A Hitchhiker's Guide to the Turing Galaxy: On naming the age of the networked digital computer

Volker Grassmuck *

Abstract:

The most commonly used name for our era is that of the `information society,` which is a rather unexpressive and, strictly speaking, tautological term. The informatics & society scholar Wolfgang Coy, following the example of McLuhan`s Gutenberg Galaxy, has introduced the concept of the Turing Galaxy. The paper retraces the pre-history of the concept, its grounding in the fundamental breakthroughs of the British mathematician Alan M. Turing, the Turing Machine and the Turing Test, analyses the reception of the concept in a variety of fields of scholarship and asks for its value in the further debate on the knowledge environment of the networked computer.

* Ph.D. at the Center for Advanced Science and Technology of Tokyo University and Media researcher at Humboldt University, Berlin, Germany

Humankind relates to its environment and to itself by processing matter, energy and information. Throughout its history the focus has shifted from the former to the latter, from the stone and iron age to the age of steam and oil, to the age of information. An important step in the self-reflection of society was Marx's analysing an era after its mode of production. Today, after capitalism has engulfed all of the globe, the term has lost its power of distinction.

Man is the symbol-processing animal. Marshall McLuhan introduced the notion of naming historic periods after the dominant symbol-processing technique, most famously the Gutenberg Galaxy. According to McLuhan's analysis, the apparently simple but ingenious innovation of moveable type printing triggered a dynamics that directly led to the reformation, enlightenment, the modern sciences and mass education, the bourgeoise society and to capitalism.

The German informatics & society scholar Wolfgang Coy in 1993, followed McLuhan's example by naming the age of the networked computer and its comparably all-encompassing implications the „Turing Galaxy." The British mathematician Alan M. Turing in 1937, by clarifying the seemingly arcane problem of computability, laid the groundwork for the digital computer. This paper retraces the pre-history of the concept of the Turing Galaxy, its grounding in the fundamental breakthroughs of Turing, i.e. the Turing Machine and the Turing Test, analyses the reception of the concept in a variety of fields of scholarship and asks for its value in the further debate on the emerging knowledge environment of the networked computer.

The digital revolution and its names

The digital revolution is not a metaphor, but it is literally a revolution. There were no barricades, still it leaves no social stone unturned. It was not a class struggle, still the power relations are thoroughly upset.

No sooner has it started than it is evident that it effects a revolution of our intellectual universe that will have consequences as profound and far-reaching as that of the media revolution of moveable type printing in the 15th Century that, thanks to Marshall McLuhan, we call the Gutenberg Galaxy.

The impact of the digital revolution is equally worthy of an eponymic name. The choice here is somewhat less clear than in the case of Johannes Gensfleisch, called Gutenberg, even though he does have competitors: Chinese technologists who came up with the same innovation at least 400 years earlier, but their names were not passed down to us, and in a very different universe of signifiers their innovation produced much less dramatic effects.

At issue is not the controversial question of the 'fatherhood' of the computer. Both Shannon and Stibitz in 1937 came up with the idea to build binary-digital computers based on Boolean logic and implemented with the help of telephone relays. Eckert and Mauchly claim authorship for functional principles, that others attribute to John von Neumann. The concept of a single memory for both programmes and data is generally attributed to von Neumann, while others give priority for this breakthrough to Alan M. Turing. Zuse has asked and received written confirmation from von Neumann that it was he who built the first real computer. A US-American federal court in 1974 ruled that Atanasoff is to be regarded as the true inventor of the basic concept of the digital computer.

The quest for the one and only major breakthrough for this complex technology is as absurd, as that for the respective historical precedence is academic. By contrast, the formulation of the concept of universal computability in a thought machine with only three basic operations in its radicality cannot be surpassed. Therefore, there is good reason to name the new era after Alan Turing. Wolfgang Coy has done so in 1993.

