechanism, that is: transcending its concrete physical materiality by means of an abstract symbolic software model. For the analysis of phenomena which "emerge" in machine learning, a reduction to their subsymbolic electronic steps, even below debugging[517], and watching parallel signal processing in ultra slow motion, provides a material sense of ML but misses its essential complexity. There actually *is* "software", but it unfolds in a new sense. Does its techno*lógos* reside in the dynamic diagram? Neurophysiologists like Ralph Gerard, at the Macy Conference on Cybernetics in New York 1950, "anxiously worked to localize the digital within the real"[518], while Claude E. Shannon, in the same conference series, for the analysis of a switching circuit - such as a telephone network, or an artificial neural net - defined the symbolic regime "as the limiting value of the real"[519].

Whereas Norbert Wiener excluded the "time of non-reality" that occurs in between binary switching states in flipflop-based electronics from binary information, AI now literally counts with intermediary adjustable "weights", with its computational mechanism approximating the "analog" domain of real numbers. Each numerical value within an artificial neural net is "mat(t)eRealized" not as sign (which exists only as an arbitrary mapping, or code), but as signal. This is a non-numerical operation of computing indeed.

From the Web to ANNs: Are material networks becoming intelligent?

As it has been frequently reminded from the side of media ecology, there is a very material condition behind the apparently virtual "Cloud" in the big data web: rare earth mining, energy consumption of Google server farms. But in the case of artificial neural nets, this material infrastructure is no longer simply a passive channels for transmission of messages / datagrams but becomes "active matter" (Wolfgang Schäffner). Artificial neural net configurations are logifications or sophistifications of the Web, inducing its "serendipity" of its inherent techno*lógos* to be reavealed (*aletheía*).

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517 See David Gauthier, To Execute, Rewrite, and Debug: On the Construction and Deconstruction of Computation, doctoral thesis at the Faculty of Humanities, Amsterdam University, 2020
518 Bernhard Siegert, Coding as Cultural Technique: On the Emergence of the Digital from Writing AC, in: Grey Room no. 70 (Winter 2018), 6-23 (8)
519 Siegert 2018: 9

Quantum physicist Karen Barad directs attention to "the agency of matter, and how we can intra-act" - rather than simply interact - "with it in an entangled dialog", instead of simply making instrumental use of it. Some kind of *implicit* material intelligence of agency might be activated "so that matter can perform itself"[520] But techno*lógos* operates not in brute physics already but only from technically informed matter. Artificial Neural Nets are still rather isolated media-epistemic playgrounds, philosophical toys (or "carpentry" in Bogost's sense) that invite for experimenting and experiencing the new kind of machine intelligence *in* and *as* a signal laboratory.

Most AI / ML applications are still trained by the symbolical machine (computers) which require digitized "big data" (with labels and "words"). The real world of continuous signals escapes such computation, even if computing, by digital signal processing (DSP), has been extended to an approximation to real physics (the Nyquist / Shannon sampling theorem). The "information machine" still processes binary symbols, ignoring matter / energy by definition (Wiener 1948), such as "idiosynchronous" human flesh, or alternative electronic hardware.

Computing (the) mind

According to Turing (1937), the machine-like parts of human reasoning may as well be enacted by a symbol-manipulating machine. To what extend do digital algorithms "partake of the extended, software-like nature of the mind, once thought is considered "a syntax that can be programmed and can run on any human or digital object"?[521] In the cybernetic Turing machine perspective, the mind and the algorithm are not categorically separated at all, but systemic symbol processing embrace both regimes, down to the DNA code approach to "life" itself.

The writing-machine, such as a word processor, no longer simply co-determines human thought (which has been Friedrich Nietzsche's insight concerning his typewriter), but with AI, computing has become a machine itself writing, capable of simulating human text generation. Is the "artificial" in AI (Latin *ars*, Greek *techné*), still a technical "objectivation" of *lógos* in Hegel's sense? When the intellect becomes machine language, the essence of its articulation is ephemeral, that is: a

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520 Ralf Baecker in interview on "Matter and Physics", in: Seiffarth (ed.) 2022: 184

521 Luciana Parisi / Stamatia Portanova, Soft thought (in architecture and choreography), in: Computational Culture, 1 (November 2011), http://computationalculture.net/article/soft-thought (accessed 5 February 2020), referring to: Andy Clark / David Chalmers, The Extended Mind, in: Analysis, vol. 58, no. 1 (1998), 7-19

tempor(e)alization of *Geist*.[522] As such it becomes a form of epistemic experimentation, which derives its appeal from its differences to neuro-biological embodiments of the mind (to which the "Behaviour-Based AI" answers), that is: as an *alien* phenomenology (Bogost 2012). This kind of "Objektivierung als 'Anders-werden'"[523] techno-logically dis/continues Hegel's *Phenomenology of Mind*. Machine learning will actually relieve humans from a couple of intelligence functions in favour of focussing on rather unexpected idiosyncrasies, just like photography once relieved portrait painting from the pressure of realism in favour of more experimental avantgarde experiments of *de*presenting the human face.

ANN-based Artificial Intelligence has become a challenge to media science in general, and media archaeology as a method (especially its logotechnical *a priori* approach). In order to cope media-epistemologically with the phenomena that arise from massively recursive "big data"-driven autoencoding and backpropagation, it does not suffice any more to focus on the program codes and hardware circuitry, that is: the single elements of the technical alphabet which still are behind all such data processing. Whether a functional analysis of machine learning should focus on the neuron itself is still an open question, since it is the random structure at the neural level that makes statistics so decisive for an analysis of such a media scene, especially when combined with big data training input. In a positivist understanding, computationally emergent AI phenomena like synthetic images is a coming-into-evidence of an already existent structure, which could then, by close step-wise analysis discretely be tracked back media-archaeologically, for algorithmic formulation. But a non-analytic, emphatic understanding presupposes the principal nonexplainability of emergent phenomena.

