WHICH KIND OF PHILOSOPHY IN / FOR TIMES OF COMPUTATION? A rather radical media-archaeological comment

[Draft version for a planned publication by David Berry / Beatrice Fazi (eds.), Philosophy After Computation]

Rooting the "post-computational": radical media archaeology

While computation is a core media-theoretical concern and falls within the comptetence of media studies (as long as its self-understanding is close to technologies), philosophy as the mother of all academic reflection of science and matter is a rich tradition which media theory only humbly dares to address. The following thoughts, arguments and hypotheses therefore limits itself to the media-archaeological way of questioning philosophy "after" computation, in its double sense: the epistemological impact (or challenge) of computation on traditional philosophy in the archaeology of knowledge, and computation "after" ("in the sense of") philosophical reasoning. Computation is operational mathematics. As method of inquiry, media archaeology - rather than being a nostalgic metaphor for discovering obsolescent technologies - therefore has to be close to both mathematics and philosophy, literally "radical" both in its focus on the *arché*, the principles (rather than simply historicial "beginnings") of technological being-in-action.

The term "post-computational" alludes to an explosion, a square potential of computing (hypercomputation); its archaeological operation is finding its square root as the inverse operation of squaring "... where √ is called the radical sign or radix"[1]. This primordial operation does not imply something historically remote, but corresponds with Heidegger's philosophical concept that Being can only be understood through what is close in the con-temporal sense. Media archaeology does not "post" the age of digital computing but "poses" the philosophical question of computation; computing is rooted in the cultural techniques of mathematical reasoning itself, therefore it is always "pre"-computational (though there are object which become explicit knowledge only by algorithmic high-speed computation at all, such as fractals).

Analytic rigour in the sense of the square root symbol (√) in mathematics and "diagrammatic reasoning" (Charles S. Peirce) is closer to techno-logics than to narrative discourse. The escalation takes place in Peirce's first sketch of an electric circuit diagram for solving a logic problem; philosophical logic here turns non-human. In his letter dated 30 December 1886 to Marquand who had build a mechanical logical machine, Peirce draws the first known electric circuitry diagram for performing logical reasoning, biased by a battery: "I think electricity would be the best think to rely on [...] where the circuit may be open or closed. [...] This is like multiplication and addition in logic"[2] - and the

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1 https://en.wikipedia.org/wiki/Square_root; accessed 12 May 2017

2 Note by the editors to Charles S. Peirce, Logical Machines, in: The New Elements of Mathematics, vol. III/1: Mathematical Philosophy, The Hague / Paris (Mouton) / Atlantic Highlands, N. J. (Humanities Press) 1976, 625-632 (632)

Arithmetic and Logic Unit (ALU) in micro-processors *in nuce*; techno-mathematics and techno-logistics converge.

The electronic computer is mathematized electricity. "Based on the fact, that a concrete realization of the universal digital machine (the turing machine) does not necessarily depend on electricity, the master's thesis reintroduces the techno-mathematical term 'mechanical procedure' - a term borrowed from the logician and mathematician Kurt Gödel who claimed its equivalence to both the turing machine and the concept of the algorithm - to point out that the digital should be grasped epistemologically, not merely as a phenomenon shaped by the use of electricity, but as an amalgam of both the mechanical (as Gödel's 'mechanical procedure' defines it) and the electric. In this sense the digital should be regarded at its fundamental technical level in opposition to the standpoint of McLuhan in Understanding Media as the mechanical in the electric."[3]

Radical media archaeology is not about nostalgia of dead media, but techno-mathematical reasoning. Its approach to the (mes-)alliance of computing and philosophy is explicitely anachronistic, uncovering implicit *liaisons* between mathematics, philosophical reasoning, and the machine. The only scientific discipline which does *not* not think is mathematics *alias* the algorithmic machine.[4] Therefore philosophy "after" computation does not address a post-computational world but the implicit interlacing of philosophy and computation. If "[t]he machine is not a thinking being, but simply an automaton"[5], then the human mind is machinic itself when "thinking" (answers Jacques Lacan[6]). Algorithms as tool of non-human philosophizing lead to "digital non-humanities".

"The essence of technique is nothing technical", Heidegger declared in his critique of the Cartesean world[7]; it is rather techno-mathematical. A colour, when measured and analyzed into its sinuoidal components (Fourier),

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3 Thomas Nückel, e-mail statement, May 2017. See p. 81 in his M. A. thesis Berechenbarkeit als Sphäre digitaler Medien [Computability as the Sphere of Digital Media], submitted Winter term 2016/17, Humboldt-University, Berlin, Insititute of Musicology and Media Studies, here referring to: Marshall McLuhan, Understanding Media. The Extensions of Man. London/New York: Ark Paperbacks (1964), 349

4 "Die einzige Wissenschaft, die nicht nicht denkt, ist die Mathematik": Friedrich Kittler, Ästhetik und Mathematik, in: Karin Hirdina / Renate Reschke (eds.), Ästhetik. Aufgabe(n) einer Wissenschaftsdisziplin, Freiburg i. Br. (Rombach) 2004, 270

5 L. F. Manabrea, Sketch of the Analytical Engine invented by Charles Babbage [1842], transl. by Ada Lovelace, in: B. V. Bowden (ed.), Faster Than Thought. A Symposium on Digital Computing Machines, London (Pitman Publishing)1953; paperback edition 1971, 349

6 See Jacques Lacan, Psychoanalyse und Kybernetik oder Von der Natur der Sprache [*1955], in: ders., Das Seminar II. Das Ich in der Theorie Freuds und in der Technik der Psychoanalyse, Weinheim / Berlin 1991, 373-390

7 Martin Heidegger, Die Frage nach der Technik, in: same author, Reden und Aufsätze, 2. Aufl. Pfullingen (Neske) 1959, 13-44

disappears in the phenomenological sense[8], just like a sound wave from within an electro-acoustic oscillator, when sampled into a computer file, is not an acoustic phenomenon any more but becomes implicit sonicity. To Heidegger's unease, nature, by media-technological measuring and calculating devices, is seduced to reveal its mathematical essence[9]. Whereas Pythagoras once saw numbers as embedded nature (like Leibniz´ *deus calculans*), the computer literally numbers the world processually - closer to mathematical Fourier analysis of physical vibrational events (sound, heat, electro-magnetic fields) than to any metaphysical aesthetics.