Pre-history

Tesla Galaxy

That media-technological innovations make new cultural and social relationships arise from the Gutenberg Galaxy was first perceived in the 1920s and 30s. Berthold Brecht expressed this perception in his radio theory.[i] Walter Benjamin built his theory of the age of mechanical reproduction of art works primarily on the new medium of film.[ii]

There is a discrete media era between the age of the book and the digital galaxy, characterized by the electrical and chemical innovations in image and sound media, for which as yet no name has gained acceptance. McLuhan spoke about "the age of Marconi" (1962). Sociologist Manuel Castells (1996) called the configuration characterized by television the „McLuhan-Galaxy". He thereby uses not the media-technological innovator, but the media-science analyst of the period for naming it. In the meantime, Nicola Tesla who was passed over by the U.S. Patent Office and by history, has been rehabilitated. Since now, he and not Guglielmo Marconi is recognised as having invented the radio and, according to one of his biographers, even the entire 20th century (Lomas 1999), I would sugges to call this era „Tesla Galaxy."

Post - Gutenberg Galaxy

In the 1950s, again a fundamental social change came to be perceived, this time already under the influence of the computer. The ‚atomic age,‘ the ‚age of cybernation,‘ the ‚information society‘ (Hayashi 1969) and the ‚post-industrial society‘ (Bell 1973) are among the attempts, to give the period a name.

Many observers initially could conceptualise the new only in the negative, as „Post-Gutenberg" Era (like the ‚horeseless carriage‘ or the ‚wireless phone‘).

In 1987 Wolfgang Coy inquired about such a "Post-Gutenbergian Era." In the paper "From QWERTY to WYSIWYG – Text, Keyboard & Paper," he analyzed the new writing system, because that rather than a reading device is the computer. The writing process will be mechanised yet again. The ensueing texts are not read on the screen, but on a paper printout. He therefore scolds the writing guild, which sees itself threatened in its essence by the Bible published on diskette. "The real attack on the written text does not come from the computers: It is the old attack of images and sounds on the text, a counter-attack, as it were, since writing was and still is an attack on the images and sounds. Its means and media are comparatively old and well-known: film, television, radio, music record. "(Coy 1987)

A critical term appears in Coy's paper: the "machinisation of mental labour," an expression that he attributes to Frieder Nake, who has been using it since 1974 („or even earlier?"). "I find it," he writes, "a lot more accurate than the indifferent and non-specific declaration of a second (third?) Industrial Revolution – which moreover turns out more of a coup." (Others at the time had a somewhat different view on this revolution from above, such as the Chaos Computer Club, founded in 1981 in Berlin.)

Coy describes in this essay the new machinised text operations that the computer enables (searching, sorting, checking spelling and style, drafting, formatting, desktop publishing, all the way to the possibility of automatic text generation). But besides changes of the printed text, computer-based word processing carries potentials that go beyond book-production: "The most important relates to non-linear reading." And he concludes his thoughts in 1987 with the question: "Could it be that the electronic footnote is the beginning of the Post-Gutenbergian Era?"

The term, however, gained its widest circulation through the cognitive scientist Stevan Harnad, who in 1991 in his essay „The Post-Gutenberg Galaxy," analysed electronic writing as the fourth revolution in the means of production of knowledge after the invention of language, writing and

printing. In 1993, also media theorist Norbert Bolz bid farewell to Gutenberg's World of script and heralded a new world of hyper-media.

Coining of the Turing Galaxy

The digital revolution gained a broad impact on society with the spread of PCs in the 1980s and of the Internet in the 1990s. Not coincidentally, it was during this time that the work of Alan Turing was discovered for cultural and media studies. Until then, there are only a few references to Turing in the scholarly literature in mathematics and informatics. Even in computer-historiography, Turing had all but disappeared behind John von Neumann.

The person and the work of Turing was first made accessible through the biography by Andrew Hodges (1983) who, for the first time, was able to access original military documents that had just been declassified. In German-speaking countries, the compilation and translation of those of Turing's works that are legible without specialised mathematical knowledge by Dotzler and Kittler in 1987 was a key event. In 1992, Harry Harrison and Marvin Minsky presented their novel „The Turing Option.“

The first to turn Turing into an epoch-marker was David Jay Bolter with his *Turing's Man. Western Culture in the Computer Age* (1984). At a time when, as he writes, most laymen had never been in the same room with a computer, he predicts that the computer ...

