JENS SCHRÖTER

ANALOGUE/DIGITAL – OPPOSITION OR CONTINUUM?*

Remark: This is a raw translation of: Jens Schröter, “Analog/Digital – Opposition oder Kontinuum?”, in: Jens Schröter/Alexander Böhnke (Ed.), *Analog / Digital – Opposition oder Kontinuum? Zur Theorie und Geschichte einer Unterscheidung* (Bielefeld: transcript, 2004), 1–30. It needs further refinement. For the sources marked in **yellow** there presumably exist English translations we haven’t manage to get hands on yet. Please don’t circulate without permission.

The distinction between analogue and digital has been widely talked about at the very latest since the early 90s of the 20th century. The ‘new media’ came with the ‘digital revolution’ proclaimed everywhere at that time – and with them the supposedly forever prospering ‘new economy’, the ‘hyperreality’ or at least the ‘end of the photographic age’. ‘Digital’ has since become a buzzword that can be assigned to almost any phenomenon. It connotes in a diffuse way ‘new’, ‘progressive’ and ‘computer-technical’. In contrast, anything analogue seems hopelessly outdated in an undefined way. One example would be *Premiere*’s advertising campaign for the television channel’s digital offering *Premiere Digital*, which was flickering across television screens at the time this book was written.

Abb. 1

Abb. 2

Fig. 1 Fig. 2: Advertising campaign of the television channel Premiere for its digital offer *Premiere Digital*

Notes

- * We would like to thank Bernhard Ebersohl for research and corrections; Nicola Glaubitz, Christian Spies, Jörgen Schäfer, Holger Steinmann, Simone Loleit and above all Alexander Böhnke for critical remarks. Also: Leila Brehme for helping the translation and additional recherche.

The users of analogue television appear as blurred types – blurred not only as images, but metaphorically also in their sexual habits (Fig. 1) (because the German word ‘scharf’ can mean ‘focused’ in the sense of image resolution at the same time as being ‘hot’ in a sexual sense). The accompanying print campaign by *Premiere* alludes to an initiative by former Federal President Herzog and calls it: ‘There must be a digital jolt going through Germany’ (Fig. 2).¹

However, beyond its fashionable use, the difference analogue/digital has indeed advanced to become at least one central distinction of media historiography. The transition from analogue to digital media, mostly meaning the transition from photographic and analogue-electronic images and analogue-electronic/mechanical sound media to their digital successors, is often understood as a world-historical caesura. It appears as a rupture, the significance of which can only be compared to the emergence of the analogue media in the 19th century, that of the printing press or even that of writing. Although there is an agreement in many places on the fundamental significance of this caesura, it is understood, accentuated and weighted very differently in various theoretical frameworks (symbol- and system theory or media archaeology etc.) – not to mention the question of when exactly the change had begun: Is the introduction of the number zero by the Arabs to the West in the 12th century,² or Leibniz’ binary calculus of the 17th century³ to be mentioned as precursors? Or is Fourier-analysis, Boole’s logic, Babbage’s *Difference Engine* (not built in his time), the telegraphs of the 19th century⁴ the actual forerunners? Or are the invention of the flip-flop in 1919 and/or the development of both analogue and digital computers – soon based on semiconductor technology⁵ – in the middle of the 20th century the conditions for the rupture? Or must the diffusion of ‘digital new media’ into the most diverse discursive practices up to everyday life on the threshold of the 20th to 21st centuries be named as the starting point for the upheaval

¹ With best thanks to *Premiere Deutschland* and especially to Julia Buchmeier for the provided materials and the permission to reprint.

² See Brian Rotman, *Signifying Nothing. The Semiotics of Zero* (Stanford: Stanford University Press 1987). But although the zero is omnipresent in the discourse about digitality (as part of the underlying 0/1 distinction), it is not constitutive for digitality, which is neither binary (although this interpretation prevails today, see below), nor – if interpreted binary – has to be understood as 0/1 distinction (this meaning is owed above all to the simple technological implementability as distinction ‘off/on’).

³ See the contribution by Niels Werber in our book “Analog/Digital” of which the present text is the foreword.

⁴ See the contribution by Geoffrey Batchen in our book “Analog/Digital” of which the present text is the foreword.

⁵ The paper in which the basic principle of the flip-flop, the central digital circuit element, is described is: William H. Eccles and F. W. Jordan, „A Trigger Relay Utilising Three Electrode Thermionic Vacuum Tubes“, *The Electrician* 83 (1919): 298. See on the role of quantum mechanics Wolfgang Hagen, „Die Entropie der Fotografie. Skizzen zu einer Genealogie der digital-elektronischen Bildaufzeichnung“, in *Paradigma Fotografie. Fotokritik am Ende des fotografischen Zeitalters*, Vol. 1, ed. Herta Wolf (Frankfurt a.M.: Suhrkamp, 2002), 195–235, here 222: „Nicht die Digitalisierung ist die Revolution des zwanzigsten Jahrhunderts, sondern die Quantenmechanik, die ihre technische Implementierung erst ermöglicht hat [...]“. // „Digitization is not the revolution of the twentieth century, but quantum mechanics, which made its technical implementation possible in the first place [...]“.

from analogue to digital? Or did the dichotomy already exist from the very beginning of writing or language, insofar as this (in contrast to images, for instance) is based on discrete sign repertoires – a thought that, however, could probably only be formulated in the late 20th century?⁶ Moreover, there are voices that generally warn against overestimating the ‘digital revolution’ and underline continuities in use, in the transported semantics and forms, or in the regulating institutional structures. But even where – quite justifiably – hasty conclusions are warned against, the distinction between analogue and digital must be referred to.

Either way – it cannot be ignored. The distinction analogue/digital is *the* media historical and -theoretical guiding difference of the second half of the 20th century and shapes most of the theoretical discourses dealing with media history of this time, but also sociological or philosophical treatises. The distinction is often defined ad hoc⁷ or used diffusely and implicitly. Then it is simply a given: Everyone seems to know what ‘analogue’ and ‘digital’ mean – and everyone seems to be able to assume that everyone else agrees as well. It is astonishing – describing an apparently self-evident blind spot of observation – that the history and thus the implications of the (different forms of this) distinction have so far hardly been addressed themselves. The present volume tries to fill this gap – not in the sense of presenting *the* definition of distinction that is valid once and for all. Rather, attention should be drawn to how presupposition- and implication-rich this distinction is.

Even at an assumed birthplace of the difference, the Macy conferences on what was soon to become known as cybernetics from 1946 onwards, it was by no means clear what *exactly* the differentiation analogue/digital implies or connotes – beyond the somewhat indefinite contrast of continuous vs. discrete – „Entropie versus Information, kontinuierlich versus diskontinuierlich, linear versus nichtlinear, Ereignis versus Wiederholung, Wahrscheinlichkeit versus Unwahrscheinlichkeit, Reales versus Symbolisches, Natur versus Artefakt, usw.“⁸ // “Entropy versus information, continuous versus discontinuous, linear versus nonlinear, event versus repetition, probability versus improbability, real versus symbolic, nature versus artefact, etc.”