Epistemology of computing dis-covers implicit techno-logical knowledge and creates sparks if insight (momentary illuminations) by making explicit (therefore theoretical language) the beauty of knowledge imbedded within machine eventality. Thereby, even the electric condenser (the venerable Leyden jar) becomes an "objet philosophique" (in Bachelard's sense).

Rethinking technology from within, and the concept of operative diagrammatic reasoning, differs from the traditional philosophical approach. Once phenomena are no longer "transcendent" but identified and grounded in technology close to the signal, visual (or auditive) appearances on human-computer interfaces are identified as what they are: computational functions.

The turingmachine from 1936 operates within a sphere of computability (different from the electromagnetic "noosphere" in Teilhard de Chardin's sense) defining everything that could possibly be executed by digital machines, analyzing „the digital“ on a fundamental level by starting right at its techno-mathematical foundations, instead of looking first at the dichotomy between „real“ world phenomena and their digital representations. This change of focus holds the advantage that it by-passes philosophically problematic assumptions about the „world“ or the human mind.[10]

Even Alan M. Turing once slippend into an archaeological metaphor when in his "Proposal for Development of an Automatic Computing Engine" he describes one process (which became mnemonic in the standard instruction tables) with BURY and UNBURY.[11] Michel Foucault's *Archaeology of Knowledge* (FO 1969, transl. 1972), though, is not related to digging out forgotten artefacts buried in past archives, but a technique of propositional logics; therefore, the appropriate way of rendering his passages intelligible is "obviously, to take the notion of a function at its mathematical face value"[12].

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8 Martin Heidegger, Der Ursprung des Kunstwerks, in: Holzwege, 4th ed., Frankfurt/M. 1963, 35 f.

9 "Die Natur wird daraufhin gestellt, sich in einer berechenbaren Gegenständlichkeit zu zeigen (Kant)." Heidegger 1962/1989: 17

10 See p. 82 in the Master thesis by Thomas Nückel, Berechenbarkeit als Sphäre digitaler Medien [Computability as the Sphere of Digital Media], submitted Winter term 2016/17, Humboldt-University, Berlin, Insititute of Musicology and Media Studies

11 In: A. M. Turing's ACE Report of 1946 and other papers. Volume 10 in the Charles Babbage Institute Reprint Series for the History of Computing, 20-105 (36)

Any non-metaphoric notion of an "archaeology" of media-implicit knowledge is strictly techno-logic: a study of enuntiative functions, correlating symbols to an object field where they are enacted and repeated.

Such investigations into the conditions of possibilities (Immanuel Kant's *a priori*) of discrete computing not only refer to arithmetic but as well to its hard-wired logic operations, revealing the knowledge machine. Foucault's set of terms proposed for discourse analysis is itself a theory-machine: "I must discover whether the machine works, and what it can produce."[13]

Mathematician and philosopher George Boole's propositional "binary" truth value logic (Laws of Thought, 1854) has not been invented for computing but results from two-millenial philosophical reasoning; at the same time, epistemologically, the mechanization (and mathemacial formularization) of logics constituted a fundamental dis-continuity, culminating in Claude Shannon's 1938 master thesis on symbolical logic based on electro-magnetic relays which has been the engineering affordance for preferring binary logics to other forms of computing (such as ternary or even multi-valued, non-Aristotelean logics). Shannon demonstrated that Boolean algebra could be applied to the same types of problems for which Charles Babbage (who considered himself a philosopher[14]) had designed his mechanical notation system.[15] Shannon proved that techno-logical implementation can be isomorphous to Boolean algebra. What had been verbal philosophical reasoning in Aristotle's *Organon*, turned into electro-mechanics, thereby becomning autonomous of the human mind.

What can be diagrammatically expressed in algebraic symbols can as well be implemented as real machine, as proposed already in Ramon Llull's *Ars Magna* concentric "paper machine"[16] of symbol-based argumentation and Leibniz' "dyadic" operations (designed, but never materially implemented) with the smallest alphabet of "0" and "1"; William Stanley Jevon's "logical piano" from 1869 has been no tool for experimenting the interrelation of "music & mathematics" in the Pythagorean sense, but an operative diagram of the implicit sonicity of philosophical reasoning itself.[17] The numerical sublime is mathematical calculation *in time* rather than Pythagorean musicality.

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

13 Michel Foucault, The Archaeology of Knowledge and the Discourse on Language, transl. from French by A. M. Sheridan Smith, New York (Pantheon Books) 1972, 135 f.

14 Charles Babbage, Passages from the Life of a Philosopher. London: Longman, Green, Longman, Roberts, & Green, 1864. See Anthony F. Hyman, Charles Babbage, 1791-1871. Philosoph, Mathematiker, Computerpionier, Stuttgart 1987; Peter Berz, 08/15. Ein Standard des 20. Jahrhunderts, Ph.Diss. Berlin (Humboldt University) 1997

15 Jeremy Norman, Describing the Logic and Operation of Machinery by means of Notation, online http://www.historyofinformation.com/expanded.php?id=3179, referring to: Claude Shannon, A Symbolic Analysis of Relay and Switching Circuits, xxx

16 See Bernhard Dotzler, Papiermaschinen: Versuch über Communication & Control in Literatur und Technik, Berlin 1996

"Ready-to-hand": *techné* with Heidegger and "Object-Oriented Ontology"

The very term technology goes back to both *techné* and *lógos*. The bias of ancient Greek mathematical *lógos* has less been actual calculation but an inquiry into its theory[18] - a presence-to-hand which differentiates it from the operative readiness-to-hand of functional computing as tool (*Zeug*).[19] Heidegger's preferred example for technique which is ready-to-hand (German *griffbereit*), the hammer, is still an instrument coupled to transitive human performance; his technical ontology fails to take into account autopoietic electronic circuits respectively algorithmic media from within. True techno-poietics takes place *within* the operative techno-logical process itself.