So is it rather not the hardware, but the software which is decisive to understand (artificial) mentality?[524] "We are not comparing the structure of neurons with the structure of transistors; we are comparing the organization of symbol-processing procedures in an algorithm with symbol-processing procedures of the mind-brain", Kenneth Colby once explained his computer simulation of paranoia.[525]

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522 See Zeljko Pavic, Hegels Idee einer logischen Hermeneutik, Remscheid (Gardez!) 2003, 177
523 Günther Anders, Philosophische Untersuchungen über musikalische Situationen [1930/31], in: idem, Musikphilosophische Schriften. Texte und Dokumente, edited and published by Reinhard Ellensohn, Munich (C. H. Beck) 2017, 13-140 (30)
524 Clemens Apprich, Die Maschine auf der Couch, oder: Was ist schon "künstlich" an Künstlicher Intelligenz? In: Zeitschrift für Medienwissenschaft, vol. 11, no. 2 (2019), 20–28 (25)
525 Kenneth M. Colby, Artificial Paranoia. A Computer Simulation of Paranoid Processes, Elmsford, N. Y. (Pergamon Press) 1975, 25

"From" machine analysis "to" statistical AI? Neural nets and / or the algorithmic approach to intelligence

Artificial neural networks are in fact not imitating or simulating the "hard" wiring of the human brain, but rather statistical modelling based on nodes of a graph. Their reprogrammability makes all the techno-logical difference to the "electronic brain" metaphor. At first sight, neural nets in Artificial Intelligence are conceived as mathematical graphs for modelling neurons and synapses of the human brain in layers where channels for transmitting data with variable signal weights concur. The operational diagram maps data into a vector space. Symbolically, its operations are expressed by literal "operators" in algebraic form. But in order for such a diagram to become technically en-active with data, it has to unfold *on* matter such as paper, or *in* matter such as Rosenblatt's Perceptron - an implementation which, in turn, modifies the diagram.[526] The techno*lógos* of AI / ML is not *human*, but *machine* reasoning.

Neural networks as artificial dynamic systems (in significant difference to the human brain neurons) are actually programmable. Even if mostly realized in digital computation, they recall Gordon Pask's "organical computers" from 1960, growing patterns as kind of electro-chemical analogue counter pieces to the discrete Turing machine.[527] In terms of hard- or wetware, two incommensurable systems come together in neurocomputers that still are electrical or optical realizations in conventional coprocessors. Even if artificial neural networks have been designed to behave as brain simulations, their inherent techno*lógos* does not care at all for such human-like metaphors.

Enhancing the difference: human vs. machine "reasoning"

The "brain model" approach of AI, once computationally enacted, is neglecting the frictions that arise once software operations are actually (electro-)physically implemented. Digital computing, in the original symbolic AI approach, is not enacting the neuronal network of the brain as bio-chemical wetware, but simulating its diagrammatic model.[528] When the mind is reduced to the "algorithm of information processing"[529], its actual (mate)realization is disregarded - which makes, though, all the difference between electronic computing and brain functions.

526 Mackenzie 2017: 49-50
527 See Seiffarth (ed.) 2022: 146
528 Kunihiko Fukushima, Neocognitron: A Self-organizing Neural Network Model for a Mechanism of Pattern Recognition Unaffected by Shift in Position, in: Biological Cyernetics vol. 36 (1980), 199
529 Fukushima 1980: 201

Instead of remaining *res extensa* in the Cartesean sense, AI technologies now challenge the human mind from within - discovering this mind as machine itself. Once they are not reduced to a human-oriented tool, AI and ML allow for "experimental epistemology" (Warren McCulloch), "phenomenotechniques" (Gaston Bachelard) or "transcendental cybernetics" (Gotthard Günther) in a way which reminds of the human audio artist being "neural-enactivisticly" coupled to a modular synthesizer while reacting to visual input in real-time improvisation.[530]

"Intelligence" here co-exits as an organic brain symbiosis with electronic circuitry. This allows for a *controlled* experimentation of creative signal processing that is different - but co-original - from the neural affect within animals.[531]

The very term "intermediation" can be modified, by a subtle manipulation of signifiers, from a sociocentric analysis of computer-society-relations (like in STS) to "intramediation": focussing attention on the kind of events which unfold *within* technological devices and computational reason.

The techno*lógos* of AI

A failure of the classical symbolic AI with its computational interpretation of the human mind has been its neglect of the divergence between "symbol grounding" in the brain and in electronic computing, that is: the alternate entanglement of symbols with their physical scene of actual operations.

The techno*lógos* of AI / ML is not pure *lógos*, no Platonic idea nor Hegelian spirit, but a technically specific form of operative being, an "assembly" (in its multipe sense of computing). Artificial neural nets are rather a collective (*légein*) technical agency, a symbolic concatenation which acts in the tempoReal.

Technology is the moment when the desire of knowledge not only confronts, but enacts real things. Beyond the extended mind model, "intelligent" thinking is enacted by its operative coupling with technical matter and thermodynamic energy itself. The assumption of a techno*lógos* replaces the outdated mind / matter dichotomy by the inspired machine. In media theory, this spook is symbolically articulated

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530 Such as Rüdiger Wenk's *Beobachtung der Beobachtung* performance in the Media Theatre of Media Science at Humboldt University Berlin, July 7, 2023; www.phonoschrank.com/ensemble-a200ms
531 Marie-Luise Angerer, Nonconscious: On the Affective Synching of Mind and Machine, Lüneburg (meson) 2022

by verbal speech or alphabetic characters, unless the words (*lógoi*) are liberated *as* and *by* machine circuitry itself, in the form of the electronic textures of artificial neural nets. All of the sudden, techno*lógos* articulates itself. "The end of the symbolic process is that non-being come to be, because it has spoken", but maybe it can only be properly understood by nonhuman machines.[532]

Artificial neural nets act "discursively" on the phenomenal interface level such as ChatGPT, but they are radically non-discursive in their techno-mathematics as *a priori* condition of possibility for such discursive enunciations (be it verbal, textual, auditory or visual).