⁶ In the sense of a symbol-theoretical formulation by Nelson Goodman, *Languages of Art* (Indianapolis: Bobbs-Merrill, 1968), 159-164. See the contribution by John Haugeland in our book “Analog/Digital” of which the present text is the foreword. Haugeland’s text appeared originally as „Analog and Analog“ in: *Philosophical Topics*, Jg. 12 (1981), 213–225.

⁷ E.g. Fred Dretske, *Knowledge and the Flow of Information* (Cambridge, MA: MIT Press, 1981), who proposes an original and most of all to his argumentation useful redefinition of the distinction: “I will say that a signal (structure, event, state) carries the information that *s* is *F* in *digital* form if and only if the signal carries no additional information about *s*, no information that is not already nested in *s*’s being *F*. If the signal *does* carry additional information about *s*, information that is not nested in *s*’s being *F*, then I shall say that the signal carries this information in analog form. [...] Every signal carries information in both analog and digital form” (137).

⁸ See the contribution by Claus Pias in our book “Analog/Digital” of which the present text is the foreword.

1. History No. 1: The emergence of the A/D distinction around 1945

Although the terms ‘analogue’ and ‘digital’ have a long and meaningful history independently of each other,⁹ the emergence of the *distinction* analogue/digital, as already indicated, can be dated relatively precisely. Even before the Second World War, especially in the heated media discussions of the 1920s, the difference analogue/digital did not exist: „[D]ie Begrifflichkeit spielt in den Mediendebatten der Zeit keine Rolle, mehr noch, es gibt sie gar nicht.“¹⁰ // “[T]he terminology plays no role in the media debates of the time, more than that, it does not exist at all.” Apparently, the term ‘digital’ in a technical sense first appeared in a patent specification in 1938.¹¹ Based on his experiences with the first American digital computer ENIAC,¹² D.R. Hartree wrote in *Nature* of 12.10.1946: “I have found it convenient to distinguish the two classes by the terms ‘instruments’ and ‘machines’ respectively; the American usage is ‘analogue’ and ‘digital’ machines.”¹³ The here timidly crystallizing difference analogue/digital then became more and more important in cybernetics that began to emerge in 1946 with regard to problems of information processing.¹⁴ This origin had at least three consequences:

*First, the universal claim of cybernetics in combination with the paradigm of the Turing machine, which had already been conceived as a universal discrete machine in 1937,*¹⁵ colored the analogue/digital distinction. Analogue/digital soon developed into a universal, but finally also asymmetrical (see below) difference, which seemed to be applicable to all natural and cultural phenomena.

*Secondly, John von Neumann, in connection with his work on the later so-called Von Neumann architecture,*¹⁶ preferred the *binary* concept of the digital (already created by

⁹ See the contributions by Simone Loleit and Holger Steinmann in our book “Analog/Digital” of which the present text is the foreword.

¹⁰ See the contribution by Albert Kümmel in our book “Analog/Digital” of which the present text is the foreword.

¹¹ See the contribution by Simone Loleit in our book “Analog/Digital” of which the present text is the foreword.

¹² See Scott MacCartney, *Eniac: the Triumphs and Tragedies of the World’s First Computer* (New York: Walker, 1999).

¹³ D.R. Hartree, “The ENIAC, an Electronic Computing Machine”, *Nature*, Vol. 158 (1946): 500–506, here 500. The analogue computers developed in the 1930s – such as Vannevar Bush’s particularly important *Differential Analyzer* – were apparently not yet called ‘analogue computers’ at that time, see Vannevar Bush, „The Differential Analyzer: A New Machine for Solving Differential Equations“, *Journal of the Franklin Institute*, Vol. 212 (1931): 447–488. At that time the term ‘computer’ was still reserved for (mostly female) calculating people.

¹⁴ See the contribution by Claus Pias in our book “Analog/Digital” of which the present text is the foreword.

¹⁵ See Alan Turing, “On Computable Numbers, with an Application to the Entscheidungsproblem.”, *Proceedings of the London Mathematical Society*, Series 2, Vol. 42 (1937): 230–265. doi:10.1112/plms/s2-42.1.230.

¹⁶ See Michael D. Godfrey and D. F. Hendry, “The Computer as von Neumann Planned it”, *IEEE Annals of the History of Computing*, Vol. 15, No. 1 (1993): 11–21 and Paul Ceruzzi, *A History of Modern Computing* (Cambridge, MA and London: MIT Press 2000), 20–27. Von Neumann’s design was first tested in an experimental computer in Manchester in 1948. In 1949 the EDSAC was created in

Turing), although the first American digital computer in operation at that time, ENIAC, was operating decimally rather than binarily. And it prevailed, although mathematically ternary systems – based on 0, 1 and -1 – could be much more efficient (a remarkable example of such an experiment was the SETUN¹⁷ developed around 1958 in the USSR). The establishment of the binary principle was mainly due to the simplicity of its implementation (switch on/off), which around 1945 held out the prospect of the imminent feasibility of programmable, electronic-digital computers. Thus, the binary coding was not only acceptable for the engineers, but also for US-American political organs interested in, for example, early results concerning the calculation of the hydrogen bomb – a prioritized goal in the just beginning ‘Cold War’.¹⁸ In any case, since then „digital‘ [...] tatsächlich das Binäre gemeint“¹⁹ // “‘digital’ [...] actually means the binary” – apart from the retroactive reconceptualization of writing as non-binary-digital (see below).

Thirdly, following the first two points, semantics of the difference analogue/digital solidified. The binary-digital did appear – for instance through procedures of ‘isolation’²⁰ – as a symbolisation artificially derived from the analogue on the basis of minimal difference, but was nevertheless or *precisely because of this* thought to be extremely effective, even able to simulate universally everything analogue.

However, it is completely appropriate to question the universality of the digital code: On the one hand because it is limited by the question of what can be formalized and calculated at all – it was precisely this limit that Turing’s 1937 thesis attempted to make more

Cambridge, England. EDVAC, which was completed in 1951 but not fully operational until 1952, is thus the first American computer based on the Von Neumann architecture (since the first UNIVAC – the first commercial computer – was already completed and operational in 1951, the pioneering position of EDVAC is occasionally disputed).

¹⁷ See B. N. Malinovskiy and N. P. Brusentsov, “Nikolai Petrovich Brusentsov and his Computer SETUN”, in *Computing in Russia. The History of Computer Devices and Information Technology Revealed*, eds. Georg Trogemann, Alexander Y. Nitussov and Wolfgang Ernst (Braunschweig and Wiesbaden: Vieweg, 2001), 104–107. See also the explanations on the deficiencies of the binary system in Alexey Stakhov, “Brousentsov’s Ternary Principle, Bergman’s Number System and Ternary Mirror-Symmetrical Arithmetic”, *The Computer Journal*, Vol. 45, No. 2 (2002): 221–236, esp. 221f. Various reasons prevented the further development of ternary computers in the USSR, which switched to the IBM standard in 1972 at the latest. Only when the so-called Moore’s Law comes to an end and further miniaturization of the established architecture will no longer be possible, could such computer concepts – besides others like quantum computing – get a chance again.

