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The Durable, the Portable, and the Processible[1]

Storage, transmission, and processing are considered the three basic functions of media (Kittler, *Gramophone*). The various techniques fulfilling these functions throughout history constitute the field of media studies.

Media studies emerged as a distinct scientific discipline after the Second World War, when Canadian economist Harold A. Innis set out to examine the role that storage and transmission of knowledge played in the rise and fall of empires from ancient Egypt to the British colonial empire. Marshall McLuhan continued Innis' work and adapted some of his central concepts to the study of new media like radio and television.

Over the last quarter century the personal computer and the Internet have brought about a change in the landscape of media comparable only to the historical shifts caused by writing, the printing press and electronic mass media. Correspondingly, scholars such as Friedrich Kittler, Lev Manovich, Katherine Hayles, Jay D. Bolter, and Matthew G. Kirschenbaum have tried to assess the techno-logic and cultural significance of digital media and processing.

Most contemporary theoretical approaches to digital media can be understood as an attempt to historicize and systematize the relation between storage, transmission, and processing. Underlying this trinity, however, are notions of orality and literacy that may

apply to the description of the durable and the portable but fail to illustrate the new features of cultural forms in the digital age.

Starting with Innis and McLuhan, then proceeding to Kittler, Manovich, and Kirschenbaum, this paper discusses the concept of processing with regard to the mediality, materiality, and dimensionality of the three basic functions of media and supplements the durable and the portable with the processible.

1. Oral and literal tradition

Innis' studies on the history of communication and media have been subject to much review and critique. In this paper I will pursue only one aspect of Innis' work: the notions of oral and literal tradition and their place in the conceptual framework of Innis' analyses.

At first glance Innis appears to focus on questions of writing. He himself identified his staples research on pulp and paper as the starting point for his later work (*Empire and communications* 6). Key terms of Innis' vocabulary seem to be made for describing the different materials, instruments, and institutions that enable the production of written records, i.e. the ensemble of techniques and facilities Kittler has called *Aufschreibesysteme*—a neologism that translates literally as 'regimes' or 'systems of inscription'.[2]

Innis begins his principal monograph on the subject of communication and media, *Empire and communications*, with a general consideration of the functions and consequences of writing. He highlights three points: Writing creates a "transpersonal memory" to extend and relieve individual memory; it promotes logical and abstract thinking; it is an instrument of power and social control. Thus writing is the prerequisite for all forms of complex social organization surpassing tribal communities. "The monarchies of Egypt and Persia, the Roman empire, and the city-states were essentially products of writing." (10)

This view of writing and its relation to social organization was neither new nor

uncommon in Innis' time. His real accomplishment lies in the fact that he looked beyond general characteristics of writing and insisted on the distinctive features of particular forms of writing. "[G]eneralizations as to the significance of writing tend to hamper more precise study and to obscure the differences between civilizations insofar as they are dependent on various media of communication." (11) For Innis, there is no 'writing' in itself. There are only historically distinct systems of inscription that vary with their media. That is why a history of communication must acknowledge the different media of writing, their inherent logic, and especially their physical properties.

Innis divides the media used for writing over the course of history into two groups: the heavier, durable kind, and the lighter, portable kind. "Media that emphasize time are those that are durable in character, such as parchment, clay, and stone. . . . Media that emphasize space are apt to be less durable and light in character, such as papyrus and paper." (7) This coupling of materiality to the dimensions of time and space allows Innis to link different systems of writing systematically to the two basic criteria that determine the success of large-scale political organizations. What Innis wants to show is the factors that guarantee the stability of such organizations: They must uphold temporal and territorial cohesion; they must last through time and space (7). As social systems they can exist only in the continuation of communication and for that they rely on media. Communication through time requires appropriate means of storage; communication through space requires appropriate means of transmission. Depending on their materiality, Innis thus distinguishes between time-biased and space-biased media.

By facilitating either the preservation of knowledge in time or the proliferation of knowledge through space both types of media emphasize contrasting features of social organizations: While time-biased media favor decentralized power, hierarchical structure, religious tradition, collectivism, and transcendental ideology, space-biased media add to the centralization of power, to less hierarchical structure, administrative control, individualism, and materialist ideology (7–11). The dynamics of time- and space-biased

media and their opposing effects Innis called the 'bias of communication'. If in a given social organization the bias of a time-oriented medium is not checked by a space-oriented counterpart (or vice versa), eventually a monopoly of knowledge will emerge and bring about a communicative imbalance. Large-scale political organizations will not persist unless there is a medial equilibrium that allows them to control both time and space (170).