Electronic circuitry including the triode or transistors, and their cybernetic coupling for signal transduction in "electrified" system and communication theory, is an escalation compared with the humble *Zeug* or the trivial machine. Smart devices in ubiquitous computing are not simply *ready-to-hand* like the Heideggerean hammer any more; their agency not primarily performed by human action but becomes an auto-poietical operative regime. Media archaeological analysis opens the flat Integrated Circuit, making it *vorhanden* in terms of critial insight. This not simply requires mechanical circuit bending but as well logical unrevealing of codes (hacking).

Is there an equivalent to Heidegger's "readiness-to-hand" in digital computing? In "post-computational" times (in the sense of "post-digital"), with ubiquitous computing and mobile communication devices, the computer turns from an object of media-theoretical observation into an everyday thing, rather *zuhanden* (ready-to-hand) than *vorhanden* (present-to-hand).[20] For most consumers, a communicational device like the cell phone is literally "ready-to-hand", used without theorizing it. The term has been extended to "object-oriented philosophy" formally coined by Graham Harman in his 1999 doctoral dissertation "Tool-Being: Elements in a Theory of Objects". Heidegger's concept of "readiness-to-hand" refers to the withdrawal of objects from human perception into a different reality[21]; they thereby distance themselves from humans not only in cultural space but as well in their proper temporality (*Eigenzeit*); the technological world escapes from man-focused "history".

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17 See Martin Gardner, Logic Machines and Diagrams, New York / Toronto / London (McGraw-Hill) 1958

18 Johannes Lohmann, Musiké und Logos, Musikwissenschafliche Verlags-Gesellschaft, 1970, 11

19 Martin Heidegger, Sein und Zeit [*1927], 16th ed. Tübingen (Niemeieyer) 1986, 63

20 Martin Heidegger [1927] 1962, 91-107

21 http://en.wikipedia.org/w/index.php?title=Object-oriented_ontology&oldid=621455791; accessed September 8, 2014

Technology only reveals itself to human perception in breaking down, when it goes from 'readiness-to-hand', being at our disposal (Heidegger) to articulating itself as a medium.

Media archaeologists listen to the technologically induced noise as the essential message from within the "medium" (channel) itself. While the signal-to-noise ratio in communication can be mastered by mathematical analysis, only in the moments of complete technological breakdown the *aletheía* of the operative machine is revealed. "The malfunctioning machine will be expressed only when experiencing the real physical machine (building it, repairing it); its operation is inextricably linked to its malfunctioning.[22] This leads to a core ontological question: Is digital computing capturing the essential operativity of the world (conceived as computational universe from Pythagoras to informational quantum physics), or is it rather its mathematical modelling (respectively diagram)? Metamathematics correlates with metaphysics, declaring its independence of the real physical world in numerically decribing abstract objects (David Hilbert), "but the actual information manipulation is still in the real physical universe"[23]. Here a radically different way of computational mathematics media-archaeologically re-occurs from the museum of "dead" technologies: the *analog computer* which metonymically models physical events by physical rather than numerical and algorithmic means (such as voltage and condensers); it is itself part the world which it analyzes, just like in quantum computing, the mechanism does not symbolically abstract from the physical world (lithographic "inscriptions" in silicium), but calculates with the computer matter itself.

Ian Bogost's concept of "carpenty" refers to technological circuit bending as a way of operative media analysis in techno-logical experimentation. Different from media "theory", media archaeology experiences technologies not simply present-at-hand but as *operative* media theatre, thereby "ready" and "present" at the same time. The concept of "machine thinking"[24] refers to both a machine’s operation and in relation to its performance for humans. Conceptual media theatre is well suited to exploring the interplay between such modes of machine thinking, e. g. by enacting the Turing test as well as re-embodied chatbots.

The *present-at-hand* attitude to technologies is media *theory*, looking (*theoría*) at something. Such contemplative observing corresponds with the Cartesian way of measuring / mathematizing the world. However, with computational machines which mechanize mathematics itself, theoretical analysis (in numbers) is re-implemented in the physical world (that is, in time / being) again.

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22 As expressed in Morton Riis, Machine Music. A Media Archaeological Excavation, PhD dissertation, The Royal Academy of Music at Aarhus and Department of Aesthetics and Communication, Aarhus University, 2012

23 R. Landauer, Computation: A fundamental physifcal view [1987], reprinted in: Harvey S. Leff / Andrew F. Rex (eds.), Maxwell's Demon. Entopy, Information, Computing, Bristol (Adam Hilger) 1990,260-267 (262)

24 As being developed in Ioana Yucan who is currently completing her PhD in Theatre and Performance Studies at Brown University

Presence-at-hand is not the way digital technologies in the world are usually encountered. It is only revealed when, e. g., a hard disc drive within a computer breaks down; then "it loses its usefulness and appears as merely there".[25] In a transfer of Heidegger's terms[26], the digital computer can be used as a tool only when it is *zuhanden*, that is: not reflecting its modalities. But different from the Heideggean hammer, a technological medium is not simply a mechanical tool any more.

A mere description of a technical object, according to Heidegger, is simply a mis-description[27], as opposed to its operative experience ("verweilender Umgang"), in its present (con-)temporality[28]. An electronic medium such as the radio is in its medium state (different from the ancient definition of the physical medium) only when transducing signals; the passive, Aristotelean notion of "medium" different from the "thing"[29] thereby turned media-active, media-dramaturgical. In a different way, this is true for computational data processing (the difference between signal transduction and discrete algorithmic steps). When thereby "in being", any technology is except from historicity. The ontological question ("What *is* a medium?") misses the essence of technology, its being in time and being a time-object itself.

Re-turn from phenomenology to processual ontology

Seen from a distance, the field of "new media" philosophy and theory seems split between two different approaches. Techno-centric media archaeologists describe the non-discursive practices of the techno-cultural *archive* in the Foucauldean spirit, while media phenomenologists in the anthropocentric, performative perspective "analyze how phenomena in various media appear to the human cognitive apparatus, that is, to the mind and senses."[30] Phenomenology stays close to the embodied affective signal indeed, while media archaeology traces effective signal processing as implemented in technologies. For Heidegger, up-dating the etymological root, phenomenology literally encourages to let that which shows itself be seen from itself (*Being and Time*, 1927). An epistemology of techological media derives sparks of knowledge from within the techno-logics.