¹⁸ See Wolfgang Hagen, „Das ‚Los Alamos-Problem‘. Zur Herkunft des Computers“, in *7 Hügel – Bilder und Zeichen des 21. Jahrhunderts. VI: Wissen. Von der Gelehrtenrepublik zur Wissensgesellschaft*, eds. Gereon Sievernich and Hendrik Budde (Berlin: Henschel, 2000), 65–69.

¹⁹ See the contributions by Wolfgang Ernst and Claus Pias in our book “Analog/Digital” of which the present text is the foreword.

²⁰ See the contribution by Hartmut Winkler in our book “Analog/Digital” of which the present text is the foreword. The fact that the digital must first be wrung from the analogue is also emphasized by Anthony Wilden, *System and Structure. Essays in Communication and Exchange* (London and New York: Tavistock Publications, 1980), 169f. and (with explicit reference to von Neumann) 189. And this is the only reason why A/D converters exist, see Rainer Eckl, Leonhard Pütgens and Jürgen Walter, *A/D- und D/A-Wandler. Grundlagen, Prinzipschaltungen und Applikationen* (Munich: Franzis, 1990).

definable.²¹ On the other hand, the architecture and speed of digital hardware determine which computations can be performed. Moreover: The Von Neumann architecture has specific limitations: There is usually only one data bus between the memory and the *Central Processing Unit*, i.e. programs are executed strictly sequentially (so-called ‘Von Neumann bottleneck’). This sequentiality slows down, for example, certain forms of higher-dimensional data processing, for example, the now increasingly important prime factorization of very large numbers, such as is used in asymmetric encryption methods (e.g. Pretty Good Privacy, ‘PGP’).²² Although the universality of the digital remains subject to certain limits, the consequences of the genealogical implications were considerable, for the claim formulated in early cybernetic discourses that the digital is the „*Medium* allen Wissens“²³ // “*medium* of all knowledge” subsequently propagates inexorably.

For example, von Neumann's own (but deliberately limited) analogy(!) between brain and digital computer²⁴ in his early *First Draft* on computer architecture soon produces the image of the ‚Elektronengehirns‘²⁵ // ‘electronic brain’. This then circulated through popular cinema as well – an important and already dystopian form can be found in Stanley Kubrick's film 2001 – A SPACE ODYSSEY (GB 1968) in the threatening supercomputer HAL 9000. This is by no means the place to pose the question of whether and to what extent human consciousness operates digitally or not.²⁶ But the fact that a metaphor like the ‘electron brain’ could be formulated at all, in which ultimately the equation of thinking and digitality is asserted, shows the attraction of the new analogue/digital distinction. And its power also lies

²¹ See Turing, “On Computable Numbers”, 241: “The computable sequences and numbers are therefore enumerable.”. See the article by John Haugeland, who explicitly denies that everything analogue can be digitally simulated. The debate about computer simulation, which also began around 1945, makes it particularly clear that digital simulation is always only operative as selective and approximative modelling and by no means as a complete duplication of a non-digital reality. An exception is the possibility to completely simulate a specific discrete system (e.g. a computer) – such cases are usually called *emulations* in contrast to the always approximative simulation. See David Harel, *Computers Ltd.: what they really can't do* (Oxford: Oxford University Press, 2000) for the limits of computation.

²² Which is why, especially since September 11, 2001, more and more consideration is being given to the use of the quantum computer that transcends both the Von Neumann architecture and binary digitality – especially since 1994 an algorithm for such a machine that is no longer completely hypothetical has been presented, which would enormously accelerate the prime factor decomposition, see Peter Shor, “Algorithms for Quantum Computation: Discrete Logarithms and Factoring”, in *Proceedings of the 35th Annual Symposium on Foundations of Computer Science*, ed. Shafi Goldwasser (Los Alamitos, CA: IEEE Computer Society Press, 1994), 124–134. With such procedures, PGP-encrypted network communication of alleged or actual terrorists, but also of ordinary citizens, would no longer be well protected information.

²³ See the contribution by Claus Pias in our book “Analog/Digital” of which the present text is the foreword.

²⁴ See John von Neumann, “First Draft of a Report on the EDVAC” [1945], *Annals of the History of Computing*, Vol. 15, No. 4 (1993): 27–75, here 36f. (In the original 5f.).

²⁵ Already in 1949 (notably 7 years before the first Dartmouth Conference on ‘Artificial Intelligence’) Edmund C. Berkeley, *Giant Brains or Machines that Think* (New York: Wiley, 1949) was released.

²⁶ See the contribution by Matthias Uhl in our book “Analog/Digital” of which the present text is the foreword. This analogy was already denied in 1950 by Ralph W. Gerard, “Some of the Problems Concerning Digital Notions in the Central Nervous System” [1950], in *Cybernetics – Kybernetik. Die Macy-Conferences 1946–1953*, Vol. 1, ed. Claus Pias (Zurich/Berlin: Diaphanes, 2003), 171–202.

in the fact that it emerged as an asymmetric, *hierarchical opposition*. In it, the analogue was implicitly coded as the original, the natural, the real (or causally connected with the real) – but also the blurry and the amorphous²⁷, while on the other hand the digital and especially the binary-digital was seen as the omnipotent²⁸, the universal and the well defined.

2. History No. 2: From the A/D distinction to analogue and digital media

The establishment of this hierarchical opposition is particularly evident in the course of the increasing spread of ‘digital media’. It is not easy to say when exactly the analogue/digital distinction was first associated with the concept of media. Since the distinction, however, is first to be found in the field of computer science or the discourses of cybernetics, it must be assumed that where computers were first described as media, a first connection between the analogue/digital distinction and the concept of media also emerges. In the 1960s of the 20th century, this is exactly what happened in different places. In 1967 Michael Noll’s text *The Digital Computer as a Creative Medium* appears, which deals with the potentials of the computer as an image medium.²⁹ In 1968 J.C.R. Licklider and Robert Taylor published their text *The Computer as a Communication Device*. Soon after, they played a decisive role in the construction of the first nodes of the ARPANET. There it says explicitly:

Creative, interactive communication requires a plastic or moldable medium that can be modeled, a dynamic medium in which premises will flow into consequences, and above all a common medium that can be contributed to and experimented with by all. Such a medium is at hand – the programmed digital computer.³⁰

And shortly afterwards, in view of the Cold War, which was at its height in the 60s and the competition between the systems, something more alarming was underlined:

The importance of improving decision making processes – not only in government, but throughout business and the professions – is so great as to warrant every effort. [...] [A] particular form of digital computer organization [...] constitutes the dynamic, moldable medium that can [...] improve the effectiveness of communication [...].³¹

²⁷ Therefore, the analogue can also be associated with a patriarchally defined ‘female’, see critically the contribution by Hartmut Winkler in our book “Analog/Digital” of which the present text is the foreword.