With AI / ML, *understanding media* by humans (as proposed in McLuhan's seminal 1964 publication) transforms into a media-active understanding among technologies themselves - as it has been discussed by Gotthard Günther's in his book on (self-)conscious machines.[533] The clue to *understanding ML* may be a literal reading of its very umbrella term: part of the very term "eplAInability" is the acronym "AI" itself.

Part II: IMAG(IN)ING "AI"

On the "creativity" of Machine Learning

While programmers still set some parameters, a machine learning artwork is actually generated by the artificial neural network itself "in a process which is considered by many to be similar to the thinking process of human beings"[534]. With AI for the sake of experimental epistemology, such a technical objectivation of the mind flips from an extension of man to narcissism (McLuhan 1964). Against such anthropocentric perspectives, media-archaeological analysis rather focuses on the differences techno-logical reasoning makes.

From within the soul of conceptual "intelligence", the *machine* returns: If the machine program results in "doing something interesting which we had not anticipated I should be inclined to say that the machine had originated something [...]."[535] The trick of "intelligent" machines resides in their heuristic capacity to outsmart human cognition. "Outsmarting",

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532 Jacques Lacan, Psychoanalysis and Cybernetics, or on the Nature of Language [*1955], in: J. A. Miller (ed.), The Seminar of Jacques Lacan. Book II: The Ego in Freud's Theory and in the Technique of Psychoanalysis, 1954–1955, New York (Norton) 1991, 294–308 (307)
533 Gotthard Günther, Das Bewußtsein der Maschinen. Eine Metaphysik der Kybernetik, Krefeld / Baden-Baden (Agis), 2nd. ed. 1963, esp. Supplement IV "Die 'zweite' Maschine", 179-203
534 G. Ajani, Contemporary Artificial Art and Law. Searching for an Author, Leiden / Boston (Brill) 2019, 5

though, is among the semantics of the ancient Greek term *mechané* itself.

An extremely slowed down analysis of the machine learning concept recalls cultural techniques of "artificial knowledge production" that have never been called Artificial Intelligence before as such: the operations of sorting and associating images or words in non-taxonomic positioning systems. Aby Warburg's former Hamburg library tracked the "memes" of classical antiquity and their transmissions in the cultural unconsciousness in the intuitive connections sparked by the random memory associative arrangement of the books and black & white photographies he collected - "an early neural-network model of the growth of connectivity"[536] indeed.

Artistic creation from AI / ML cannot be "understood" in terms of humanities - not even "Digital Humanities". When hermeneutics (as revelation of "meaning") fails, there rather remains the option of archaeo-logically debugging its paths instead. The ontological question "what is intelligence" gets replaced by identifying intelligence functions, thereby making it mechanizable.

As quoted in Alan Turing's seminal paper on "Computing Machinery and Intelligence"[537], Lady Lovelace, in 1842, commented on Charles Babbage's prototypical programmable computer: "The analytical engine has no pretentions whatever to originate anything. It can do whatever we know how to order it to perform." This has been imperative programming in computation since but has even be questioned by Turing himself (ibid.). As an information processing device, machine learning is redundant: "it cannot create any new information not contained in the original source" (ibid.). But by massive big data training it is capable of revealing - or presuppose - hidden pattern in data clouds in latency - un"known" to humans so far.

GANs and the autonomous simulacrum of the human "portrait"

535 Alan Turing, Can digital computers think?", typescript of a talk broadcasted by BBC Radio on May 15, 1951; www.turingarchive.org/browse.php/B/5

536 Barbara M. Stafford, Reconceiving the Warburg Library as a Working Museum of the Mind, in: idem, Ribbon of Darkness. Inferencing from the Shadowy Arts and Sciences, Chicago, Il. / London (University of Chicago Press) 2019, 71-77 (75); reference thanks to art historian Monika Perenyei, Budapest

537 Alan M. Turing, Computing Machinery and Intelligence, in: Mind. A Quarterly Review of Psychology and Philosophy 59, no. 236 (October 1950), 433-60

Since 2014, the competition between two machine learning systems (GANs) has started to exclude the human from the creative sphere at all. This resulted in an internalized, inner-technical "Turing test" for visual perception - transcending Turing's mathematical anthropocentrism. The "generators" in Generative Adversarial Networks are first of a "hallucinating" images from noise, before they are stepwise "corrected" by the "discriminator" that has been fed with the archive of cultural images. Synthetic AI images are therefore, even though they are retrieved from the cultural image archive, rather inventions.[538]

The arts collective Obvious, in 2018, has been signing their AI-generated, notorious *Portrait of Edmond de Belamy*[539] by its core mathematical formula - even if this is just a hint to the actual calculus operating behind, such as the code for the training of a stochastic adversarial net for the recognition of numerical ciphers, or human portraits. Obviously, the previously so-called "artistic" human agency has been displaced into techno-mathematical creativity.[540]

An AI-generated image finally dissimulates the dataset from which it has been trained as input. The precise bifurcations from data input to the iconic output become lost in a labyrinth of hidden pattern-recognizing layers. While the neural network model for a mechanism of visual pattern recognition explicitly presupposes *human* image cognition[541], media archaeological experimentation, in the signal laboratory, rather amplifies the creative difference between techno-logical and human "intelligence".