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25 For an application of this thought to computing, see Terry Winograd / Fernando Flores, Understanding Computers and Cognition, Norwood, N. J. (Ablex) 1986

26 Martin Heidegger, Sein und Zeit, 19th edition, Tübingen (Niemeyer) 2006, 70 f.

27 "[e]ine Fehldeskription der alltäglichen Welt": Martin Heidegger (Gesamtausgabe, im Band Ontologie), Hermeneutik der Faktizität, Frankfurt/M. (2nd ed.) 1995, § 19, 88 f.

28 "in der Zeitlichkeit der Alltäglichkeit": Heidegger 1927: 90

29 See Fritz Heider, Ding und Medium, in: Symposion, Bd. 1, Heft 2 (1927), 109-157

30 Kjetil Jakobsen, Anarchival Society, in: Eivind Røssaak (ed.), The Archive in Motion. New Conceptions of the Archive in Contemporary Thought and New Media Practices, Oslo (Novus) 2010, 127-154 (141), referring to Wendy Hui Kyong Chun / Thomas Keenan (eds.), New Media, Old Media. A History and Theory Reader, New York / London (Routledge) 2006, 3 f.

Philosophy in times of mathematical computation breaks with phenomenology. James Clerk Maxwell's differential equations (his paper "A Dynamical Theory of the Electromagnetic Field" from 1865) have been the computational tool to master the phenomenon of what Michael Faraday has called the "field", i. e. the sphere of electro-magnetic interaction and induction. Instead of empirical study with a mechanical model (as preferred by Maxwell before), mathematics itself became the model of an inivisble event event with symbolical means (operators).[31] Finally, the computer itself is derived from mathematical deduction: the first theory-born machine. Beyond the static Pythagorean empirico-philosophical equation (harmonic order in integer number ratios), the processual derivate of meta-mathematics (the algorithm as machine) became a worldly medium.

Ontology has been the philosophical inquiry into the nature of being as existence and becoming. As a philosophical enterprise is has been, so far, highly hypothetical, but gained "practical application in information science and technology, such as ontology engineering"[32] which deals with formal representations of a set of concepts within the domain of temporal action. With applied ontology[33], a core concept of occidental philosophy has become functional and adaptive to the changing underlying algorithmic domain.

While in its root meaning, phenomenology is the study of *phenomena* (appearances as opposed to reality, specified in the philosophical model of Plato's cave) and linked to empirical, especially sensory appearances, Edmund Husserl took up the term for a science of consciousness and subjective embodied action, especially the complex procedures of temporal awareness

Media archaeology, on the contrary, does not begin the inquiry into the meaning of being in the anthropocentric sense, examining human existence, but object-oriented, granted a definition of media that a technological device is in "media being" only when in action (that is, signal processing).

Media archaeology learns from posing the philosophical question in Heidegger's *Sein und Zeit* but extends and specifies it to the question of computaitonal media tempor(e)alities.

In 1936 the "invention" of the computer (symbolical machine) has been a by-product of Alan Turing's answer to the problem of the mathematically undecidable: "Computable" numbers are those which are calculabe by *finite procedures*. The question if there is an algorithm capable to decide whether a mathematical procedure can have a sense of ending (the *Halteproblem*) leads to the more general consideration of media-induced temporality. Computational systems internally develop new forms and operatations of temporal sequences and a different notion of "ending" (recursive functions, real-time operations)

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31 See Hugh G. J. Aitken, Syntony and Spark. The Origins of Radio, New York / London / Sydney 1976, 21

32 Wikipedia, entry "Ontology", accessed May 2017. See as well Frans Smit et al. (eds.), Philosophy of Information Aesthetics, forthcoming (2017)

33 Wikipedia, entry "Ontology engineering", accessed May 2017

and enact a micro-dramaturgy of synchronizations where smallest bits of time are decisive ("critical") for the success of the whole media event.

Media theory replaces the ontological definition of media by a dynamic one: media-in-being, its temporal mode of existence, a technical implementation of Heidegger's philosophical claim.[34] Continuous or discrete processuality is the core definition of electro-mechanic and electronic media as such.

Close to mathematics: combinatorial reasoning

For ages, philosophy has been primarily performative as a cognitive procedure, while computing is operational (even when taking place with a human coupled to paper by a pencil equipped with an eraserhead), until Leibniz dreamt of a way to express philosophy algebraically and to communicate by mathematical formulas, in symbolic language (*characteristica universalis*) ("per Artem Combinatoriam"):

The media-archaeological question therefore is put into this form: To what degree is computation (in terms of turingmachine) - still - rooted in philosphy, or does it depart from any "speculative" realism, with a veto? Is philosophical analysis essential to the origin of algorithmic computation itself, assuming that methodological reasoning is algorithmic already? For Babbage as well as for Turing, the symbolic (algebraic or diagrammatic) representation of the machine is (or can be) the same as the machine itself.

As opposed to the universal discrete machine named computer the *ars combinatoria* of the Baroque era has not been able to calculate by itself, nor was it capable of effectively storing intermediary results or to be programmed. The coupling of machines and mathematics here has not yet led to a to a mathematization of the machine, but simply to a mechanization of mathematics.

Henri Bergson had been concerned with what happens when in intellectual history, the "spiritualization of matter" will, in reverse, flip to the materialization of the mind.[35] Cybernetians frequently took mathematical machines for thinking machines, which meant automatisation of mathematical intelligence as opposed to the trivial mathematization of mechanical tools. Simple mechanics may be able to implement simple calculating rules or algorithms, such as the four-species-machine which Leibniz presented to a the Royal Society successfully translated the Indian-Arabic counting system by ciphers into a hardware of decadic cog-wheels. But this flow of numbers between mechanical wheels is not yet a program which would be able to start,

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34 "Um dem Seinscharakter dessen, was hier Thema ist <sc. die Zeit>, zu entsprechen, müssen wir von der Zeit zeitlich reden <...>. Die Zeit ist das Wie." Martin Heidegger, Der Begriff der Zeit, lecture Marburg 1924, quoted here from: Hartmut Tietjen (ed.), Der Begriff der Zeit, 2. Aufl. Tübingen 1995, 27

35 Henri Bergson, La signification de la guerre, Paris 1915, 20; see Friedrich Kittler, Die Nacht der Substanz, Bern (Benteli) 1989, 30

control and finish calculations on its own account, while a digital computer can be structurally programmed[36]; logic of engineering is one aspect and another one is the engineering of logic (modelling or the building of logical machines).