> "... will be a principal medium of communication for the educated community of Europe and North America. The philosophy and fiction of the next hundred years will be written at the keyboard of a computer terminal, edited by a program, and printed under electronic control. " (Bolter 1984)

At the beginning of "Turing's man" stood, according Bolter, two "manifestos," the two seminal papers by Turing „On Computable Numbers“ (1937) and „Computing Machinery and Intelligence“ (1950).

> "We are all liable to become Turing's men, if our work with the computer is intimate and prolonged and we come to think and speak in terms suggested by the machine. [...] Turing's man is the most complete integration of humanity and technology, of artificer and artifact in the history of the Western cultures. " (Bolter 1984)

In analogy to McLuhan, Bolter sees a shift in the preferred organ of perception. Had the "Faustian Man" related with the World foremost by means of the eye, so his descendant relates with the World by means of the hand. The computer is a "gripping tool," that "manipulates" information, thus promoting a tactile form of problem solving and "has much of the intimacy of the potter shaping his clay." Closely related is another outlook that the computer introduces into the World: the game. Like the child in a sandbox Turing's man shapes and modifies his ideas, and, as a programmer, his code. Like in play, his trial and error is of limited seriousness, because it is never irrevocable, and a reboot is always possible. "[A] programmer can never forget that every solution in the computer world is temporary, makeshift, obsolescent. [...] He does not speak of 'destiny' but rather of 'options'." This makes Bolter draw the optimistic conclusion, that "the computer age [...] is perhaps less likely to produce a Hitler or even a Napoleon." Finally Bolter, like after him Coy, sees an awareness of the limitations of the World as characteristic of the Turing Galaxy. The Faustian man was driven by a policy, an economy, or in general: a love of infinity, as it manifests itself in God.

> "Turing's man does feel limits, not the confines of tradition but instead the ultimate confines of his materials. Perhaps the most revolutionary change of all is that the computer man thinks of his world, intellectual and physical, as finite. [...] by its very nature [the computer] encourages a finite world view, and this may well be the greatest good fostered by the computer. The prime task of the programmer is to manage his scarce resources, to accomplish what he can with near and ready materials rather than solve problems by expansion. Computer specialists are always looking forward to expanded systems – more memory and faster central processors – but they know that no improvement will remove the finitude of their machine. [...] This is a paradigm for individual expression in a crowded world. " (Bolter 1984)

Wolfgang Coy: Turing Galaxy

The year 1993 was a historic turning point. The Internet makes its public appearance and a galaxy is born.

On the 15th September of the year, U.S. Vice President Al Gore announced the "National Information Infrastructure Agenda for Action," in which digital networks not only featured as a multi-billion-dollar industry in itself, but to as a basic infrastructure for all of the economy, education, science and culture.[iii]

In 1990 Tim Berners had created the first web server, a client (browser and editor) and the first web pages. The breakthrough came in 1993 as well. When the University of Minnesota announced that it would demand royalties for its implementation of the Gopher server, CERN responded by declaring that the World Wide Web will remain free of rights and royalties. This sealed the fate of the Gopher protocol that had emerged in parallel with the WWW.[iv]

The World Wide Web turned the Internet clickable, introduced images and sound and made it fit for mass-media use. Even so, the authors of this time never failed to mention that the real "killer application" of the Internet is email. But we already knew emails and we were happy when we received another one every few days. Websites were initially private home pages: calling cards on net, collections of one's scientific papers and hobbies, public diaries, even back then, long before social networks and blogs. The Internet is primarily a publication medium for self publication: one can publish one's own materials and oneself. Big Media came onto the Internet like a bull into a china shop, when MTV in 1993 sued its former employee Adam Curry. Curry, with management consent, had registered and developed the Internet presence mtv.com. By now, the company had begun to understand what the Internet is about. Instead of learning from their pioneering staff member, the brought charges against him in order to take control over their

brand.[v] With Big Media, conflicts over intellectual property promptly made their arrival on the net.