²⁸ The trace of this ‘omnipotentization’ leads back to Leibniz, see the contribution by Niels Werber in our book “Analog/Digital” of which the present text is the foreword.

²⁹ See Michael A. Noll, „The Digital Computer as a Creative Medium“, *IEEE Spectrum*, Vol. 4, No. 10 (1967): 89–95.

³⁰ J. C. R. Licklider and Robert Taylor, „The Computer as a Communication Device“, *Science and Technology* (April 1968): 21–31, here 22.

³¹ Licklider and Taylor, „The Computer as a Communication Device“, 25. On the causes of the computer becoming a medium in the Cold War see Jens Schröter, *Das Netz und die Virtuelle Realität. Zur Selbstprogrammierung der Gesellschaft durch die universelle Maschine* (Bielefeld: transcript-Verlag 2004).

Here the digital computer is obviously conceived as a medium, ergo: as a digital medium – long before the relevant debates on media theory. Interestingly, in Marshall McLuhan's *Understanding Media*, one of the most important precursors of current media theories, the computer appears explicitly as a “media of communication”³², but the distinction between analogue and digital media does not yet play a role there.

It took a good 15 years before the ‘digital media’ were to penetrate from the informatic subtext into the general public: in 1982, the *Compact Disc* appeared as the first digital ‘new medium’ on the market with a huge amount of marketing.³³ During this time there was a lot of talk about AAD, ADD and DDD – the question of whether recording, mixing and finally storing music production was analogue or digital.

Fig. 3: Mediation of the A/D distinction in the booklets of early CDs

While the self-proclaimed technology progressives celebrated the ‘best possible sound reproduction’ given by the digital medium, conservative high-fidelity extremists complained that CDs supposedly sound cold and ‘technical’ compared to warm and authentic sounding analogue records. Be that as it may: with the CD, the analogue/digital difference became more and more known, even tangible, and with it the genealogical connotations: Both euphorically and culturally critically the subcomplex dichotomy established itself, that *analogue=real, but*

³² Marshall McLuhan, *Understanding Media. The Extensions of Man* (Cambridge, MA.; London: The MIT Press: 1994), 43.

³³ Friedrich Kittler, „Der lange Weg zur Compact Disc“, in *Amor vincit omnia. Karajan, Monteverdi und die Entwicklung der Neuen Medien*, ed. Herbert von Karajan Centrum (Wien: Zsolnay, 2000), 215–232.

also afflicted with the clouding of the world vs. digital=hyperreal, realer than real, but potentially also surreal.

Soon after the CD, in 1984, the Apple MacIntosh, the first PC with a ‘user-friendly interface’, came onto the market. And finally, around 1989, ‘digital photography’ spread and after 1990 the image processing software *Adobe Photoshop* followed as well.³⁴ The discussions that had already accompanied the CD reappeared. Though all too often faked themselves, analogue photos were suddenly stylized against the allegedly everywhere spreading “liquidation of all referentials”³⁵ as the (freely after Kracauer)³⁶ new ‘salvation of the external reality’.³⁷

Soon, however – as the *Premiere Digital* advertising strategy shows vividly – the pessimistic cultural voices were silenced. The tendency already evident in the original marketing of the A/D distinction (Fig. 3) is gaining ground: The analogue is now the blurred, the noisy, the deficient, even literally the impotent – against the glittering hyperbrilliance and also explicitly sexually overdetermined omnipotence of the binary-digital...³⁸

3. Theory No. 1: A/D, the root of the difference and the Big Bang

At the time of the diffusion of multimedia PCs, the *computer as a medium* was also discovered in incipient media theory.³⁹ In the theoretical debates on digital media in the German-speaking world (which often leaned towards the utopian), the binary was short-circuited with (so-called) poststructuralist theory spreading at the same time, which puts difference – as 0/1 is – at the centre.⁴⁰ In particular, Lacan’s concept of the *symbolic*, following his explicit reference to cybernetics,⁴¹ was prominent in these discussions. Thus the

³⁴ See Jens Schröter, „Eine kurze Geschichte der digitalen Fotografie“, in *Verwandlungen durch Licht. Fotografieren in Museen & Archiven & Bibliotheken*, eds. Wolfgang Hesse and Wolfgang Jaworek (Esslingen: Museumsverband Baden-Württemberg e.V., 2001), 249–257.

³⁵ Jean Baudrillard, “The Precession of Simulacra”, in *Simulacra and Simulation*, transl. by Shari Faria Glaser (Ann Arbor: University of Michigan Press, 2007), 1–42, here 2.

³⁶ See the contribution by Georg Stanitzek in our book “Analog/Digital” of which the present text is the foreword.

³⁷ See my contribution on analogue and digital images in our book “Analog/Digital” of which the present text is the foreword.

³⁸ In his contribution Ralf Adelman (in our book “Analog/Digital” of which the present text is the foreword) points out that the use of computer animation in documentary television formats – in an obvious reversal of the alleged lack of reference of digital images that was lamented at the end of the 1980s – makes the generated image appear to be the actual representative of truth and reality.

³⁹ See for the German-speaking part of the world: Norbert Bolz, Friedrich Kittler and Georg Christoph Tholen, eds., *Computer als Medium* (Munich: Fink, 1994). See for the Anglo-American regions Peter Bogh Andersen, Berit Holmquist and Jens F. Jensen, eds., *The Computer as Medium* (Cambridge, MA and New York: Cambridge University Press, 1993).

⁴⁰ See Hartmut Winkler, *Docuverse. Zur Medientheorie der Computer* (Munich 1997), who undertook to critically reconstruct the „implizite[n] Utopien“ (17) // “implicit utopias” in the theoretical discourse on digital media and the appropriation of poststructuralist theoretical material.

⁴¹ See Jacques Lacan, “Psychoanalysis and Cybernetics, or on the Nature of Language”, in *The Seminar of Jacques Lacan. Book 2, The Ego in Freud's Theory and in the Technique of Psychoanalysis 1954-1955* (Cambridge: Cambridge University Press, 1988), 294–308, esp. 300 on binary code and 304: “And a sequence of signs always comes down to a series of 0s and 1s.”

„World of the Symbolic” became “A World of the Machine”⁴². By the connection of the historically contingent binary principle with fundamental or original differences – determined differently by various poststructuralist theories – the transformation of the binary-digital into the omnipotent threatens.