The concepts of time- and space-biased media, of durable and portable materials with all their implications for culture and society seem wedded to regimes of inscription. It looks as if Innis' key distinction concerns aspects of writing, and writing only. But this distinction is in fact built—genealogically and systematically—upon another distinction: the one between oral and literal tradition, the difference between the spoken and the written word. I will try to show this with regard to Innis' earliest published text on the history of communication.

"Minerva's Owl" is the first paper in which Innis takes a macro-historical perspective to examine the relation between communication and empires from ancient Egypt to the modern day. But nowhere is there mention of the time- or space-bias of media in the text. Neither are the categories of time or space used in a systematic way to describe the success or failure of the empires Innis analyzes. Related distinctions like centralized and decentralized structure or religion and administration that play an important role in later texts are also lacking. Still, Innis' principal argument about the dynamics of competing media and monopolies of communication is recognizable—but the competition is not between different systems of inscription. Unlike in his introduction to *Empire and communications*, Innis lays emphasis not on the general characteristics or physical properties of writing but on the relation between the spoken and the written word, and what is crucial about writing is not the materiality of media—it is the complexity of its code ("Minerva's Owl" 4).

Monopolies of knowledge also appear in a slightly different light, since in this text they are directly related to issues of complexity: On the one hand a complex code of

writing like the Egyptian hieroglyphic script is difficult to master and necessitates a highly trained group of scribes. On the other hand, the complexity of the code inhibits the vernacular form, develops an elaborated but rigid grapholect and loses its connection with the oral tradition. "A complex system of writing becomes the possession of a special class and tends to support aristocracies. A simple flexible system of writing admits of adaptation to the vernacular but slowness of adaptation facilitates monopolies of knowledge and hierarchies." (4) Monopolies of knowledge are ways of controlling the discourse; they are "monopolies in language" (29). They occur wherever large parts of society are shut out of participating in public discourse because written communication remains the exclusive property of an elite and becomes an instrument of power and control. In the same way as economic monopolies hamper the competition for goods and services, monopolies in language interfere with the competition of ideas and opinion making. "[Oliver Wendell Holmes Jr.] stated that 'the best test of truth is the power of thought to get itself accepted in the competition of the market' without appreciating that monopoly and oligopoly appear in this as in other markets." (32)

The antidote to a monopolized discourse built on a complex regime of inscription is the flexibility of the spoken word, and this flexibility can only be preserved in writing if the code is as simple as possible and adapts well to the vernacular. Opposition to monopoly in language takes the form of democratizing the public discourse by means of a common system of writing. For Innis, the paradigmatic case of such a system is the Greek alphabet, and that is why Innis' analysis of communication in ancient Greece is the pivotal element in his understanding of media. In the study of all historical epochs and cultural regions Innis always concentrates on the antagonism between competing regimes of inscription (what he will later call the time- or space-bias of media): stone and papyrus in Egypt, stone and clay in Babylonia, papyrus and parchment in the Byzantine Empire, and so on. It is only in his description of Greek culture that he focuses on the interplay of oral and literal tradition.

According to Innis, the greatness of Greek culture lies in the power and vitality of the spoken word. "The significance of the oral tradition was shown in the position of the assembly, the rise of democracy, the drama, the dialogues of Plato, and the speeches including the funeral speech of Pericles in the writings of Thucydides." (7) The oral tradition could rise to the highest reaches of cultural expression only because it commanded a suitable system of writing: "The Greeks took over the alphabet and made it a flexible instrument suited to the demands of a flexible oral tradition by the creation of words." (7) Oral and literal tradition, the spoken and the written word are the conceptual nucleus of Innis' future distinction between time- and space-biased media. It is not that the spoken word is one example of time-biased media among others and the written word is either a time- or a space-biased medium (depending on the code or material used). It is the other way around: Speaking and hearing are the principle of time-bias, and writing and reading are the principle of space-bias.

A few remarks will hopefully illustrate this point: Allegedly, there is a basic correspondence between language and the categories of time and space. Spoken words are experienced as acoustic events vanishing in time, while written words constitute visual phenomena occupying space. As time is the dimension of oral language, so space is the dimension of written language. In addition to time and space, the features of social organization Innis later attributes to time- and space-biased media can also be matched to spoken and written language: Spoken language is often described as inherently dialogical, whereas written language is seen as fundamentally monologic. The structure of oral communication seems decentralized, for in an ordinary conversation speaker and hearer constantly switch roles and the center of dialogue is always shifting. In contrast, communication by written language appears to be centralized. Writing installs the author as the fixed center of a temporally and spatially expanded discourse and relegates readers to the margins of a written monologue. While spoken language gathers people into groups of speakers and hearers, written language isolates them as individual authors and

readers. Finally, fleeting spoken words seem to be imbued with the spirit of the speaker, while writing materializes language into concrete signs. "The oral tradition implies the spirit, but writing and printing are inherently materialistic." ("Problem of Space" 130)