Also in spring of 1993, Wolfgang Coy held a lecture at the conference „Interface II" in Hamburg, entitled "The Turing Galaxy. Computer as Medium." The paper appeared together with two others in July 1994 as "Research Report of the Informatics Faculty of the University of Bremen." This is the original trilogy of the Turing Galaxy.[vi] Neither the person nor the innovations of Turing are the focus of Coy's attention in naming the era. His main concern is rather to counter the popular idea of the computer as automaton with the realisation that the computer is, in fact, a medium. The former consistently leads to an artificial intelligence approach, while the medium computer organises the relations between people.

The term „Turing Galaxy" appears in the main title of the central paper, but otherwise only *en passant*. Quite clear, however, is the awareness of a historic turning point. Thus ends the introduction to the „Computer as Medium"-trilogy as follows:" The pre-history of digital media as a history of digital computing technology comes to an end, from now on, the history of digital media will carry on writing itself. "

> „More than one hundred million PCs were built in the eighties. They form the basis of a media revolution, that assigns these programmable machines their historical perspective. This revolution was not effected by the mainframes of the first, second and third generation, whose use remained restricted to large companies and administrations, but by the PC. [...] The PC has become the copiously usable new medium, which can simulate and replace all other media. We are at the beginning of a culturally subversive process, which will unfold over many decades to come." (Coy1994)

The passage central to the eponymic naming of the new era reads:

> „Alan M. Turing finalises Gutenberg's system of typsetting and print by answering the seemingly peripheral question: ‚What is a computable function (an algorithm)?' [...] The Turing-Church thesis states that all clarifications of the intuitive notion of ‚computability' lead to a definition that is equivalent to a Turing Machine.

> The Turing Machine shows its explosive power through its technical realisation in the computer. The v.-Neumann-architecture reproduces the Turing Machine. [...] The (algorithmicly) describable doing, in the world of Turing's thoughts and in its image in the computer, becomes automatically executable action." (Coy1994)

This action, writes Coy, manifests itself first as a new form of transformation of script, then in the form of the automaton as transformation of sensor data into actions by robotic arms etc., and finally, through networking, as a transformation of anything at all that can be thought and that can be stored in media, into the digital universal medium.

> "Turing was certain of the potential of his universal computing machine. Just as (the early) Wittgenstein saw the ,sayable' as describable through logical interconnexions between elementary statements, it seemed to Turing that everything ,thinkable' can be grasped through a programmable algorithm, i.e. precisely a universal Turing Machine (see Turing 1950). The Gutenberg Galaxy of static print media is absorbed in the Turing Galaxy of dynamically programmable media." (Coy1994)

Linked with sensors and effectors to its immediate environment and, by its intimate connection with communications technology, globally networked, the Turing Machine, similar to the book, constitutes a media knowledge space. The computer is not only a medium, it is the "media-integrating machine per se," the universal medium. "All written, optical and electrical media can, by means of microelectronics and computer technology, ultimately merge into a general digital medium. Thereby, any digital medium becomes expandable by the properties of the other digital media." (Coy 1994)

The new medium is still being thought in Gutenbergian terms, when Coy speaks of a "network of functionally advanced typewriters with screens." But then, text production is radically expanded to become hypertext and hyper media. Vannevar Bush, Doug Engelbart, Ted Nelson and Alan Kay are the names that mark the line of development toward the computer as intelligence-augmenting knowledge machine (in contradistinction to artificial intelligence attempting to replace human intelligence).

Coy also formulated a political critique of the computer when he calls the mainframes "coagulated control instruments of the Taylorist and Fordist labour systems [...] whose military origins remain also organizationally identifiable." He juxtaposes this with the "Computer-Liberation" (Ted Nelson) by the PC revolution that brings "decentralized, interactively usable application programmes onto the desktop."

> "The start of the actual history of the medium computer can most likely be dated with the idea of the Apple Macintosh in January 1984." (Coy1994)

This allegation, justified in a footnote by the comparatively low price and mass acceptance of the Mac, is attributable to a charming idiosyncracy.[vii] A revolutionary mass impact of Apple at this time can actually be recognize only indirectly: through its technology transfer out of Xerox PARC and mediated through IBM, that let itself be challenged by Apple into building a machine that it did not want to build at all, the IBM PC, which had come on the market already in August 1981.[viii]

And then comes the network, first in the form of bulletin board systems and specialised data communications services by what was still a public post and telecommunications monopoly, and finally, the Internet, with its client-server structure, to which by 1992 one million computers were connected. The network, according to the famous Sun slogan had become the computer (Coy1994).