Combinatorical reasoning, as described in his *Dissertatio de arte combinatoria* by Leibniz in 1666, aimed at reducing all reasoning and discovery to a combination of basic elements such as numbers, letters, sounds and colour, but has not been able to calculate on its own, even less to store data in RAM or registers. The coupling of machine and mathematics that enabled the creation of computers occurs as a mathematization of the machine itself, not as a mechanisation of mathematics.

Technologies once changed from tools to machines, then to "symbolical machines" (algorithms).[37] Any archaeology of contemporary media culture is therefore as close to mathematics as it is to phenomenology. In alliance with George David Birkhoff who on the congress of mathematicians in Bologna 1928 delivered a lecture proposing a measure for aesthetic perception (so-called "Gestaltmaß") as ratio between order and complexity)[38], philosophers like Max Bense as well as artists made cybernetics and aesthetics converge.[39] *Onto-aesthetics* is the belief that works of arts can disclose their ontology"[40]. Onto-techno-analytics, while being aware that all technological artefacts are emanations of cultural knowledge, aims at a "culture-free" understanding of computational events. The Object-Oriented Ontology approach hereby equals media archaeology.

Materialist philosophy: Is dialectics computable?

There has been developed a couple of technical "philosophies" such as Gilbert Simondon's *Du Mode d'Existence des Objets Techniques, Paris (Aubier) 1958*, or Maurizio Lazzarato's Bergsonean *Videophilosophie*[41], but only in computing happens the marriage of engineereing (techné) and *logos* (mathematics.

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36 Friedrich Kittler, Hardware, das unbekannte Wesen, in: Lab. Jahrbuch 1996/97 für Künste und Apparate, edited by the Academy of Media Arts, Cologne 1997 (Walther König), 348-363 [paraphrase W. E.]

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

38 "Quelques éléments mathématiques de l´art", reprinted in: The collected mathematical papers of G. D. Birkhoff, published by the American Mathematical Society, vol. 3, pp. 288-306 (1968)

39 *When Cybernetics meets Aesthetics* has been the title of a conference organized by the Ludwig Boltzmann-Institute for Media.Art.Research at Linz (Austria), 31 August 2006, on occasion of the Ars Electronica festival of media arts.

40 Brian Kane, Sound studies without audiotory culture: a critique of the ontological turn, in: Sound Stuides vol. 1, No. 1 (2015), 2-21, referring to Christoph Cox, Greg Hainge, and Steve Goodman's "vibrational ontology"

41 Maurizio Lazzarato, Videophilosophie. Zeitwahrnehmung im Postfordismus, Berlin (b-books) 2002

Any archaeology of the computer and its programming practice oscillates between two poles, the mathematization of machines and the mechanisation of mathematics. "The *logic of engineering* is one aspect of technical logic and another one *is the engineering of logic* that is *logical modelling* or the building of logical machines."[42]

This is one reason for the rupture between the developers of computer engineering (typically electricians) and the mathematicians working on meta-calculations, unable to affect the development of computing engineering.[43]

Rather than just being a modification induced "after" the arrival of mechanized computation, stored program computing (Babbage's Analytic Engine and the Von-Neumann architecture) disrupted the philosophical cosmos.

The notion of matter, so hard thought through by G. W. F. Hegel, dissolved into matter and mathematics (like the very meaning of "techno/logy", reminding of the Aristotelian distinction between *logos* and *physis*). Just in the very epoque when Charles Babbage was about to extend his arithmetical *Difference Engine* to an storage-programmable, thus algorithmic *Analytical Engine*, G. W. F. Hegel who opposed the idea that the act and procedures of thought might be - as expressed later in Boole's *Laws of Thought* - performed by a logical machine (rather than by "working through" in philosophical terms) regarded mathematical machines which claimed intelligence as a provocation.[44]

But within the algorithmicized computer, calculation and intelligence converge.[45] As long as the computer is seen desintegrated in an electronic waste deposit, it is indistinguishable from other fragments of ("analoge") electronics. Its specificity is not in its hardware materiality, but in its algorithms, which might be performed in organic mattes as well (such as the DNA computer). If future archaeologists disover among the ruins of Berlin strange artefacts which look like electronic devices, they probably miss their essential interpreation as computers. What (literally) *matters* for computers? Is it mathematized matter or material mathematics ("mathematische Maschinen")? The Turing Machine is a heuristic fiction, but it has to take place on paper and with ink at least. Diagrammatic resoning is never purely intellectual but as operation depends on the material trace to take place.

Heinrich Hertz' theorem of conceptual modelling[46] corresponds with Charles S. Perice's definition of *me/diagrammatical resoning* as "[...] reasoning which constructs a diagram according to a precept expressed in general terms, performs experiments upon this diagram, notes their results, assures itself that

42 Gellius N. Povarov, Logic, automation and computing, in: Alexander Nitussov et al. (eds.), Computing in Russia, Braunschweig (Vieweg) 2xxx, xxx

43 Stanslav V. Klimenko, Computer Science in Russia: A Personal View, in: IEEE Annals of the History of Computing, Vol. 21, No. 3 (1999), 16-30 (24)

44 On "computing with numbers" see , see G. W. F. Hegel, Wissenschaft der Logik, vol. 1: Die Lehre vom Sein (1832), ed. Hans-Jürgen Gawoll, Berlin (Akademie-Verl.) 1990, 230

45 "Mechanisierung des Geistes und Vergeistigung der Materie fallen seitdem zusammen." Kittler 1989: 31

46 Heinrich Hertz, Die Prinzipien der Mechanik in neuem Zusammenhange dargestellt, Leipzig 1894, 1

similar experiments performed upon any diagram constructed to the same precept would have the same results [...]."[47]

Each medium needs some physical or biological embodiment (implementation) to be operative, that is: to be a medium (in performance). But "implementation", in software science, does not mean physical embodiment, but rather "the realization of a technical specification or algorithm *as a* program (that is: software). For example, Word Wide Web browsers contain implementations of WWW Consortium recommended specifications, and software development tools contain implementations of programming languages"[48].