In all his historical analyses Innis underscores the importance of a balance between time- and space-orientation for the viability of empires. How, if at all, does this idea of balance apply to the dynamics of oral and literal tradition in Greek culture? As we have seen, in Innis' mind simple writing systems alone can avert the risks of monopolies in language. Writing must not be a specialized code detached from the vernacular or the exclusive domain of a specialized class. It must be easy to learn and use and serve as a malleable medium for the oral tradition. Of all the systems of writing known to man only the Greek alphabet meets these conditions. As opposed to difficult and complex scripts like the Sumerian cuneiform or the Egyptian hieroglyphics, which establish a hermetic discourse far removed from everyday speech, the alphabet adapts to colloquial language.

In *Empire and communications* Innis describes the accomplishment of the Greek alphabet in more detail. Unlike all other systems of writing it maps spoken language on the most elementary linguistic level: It marks down phonemes, the smallest distinctive sounds of spoken language. "Distinctiveness was combined with simplicity of form. Sounds of human speech were analysed into primary elements each represented by a separate visual symbol." (*Empire and communications* 43) In comparison to the complex codes of the cuneiform or the hieroglyphics the Greek alphabet is a "flexible", "simplified type of writing" for "efficient representation of sounds" characterized by its "adaptability to languages" (53–54). The Greek alphabet is therefore a code that erases itself, as it were, in favor of the spoken word. Its success is "the success with which writing linked the written to the spoken word" (54). It is a system of inscription that ceases to be writing proper. At the level of the fundamental distinction between the spoken and the written word there is no balance of competing media. Instead there is the primacy of the oral tradition.

Similar judgments on language and writing in general and the alphabet in particular are common and widespread throughout the field of communication and media studies. Paradigmatic is Eric A. Havelock who, in following Innis, claimed that the Greek alphabet reduced writing "to a trick" and "came to resemble an electric current communicating ... directly to the brain ... without reference to properties of the letters used." (84). Innis and Havelock share the belief in a 'transparent immediacy' (Bolter and Grusin) intrinsic to communication, an immediacy that can be obtained by use of a diaphanous medium, a medium that serves as a noise-free channel, a medium that withdraws completely behind the message and thus ensures perfect understanding. The shortcomings and misconceptions of such notions of communication, language, and writing cannot be discussed here. At any rate, it should be noted that from a linguistic standpoint the supposed superiority of the Greek alphabet over other writing systems is dubious (Coulmas) and that from a grammatological perspective like Derrida's the claim of priority of spoken language or of any other system of signs is unsustainable (*Grammatology*).

To sum up our conclusions so far: Firstly, Innis' concepts of time- and space-biased media with all their implications rest upon an idealized distinction between spoken language and writing. They are the results of applying an alleged difference between spoken language and writing on writing itself once more. Secondly, spoken language is the unmarked term in the pair spoken language/writing. Writing is defined through its relation to spoken language only, and good systems of writing are those that make themselves disappear behind the spoken language they represent. At the center of Innis' notion of media there is not mediacy but immediacy—the immediacy of the spoken word and of the alphabet as its transparent medium.

Innis never made a secret of his preference for the spoken language and in his talk at the 1948 Conference of Commonwealth Universities declared: "My bias is with the oral tradition, particularly as reflected in Greek civilization, and with the necessity of

recapturing something of its spirit." ("Critical Review" 190) In his introduction to *Empire and communications* he points out the derivative character of writing: "[W]riting as compared to speaking involves an impression at the second remove and reading an impression at the third remove." (*Empire and communications* 11) Throughout the book he stresses the "powerful tradition" of orality, its "freshness and elasticity" and warns of writing's "dead hand" that threatens "the spirit of Western man" (66, 57). Accordingly, the end of Greek culture had come when "[t]he living growth was replaced by the dead letter" (105). As Innis reminds his readers in the preface to *The Bias of Communication*: "The letter killeth and the concern has been with the diverse means by which different types of letters bring about their deadly results." (*Bias* xliv)

2. Mechanical and Electric Age

Since Innis' concepts of time- and space-biased media are inextricably linked to notions of the spoken and the written word their historical scope is limited by the appearance of technology that does not easily fit into the categories of orality and literacy. This seems to be the case particularly with electricity and electronic media. Unsurprisingly then, Innis' most prominent critic is one who has occasionally been hailed as the prophet of the electric age and the theoretician of television: Marshall McLuhan. McLuhan considered Innis his predecessor in the study of communication and adopted his fundamental assumptions on the influence of media on culture and society. He followed Innis in analyzing human history as a history of the media but in the course of it reinterpreted some of Innis' central concepts. The connection between the two men and their work has been discussed extensively. Here I will only deal with McLuhan's reinterpretation of Innis' terms of time- and space-biased media.