Classical "machine learning", such as Rosenblatt's Perceptron (around 1960), has been developed to provide a "clue to the understanding of the neuronal mechanism in the brain"[542] for *analytic* purposes. Once brain activity is assumed to be a "mechanism", it can be replaced by a Universal Turing Machine indeed. In contrast to this " symbolic AI" approach, in order to arrive at the real, just like subtractive synthesis in electronic sound composition, a GAN derives order from noise in the combination of stochastics with visual (though still logocentric) archives like ImageNet. But even the art(ificiality) of "deep fake" imagery is still anthropocentric.[543] A GAN for generative imaging is not just another

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538 An argument made by Fabian Offert, in his talk at *transmediale* festival Berlin 2020 (panel "Neural Network Cultures")
539 See https://en.wikipedia.org/wiki/Edmond_de_Belamy
540 See as well Mario Klingemann's GAN-based installation *Memories of Passersby I* (2018)
541 Kunihiko Fukushima, Neocognitron: A Self-organizing Neural Network Model for a Mechanism of Pattern Recognition Unaffected by Shift in Position, in: Biological Cyernetics vol. 36 (1980), 193-202 ("Abstract")
542 Fukushima 1980: 202
543 See Blaise Aguera y Arcas, The Work of Art in the Age of Machine Intelligence, in: *Artists + Machine Intelligence,* February 23, 2016:

technical tool for (still human) artistic creation but becomes an objectivation - and therefore alternative - of the creative mind itself. This is not simply an extension of the human brain any more - just as for G.W. F. Hegel, the voice is no simple "exteriorization" of the inner self - but might serve as a primary instantiation of experimental epistemology.

Once AI images become indistinguishable from traditionally captured photographies, they may still look photorealistic but are essentially different.

Towards a computational *Laokoon*: parallel processing, and AI "imaging"

So far the media-phenomenological view. Media archaeology, though, rather radically uncovers the structural techno-logics behind AI's mimikry of the human. Artificial "neural" topo-logics is electro-technically mate*realized* in arrays of special purpose processing units which, besides the conventional CPU, were once developed for computer (game) graphics.

There is still algorithmic coding; the programming language frequently used in AI / ML Python is simply knitting together program libraries and privileges sequential procedures as the core of digital computing. The massively parallel processing of data in the layers of artificial neural nets themselves, though, are closer to the definition of the "image" as synchronous spatial order than to the linear sequential text. It is not by coincidene that GPUs, originally intended or computer graphics in its (pseudo-)parallel data processing, became an affordance for AI applications - as if the actual media massage of GPUs - its techno*lógos* - has not been *imaging*, but "acoustic space" (in McLuhan's sense of simultaneity).

With its computing in Graphics Processing Units (GPUs), the implicit iconicity of "deep" machine learning is revealed: its (pseudo-)parallel, rather than time-sequential, symbol manipulation. Lessing's 1766 *Laokoon* theorem makes a categorical media-aesthetic difference between visual coexistence of units in space, against literary, or dramatic, sequential unfolding in time. GPUs, when compared to the traditional CPU in microprocessors, are more effective at handling multiple calculations with their time-critical synchronization of parallel threads. In that sense the Graphic Processing Units had been developed for visual object rendering in gaming applications. Most of these computations involve matrix and vector operations. The same type of mathematics can now be used to accelerate other non-gaming geometric

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https://medium.com/artists-and-machine-intelligence/what-is-ami-ccd936394a83

calculations. In one of its major applications, which is visual pattern recognition and similarity-based image sorting, this *implicit iconicity* of "deep" machine learning, when processed in GPUs, becomes explicit.

Fukuyama's diffractive approach to automatic character recognition once let the digital computer process fractions of an input character in order to maintain machine-perception invariance across divergent individual concretizations.[544] But even if such a model has been anthropocentric in its orientation at human image recognition, within its black box it created solutions according to their own techno*lógos*. Machine learning becomes epistemogenic once its anthropocentrism is reversed, revealing the point of view of the "eyes of the machine": Humans may learn *from* machines about alternate, more processual definitions of the "image" such as layered low level shape and texture, and high level feature detection.[545]

"Big data" training sets for machine learning aim at the automatic assignment of labels to unknown data objects, such as in image recognition. The input labels of data sets to artificial neural networks are biased less on the features level but on their labelling (metadata), such as in search engines.[546] The new kind of "archive", for researchers and artists working with GANs, are thousands of large, publicly available datasets such as ImageNet, or from platforms like Instagram or Google Images.

Artificial imaging, and the "imaginary"

The difference between machine vision and human perception becomes evident in glitches. "Artificial" here becomes "artefactual" intelligence. Media-archaeological analysis, and its related artistic research, enhances instead of eliminates errors that occur in ML as sparks of media-epistemic knowledge.

In conventional man-machine communication, the human "me" confronts the computational "it". Does the "imaginary" concerning AI / ML still take place outside the machine that only knows the electro-physical real and the coded symbolic? Or has Artificial Intelligence already developed an "imaginary" of its own which symbolical (computational) machines, so far, did not know?

True machine learning, with an emphasis on the "machine", is not biased

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544 See Fig. 5, in: Fukushima 1980: 198
545 See W. E. / Stefan Heidenreich / Ute Holl (eds.), Suchbilder. Visuelle Kultur zwischen Algorithmen und Archiven, Berlin (Kulturverlag Kadmos) 2003
546 See Safiya Umoja Noble, Algorithms of Oppression. How Search Engines reinforce Racism, NYU Press 2018

by the human brain model any more. It will rather be future non-classical computers among themselves which truly "recognize" (the other meaning of "intelligence") how knowledge arises, in artificial neural nets, from patterns in the combination of big data and high-frequency computing. Only then will the techno-logical medium message of AI be self-fulfilled. *Understanding media*, in "deep" machine learning, becomes media-active, liberated *from* human intelligence *to* of an intelligence of its own.

EXPLAINABLE "AISTHETICS" IN MEDIA-ARCHAEOLOGICAL TERMS

[Abstract]

Different from the rather political and ethical concern of this Glowing Globe conference on "AIsthEthics",

The media-archaeological argument twists the title of the Glowing Globe festival symposium *AIsthEthics: artificial intelligence, aesthetics, ethics in art*[547]. The prevalent anthropocentrism of AI "ethics" and its phenomenological "aesthetics" will be counter-balanced by asking instead: Is there an implicit AI aesthetics of its own, an "alien AIsthetics" from the inner-technical perspective that can be identified by revealing and opening the "deep" black box of Machine Learning itself?