The second paper in Coy's trilogy again concludes with McLuhan:

> "McLuhan's global village is becoming real – the dispute is at best over the question of whether it is going to be an electronic fortification of the upper two-thirds of society or a global suburbia of companies, hoods and gangs." (Coy1994)

A year later, Coy in his introduction to the new German edition of McLuhan's book „The Gutenberg Galaxy," links the computer age closely to that of the

book. "At the borders of the typographic, there remains a discontinuous rupture: Namely, the script itself can already be seen as a 'digital,' discontinuous configuration. Inside the typographical grid, in its digital basic structure, the perspective of the Turing Galaxy is already implied." In the competition between book and computer, it seemed to him that for now the book still emerged victorious. But not for much longer:

> "The gradual replacement of the keyboard by mouse, stylus or voice input will help the digital media society to peel off the egg shells of its literal birth. With networking and media integration the real power of informatics in media technology becomes visible. Similar to book printing, it can in the long term change the perception – from literal societies to a global media society. Work and culture, politics, law, economics and virtually all social sectors will not be able to shirk this process. [...] The replacement of a script culture by a computer culture has only just begun. The Gutenberg Galaxy expands to the Turing Galaxy." (Coy 1995)

In 1996 Coy supplies us with further components of the Turing Galaxy, in which fundamental processes of perception and with them "work and culture, politics, law, economy, science and virtually all areas of society" are reconfigured. Again, he highlights the importance of broadening the access to media from coporate to personal computing and now also the political dimension of the inherent globalisation trends and the potential for abuse through violations of privacy.

Here, also the term ‚knowledge order' coined by Karlsruhe philosopher Helmut Spinner appears for the first time, a notion that will take a central role in Coy's further research on the Turing Galaxy.

> "The knowledge order, alongside the legal and the economic orders, governs the use of, the access to and the exploitation of information. The protection of intellectual property through patent or copyright law is a part of the knowledge order, just as the press law or censorship. Freedom of research and teaching is part of our knowledge order, as well as ensuring universal access by public libraries to publicly distributed, printed works or material published in other media. Through the digital transformation of all media and their networking, the grown national knowledge order is radically called into question." (Coy 1996)

The Knowledge Order of the Turing Galaxy

At the closing of the 20th Century, next to the technical and the media order, the legal order of the Turing Galaxy, until now an arcane field even within law, takes center stage. While John Perry Barlow in his Declaration of Independence of Cyberspace[ix] in 1996, for good reasons could still declare the Internet to be a legal vacuum, concurrently its legal regulation sets in. This concerns in particular intellectual property rights. In the same year of 1996, the UN World Intellectual Property Organisation (WIPO) adopted in its two Internet treaties a copyright specific to the Turing Galaxy.[x]

Ted Nelson had already realised that hypertext, together with the unity of the work, would also make the assignment of this work to an author and his property problematic. Copyright law, to his mind, would thereby become far from superfluous, but to the contrary should gain higher resolution. „Transclusion," i.e. the inlining of elements of other's works in one's own new work (in contrast to the citation), would require a „Transcopyright."[xi] Nelson envisaged a programmed knowledge environment, in wich the smallest parts of works down to single words would be marked with their owners so that the payment of a composite work would automatically lead to crediting of all the owners of the ingredient components. One can read this vision as metastasis of intellectual property, but also as an anticipation of the debate over sampling and remixing that started over Hip Hop in the music industry and continues to this day in all areas of creative expression.

At the end of the 1990s, the free software movement stepped into the limelight, and with it a class of licenses that by means of copyright create a free space in which thousands of authors distributed around the world, in an open cooperation can jointly create works.