McLuhan begins his critique where Innis' historical investigation ends: the advent of electricity and 'electric media'. Under the impression of 19th century colonial imperialism and two world wars Innis regarded the modern Western world as being

obsessed with the idea of territorial expansion. Accordingly, he saw contemporary means of communication as an expression and instrument of the extreme space-bias of his time ("Plea for Time"; "Problem of Space"). The connection between these media and the domination of space is more than plausible if one considers the importance all media—and especially those of transmission—have always had for the military (Virilio). The problem, though, is that while the label of space-biased media correctly identifies one essential aspect of the new technology, it misses the novel character of electricity and electronic media.

Bound to his bias towards the oral tradition, Innis rated technologically advanced media as an extension and amplification of the space-bias of literal tradition or, more general, of writing. The names of many 19th and 20th century media alone seem to prove him right: Photography, telegraphy, phonography, and cinematography all carry the same suffix derived from the Greek γραφειν ('graphein'), meaning to 'to carve' or 'to write'. The term 'graphic media' could therefore be applied not only to the various tools of image-making such as pencil, paint, and photography but primarily to all space-consuming techniques of inscription, irrespective of whether these inscriptions are meant for human eyes, ears, or even for technical devices alone.

Innis' reluctance to recognize electric technology as something new and different in the history of communication shows in his vocabulary. As electronics, the first digital computers, and the science of cybernetics ushered in the end of the mechanical age, two years after Claude E. Shannon's "A Mathematical Theory of Communication" and Norbert Wiener's *Cybernetics* appeared and in the same year that Alan Turing's "Computing Machinery and Intelligence" was published, Innis still spoke of the "mechanization" of culture (*Empire and communications* 162–169). In Innis' words, modern technology had lead to a "large-scale mechanization in communication" (163); language was "reinforced by mechanized communication" (167); and the "pressure of mechanization on words" affected the printed word as well as "the spoken word in the radio" (165).

The view Innis had of 'electric media' as inherently space-biased and as manifestations of the mechanical age marks the main difference between his and McLuhan's theory. The following passage taken from *Understanding Media* reads like a direct response to Innis' allegations.

> By many analysts, the electric revolution has been regarded as a continuation of the process of the mechanization of mankind. Closer inspection reveals quite a different character. ... Many analysts have been misled by electric media because of the seeming ability of these media to extend man's spatial powers of organization. Electric media, however, abolish the spatial dimension, rather than enlarge it. By electricity, we everywhere resume person-to-person relations as if on the smallest village scale. ... The organic everywhere supplants the mechanical. (255–256)

In McLuhan's mind, the electric revolution had brought the mechanical age to an end and in the place of mechanization established a new techno-logic of culture—a culture that was no longer fragmented but holistic.

McLuhan describes mechanization as the procedure of analyzing and splitting up all things and tasks into elementary parts or work steps in order to be reproduced in identical form (248). But in the study of media and communication, mechanization must not be understood simply as a way of reinforcing the spoken or the written word, as Innis did. According to McLuhan, mechanization itself is affiliated to the written word. Technologies of writing serve as the models and most powerful agents of the mechanical age. The historic precursor of mechanization is the phonetic alphabet, which analyzes speech into elementary sounds, while the first technical implementation of mechanical logic is the printing press, which enables exact reproduction of the written word.

The combination of Greek letters and Gutenberg's printing press accounts for every major aspect of the mechanical age: mass-production and mass markets, universal literacy and education, modern science and industrialism, nationalism and individualism (173).

The uniform 'writing space' (Bolter) of alphabet and typography fabricates the equally uniform environment for perception and action in the 'Gutenberg Galaxy': visual space. McLuhan argues that alphabetic writing gave man "an eye for an ear" (84) and that printing intensified the precision and quantity of visual information until the entire world was perceived as purely visual. For that reason McLuhan replaces Innis' distinction between the spoken and the written word, oral and literal tradition, time- and space-biased media with his own complementary concepts of acoustic and visual space.