For example, in an important essay of 1994, Tholen, in almost literal reference to Lacan and his identification of the ‘symbolic’ with the 0/1, formulated: „Dank der Konnotation von Präsenz und Absenz, die in beliebiger Austauschbarkeit von der 0 und der 1 besetzt werden können, sind wir [...] technisch in der Lage, *alles zu repräsentieren, was sich präsentiert* [...]“⁴³ // “Thanks to the connotation of presence and absence, which can be occupied by 0 and the 1 interchangeably, we [...] are technically capable of *re-presenting everything that presents itself* [...]” A short time later Tholen carefully restricted this very extreme claim: „Dank der Konnotation von Präsenz und Absenz, die in beliebiger Austauschbarkeit von 0 und 1 besetzt werden können, sind wir [...] technisch in der Lage, *digitalisierbare Daten zu repräsentieren*“⁴⁴ // “Thanks to the connotation of presence and absence, which can be occupied by 0 and 1 interchangeably, we [...] are technically able to *represent digitizable data*.” However, this example clarifies which problems threaten the overdetermination of the binary principle – especially if connected with quantum theory⁴⁵ or cosmology and/or Zuse’s theses on *calculating space*⁴⁶. Then the “0/1, the binary scansion” really threatens to become the “divine form of simulation”⁴⁷. Thus, a more recent *history of the media* actually allows the binary principle to be begin with the Big Bang:

All das, was der Fall zu sein begann, all das, was da im Knall war, all das, was da vor 12 Milliarden Jahren [...] als Ab-Fall von der zeitlosen Reinheit des Nichtseins startete, organisierte

⁴² See Friedrich Kittler, “The World of the Symbolic – A World of the Machine”, in *Literature, Media, Information Systems* (Amsterdam: Gordon & Breach, 1997), 130–146, esp. 138 and 141. Lacan’s Trias of real, imaginary and symbolic structures Kittler’s book *Grammophon, Film, Typewriter* (Stanford, CA: Stanford University Press, 1999) well.

⁴³ Tholen, Georg Christoph: „Platzverweis. Unmögliche Zwischenspiele zwischen Mensch und Maschine“, in: Bolz, Kittler and Tholen, *Computer als Medium*, 111–135, here 131, mark-up J. S., see Lacan: *Das Ich in der Theorie Freuds*, S. 361f.

⁴⁴ Tholen, Georg Christoph: „Digitale Differenz“, in *HyperKult. Geschichte, Theorie und Kontext digitaler Medien*, eds. Martin Warnke, Wolfgang Coy and Georg Christoph Tholen (Basel and Frankfurt a.M.: Stroemfeld, 1997) 99–118, here 111, mark-up J. S.

⁴⁵ Such references were made early on, see John Stroud’s statement of 1950: „You begin with the rather highly digital electron [...]“, in: Pias, *Cybernetics – Kybernetik*, 182.

⁴⁶ See Konrad Zuse, *Calculating Space*, MIT technical translation AZT-70-164-GEMIT (Cambridge, MA: Massachusetts Institute of Technology, 1970). Zuse ponders the question – in explicit reference to cybernetics – “*Is nature digital, analog or hybrid?*” (22) and sketches a cellular-automatic-theoretical model of a fundamentally digital cosmos.

⁴⁷ Jean Baudrillard, *Symbolic Exchange and Death*, revised Ed. (London: Sage Publications, 2017), 112/113 im Ebook orig.: 110.

sich alsbald in binären Schemata. Makro und Mikro, Neutronen und Elektronen, positive und negative Ladungen, Materie und Antimaterie, Sein und Nichts, Atome und Bits, 0/1, i/a...⁴⁸

// Everything that began to be the case, everything that was in the bang, everything that started there 12 billion years ago [...] as an apostasy from the timeless purity of not being, soon organized itself into binary schemata. Macro and micro, neutrons and electrons, positive and negative charges, matter and antimatter, being and nothing, atoms and bits, 0/1, i/a...

This assertion is problematic, because the world of elementary particles is not binary at all: If positive and negative charges are mentioned (and neutral non-charge is not mentioned at all), at least besides neutrons and electrons protons should be mentioned. Not to mention that the fundamental particles (which do not include neutrons or protons) and forces according to today's standard model are not two, but much more.⁴⁹ Obviously, the binary principle is difficult to apply to nature. Whether nature is analogous, however, seems questionable in view of Planck's discovery of the quantum principle. Whether it is non-binary-digital, on the other hand, must seem at least problematic in view of the wave/particle dualism.⁵⁰ Whichever way we look at it: Quantum physics and cosmology are probably not the primary fields of validity for analogue/digital distinction.

4. Theory No. 2: A/D and the 'medium' – Luhmann and Kittler

And that is not surprising. The distinction did not arise primarily in the natural sciences⁵¹ and spread with the popularization of digital 'new media'. Consequently, the field of *media* is (at least at present) the dominant "fields of constitution and validity"⁵² of distinction. Consequently, how the distinction between analogue and digital is viewed depends on the systematic function and definition of 'medium' in a theoretical discourse.

To give a first authoritative example: Luhmann remarks in 1990 in the context of the discussion of the medium/form distinction (introduced into system theory in 1986): "The medium", „Das Medium muß (digital) eine gewisse Körnigkeit und (analog) eine gewisse

⁴⁸ Slightly ironic; Jochen Hörisch, *Der Sinn und die Sinne. Eine Geschichte der Medien* (Frankfurt a.M.: Eichborn, 2001), 22–23.

⁴⁹ Six quarks, each in the three 'colours red, green and blue'; six leptons (to which the electron belongs) and a whole phalanx of particles which transmit the four (perhaps five – but certainly not two) original forces: The photon (γ) for the electromagnetic force; W^+ , W^- , Z^0 for the weak nuclear force; eight 'mixed-colored' gluons for the strong nuclear force; the still hypothetical graviton for gravity – and then the Higgs-boson as the field quantum of the Higgs-field, which gives mass to all other particles. Then there is an antiparticle to most of these particles; and hypothetically there might be a supersymmetric partner for most particles. And even more fundamental particles (e. g. the axion) are described by various theoretical approaches.

⁵⁰ It is possible, however, that space-time is discrete in the range of the Planck length (10^{-33} cm) – at least this is assumed by more recent theoretical approaches to 'quantum geometry', see Rüdiger Vaas, „Jenseits von Raum und Zeit. Das geheime Netzwerk der Welt. Die Quantengeometrie soll Einsteins Traum vollenden“, *Bild der Wissenschaft*, No. 12 (2003): 50–56.

⁵¹ On how the analogue/digital distinction operated in particle physics detection systems, see the contribution by Peter Galison in our book "Analog/Digital" of which the present text is the foreword.

⁵² Michel Foucault, *Archaeology of Knowledge* (New York: Pantheon 1972), 4.