Thus also the research interest of Wolfgang Coy is now directed at what he calls, in the phrasing of Helmut Spinner, the knowledge order. The research projects „From the order of knowledge to the knowledge order of digital

media" (1998-2000, together with Jörg Pflüger and myself), as well as „Image, script, number in the Turing Galaxy" (2004-2007, together with myself) need to be mentioned here, as well as the the four „Wizards of OS" conferences (1999-2006).[xii]

These contributions on the one hand, in an informatics perspective on the knowledge order, centre around the idea history of interactivity (Jörg Pflüger, „Conversation, Manipulation, Delegation," 2004) and the guiding notions of the history of programming (Jörg Pflüger, „Writing, Building, Growing," 2004). On the other hand, they focus, in a legal, knowledge sociological perspective on free knowledge cooperations, for which the US-American legal scholar Yochai Benkler coined the term „commons-based peer production," as well as the opposing aspirations of the copyright industry, by means of DRM to transform the universal medium into a controlled rights-player device (Grassmuck 2004).

Reception History of the Turing Galaxy

The media and cultural science debate about the computer from the mid-1990s, revolves around the concepts of convergence, hypertext and hypermedia, interactivity and simulation. Starting from the changing nature of text, author and reader, the reception of the Turing Galaxy concept is most pronounced in literature studies-oriented media theory. In addition, also cultural studies researchers, sociologists, historians and designers take up the concept.

     In my own contribution, the essay „The Turing Galaxy. The Universal Medium on the Way to World Simulation" (1995), I start out from the media genealogy of Vilém Flusser:

> "Every phase of media development is based on certain basic elements, a stock of signifiers and their materiality, that in turn allow for characteristic operations, such as forms of storage or interconnexion. Throughout this history, the operands are subject to increasing dematerialisation. If one follows Vilém Flusser's media genealogy, one finds universes of increasing abstraction and decreasing dimensionality: 'that of the sculpture – timeless bodies

–, that of images – depthless surfaces –, that of texts – surfaceless lines – and that of computation – lineless points.'" (Grassmuck 1995)

I then reconstructed this development from the four-dimensionality of the media system of nomadic people to the implosion in the point-universe of the Turing Galaxy and beyond:

> "In the Turing Galaxy, the universe of the integrating and informing universal machine, so the thesis, we today observe the reversal of the path described by Flusser: from the zero-dimensionality of bits, via one-dimensional texts and two-dimensional pictures, to differentiated hypertext spaces, complex networks and three-dimensional visual spaces, and finally to four-dimensional interaction spaces." (Grassmuck 1995)

To Wolfgang Coy's grounding the Turing Galaxy on the Turing Machine, I added here, as did David Jay Bolter, the Turing Test. In this experimental setup that Turing himself in 1950 called the imitation game, a questioner enters into a conversation with a human and a machine via a teletypewriter, and after a finite period of time is supposed to decide which of the two is the machine. Turing assumes the possibility of an intelligent machine that does not allow for such a decision. Human and machine would be indistinguishable.

In conclusion of a phenomenology of the Turing Galaxy, I then characterised the universal Turing Machine as a space of possibility:

> "In the Turing Galaxy, to speak with Flusser, we stand at the zero point of the dimensions, the world of points, 'immeasurable, a nothingness, and yet at the same time immeasurable, an all'. 'The universe of points is empty because it contains nothing but possibilities, and because it contains all the possibilities, it is a full universe." Flusser derives from this the requirement that we must learn to think, feel and act in the category of 'possibility'." (Grassmuck 1995)

Friedrich W. Block is a practitioner and theorists of visual poetry. In his essay „On the high See in the Turing Galaxy – Visual Poetry and Hypermedia" (1997) he follows the experimental poet Oswald Wiener in his

claim that today, the understanding of understanding has become the central issue of the sciences and the arts alike, and that for this operation the Universal Turing Machine represents the fundamental model. "In that sense, [the computer] as a medium and as a metaphor (already etymologically we are therefore dealing with mediation) stands in the center of contemporary media art and its aesthetics." But in studying the theories of electronic texts, he realises with astonishment that these perpetually reformulate positions of the modern avant-gardes: "This is true not only in terms of decidedly literary texts, but of any writing and reading of hyper and cyber-texts. As a fundamental aspect, among others, the explication of spaciality and visuality, the intermediality, the concept of an active reader as second author and the self-reflexivity in the use of hypertexts are stressed." (Block 1997)