In Search for the Medium Specificity of AI

Critical AI studies are currently dominated by discursive concerns to a degree that it risks to miss the core agenda of any philosophy of generative media arts: the question concerning its genuine techno-aesthetics.

For example, the political "bias" in products of "Deep" Machine Learning is discussed concerning the "colonial" and other prejudices that arise from the available Western training data sets. For "critical media archaeology" (Shintaro Miyazaki), though, the *bias* is, first of all, a technical term that refers to the electric potential of an artificial neuron that enables it to react to incoming signals at all.[548] AIsthetics deserves to be discussed on its technological ground.

In a radical concretization of McLuhan's plea to focus critical attention not on media content but on the *medium message*, media aesthetics is the ability to recognize, for example, the synthesizer circuitry itself when

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547 October 17, 2024, University of Rijeka, Department of Philosophy
548 See Noack / Sanner 2023: 208

listening to electronic music.[549] The engineering of an artificial neuron immediately reminds that this may be a logical model of the human brain, but its completely different electric implementation (different from human neural *embodiment*) induces a different mode of (mal-)functions that is closer to innertechical diagrams than to biochemical and bioelectrical wetware.

Fig.: Neuron-Lectron.png

"AIsthetic" implications can be transformed into a more epistemological dimension by discussing artistic concerns like intentionality, creativity, responsibility and authorship in terms of literally "artificial", that is: technical agency".[550] Especially with "deep" machine learning, the emphasis should less focus on the anthropocentric quality of the "I" (for intelligence) but on the "A" (for the artificial) in Simondon's techno-epistemic sense, Barad's "new materialism", and indeed, the hypothesis of a genuine techno*lógos*[551].

Is there a medium-specific aesthetics of AI?

In most media artworks, its technical "ground" (to use terminology from the *gestalt* theory) is most frequently hidden against the phenomenal audio or visual "figure". But as it has been discussed by Clement Greenberg[552] in an art-critical update of G. E. Lessing's 1766 *Laocoön* theorem[553], only when the material, or technical, medium, in its *medium-specificity*, becomes part of the aesthetic message itself, the term "media art" is justified.[554] Against linguistic and cultural semiotics[555],

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549 "[...]to hear or see the circuits in the synthesized sound of CDs or in the laser storms of a disco [...]." Friedrich Kittler, Gramophone - Film - Typewriter, Stanford, Cal. (Stanford UP) 1999, "Preface", xli
550 See Francesco Striano, Can artificial agents act? Conceptual constellation for a de-humanised theory of action, in: Scienza e Filosofia no. 31 (2024), 224-244
551 See W. E.,Techno*lógos* in Being. Radical Media Archaeology, and the Computational Machine (New York / London) 2021
552 Clement Greenberg, Towards a New Laocoon, in: Partisan Review Bd. VII, Nr. 4 (1940), 296-310
553 Gotthold E. Lessing, *Laocoön. An essay on the Limits of Painting and Poetry* [1766], transl. by Edward Allen McCormick, New York (Bobbs-Merrill) 1984
554 See N. Katherine Hayles, Print Is Flat, Code Is Deep: The Importance of Media-Specific Analysis, in: Poetics Today, 25 (1) (2004), 67-90
555 As indicated by the lecture of Hanna Hamel "Longing for Literature: Aesthetics of Postdigital Writing" at the conference *Semiotic Machines: Artificial Text and the Praxis of Reading*, 29 May 2024 – 31 May 2024, Leibniz-Zentrum für Literatur- und Kulturforschung, Berlin

AIsthetics refers to the signal-processing, "subsymbolic" level of technical operations themselves. With AI, "medium specificity" does not exlusively relate to the material any more (such as the painterly screen), but shifts towards its entanglement with the techno-mathematical regime that has in the meanwhile developed a diagrammatical elegance and knowledge-aesthetical beauty by itself.

If Artificial Neural Networks are still considered a "medium" in terms of technical communication theory, the *medium specificity* of AIsthetics is its techno-mathematical stochastics, both in its "noisy" becomings and in its algorithmic limitations. Since the epoch of informational aesthetics (Birkhoff, Moles, Bense), the issue of "order from noise" (von Foerster) has been a radical break with conventional artistic aesthetics indeed. The essential idea behind the Stable Diffusion or Midjourney algorithms that synthecize AI images has been inspired by non-equilibrium statistical physics: it systematically and slowly destroys "structure in a data distribution through an iterative forward diffusion process"[556]. Then a reverse diffusion process is "learned" that restores structures, "yielding a highly flexible and tractable generative model of the data" (ibid.). Such an evaluation of probabilities requires "deep" generative models with thousands of layers and time steps.

Can the Production of AI still be Experienced by / as Aisthesis?

In alliance with the "eXplainable Artificial Intelligence (XAI) movement, and contrary to the cybernetic system approach, media archaeology aims at "whitening" the black box. In that effort, it resists a merely phenomenal "explanation" of AI / ML procedures by visual or sonifying metaphorization[557] or computer-graphics, in favour of an analytic techno-aesthetics.

To what Degree can there be Artistic / Aesthetic Insight into AI?

The achievement of an "exact aesthetics" (a term coined by Max Bense) in the scientific sense of information theory (Shannon) has been the field of media-artistic research. In its ancient sense, the "artistic" primarily refers to the technical and the "artificial" indeed. Artistic and Artificial Intelligence are literally intertwined by Latin *ars*, Greek *techné*. Techno-

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556 Jascha Sohl-Dickstein et al., Deep Unsupervised Learning using Nonequilibrium Thermodynamics (2015), Abstract, arXiv:1503.03585, accessed 29 November 2022
557 Such as Tim Otto Roth's "audio neuron" installation Theatre of Memory at Tieranatomisches Theater of Humboldt University Berlin (Campus Nord), January to March 2024; see :/tieranatomisches-theater.de/project/ausstellung_theatreofmemory_2023_de

aesthetics migrated from the human body-mind into the mind machine, from the moment in the 1960s when *artistic* creativity became *artificial* in so-called generative art. Such a second-order aesthetics from within the machine turns "artworks" themselves into expistemic toys.