Viskosität aufweisen.⁵³ // “The medium must have a certain granularity (digital) and a certain viscosity (analogue).” Luhmann’s generalized medium is digital *and* analogue because, by definition, it consists of loosely coupled elements. On the one hand, the elements must be relatively discrete (digital), because if they were too closely connected, they could not be coupled more rigidly by changing forms. Fritz Heider, from whose Thing/Medium differentiation Luhmann draws his Medium/Form differentiation, already remarked: „Die Buchstaben lassen sich auf mannigfaltige Art zusammensetzen, weil sie nicht zusammengekoppelt sind, allgemeiner ausgedrückt, weil sie voneinander unabhängig sind.“⁵⁴ // “The letters can be put together in many different ways because they are not coupled together, more generally, because they are independent of each other.” If, on the other hand, the elements were too independent of each other, they would no longer be elements of *one* medium, no coupling could temporarily subject them to a form. In this sense, they must be connected and therefore ‘viscous’. Therefore, the identification of ‘analogue’ with a *limitation* of liquidity, i.e. the viscous, does not surprise at first. Viscosity is the property that makes *media* possible at all, because a medium that does not have one seems to be none: In water no e.g. written or pictorial forms can be drawn, differently than in the wax tried by Luhmann at least in one instance⁵⁵, since they melt again immediately again. Although water cannot *store* pictures or writings, it can *transmit* sound, just like the less viscous air: „Man hört die Uhr ticken nur deshalb, weil die Luft selbst nicht tickt.“⁵⁶ // “You can only hear the clock ticking because the air itself does not tick.” What the viscosity of Luhmann is exactly becomes unclear on closer inspection when air is supposed to be viscous in order to transfer forms: the boundary of viscosity (analogue) moves away into the barely comprehensible – perhaps only a plasma or a superfluid substance⁵⁷ can no longer form forms because they no longer have a ‘viscous’ connection between their ‘elements’. Moreover, it is not easy to understand exactly what the viscosity of the letters, for example, as elements of the medium of writing should be, which, despite their relatively discreet character as elements of a medium – writing – binds them together. Luhmann’s viscosity does not only seem to refer to substances, which would be strange regarding Luhmann’s functionalism, but also to systemic ‘conventions’. But be that as it may: With Luhmann – if one may generalise this passage from *Wissenschaft der Gesellschaft* – analogue and digital are rather extreme limits of a *continuum* between the independence and the interdependence of the elements of a medium in general. And they are relative to observation regarding the formation of forms. Graininess (digital) and viscosity (analogue) are interdependent and the degree of viscosity at least tends to imply the distinction between storage and transmission media.

⁵³ Niklas Luhmann, *Die Wissenschaft der Gesellschaft* [1990] (Frankfurt a.M.: Suhrkamp, 1998), 53.

⁵⁴ Fritz Heider, „Ding und Medium“, *Symposion*, Jg. 1, H. 2 (1927): 109–157, here 121. See the contribution by Leander Scholz in our book “Analog/Digital” of which the present text is the foreword.

⁵⁵ Niklas Luhmann, *Art as a Social System*, (Stanford, CA: Stanford University Press, 2000), 103.

⁵⁶ Niklas Luhmann, „Das Medium der Kunst“, *Delfin*, Jg. 4, H. 1 (December 1986): 6–16, here 7.

⁵⁷ Like Helium (⁴He) from -270,97 C° at 1 Atm. Pressure.

In Friedrich Kittler's media archaeology, the first important manifestation of which took place around the same time as Luhmann's introduction of the medium/form distinction in the books *Discourse Networks* and *Grammophon Film Typewriter* published in 1985 and 1986, media are defined as *techniques* for "storage, processing and transmission of messages"⁵⁸. Thus (in a later text), firstly, a distinction is made between writing as a pre-technical medium and technical media. The technical media themselves are in turn replaced by "analog media"⁵⁹ – such as film and gramophone – and "Digital technology [...] [which] replaces the continuous functions into which the analog media transform input data, which are generally also continuous, with discrete scannings at points in time as equidistant as possible[...]"⁶⁰. Here, the distinction analogue/digital does not describe – still in Luhmann's jargon – the relationship between elements of a medium, but rather how the medium stands in relation to the forms. Are forms (within the framework of physics) continuously mapped? Or are they, in relation to the sampling theorem of Nyquist, Shannon and Weaver, stored as discrete samples or codes that allow reconstruction, but above all – through formalization and its operationalization in computers – also transformation of forms? Here the *opposition* between analogue and digital is rather significant. But doesn't Kittler also stress that there are overlaps? Thus the principle of discrete sampling had already been anticipated by the "24 film exposures per second or, at a much higher frequency since the Nipkow screen, television [...]"⁶¹. And this despite the fact that one would describe (chemical) film as an analogue medium, as the individual film images are based on analogue (continuous) translations of light intensities and colours into associated chemical or electronic effects. For Kittler, however, the existence of analogue/digital hybrids does not mean a continuum between analogue and digital (as is the case in Luhmann's media theory), but only that a given technical device can be analogue and digital at *different* levels simultaneously.⁶²

Despite all the differences, there are also elements that subliminally connect Luhmann and Kittler – interestingly enough regarding the universal role of the binary-digital compared to analogue media. For Kittler's recourse to the specificity of media techniques and their various ways of "registering, transmitting, and computing any data [...]"⁶³ paradoxically leads precisely to accepting the "electronic end"⁶⁴ of media, indeed of the concept of media in

⁵⁸ Friedrich Kittler, "The History of Communication Media" in *Kunst im Netz*, eds. Dr. Helga Konrad, Steirische Kulturinitiative (Graz: Steirische Kulturinitiative, 1993), 66–81, here 66.

⁵⁹ Kittler, "History of Communication Media", 77.

⁶⁰ Kittler, "History of Communication Media", 77.

⁶¹ Kittler, "History of Communication Media", 77.

⁶² This applies, for example, to various forms of pictorial telegraphy in the 19th century, see Birgit Schneider, Peter Berz, „Bildtexturen. Punkte, Zeilen, Spalten. I. Textile Processing/II. Bildtelegraphie“, in *Intervalle 5 Mimetische Differenzen. Der Spielraum der Medien zwischen Abbildung und Nachbildung*, eds. Sabine Flach and Georg Christoph Tholen (Kassel: Kassel University Press, 2002), 181–220, here 214.

⁶³ Kittler, *Literature, Media, Information Systems*, 126.

⁶⁴ Kittler, *Grammophon*, 3.

general, in the non-specificity of the coming universal medium. Kittler emphasizes, however, that “Sound and image, voice and text are reduced to surface effects, known to consumers as interface.”⁶⁵ This means that the different media do not disappear, but become different forms of the digital – both on its surface and on the level of the file formats (a .wav file, for example, cannot be opened with *Photoshop*). Conversely, Luhmann’s idea of an empty and therefore unobservable medium as – as he puts it – „reine Virtualität“⁶⁶ // “pure virtuality“, which is strictly coupled, one might almost say *programmed*⁶⁷, by forms seems to describe digital computers. Thus at the same time as specific media techniques tend to disappear through virtualization, the concept of a *technically* unspecific medium open to various forms emerges. Luhmann calls computers “invisible machines”⁶⁸ – almost like Kittler, except with opposite intention – and explicitly compares the process of medium/form coupling with the ‘von Neumann machine’.⁶⁹

From *both* paradigms’ point of view it is questionable whether there can be ‘pure’ digital media without analogue output or surface at all. Rather, reading Luhmann with Kittler in mind, one could grasp the digital as a medium. A medium that is, or indeed must become more strongly coupled by analogue forms, since it itself is empty and open, thus absolutely indeterminate. Then the digital media would not come *after* the analogue media, but rather the analogue media would be ended as well as continued by their digital sampling, their digital simulation – the mentioned examples of CD and ‘digital photography’ (or also of computer graphic photorealism⁷⁰) seem to be compelling evidence for this. Yes, it could even be formulated: By moving into the ‘media spaces’ previously held by analogue media (e.g. digital video instead of analogue video or photography in the media reproduction of the family), digital techniques first become media. The digital media would, so to speak, only be a new phase of their analogue predecessors.⁷¹

5. Theory Nr. 3: Restructuring Media History in the Light of the A/D Differentiation: Goodman’s Theory of Symbols

Seen in this light, the ‘digital revolution’ never took place as an absolute and radical break, but rather as a transformation. And this also seems to apply to the *historiography of the*

⁶⁵ Kittler, *Grammophon*, 1.