Block examines the question of how the computer media extend the current spectrum of visual poetry. He notes that the few canonical examples of hypertexts, like Michael Joyce's „Afternoon, a Story" (1987), hardly reach up to a so delicate a multi-linear syntax as that of „Finnegans Wake" by James Joyce that is often cited as a precursor. A really new quality in the Turing Galaxy he recognises, similar to myself, in the inclusion of the body. First examples he sees in the digital Holopoetry by Eduardo Kac, and in the „currently most famous media artwork," „The Legible City" (1989-91) by Jeffrey Shaw and Dirk Groeneveld.

Also the cultural informatics scholar Martin Warnke in his work, times and again engaged with Alan Turing and his extension of the Gutenberg Galaxy that we owe to him. In the paper „The Medium in Turing's Machine" (1997), he starts from the observation: "In Turing's machines there must be more than the computing machine." And he continues: "He arrives at this 'more' in his construction, in his quest for the thinking machine. Thus Turing's thought machine ... is pushed in between the domain of the computable and the contingent environment of intelligent living organisms." Warnke here refers to Turing's model of a child machine that throught its interactions

with teachers slowly and gradually forms an intelligence. This expresses, says Warnke, Turing's awareness of intelligence as a social phenomenon, and of the "misery of Artificial Intelligence", which attempts to generate intelligence completely inside the space of computability, i.e. inside a Turing Machine.

> "Turing began his work on the computing machine from the autistic automaton in order to clarify the notion of computability. For his dream, the intelligent machine, he had to release his creation into life because, as we can complement and interpret today: intelligence is not a computable function. When the Turing Machine computes something uncomputable from the uncomputable, when it stands on the cross section between the determined, explicit and finite nature of the algorithm and the contingency of life, then it can no longer be denied mediality." (Warnke 1997)

The recognition that the Comupter is a medium, that informatics had only achieved in the 1990s, is thus already present in Turing's thinking, "even though the word 'medium' appears nowhere in his writings." (Warnke 1997)

The Danish humanities researcher Niels Ole Finnemann begins his essay „Hypertext and the Representational Capacities of the Binary Alphabet (1999) without any reference, by simply stating that „it is often said," that we are at the end of the Gutenberg Galaxy and on the road to a new Turing Galaxy, to electronic media, that are based on non-sequential or multilinear hyper-texts, that give the user the freedom of choice to create the links between the components. "In philosophical terms the transition is interpreted as a transition from modernity (print culture) to postmodernity (virtual cyber culture). If this scheme of opposition is not always explicitly stated nowadays, the reason is not – I assume – that the scheme has been given up, but rather that it is now a widely acknowledged precondition which is often taken for granted."

Finnemann makes it his task, to point out that the Turing Galaxy does not replace the Gutenberg Galaxy, but that their relationship is rather one of "co-evolution and integration". He sees both as textual and therefore linear and serially processed representations manifested in an alphabet. "There

has never been any simple seriality and linearity in the universe of meaning and fiction not even if it is imprisoned in a linear alphabet and printed on paper in a book." (Finnemann 1999) The real difference relates not to the text and its seriality, but to the roles of author and reader:

> "Basically, one could say that it is not the Author, but the Reader of a Hypertext system, who is now responsible for the ordering of the sequences. ... Contrary to the idea that the role of the author is diminished it is increased: in predicting the interest of users; in overviewing a variety of possible routes; and in developing solutions to the jumps between reading modes and browsing/navigating modes." (Finnemann 1999)

The historian Uwe Dörk in his essay „From the ‚Gutenberg‛ to the ‚Turing Galaxy‛" (ca. 1997) draws a line from the Turing Test of 1950 (concerning the question: "can machines think?") to the Summer Academy in Dartmouth in 1956, at which John McCarthy formulated the programme of "Artificial Intelligence." His rather conservative conclusion: When science wants to remain science, i.e. not become cyber-punk, it has to keep relying on the Gutenbergian access to knowledge: "Thinking contemplation, analytical reflection and transformation into long chains of reflection, which admittedly are no longer limited to pure textuality, remain irreplaceable essentials." (Dörk ca. 1997)

The Austrian literature scholar Peter Plener in his essay „Per Gutenberg through the Turing Galaxy" (2006), tracks the card box, this central mechanism of book-age knowledge management, from its wooden form into the current hard disks.