While the cultural (human) "user" perspective still logocentrically subjects AI image generation to verbal tagging in the training phase and to verbal "prompts" in a new "art of description" (meanwhile ironically aided by AI tools themselves), from within the technoaesthetics of AI (and its techno*lógos*), a different "generative aesthetics" (Bense again) arises.

A specific mode of artistic tinkering is experimenting with AI code and data sets that govern its aesthetic surface effects (text, sound or image). Pit Noack's book on *Understanding AI* (*KI verstehen*) offers the option to playful manipulate the code in *online* instantiations of machine learning algorithms and diagrams. Media-archaeological toys are analytic mechanisms that remain close to the machine.

For philosophizing not simply *about* aesthetics but actually *with* AI, the production of algorithmic artworks is a perfect epistemic tool indeed "that allows to [...] better understand how it all works", since media-artistic research - different from abstract media theory - "is tangible: it offers some concrete results when experimenting"[558] with AI.

The Implicit "Imag(in)ing" Aesthetics of AI

The massively parallel processing of data in the layers of artificial neural nets are closer to the "image" as synchronous spatial order than to the linear sequential text indeed. It is not by coincidence that Graphics Processing Units, originally developed for computer graphics in its (pseudo-)parallel data processing, became an affordance for AI applications - as if the actual media massage of GPUs - its techno*lógos* - has been *imaging* in the operative sense.

There is an immanent *imagination* originating from the machine indeed. It is generative image ANNs like Deep Dream (by Google) that reveal a different *aisthesis* from the machine. The "eyes of the machine" focus on features that usually escape human attention, as it has been revealed by an eye-tracking system (as it were) for neural nets in order to document which kind of pixels are focused by an AI system during a pattern recognition task.[559]

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558 Obvious, Creating Art with AI. A Philosophical <sic> Essay about the Consequences of Creativing Art with Algorithms, https://obvious-art.com/wp-content/uploads/2020/04/MANIFESTO-V2.pdf, p. 6
559 Andreas Sudmann, Künstliche neuronale Netzwerke als Black Box.

Classical aesthetic theory thus turns into AIsthetics, phonetically and substantially reminding of ancient Greek *aisthesis* that is: signal perception and transduction. There is an image AIsthetics indeed - though not in the sensual but structural sense.

A honhuman AIsthetics is revealed by the stubbornness and "tricks" (old Greek *mechané*) of the artificial learning mechanism. This becomes evident in the distortions and misrepresentations of "obsolete" every day communication tools like the analog telephone once it is "hallucinated" (and may subsequently even be 3D-printed as a techno-surrealist item[560]) by present synthetic image generators like Midjourney that rather "knows" the smartphone.

The difference between machine vision and human perception becomes evident in such glitches. "Artificial" here becomes "artefactual" intelligence. Media-archaeological analysis and its related practices of "artistic research" enhance (instead of eliminate) errors that occur in ML as sparks of media-epistemic aesthetic knowledge. Has Artificial Intelligence already developed an "imaginary" of its own which symbolical (computational) machines, so far, did not know?

There is no *aisthesis* in machines

[AIsthethics reminds of the double sense of "intelligence" in English: a) human reasoning, b) military reconnaissance. AIsthetics as machine *aisthesis* is defined by the kind of media-active pattern recognition that film maker Harun Farocki once termed the "operative image".

The central human category of *aisthesis*, as perception of the senses and its cognitive abstraction into aesthetics, becomes *mimesis* in / as AI. Perception has been modelled by Rosenblatt's Perceptron in the 1960s and by Fukushima's Neocognitron in the 1980s. For current Q-Learning

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Verfahren der Explainable AI. Medienwissenschaftliche Perspektiven, in: P. Klimczak /Christer Petersen / Samuel Schilling (eds.), Maschinen der Kommunikation. Interdisziplinäre Perspektiven auf Technik und Gesellschaft im digitalen Zeitalter, Wiesbaden (Springer Fachmedien) 2020, 189-199 (195). For a previous study on conent-based image recognition, see W. E. / Stefan Heidenreich / Ute Holl (eds.), Suchbilder. Visuelle Kultur zwischen Algorithmen und Archiven, Berlin (Kulturverlag Kadmos) 2003

560 As part of the exhibition *New Realities. Stories von Kunst, KI und Arbeit*, Museum of Communication, Berlin 26 April until 15 September 2024, https://new-realities.museumsstiftung.de. See as well Antonio Koludrovic's 3D-printed biosynthetic plants in the Glowing Globe exhibition at Gallery Kortil, Rijeka, 17 - 25 October, 2024

algorithms, the "world" is internally modelled as a finite *Umwelt* of discrete states.[561] Even in robotics the equivalent to the multimodal senses that interface human cognition to the external environment is technical sensors that immediately transduce analog signals into equivalents of "numbers" to make them digitally computable. For a convolutional net, the image of a cat is nothing but a spatial configuration of features that have been "reckognized" by filter kernels - a complex signal that is processed and modified in its itinerary through "hidden" neuronal layers.[562] From a media-archaeological perspective, though, that looks at humans with the eyes of the machines, this technical modelling is revealing: it reveals the computational essence of human pereption itself.]

Transformers that are the ML architecture for "generative aesthetics" such as ChatGPT apparently can "imagine"[563] texts, sounds and images. But this kind of generational aesthetics in fact grounds in the most unaesthetic operation: numerical statistics. Even if the effect looks like natural language, every "word" has to be coded in order to become computable for AI. Logos becomes operative only in its strictly mathematical sense here. That is how machine "language" can be trained without ever understanding the training texts[564]: *mimesis* instead of hermeneutics. There is no "sense" for AI: neither aisthetically nor hermeneutically. The "hermeneutic" XAI ambition to reveal the code behind the media-theatrical scenes of AI[565] comes from the human perspective only. Once the notion of "culture" is extended, by data science, to nonhuman beings as well, anthropocentric *aisthesis* is widened - or even replaced - by modelling operative chains of signal processing.