Writing goes hand in hand with visual space and mechanization. But contrary to Innis, McLuhan conceives of electric technology not as a reinforcement of the written word, literal tradition, space-biased media, and mechanization. Instead, with the electric revolution the acoustic space of the spoken word and of oral tradition returns. Mechanical fragmentation and expansion of space are reversed. "The stepping-up of speed from the mechanical to the instant electric form reverses explosion into implosion." (35) Electricity annihilates the spatial dimension and leads mankind into "the new world of the global village" (93). Visual space makes way for an electrically mediated acoustic space of instantaneous communication. "[T]he electric implosion now brings oral and tribal ear-culture to the literate West. . . . [E]lectric technology now begins to translate the visual or eye man back into the tribal and oral pattern with its seamless web of kinship and interdependence." (50)

As we have seen, both Innis and McLuhan use the same distinction between orality and literacy as the conceptual basis for their inquiries into media and communications, while in their respective historical analyses they draw opposite conclusions. Innis associates the new media of his time with mechanization and treats them as technologically advanced amplifications of a space-biased literal tradition; McLuhan, on the other hand, claims that electricity overcomes the logic of mechanization and brings back the acoustic space of oral tradition. Neither of the two seems to credit electric technology and media with qualities beyond those attributable to the spoken or the

written word. Yet McLuhan's notion of the acoustic space contains the seeds of something new that cannot be assigned to the logic of either spoken language or writing.

Acoustic space for McLuhan is not simply the dimension of the audible, of the spoken word. It is, more accurately, the dimension of the tactile. But again, tactility is not simply the sense of touch. McLuhan rates tactility not as one sense among others. In fact, tactility is the primary and most important sense because it is the interaction of all the senses with one another. Tactility is the mode of holistic perception and comprehension.

> Our very word "grasp" or "apprehension" points to the process of getting at one thing through another, of handling and sensing many facets at a time through more than one sense at a time. . . . "[T]ouch" is not skin but the interplay of senses, and "keeping in touch" or "getting in touch" is a matter of a fruitful meeting of the senses, of sight translated into sound and sound into movement, and taste and smell. (60)

Under conditions of orality total sensory involvement was the norm. Literacy intensified the visual sense at the expense of all the others and thereby diminished tactility (84). Finally, electricity retrieves orality and thus marks the return of the tactile. Although media like television may seem to be audiovisual by their nature, "[e]lectricity is only incidentally visual and auditory; it is primarily tactile." (247–248)

Tactility is the sensory mode of the spoken word and of oral tradition. In the electric age, though, it achieves a very different quality. This technological change announces itself in modern art.

> The stipple of points of Seurat is close to the present technique of sending pictures by telegraph, and close to the form of the TV image or mosaic made by the scanning finger. All of these anticipate later electric forms because, like the digital computer with its multiple yes-no dots and dashes, they

caress the contours of every kind of being by the multiple touches of these points. (247–248)

Admittedly, the phrase "yes-no dots and dashes" in conjunction with computers is odd. But it is clear that McLuhan means to describe the binary digital logic of computers. He aligns computer technology with the technique of discrete representation—the "logic of factory" that all modern media follows (Manovich, *Language* 28)—and at least hints at the procedure of digital sampling. What McLuhan calls the "scanning finger" of electricity is really the digit of digitization. Tactility in the electric age amounts to more than just the multisensory experience of the sounds and images of television, video, or similar media. In a very basic way it is the sensing, scanning, and sampling of all cultural forms by encoding them in binary digits and making them available for digital computing.

McLuhan has occasionally been accused of misunderstanding digital technology. This is correct in that he doesn't bother with the technical details of digital computing. One could say, however, that he doesn't need to. McLuhan's theory is an aesthetic theory. He is interested in the internal workings of media only insofar as they have effects on human perception. From this viewpoint, the crucial thing about digital technology is not how it works but what kind of tactility it implements, and even if McLuhan doesn't have much to say about the functioning of digital computers, he still correctly outlines the impact of digital technology: "[T]he difference between the previous mechanical age and the new electric age appears in the different kinds of inventories. Since electricity, inventories are made up not so much of goods in storage as of materials in continuous process of transformation at spatially removed sites." (347) McLuhan here refers to the automation of industrial production and the coming of on-demand production and just-in-time delivery. But since automation is an application of digital technology one only needs to replace 'electricity' with 'computer' and 'inventory' with 'data' to get a fairly accurate description of data processing: 'Since *computers*, inventories are made up not so much of goods in storage as of *data* in continuous process of transformation . . . .'; or: 'Since

computer networks, inventories are made up not so much of goods in storage as of *data* in continuous process of transformation at spatially removed sites.'