⁶⁶ Niklas Luhmann, „Die Form der Schrift“, in *Schrift*, eds. Hans Ulrich Gumbrecht and K. Ludwig Pfeiffer (Munich: Fink 1993), 349–366, here 356.

⁶⁷ See Niklas Luhmann, *Theory of Society*, Vol. 1 (Stanford, CA: Stanford University Press, 2012), 66.

⁶⁸ Luhmann, *Theory of Society*, 66.

⁶⁹ Luhmann, *Theory of Society*, 119. See Bernhard Dotzler, „Unsichtbare Maschinen – Irritationsbeständen aus der Geschichte der Kybernetik erster Ordnung“, in *Widerstände der Systemtheorie. Kulturtheoretische Analysen zum Werk von Niklas Luhmann*, eds. Albrecht Koschorke and Cornelia Vismann (Berlin: Akademie-Verlag, 1999), 121–132.

⁷⁰ See my contribution and that of Barbara Flückiger in our book “Analog/Digital” of which the present text is the foreword

⁷¹ See Jens Schröter, „Intermedialität, Medienspezifität und die universelle Maschine“, in *Performativität und Medialität*, ed. Sybille Krämer (Munich: Fink, 2004), S. 15–41.

media. The distinction between analogue and digital allows to subject media history to a series of “recurrent redistributions”⁷² One of the first of these new classifications is technology-centred, focusing on the materiality of media technology and its type of storage – hardly surprising, given the establishment of the analogue/digital distinction through the spread of new technology such as the CD. In this way the idea of an abrupt transition from analogue to digital that is created, an idea which seems so problematic according to the remarks made above.

In historiographies like this, the beginning of the analogue/digital distinction is shifted back to the beginning, or the middle of the 19th century. Although at that time this distinction played no role – rather image and text were differentiated. According to this narrative, the era of analogue began with the invention of self-recording techniques such as Chladni's sound figures (1787), photography (1826/1839), Mareys' sphygmograph (1860), the phonograph (1877), the gramophone (1887) and film (1895), or transmission media such as the telephone etc... In such a model, analogue media are equated with *indexical* media, i.e. media based on a causal relationship between represented entity and representation. According to the apparent *common sense*, this era comes to an end in the middle, or late twentieth century with digital media. But, of course, such a simple model is relatively problematic: *First*, (so defined) analogue media continue to exist in niches (such as analogue records in the DJ scene) and vice versa, analogue, (proto-)digital and hybrid media coexisted side by side already in the 19th century.⁷³ *Secondly*, digital media must remain *aesthetically* analogue on the surface (and if necessary sample and/or simulate analogue media) – not only because of the media theoretical arguments discussed above – but already and first of all because human senses normally only process continuous signals.⁷⁴ *Thirdly*, digital media necessarily are based on an ultimately analogue electronics.⁷⁵ And *fourthly*, the ‘successionist’ model assumes that digital media are *eo ipso* non-indexical, which is questionable at least with regard to digital sensors such as the CCD.⁷⁶

Moreover, regarding the presumed ‘analogue era’ more problems emerge. It becomes unclear whether a painting, just to select *the* exemplary pictorial medium before the (strictly speaking) technological pictorial media, is analogue, digital, a hybrid or any of it – and one could moreover ask whether pointillism, for instance, has produced a kind of proto-digital image. The representation of objects in representational painting is not based on an indexical

⁷² Foucault, *Archaeology*, 5.

⁷³ See the contribution by Geoffrey Batchen in our book “Analog/Digital” of which the present text is the foreword. In the 19th century there was already a purely digital form of picture telegraphy with the ‘Zwischenklischee’ method, see Berz and Schneider, „Bildtexturen“, 214–216.

⁷⁴ See the contribution by Matthias Uhl in our book “Analog/Digital” of which the present text is the foreword. This is the only reason why D/A converters exist, see Eckl, Pütgens and Walter, *A/D- und D/A-Wandler*.

⁷⁵ As e.g. Norbert Wiener had already emphasized (in Pias, *Cybernetics – Kybernetik*, 158).

⁷⁶ See my contribution in our book “Analog/Digital” of which the present text is the foreword.

relationship between represented object – which, unlike in photography, can also be non-existent – and image. Thus, painting *cannot* be analogous, apart from the inscription of the painting gesture onto the picture plane, which could be described as indexical and so as – within the framework of a presumed equation of indexical and analogue – analogous. Even more: the optical-chemical self-inscription of the object, for example in photography (but also in the analogue sound media), was formulated in relevant debates – sometimes emphatically – as a central difference between painting and photography.⁷⁷ But to call painting ‘digital’ seems even less convincing, despite algorithmic phenomena like central perspective⁷⁸ and the coherent pictorial space it creates. In any case, the example of painting suggests that the analogue/digital distinction does not (strictly speaking) apply to pre-technical media. However, all this only applies if an analogue/digital distinction, which is itself already *technologically* understood, is applied. But that doesn’t have to be.

In 1968, *long before the spread of digital media* such as CDs, Nelson Goodman formulated in his book *Languages of Art* a symbol-theoretical variant of the distinction. This decription of the distinction does not relate it to the materiality of storage, but to the aspect of the constitution of signs (‘symbols’ in Goodmans lingo). This sign-theoretical formulation of the analogue/digital distinction, is, alongside Kittler’s media-archaeological, and Luhmann’s systems-theoretical variants, the third central theoretical approach used in the present book. It describes signs regarding the rules of their identification: Are all traits potentially constitutive for the sign? Such a symbol scheme would be analogous.