How "obvious" is AI? AIsthetics vs. AIsthesis

[The idiosyncratic typography of AI*sthetics* itself reminds of the original ancient Greek sense of *aisthesis* that is no philosophically abstract theory of aesthetics but pure sensual perception. This is nowadays is emulated by pattern recognition in artificial neural nets.]

It had been a liberating argument when the cybernetic art movement in

561 See Pit Noack / Sophia Sanner, Künstliche Intelligenz verstehen. Eine spielerische Einführung, 2nd actualized ed. Bonn (Rheinwerk) 2023, chap. 7 "Q-Learning", 133-166 (166). For an answer to this challenge by "Deep Q-Learning" see subchapter 15.5.1 "Wie kommt die Umwelt in Modell", 265
562 See Noack / Sanner 2023: 256
563 Noack / Sanner 2023: 267
564 Noack / Sanner 2023: 270
565 Noack / Sanner 2023: 296

the 1960s and 1970s, and the emergent materialist media science in the 1980s and 1990s, reminded of the original sense of the Aristotelean category of *aisthesis* that refers to material sensual perception (and by analogy to technical sensors).[566] *Aisthesis* has been rehabilitated against the predominant philosophical notion of abstract "aesthetics" as the quest for relational harmonics. Art has been its autonomous agency - suspended from religious, political, or other discourses. But AIsthetics, nowadays, stands for technology becoming autonomous from the human model, emancipating from being reduced to simply functional and instrumental "extensions of man". In more active media-archaeological terms, AIsthetics stands for the moment when nonhuman intelligence develops a proper, media-specific aesthetics of its own - in accordance with its proper techno*lógos*.

But in most AI-generated art works, the operational mechanism behind "machine learning" remains "deeply" hidden, dissimulating the abstract (algebraic) and concrete (hardware) mechanism / procedures, becoming *an*aisthetical.

Christiane Mudra's investigativel musical theatre production BETA[567] recently illuminated AI's "risks posed by non-transparent data sets and the monetisation of private user data."[568] Can the otherwise invisible data processing still be made transparent for humans on the aesthetic level?[569] Philosophy itself has created a category for such an (an)aesthetics: Edmund Burke's notion of the *sublime*. In terms of the digital sublime, "post-digital" art - with its "greater emphasis on humanity than on digitality" (symposium draft) - is more digital than ever, but dissimulating its technological intelligence phenomenally.

With synthetic) imaging the "human" is still referenced, but on the level of (neural) medium message, the meaning of "humanity" is questioned itself: With more and more modelling of humans by artificial mechanisms (first automata for bodies, now AI for the mind), humans get used to

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566 See Herbert W. Franke / Gottfried Jäger, Apparative Kunst. Vom Kaleidiskop zum Computer, Köln / München (DuMont Schauberg) 1973, 120, and Karlheinz Barck / Peter Gente / Heidi Paris / Stefan Richter (Hg.), Aisthesis. Wahrnehmung heute oder Perspektiven einer anderen Ästhetik, Leipzig (Reclam) 1990
567 World premiere February 17, 2024, "Tischlerei" at Deutsche Oper Berlin
568 https://deutscheoperberlin.de/en_EN/home, accessed February 25, 2024
569 "auf einer ästhetischen Ebene"? Libretto #6 (2023/24), entry "Gesetzlos im Ozean. Google, Meta und Co. bauen eine Zukunft, die Freiheit verspricht – und Überwachung bietet. Christiane Mudra zeigt mit BETA investigatives Musiktheater über die Gefahren der Tech-Branche", https://deutscheoperberlin.de/de_DE/gesetzlos-im-ozean (Abruf 24. Februar 2024)

rethink essentially "human" features in techno-mathematical terms.

How "obvious" is the techno*lógos* in AI-generated imagery? It is revealed in the "artist signature" of one of the first AI images that succeeded in the commercial art market: the *Portrait of Edmond de Bellamy* by the computer art collective Obvious, signed by a core mathematical algorithm of "deep" machine learning:

Fig.: Obvious-Belamy.png

Fig.: Obvious-Belamy-Signatur.png (Wiki commons[570])

Enhancing non-human AIsthetics

[Can aesthetics be automated?[571] "AIsthethics" (with its typographic gesture) is no metaphor any more once "the anthropomorphization of AI creates a human that did not exist prior to humanization"[572], since it transforms the concept of the human itself - towards an image of the human as seen from the perspective of the machine.

In "deep" machine learning, an AI "learns" pattern recognition from big data training. As longs as its algorithms are (still) written by computational scientist, its aesthetic aim remains anthropocentric in its bias.

Media archaeology reverses that perspective in favour of what Ian Bogost calls *alien phenomenology* (2012). French poet Rimbaud once wrote to his teacher: "Je est un autre." In that sense, true AIsthetics reveals the "otherness" of human intelligence *as* machine itself, like the "mirror scene" in Jacques Lacan's theory of the psychic apparatus where the human infant becomes, for the first time, conscious of its own identity when recognizing his coherent body as its own counter-image.[573]]

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https://upload.wikimedia.org/wikipedia/commons/thumb/c/c1/Edmond_de _Belamy.png/540px-Edmond_de_Belamy.png
571 Lev Manovich, Automating Aesthetics: Artificial Intelligence and Image Culture, in: Flash Art International Nr. 316 (September / Oktober 2017) http://manovich.net/content/04-projects/101-automating-aesthetics-artificial-intelligence-and-image-culture/ automating_aesthetics.pdf
572 Mark Coeckelbergh, The Political Philosophy of AI, Camrbidge, UK (Polity Press) 2022, 147
573 On Lacan's 1949 paper on the mirror stage and its successive versions, see Sol Aparicio (Tel Aviv Forum, entry June 20, 2015), "Je est un autre." A psychoanalytic approach to the question of identity, https://forumlacan.com/articles/je-est-un-autre-a-psychoanalytic-approach-to-the-question-of-identity-2, accessed August 1, 2024