McLuhan's analysis of the electric age and his concept of tactility have finally brought us to the issue of digital processability. Digital media cannot be judged in conventional terms of orality or literacy. The complements of the spoken and the written word—the conceptual foundation of Innis' and McLuhan's theories—fail to convey what makes digital media so different: the techno-logic McLuhan describes as the 'continuous process of transformation'. Digital media are, perhaps, best understood as special kinds of processes. These processes are neither spoken nor written (though they must be written as programs so they can be executed); they are not biased towards either time or space (though they consume both space and time); they are not durable or portable (though they require and produce such records). Digital media take form as forms that are first and foremost *processible*.

3. The Processible

In his discussion of writing and printing McLuhan designates the capacity "to store and expedite information" as the basic function of media (158). Digital computers, meanwhile, realize a third capacity. To storage and transmission they add processing of information. How does the notion of the processible relate to the durable and the portable, to time- and space-binding media, to the spoken and the written word?

Innis' communications theory and his terms of time- and space-biased media are exemplary of the transmission view of communication. The concept of transport across temporal or territorial distance implies stability of the transported messages or forms. This is most obvious in the case of literal tradition. What is put down in writing does not change. *Verba volant, scripta manent*. The written word, as Socrates tells Phaedrus in Plato's dialogue, "always says only one and the same thing" (275d). Since the beginning of Western philosophy invariability has been seen as one of writing's defining characteristics.

The fixity of the written word is intensified still by the printing press (McLuhan; Eisenstein; Ong). As 'immutable mobiles', written or printed records "move without transformation from one place to another" (Latour 35).

Invariability also manifests itself in the concept of orality. Spoken words apparently leave no lasting trace. Nevertheless, one may consider the spoken word to be an embodiment of invariability in an even higher or nobler way. According to Western metaphysical tradition, the constancy of spoken language applies not to its medium—sound and voice—but to its meaning. Derrida has shown that linguistics and Western philosophy have long relied on the assumption of an "immediate presence of sense to the soul within the logos" (37). And on the scale of oral communities invariability takes on yet another form: Due to the lack of written records that would allow for the experience of historical changes such communities are characterized by a "homeostatic organisation of the cultural tradition" (Goody and Watt 307).

Storage and transmission both aim at stability of form. Forms stored or transmitted are supposed to last through time or to move through space without noticeable changes. What is stored is 'fixed' so it can be retrieved in identical form later; and what is transmitted is expected to arrive at its destination in identical form. As Claude Shannon put it in "A Mathematical Theory of Communication": "The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point." (379) Although Shannon here is concerned with the transmission of information, the terms "reproduce" and "select" allude to the procedure of encoding and decoding that is crucial for digital processing. Shannon's theoretical work marks the historical shift from media of storage and transmission to media of processing and computation.

This shift has prompted Lev Manovich to call for a revision of media theory. Concepts of time- and space-biased communication, of orality and literacy, of stable forms being stored and transmitted no longer adequately describe the workings of media in the

digital age.

> New media calls for a new stage in media theory whose beginnings can be traced back to the revolutionary works of Harold Innis and Marshall McLuhan of the 1950s. To understand the logic of new media, we need to turn to computer science. It is there that we may expect to find the new terms, categories, and operations that characterize media that became programmable. *From media studies, we move to something that can be called "software studies"—from media theory to software theory.* (Manovich, *Language* 48)

Digital technology, Manovich claims, forces us to eliminate media as 'hardware' from media theory and points us to software instead. With digital computers the concept of media itself seems to have served its time. But should the theoretical program formulated by Innis and McLuhan that turned its attention to the factuality of media, to stone and papyrus, to the printing press and television really ignore the materialities of communication? In fact, it is precisely the material qualities of digital computers that constitute the 'processible'.

Software in Manovich's recent work assumes the position electricity held in McLuhan's theory: "I think of software *as a layer that permeates all areas of contemporary societies.*" (*Software* 8) Software, indeed, can be regarded as a distinct layer or entity by virtue of the stored-program architecture of digital computers. Without software, such computers will be of no use because as general-purpose machines they must first be instructed to perform a specific computation or task. But this must not lead to a naive digital idealism. Kittler has notoriously remarked that "There is No Software." To Kittler software is not just an obstruction of the self-determined user that serves the interests of the computer industry. It is first and foremost a deceiving abstraction from the concrete physical conditions and workings of computing. There would be no software, were it not for the restraints that everyday speech puts on our handling of computers. So while

software at once conceals hardware and simplifies the writing of programs by humans, programmability as such, Kittler reminds us, remains "an exclusive feature of hardwares, more or less suited as they are to house some notation system" ("No Software" 153).