In his preface to Gotthard Günther´s publication *Das Bewußtsein der Maschinen. Eine Metaphysik der Kybernetik*[49], Georg Klaus (holding the chair of Philosophy of Logics at Humboldt-University in East-Berlin) counter-attacked, "prompted by the fact that the second edition of *Das Bewusstsein der Maschinen* contained an added chapter on dialectic materialism in which the author of this Proposal suggested that it should be possible to test the validity of the dialectic theory by translating it into a formal algorithm of mathematical logic. Both Marxist authors insisted that this was not only contrary to the spirit of Marxism and Leninism but also technically impossible; because, according to Hegel, dialectic theory is not capable of formalization"[50].

"Information is information, not matter nor energy, and any materialist philosophy which does not recognize this cannot survive these days", Wiener declares in his *Cybernetics* (1948). Different from mechanic engines driven by steam or electric force as known from industrial modernity, trans-classical machines (Gotthard Günther) are primarily devices for processing binary information. Abraham A. Moles on "machine art" expressed a cybernetic understanding of the machine which is no longer reduced to matter and energy transformation but first of all an informational device.[51] "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"[52]; the technol-logical works at its best in a mode well known from ancient rhetoric (definined by Quintilian) as *dissimulatio artis*.

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47 Charles S. Peirce, The New Elements of Mathematics, vol. IV: Mathematical Philosophy, The Hague / Paris (Mouton) / Atlantic Highlands, N. J. (Humanities Press) 1976, 48

48 http://en.wikipedia.org, entry "Implementation"

49 Krefeld / Baden-Baden (Agis) first edition 1958, second edition 1963

50 Quoted from the typoscript: PROPOSED: To develop a mathematical calculus of dialectics to anticipate recent Marxist intentions in this field since they are aiming at new technical designs in Cybernetics, in: Estate of Gotthard Günther, Staatsbibliothek (Preußischer Kulturbesitz) Berlin, file 471, 1

51 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 (263)

52 Moles 1968 / 2011: 264

Human hands actually get *off* instruments by automation. Machinic typewriting had differentiated the hand(s) into ten discrete fingers. Finally the binary code reduces decimal fingers to two. What still looks like a playful *performative* handicraft, in reality is already a techno-mathematical *operation*. While fingers hack such thoughts in symbolical code on the keyboard of a laptop, the media-archaeological distance is aware that most writing is done within the micro-processors themselves where algorithms reign. Different from a typewriting machine which is still an instrument, the computer has already become what Gotthard Günther once called the *trans-classical machine*. When discretely (not diagramtically "analog") calculating either in his mind or when coupled to pen, eraser and quare paper, man is already in a (turing-)machine state.

The initial statement in Semen Karsakov's *Aperçu d'un procédé nouveau d'investigation au moyen de machines à comparer les idées* (St. Petersburg 1832) declares: "L'homme pense et ses actions sont machinales." Speech and writing "ne sonst que des opérations mécaniques de l´intelligence"; follows a truly media archaeological definition of writing as "fixer les idées sur la matière". Digital computers are, as Hegel might say, instantiations of an "objective mind".[53] Such second-order machines are different from the thermodynamic engines; logical mechanisms *invite* to be materialized as techno-logic, just as Charles S. Peirce designed first electric circuit diagram for logical reasoning. *Diagramatic reasoning* (Peirce) of media-in-being results from symbolic notations which are themselves already symbolical machines, as designed and commented in the 1842 "Sketch of the Analytical Engine invented by Charles Babbage" by L. F. Menabrea, Turin.[54] On the previous Difference Engine it says: "The drawings are nearly finished, and the mechanical notation of the whole, recording every motion of which it is susceptible, is completed"[55], as "operative writing" (Sybille Krämer). This correlates with Alan Turing's model of the (both human / non-human) *paper machine*.

Man becoming inhuman in the calculating state

With step-wise "digital" calculations in the mind or on paper, humans are (momentary) in machine states. The turingmachine is not an extension or prosthesis of human organs; it rather equals the definition of humans as speech-articulating beings: as indicated by the very term "programming language", culture has generated machines which can operate what has been

53 "Objektiv insofern, als es ein materielles Stück der Außenwelt ist, und Geist insoweit, als die Natur von allein keine Werkzeuge hervorbringt [...].": Gotthard Günther, Die "zweite" Maschine. Kommentar zu Isaac Asimov, Ich, der Robot, Düsseldorf / Bad Salzig 1952, 219-242 (220). For a modified version see same author, Das Bewußtsein der Maschinen. Eine Metaphysik der Kybernetik, Krefeld / Baden-Baden (Agis), 2nd edition 1963, supplement IV (Die "zweite" Maschine), 179-203

54 Orig. in the *Bibliothèque Universelle de Genève* Nr. 82, Oktober 1842

55 "Sketch of the Analytical Engine invented by Charles Babbage" durch L. F. Menabrea, quoted here after Bowden (ed.) 1971: 342 (Appendix)

unique privilege of humans so far: operating with symbols in a language-like way.

Writing, reading and culculating is "elementary" cultural techniques. But man, endowed with paper, pencil and eraser, when calculating, is in a (turing) machine state - revealing the mechanism within the "human" itself. A machine is not simply cultural technique any more but a techno-logics of its own. It makes a time-critical difference when this process is implemented into non-human procedures: not conceptual, but actual *computing*. All of the sudden, a world in itself unfolds with all its break-downs, side-effects, unknown phenomena, achievements, timing (ahistorical temporealities). Such implementations are cultural products; technique is always cultural already, but results in a different kind of the physical un-natural: the symbolic implemented in the real.

Different from applied "cultural techniques" such as geometry, there are techno-epistemic constellations in terms of Process-Oriented Ontology like the notorious *turingmachine* as "carpentry" (Ian Bogost) *avant la lettre*. The turingmachine has been modelled in 1936 not to solve a concrete numerical operation like calculating mechanisms so far, but as a meta-mathematical tool, equalling algorithm with machine.