On the other hand, if a given sign can be compared to a differentiated and disjunctive repertoire (e.g. the alphabet), certain traits can be excluded as contingent (a green ‘A’ is as good as a black one). That would be Goodman’s criterion for digitality.⁷⁹ The distinction between analogue and digital would then correspond to the distinction between image and text.⁸⁰ Consequently, a term such as ‘digital images’ – based, for example, on images consisting of pixels – would be simply absurd in the context of this concept: “In other words,

⁷⁷ This was already noticed in the 19th century and used as an argument against the art-worthiness of photography. 1946 this was very clearly formulated by André Bazin, “The Ontology of the Photographic Image”, in *Film Quarterly*, Vol.13, No. 4 (Summer 1960), 4–9, here 7. See also Friedrich Kittler, *Kunst und Technik* (Basel: Stroemfeld, 1997), 14f.

⁷⁸ Kittler comments on this in *Kunst und Technik*, 9: „Es hat also lange vor Digitalrechenanlagen oder Computern schon eine Mathematik gegeben, die Kunstwerke nicht [...] nachträglich durchmisst, sondern ihrer zukünftigen Hervorbringung schon Mass und Zahl vorgibt.“ // „Long before digital computer systems or computers, mathematics had already existed that did not [...] measure works of art retrospectively, but rather already determined the measure and number of their future production“.

However, central perspective in painting was rarely applied rigorously.

⁷⁹ See Goodman, *Languages of Art*, 127–176; on the alphabet 137, and on Goodman’s definition of analogue and digital 159–164. Jörgen Schäfer (in our book “Analog/Digital” of which the present text is the foreword) discusses in his contribution the possibilities of describing a ‘digital literature’ – because, according to Goodman, the symbolic scheme of language is indeed digital; but, as he says, normal languages are by no means semantically disjunct (152) and thus also analogue/digital hybrids.

⁸⁰ See the contribution by John Haugeland.

nondotted pictures belong to as many digital schemes as do dotted pictures.”⁸¹ For Goodman “[...] no symbol by itself is digital, and none by itself is analog”.⁸² Image and text are even interchangeable when the schema changes: Is ‘oo’ the presence of two specimen of the fifteenth letter of the alphabet or a picture of eyes? However, there are also limits to this – extremely productive – approach⁸³, which some contributions in this volume are devoted to. In the light of the enormous role of typographies and typologies in the 20th century and the ensuing tendency towards the intermedial entanglement of text and image, for example, the assumption that the colour of a letter is irrelevant to its unambiguous identifiability as a character of the alphabet is at least worthy of discussion.⁸⁴ Cases in which the picture by its reduction to the difference picture/non-picture seems more like a digital scheme exist in the radical experiments of modernist painting.⁸⁵

Once again, there are indications that the analogue/digital distinction cannot be equated with an overly clear or even ontological dichotomy – simply because the analogue/digital distinction, as the differences between Kittler, Luhmann and Goodman show, can be made productive in very different ways. Instead of demanding privileges for one of these perspectives, the aim of this volume is to promote dialogue: After all, Goodman and Kittler seem to meet each other at the point that both connect ‘digital’ with ‘discrete’ and ‘analogue’ with ‘continuous’ – although both map this difference onto completely different fields of objects. Although Luhmann’s granularity also seems to be close to discreteness, it remains to be discussed whether viscosity merges with the continuous...

6. Conclusion and Acknowledgement

If it is true „dass eine Kultur immer erst dann für das ‚historische Apriori‘ einer Epoche sensibilisiert wird, wenn diese sich dem Ende zuneigt“⁸⁶ // “that a culture is only

⁸¹ Nelson Goodman and Catherine Z. Elgin, *Reconceptions in Philosophy and other Arts and Sciences* (Indianapolis: Hackett; London: Routledge, 1988), 128. In this context shall be noted that Vilém Flusser – contrary to common belief – already regards the photo as a ‘digital picture’: “The first picture to be synthesized from points – the first grainy picture – is the photo. [...] Very characteristically, the computer should not be taken as a consequence of the camera – it should not be explained causally – but on the contrary, the camera should be taken as a primitive computer (it should be explained prospectively)”, from a typescript for an article in *Artforum*, 1988 (from the Vilém Flusser-Archive at the KHM Cologne. My best thanks to Silvia Wagnermaier).

⁸² Goodman and Elgin, *Revisionen*, 127. Also Wilden, *System and Structure*, 188 understands the distinction analogue/digital as dependent on observation or context. Already in 1950, at one of the Macy conferences, Lawrence S. Kubie held a similar view (in Pias, *Cybernetics – Kybernetik*, 190).

⁸³ See Oliver Scholz, *Bild, Darstellung, Zeichen. Philosophische Theorien bildhafter Darstellung* (Freiburg: Verlag Karl Alber, 1991).

⁸⁴ See the contribution by Alexander Böhnke in our book “Analog/Digital” of which the present text is the foreword.

⁸⁵ See the contribution by Christian Spies in our book “Analog/Digital” of which the present text is the foreword.

⁸⁶ See the contribution by Wolfgang Ernst in our book “Analog/Digital” of which the present text is the foreword.. In his contribution Helmut Schanze (in our book “Analog/Digital” of which the present text is the foreword) discusses the viability of the talk of a historical ‘technical-medial’ a priori.

sensitized to the ‘historical a priori’ of an epoch when it is drawing to a close”, is then the recollection of the distinction analogue/digital in this book, or at the *Hyperkult 12* (Lüneburg 2003) perhaps a sign of its end? Yes and no. *On the one hand*, the reduction of the complex media transformations and shifts to *the one* ‘digital revolution’ is more and more seen as problematic. This is already obvious because the assertion of a pure transition from the analogue to the digital must hide the fact that analogue and digital always only make sense differentially in relation to each other. Hence, in the epoch analogue (if this formulation makes sense at all) there must always have been something digital one and vice versa – the findings of media history confirm this. So, the awareness grows that the distinction analogue/digital was probably never only a question of pure succession, but neither of *opposition or continuum*.

On the other hand, this does in fact not mean that the distinction is now simply meaningless – on the contrary. Only if it is handled as a strict rupture, many old and new phenomena don’t fit into its’ scope of validity and the distinction is marginalized. It only provides interesting observations, if one allows for the complexity of its historical manifestations. This becomes particularly clear with new phenomena: the technology of quantum computers is already visible on the horizon, which on the one hand represents a return of the analogue and therefore raises problems, which on the other hand can only be solved ‘pseudo-digital’.⁸⁷ The distinction analogue/digital is obviously not obsolete here and also neither at work in a previously known way – the distinction is rather *rearranged*. The fundamental significance of the analogue/digital difference can be seen precisely in the fact that *it can be rearranged without disappearing*.

This points out that the *transition* from analogue to digital does not take the form of a pure incision, but rather that of an “autochthonous transformation”⁸⁸ in which, as some examples have already indicated, differences and continuities are equally irreducible. Media upheavals are not strictly incisions and rifts, but rather rearrangements of complex constellations. That is why they are called upheavals as opposed to ruptures.

⁸⁷ See Mark Friesen, Robert Joynt and M. A. Eriksson, „Pseudo-Digital Quantum Bits“, *Applied Physics Letters*, Vol. 81, No. 24 (December 9, 2002): 4619–4621.

⁸⁸ Foucault, *Archaeology*, 15.