The forms of digital culture are by no means 'virtual', 'immaterial', or 'unreal'. In spite of ever-shrinking devices and embedded systems, of wireless networking, cloud computing, and the like, our medial environment is built upon the very physical and material realities of computer hardware. The processible does not replace the durable and the portable—the materialities of storage and transmission—with an immateriality of digital information. Matthew Kirschenbaum has recently made a strong case for considering the physical framework of digital culture (*Mechanisms*). In an exhaustive examination of electronic text he unmasks what he calls the "medial ideology" of the digital age—the assumption that digitally stored, transmitted, and processed information is immaterial in character—as an effect of a highly complex arrangement of physical mechanisms. Kirschenbaum introduces the terms 'forensic materiality' and 'formal materiality' to describe this specific materiality of computer hardware.

The forensic materiality of digital devices comprises their concrete physical setup from the casing down to the nanometer-sized circuits and micrometer-sized electromagnetic inscriptions of data on hard drives. While on this level of materiality all parts and aspects of the setup are unique, individual phenomena in time and space, in their interaction they aim at eliminating all variances and deviations occurring in the storage, transmission, and processing of data. The resulting formal materiality is an abstraction that has cleansed data from the 'dirt' and 'noise' of physical inscriptions, elevated it to the state of 'pure' digital information and thus gives the illusion of "*immaterial* behavior: identification without ambiguity, transmission without loss, repetition without originality". (11) Just as the shapes of all the letters *e* printed on the page of a book may vary ever so slightly and still be identifiable as the type 'e', the rectangular shapes of electromagnetic inscriptions on a hard drive platter may be

minimally distorted. Within the defined range of tolerance such variations on the level of forensic materiality do not matter. As bits, i.e. on the level of formal materiality, the inscriptions always represent the distinct value of either 0 or 1.

The purpose of forensic and the property of formal materiality are absolute definitude and sameness of form—but definitude and sameness of form not only for the sake of stability (though that is a technical option and the objective in storage and transmission) but also, and more importantly, for exact switching of form. Formal materiality disambiguates forms stored and transmitted in order to process them in precise and predictable ways (Kittler, "Real Time"); it is "the formal environment for symbol manipulation that is the reservoir for every function of a computer" (Kirschenbaum 12). Digital media store and transmit texts, sounds and images, the written and the spoken word and all other kinds of information as processible data. The techno-logic of the computer turns every form into a variable that can automatically be changed according to requirements. In digital media, "[i]f something stays the same for a while, that is an exception rather than the norm." (Manovich, *Software* 175) Mechanization splits up tasks into their elementary steps so they can be reproduced in identical form; computerization digitizes objects into bits in order to transform them at will. While the message of the mechanical is "more of the same", the message of the processible is an alchemic "everything in every form".

What are the cultural consequences of digital processability? First of all, there is the simple and basic fact that processible forms can and will be processed: Text documents are being edited, images retouched and composited, sound recordings remixed, spreadsheets updated, lists sorted, confidential files encrypted and decrypted, databases extended, applications upgraded, and so on. But not only can processible forms apparently be modified constantly and without end. Every act of accessing such forms in itself requires their processing for human eyes and ears (and possibly other senses too). "[W]hether we are browsing a web site, use Gmail, play a video game, or use a GPS-enabled mobile

phone to locate particular places or friends nearby, we are engaging not with pre-defined static documents but with the dynamic outputs of a real-time computation." (17) Moreover, for many—if not most—processed objects there is not one object prior to processing that can be identified as the single 'source' of the process. Typically, processed objects are assembled from various sets of processible forms. This is most obvious in complex websites that are often made up of different blocks of texts and a number of images, videos, or sounds coming from one or more databases, but the same holds true for other digital objects as well. In short, the structure of the processible is modularity (Liu).

The most serious implication of processability for cultural forms, though, is that it radically questions the idea of 'authentic form' or 'proper representation'—an issue that is paramount to storage and transmission of forms. In the realm of digital processing, there is no 'true' state or appearance of any object conforming to its 'actual being'. There are only momentary states in the course of a potentially endless chain of processing that may or may not be adequate to some specific demand or task (Kirschenbaum 145–146). Referring again to the example of websites: The 'content' of a website can be rendered by different browsers and devices in different ways for different needs. Still, the matter is more profound. Even in the case of a single and seemingly simple file—like, for example, an image file—one cannot point to a certain visual (or other) presentation and designate it as the 'authentic', 'true', or 'actual' form of the file. An image file may appear as a directory list item giving its name, date, and time of last change, size and type; it may also appear as an icon or as a thumbnail preview in an image browser; it may appear as metadata describing the camera settings in effect when the picture was taken; it may appear as a magnified detail of the picture; it may appear as a color histogram; it may even appear as a string of binary or hexadecimal values, when opened with a hex editor. One could call this string of binary digits the 'true' form of the file, but that would be beside the point, for these digits 'exist' only as physical inscriptions in forensic materiality to be processed into diverse forms of formal materiality, *one* of which is the shape of a long

series of 0s and 1s displayed on a computer monitor.