There is philosphical reasoning *with*(*in*) computation. Philosophy becomes inhuman when coupled to / with a machine, thereby constituting a cybernetic system, with the human lending counsciousness to the machine (an argument by philosopher of multi-valued, trans-Aristotelean logic ("kenogrammatics") Gotthard Günther. In a letter to Kurt Gödel from May 23, 1954, Günther declares symbolic mathematical logic as condition for philosophical metaphysics.[56]

Computational technology is not simply an extension of human thinking into material objects but is trans-subjective tools for operative reasoning which in its complexity can not be performed by humans themselves.

Ada Lovelace de-coupled mechanic computing of mathematics from the human hand/mind, and from the "subject" in both meanings: "The science of operations […] is a science of itself, and has its own abstract truth and value, just as logic has its own peculiar truth and value, independently of the subjects to which we may apply its reasings and processes"[57];

The "trans-classic machine" *alias* digital computer can perform functions of consciousness; self-consciousness it gains rather by its coupling with the engineer.[58]

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56 Kurt Gödel, Correspondence A-G, in: Solomon Feferman et al. (eds.), Collected Works, vol. IV, Oxford 2003, 456-535

57 James Essinger, A female genius: How Ada Lovelace, Lord Byron's daughter, started the computer age, London (Gibson Sqiuare) 2014, 173

58 Maschine, Seele und Weltgeschichte, in: Gotthard Günther, Beiträge zur Grundlegung einer operationsfäigen Dialektik, vol. 3, Hamburg (Meiner) 1980, 211-235

Re/thinking computation in philosophical terms: cybernetic reasoning

Cybernetics can not be reduced to a historical discourse of applied engineering, but in the tradition of Norbert Wiener, it is both a mathematical and a philosophy. Heidegger has been well aware of the transition from *techné* as handicraft (cultural techniques) and "Kraftmaschinentechnik" (thermodynamic machines) to "'Automation", essentially defined by cybernetic communication and control.[59] Confronted with cybernetic thinking, Heidegger "conceptualized the beginning of computers as the factical end of phislophy itself"[60]. Man (as mathematicians, or technicians) vanish themselves into the machines.[61] With the algorithm itself identified as "machine"[62], a challenge to traditional philosophical reasoning arose. (Meta)Mathematics displaced discursive philosophy by logics in formal (and formular) languages.

While technique (or cultural techniques[63]) is still body-related (as extensive *handling*[64]), technology in its true sense is the marriage of in-formed physics and *logos* (mathematics, logic circuitry). This relation has been radically turned upside down by the *turing machine*: techno-mathematics is not simply the mechanization of mathematical calculation (like in ancient calculating machines since the Antikythera mechanism) but revealing the machinic within mathematical reasoning itself - a "sphere of *Berechenbarkeit*" (Thomas Nückel) which challenges the sphere of philosophical thinking.

Cybernetics is rooted in philosphy, engineering and mathematics: a trinity which asks for media-epistemological unfolding. The ambition of primary cybernetics (before it split into separate, therefore epistemologically reduced fields like second-order cybernetics, computational science, neuro-science, technical informatics et al.) has been to embrace computing both mathematical, electro-technical, and mathematical (case Gotthard Günther). It

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59 "Was hier überall der Name Technik meint, ist nicht ohne weiteres klar." = Martin Heidegger, Überlieferte Sprache und Technische Sprache [lecture 1962], St. Gallen (Erker) 1989, 10

60 Friedrich Kittler, Towards on Ontology of Media, in: Theory, Culture & Society vol. 26, no. 2/3 (2009), 23-31 (24)

61 "Seit Alan Turing 1954 Selbstmord begann, heißt die *Turing machine* schon *turing machine*." Friedrich Kittler's talk "Phänomenologie versus Medienwissenschaft", http://hydra.humanities.uci.edu/kittler/istambul.html, referring to: Andrew Hodges, Alan Turing: The Enigma, London 1983, 530

62 Alan Turing, On Computable Numbers, with an Application to the Entscheidungsproblem, in: Proceedings of the London Mathematical Society (2), vol. 42 (1936), 230-265, and vol. 43 (1937)

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

64 "*'Technik' im weisteren Sinne*: handwerkliches, werkzeugliches Arbeiten; Gerätegebrauch <...> *téchne*, Sichauskennen in der Handhabung, Können, 'Kunst'": Martin Heidegger, Leitgedanken zur Entstehung der Metaphysik, der neuzeitlichen Wissenschaft und der modernen Technik [= Gesamtausgabe, vol. 76], Frankfurt/M. (Vittorio Klostermann) 2009, 293

is therefore mandatory to media-archaeologically de-historicize to cybernetic approach in order to rescure it from being reduced to a simple chapter in the history of ideas.

"Treat time as discrete": Towards a computational epistemology of tempor(e)alities

Philosophy of technology and / or computation? Ernst Kapp's *Grundlinien einer Philosophie der Technik. Zur Entstehungsgeschichte der Cultur aus neuen Gesichtspunkten* (1877) ends up calling the steam engine the "machine of machines." This is the point that marks the closing of the technological feedback loop: the autopoietic emancipation of technical media from their direct link to a cultural environment. Bense called this cybernetic revolution "machine metatechnics" [65] – something that detaches itself from cultural history on its own terms. Thus media technology gains autonomy from culture, in the cybernetic marriage of machine and mathematics.

Object-oriented ontology actually rejects the privileging of human existence over the existence of non-human objects.[66] In a rather (hypothetical) media-centric view, object-oriented philosophers - somewhat in alliance with media archaeology - "maintain that objects exist independently of human perception and are not ontologically exhausted by their relations with humans or other objects"[67].