The media scholar Irmela Schneider, like Wolfgang Coy and myself, raises the issue of copyright ordering of digital media. In her paper „Concepts of Authorship in the Transition from the 'Gutenberg' to the 'Turing'-Galaxy" (2006), she refers to copyright law as a "sustained stabilizer of the author concept that, at the latest in the 19th century, entered a state of crisis. This crisis increases in the dawning of the Turing Galaxy by the potential of decoupling of material artefact and property and now covers not only

literary, but also journalistic and scientific authors. She closes with the question: "Who are the book printers of the Turing Galaxy? ... a question of societal discourse power."

As these excerpts from the ongoing reception of the Turing Galaxy concept have shown, it has developed a significant discourse power of it own.

The Turing Galaxy Tested

Today, key concepts from the debate of the 1990s, as Finnemann had already attested in 1999, have become so obvious that their terms have fallen into desuetude. To say that the Wikipedia is a hypertext or Second Life is interactive, has lost all explanatory value.

As name for our era, the "information society" continues to dominate –, which strictly speaking is a tautology, because each social formation that has transitioned from community to society is necessarily based on the storage, transmission and processing of information.

In contrast, the much richer era name „Turing Galaxy" has two major advantages:

1. It specifically links today's society back to the Gutenberg Galaxy, that the Turing Galaxy does not replace, but nevertheless, within only one generation has fundamentally transformed. Ten years ago, who would have imagined that it would be possible to complete a university degree without ever having set foot in a library?

2. It attributes the foundation of the knowledge order of digital media to the universal Turing Machine, that in its elegant simplicity and comprehensive definition of computability cannot be surpassed. Furthermore, by pointing to the Turing Test that a ‚child machine' interacting with its teachers and environment might eventually pass, it brackets forty years of vain attempts

at computational intelligence and emphasises that intelligence is a social phenomenon. To explore the space of possibility that the universal Turing medium has opened up, will remain the programme of our era.

The varied reception history has indicated how resonant and evocative the Turing Galaxy concept has been. It thus has passed the test of time and can be expected to remain fruitful and productive in all disciplines that analyse our digital and networked epoch.

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Notes

[i] Bertholt Brecht, „Der Rundfunk als Kommunikationsapparat. Rede über die Funktion des Rundfunks" (1932/33) and „Vorschläge für den Intendanten des Rundfunks" (1928/29).

[ii] Walter Benjamin, „Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit", 1936 (Engl.: "The Work of Art in the Age of Mechanical Reproduction", 1968).

[iii] White Paper on the National Information Infrastructure (NII) initiative, September 1993, http://ibiblio.org/pub/academic/political-science/internet-related/NII-white-paper

[iv] See Tim Berners-Lee, Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web by Its Inventor, San Francisco 1999

[v] See Curry's email from 10 May 1994, explaining the case: http://dvinfo.net/conf/archive/index.php/t-41289.html

[vi] Comparable to other Big Narratives like Wallenstein, Illuminatus or The Hitchhiker's Guide to the Galaxy (that Douglas Adams called „a four-part trilogy in five volumes").

[vii] Coy is an avid Mac user.

[viii] One paragraph further on, Coy indeed writes: „With the Apple II and the IBM PC ends the pre-history of the medium computer."

[ix] John Perry Barlow, A Declaration of the Independence of Cyberspace, February 8, 1996, http://homes.eff.org/~barlow/Declaration-Final.html

[x] The WIPO Copyright Treaty (WCT) and the WIPO Performances and Phonograms Treaty (WPPT), http://www.wipo.int/copyright/en/treaties.htm

[xi] Transcopyright: Pre-Permission for Virtual Republishing, http://xanadu.com.au/general/transcopy.html

[xii] Wizards of OS, http://wizards-of-os.org