Even the cultural role of the art critique gets relaced from within the machine in so-called General Adversal Networks (GANs). The very name *Belamy* in the notorious AI-generated image by Obvious is "a pun based on Ian Goodfellow, inventor of GANs"[574], and this is thereby a recursion of its technological model. [In such an artificial neural architecture, a Generator network, from random input vectors, produces patterns similar to the training data, while the Discriminator network aims at differentiating between the "generated" and the "true" data sets - a kind of inner-technical "imitation game" (Turing 1950) or CAPTCHA.] Aesthetics has become autonomous not *from* technology, but *within* the machine. According to Adorno, the "Eigensinn des Ästhetischen" has been able, so far, to escape the techno-functional logics of capitalisms: its "begriffslose Form" (Marx).[575] But with AIsthetics, technology has begun to develop an (an-)aesthetic *Eigensinn* itself - or rather "stubbornness", since this quality derives from the strictly non-semantic aesthetics of the computational mechanism.

When it is understood most literally, the neologism AIsthetics remains an oxymoron. There can be an aesthetics of synthetic AI artworks as products, but no *aisthesis* of AI / ML as a revelation of the inner logics of the machine.

[SUPPLEMENTS ON "AISTHETICS"]

AIsthetics *avant la lettre*: "generative art"

The ambition of "generative aesthetics" (Abraham Moles, Max Bense et al.) has been to replace idealistic aesthetics by information theory with its claim that even the sense of beauty can be mathematically measured and (consequentially) calculated.

At the peak of the heroic epoch of cybernetics in the 1960s, Bense coined the term "informational aesthetics". While the field of aesthetics (as a qualitative definition of the "beautiful") had been discussed in philosophy so far, Bense aimed at a scientifically "objective" concept that allowed to actually measure aisthetic degrees in terms of Shannon's mathematical theory of communication, that is: no inherent quality of a material semiotic carrier, but the calculable "bits" of subjective information created within the range of redundancy and negentropic

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574 Wikipedia, entry "Edmond de Belamy", https://en.wikipedia.org/wiki/Edmond_de_Belamy, accessed September 6, 2024
575 See Tom Holert, Knowledge Beside Itself. Contemporary Art's Epistemic Politics, Berlin (Sternberg Press) 2020, 96

surprise.[576] With so-called "generational AI", aesthetics has become computable indeed - in equivalence to creative "intelligence" as such.

Bense's generative aesthetics has not been developed for artistic reasons, but in a post-idealist effort to transform the otherwise philosophical concern for "aesthetics" (Hegel) into a scientific field. The target was to achieve a non-subjective approach to measure "aesthetic" value in mathematical "stochastics" (the term used for nonlinear chaotic phenomena *avant la lettre* "to describe the qualitative structure of phase trajectories generated by deterministic models [...] motivated by the so high complexity degree of trajectories, that from a casual point of view" - rather: causal? - "they appear to be random, without being really random. Now '*stochastic*' is only reserved for processes defined as a one-parameter family of random variale, a random variable being defined as a measurable function"[577]. This brings the field of nonlinear dynamics close to the XAI ("eXplainable Artificial Intelligence") demystification of the metaphysics of "emergence" in AIsthetics. There has been an "émotion esthétique" (Poincaré) indeed triggered by early experimentation with computational images of nonlinear chaotic behaviour, with reference as well to Birkhoff's papers on the laws of aesthetics.[578]

The seminal "generative art" approach from the heroic age of cybernetics is nowadays radicalized (if not *dis*continued) by synthetic Artificial Intelligence in "Deep" Machine Learning. Text-, image-, sound and video-generative "AIsthetics"[579], with its stochastic approach (such as the Stable Diffusion software environment) is inheriting and up-dating the "generative aesthetics" computational approach from classic cybern(aesth)etics indeed.[580]

Media-Artistic Archaization of AI / ML

Can the techno*lógos* of AI - instead of reducing it to the protocol of symbolic program changes - be identified by media-archaeologically

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576 Helmar G. Frank / Herbert W. Franke, Ästhetische Information. eine Einführung in die kybernetische Ästhetik, Berlin / Paderborn (Institut für Kybernetik) 1998, VI seq. and 66

577 Mira 2000: 121

578 See Christian Mira, I. Gumowski and a Toulouse Research Group in the "Prehistoric" Times of Chaotic Dynamics, in: Ralph Abraham / Yoshisuke Ueda, The Chaos Avant-Garde: Memories of the Early Days of Chaos Theory, Singapore et al. (World Scientific) 2000, 95- 198 (175 seq.)

579 A reference to the / Rijeka Glowing Globe festival theme AIsthEthics, October 2024

580 Day 2 of the Generative Art Summit Berlin conference (July 4th, 2024) has been devoted to the topic "From Algorithms to Artificial Intelligence".

slowing down and enlarging its elementary *material* actions themselves?

According to philosopher Leibniz' monadology, perception itself cannot be explained, and therefore not be simulated, by mechanics. Entering such a "Perceptron" (*avant la lettre*), one would perceive just moving elementary units, but they do not assemble (*legein*) to something which comes close to a cognitive figure in human perception.1 Nowadays, though, ANNs enact exactly such a mechanism.

Fig.: Baecker-Floating-Codes-Madrid.jpg

Ralf Baecker's light and sound installation *Floating Codes* at the Ars Electronica Festival 2022 in Linz explored "the inner workings *and hidden aesthetics* [sic] of artificial neural networks" by concretizing "the fundamental buildings blocks of machine learning systems"[581] in the form of 250 custom-made artificial neurons. Their idiosyncrasies made it evident to the human observer that media-art/ificial techno*lógos* is no derivation of the mind but developing an alternative"intelligence" of its own.

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581 Carsten Seiffarth (ed.), Ralf Baecker.Cybernetic Imaginaries, Berlin (Distanz) 2022, 158