From a cult(E)urocentric perspective, a book without human reader might be a meaningless object. But in Charles Babbage's sense of computing, "logarithmic tables can be generated by a computer and be printed. These numbers may probably never be read by humans on earth."[68] but incorporate what Popper termed as "objectives knowledge". Such a computational world does not require the human subjects in order to be known, and indeed recalls the hypothesis of *anamnesis* in Plato's philosophical dialogue Menon. "Even though this [...] world is a human product, there are many theories in themselves and arguments in themselves [...] which have never been produced or understood and may never be produced or understood by men."[69]

In his most radical thought experiment, Popper envisions even the storage media of knowledge destroyed (like in antiquity the library of Alexandria including its philosophical machines): "there will be no re-emergence of our

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65 Max Bense, Kybernetik oder Die Metatechnik einer Maschine, in: Ausgewählte Schriften, vol. 2: Philosophie der Mathematik, Naturwissenschaft und Technik, Stuttgart 1998, 429-446

66 https://en.wikipedia.org/wiki/Object-oriented_ontology; accessed 11 May 2017

67 https://en.wikipedia.org/wiki/Object-oriented_ontology (accessed 11 May 2017), referring to Graham Harman's 1999 doctoral dissertation *Tool-Being: Elements in a Theory of Objects*

68 Popper 1979: 115

69 Karl R. Popper, Objective Knowledge. An Evolutionary Approach [1972], Oxford, 2nd. ed. (Clarendon Press) 1979,

civilization for many milennia."[70] Machines may have been completely destroyed, but techno-mathematical machines (alias computer) are of a different kind, as expressed in Babbage's vision of the universe itself as Analytical Engine. "Knowledge in this objective sense is totally independent of anybody's claim to know."[71]

Manuel De Landa envisioned a future "robot historian"[72]; to what degree may computational machines become themselves future techno-philosophers, displacing human philosophy of technology? Technology implicitely knows more than humans who have to invent it in order to turn it into explicit knowledge.

Once human senses are coupled with a technological setting, man is within its autopoietic temporal field[73], a chrono-regime of its own almost sonic dynamics or mathematics, when data are registered digitally.

Such couplings create moments of literal ex-ception: Man is taken out of the man-made cultural world (which is Giambattista Vico's definition of "history") and confronts naked physics and / or pure logical reasoning.

Mathematics and technologies of computation are a core concern of a contemporary media theory. That necessarily leads to anachronisms in its re-reading of technologial genalogies. While so-called "analogue" media such as telephony, radio and television (based on electro-magnetic waves) had intervened in modern communication culture and apparently made obsolete the printed book culture and telegraphy, with computing, the "digital" recurred, recalling the ancient alphabetic "technologizing" of speech[74] and the discrete telegraphic code, but in a dialectically new form: processed algorithmically.

Gilbert Simondon at a conference on "machinology" declared: "There is something eternal in a technical schema [...] and it is that which is always present and which can be preserved in a thing."[75] A media archaeology of digital "machines" (in both senses as archaeology *of* the digital and knowledge archaeology *by* digital media) reveals principles and commands (the *archê*) within the techno-mathematical field, with a focus on the innertemporal, time-critical axis, that is: the *chonopoetics* of algorithmic media, while at the same time questioning the being of technologies in culturally emphatic, symbolic, "historical" (historiographical) time.

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70 Popper 1979: 108

71 Popper 1979: 109

72 Manuel De Landa, War in the Age of Intelligent Machines, 1991

73 "Wenn der Mensch nur dort ganz Mensch ist, wo er spielt, so wird auch er, wenn sein Mitspieler Automat ist, zum Unmenschen": Friedrich Kittler, entry "Flipper", in: Baggersee. Frühe Schriften aus dem Nachlass, ed. Tania Hron / Sandrina Khaled, Paderborn (Fink) 2015, 58 f.

74 Walter J. Ong, Orality and Literacy. The Technologizing of the Word [*1982], New York (Routledge) 2000

75 Gilbert Simondon, in: Cahiers du Centre Cultural Canadien No. 4 (Deuxième Colloque Sur la Mecanologie), Paris 1976, 87; Übersetzung: John Hart, Vorwort zu: Gilbert Simondon, On the Mode of Existence of Technical Objects [franz. Orig. Paris 1958], University of Ontario, 1980.

Philosophy in time(s) of computing questions a core ontology of occidental philosophy since Greek antiquity: time. When being in an operative, signal-transducing (analog) or signal-processing (digital) state, any technology assumes autonomy and is phenomenologically "bracketed" (Husserl's term for ancient Greek *epoché*) from cultural, that is: "historical" and human time (to which software pays respect by the interfacial "interrupt" order).

The "post-computational", taken literally, refers to the challenge of preservation of digital heritage. Every digital object is a trinity of physical, logical and conceptual object.[76] Object-oriented philosophy here extends to a different epistemology of time (missed by previous philosophy of history). When extended to "deep" temporality (*alias* cultural history), the techno-logical being in the world as time-objects provides them with the option of equiprimordiality, since their actuality ("event") can be a-historically re-enacted. In that context, the emulation concept for the preservation of "post"-computational heritage (such as computer games: their hardware, their operative system, their software) represents an epistemological new concept produced by computing culture itself. With "emulation", computing culture contributes an epistemological neo-logism to contemporary philosophy of (im/material) media.

Next to ontology, epistemology, logics and phenomenology, remains ethics as branch of philosophical reasoning. In times of computing, this disguises in the name of "media ecology". While the energy consumption and material recycling involved in computing technologies remain external to its key operator which is information, the micro-relation between informational and thermodynamical entropy (down to quantum computing) is a much more delicate one. Maxwell's demon appears not in the reading but in the erasure of information from computer memories. A philosophical or mathematical text composed by Leibniz, Boole or Turing ages away in thermodynamic terms (the irreversible "historical" time arrow), but a human or non-human (that is: turingmachine) time-modulated reading of such texts only requires energy which is sub-critical to its informational enunciation.[77] It has been Turing himself who advised: "Treat time as discrete."[78] So we end within a computational time which is both a function of the alphanumeric code and of discrete clocking. Any analysis of philosophy in times of computing has to regard this *en archè*.

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76 Kenneth Thibodeau, Overview of Technological Approaches to Digital Preservation and Challenges in Coming Years; http://www.clir/pubs/reports/pub107/thibodeau.html (accessed May 2017)

77 See Rolf Landauer, Information is physical, in: Physics Today (May 1991), 23-29 (25)

78 Alan Turing, Proposal for Development in the Mathematical Division of an Automatic Computing Engine (ACE), in: B. E. Carpenter / R. W. Doran (eds.), A. M. Turing's ACE Report of 1946 and other Papers, Cambridge, Mass., et al. (MIT Press) 1986, 20-105 (23). See as well Timothy Scott Barker, Time and the Digital. Connecting Technology, Aesthetics, and a process Philosophy of Time, Hannover, New Hampshire (Darmouth College Press) 2012