The processible must not be mistaken for an antithesis of the durable or the portable, just as the function of processing is not opposed to the functions of storage and transmission. On the contrary, digital technology makes possible the storage of huge amounts of data in a manner more persistent than is often assumed and it allows for transmission through space in fractions of seconds. Yet, the logic of digital processing is fundamentally different from the principles governing storage and transmission. Consider the dimensional aspect: Storing and transmitting deal with large-scale temporal and spatial problems. Forms must be preserved for long periods or sent across wide distances. In processing, on the other hand, time and space seem to collapse. The technical implementation of digital processing systematically minimizes temporal and spatial differences. The clock cycle of a modern processor is shorter than a nanosecond and its circuits are measured in mere nanometers. The dimensions of the processible are not great spans of time or long stretches of space but the near zero time and space of the switch.

The distinct features of the processible also show when compared to oral and literal language. It has already been noted that the spoken word is often thought to be immaterial because of its fleeting character, whereas written words always take material form in physical inscriptions. Kirschenbaum's concepts of forensic and formal materiality provide a deeper understanding of the processible as being neither simply material nor immaterial but a strange kind of technical hybrid between the material and the immaterial. A similar duality of the processible becomes apparent when it is discussed in terms of software: Every piece of software must be produced as a written text in a particular programming language (or sometimes even in so-called machine code). But, as written text alone software does not do any of the things it is written for. These things only happen when software is executed in the form of compiled or interpreted code, and this execution of code is in a way much more similar to spoken discourse than to written text. Software is 'written' in more or less stable inscriptions consuming space on paper,

electromagnetic tape, hard drives, and RAM or ROM chips; and it is 'spoken' or performed as operations consuming time.

The processible seems to be suspended in an undecidable position between its material and its immaterial aspects, between the written and the 'spoken' manifestation of its forms, between being an object in space and an event in time. Processible forms are bound to change constantly into other forms, themselves assembled from multiple sources and different sets, never to reach a final state that could be called a 'true' representation. The processible is that which can and will be switched.

The impact of digital processability on traditional concepts of the work of art, originality, and authorship have been extensively reviewed in various fields and by many scholars usually and unfortunately labeled as "postmodernists". Arguably, among all cultural forms it is written language that has been affected the most by the techno-logic of digital media. Hypertext, online chat, text messaging, and micro-blogging, to name but a few, all attest to the shifting and blurring of boundaries which seemed to demarcate clearly the spoken word from the written and thereby secured the primacy of orality. This is not to say, however, that in the digital age technologies of writing claim the place once held (or thought to be held) by spoken language or speaking beings. It seems as if the processible belongs neither to the spoken forms of language nor to the written ones, neither to 'referential' speech nor to 'operative' or 'auto-operative writing' (Krämer). It appears to point, instead, at a form or figure that thinkers like Aristotle, Nietzsche, and Derrida have identified—each in their own way—as a central technique of language, not of spoken *or* written language but of language as a symbolic order: the metaphor. The switch of the digital computer is, as it were, a technical implementation of metaphoricity. It conveys the transferability of metaphor to digital processability. A general-purpose machine open to all programmable uses such as calculator, typewriter, and musical instrument, the digital computer "only exists in its manifold metaphoricity" (Tholen 669).

4. Media in transition

McLuhan claimed that "[a]ll media are active metaphors in their power to translate experience into new forms" (57); he also remarked "that the 'content' of any medium is always another medium" (8). The digital computer, following McLuhan's argument, is an especially powerful metaphor. It cannot only have one particular medium as its content but *any* media; and since digital forms are by definition processible, the computer is not restricted to simply represent 'old' media but open to endless transforming remediations. The forms of 'old' media—i.e. their distinct mediality and specific materiality—are modeled in the formal materiality of digital computing so they can be processed in any way desired. This is what is 'new' about digital media: "*'[N]ew media' is 'new' because new properties … can always be easily added to it.*" (Manovich, *Software* 71) The digital computer acts as a *metaphor machine*, capable of generating ever-new media by simulating, decomposing and reassembling 'old' media like the typewriter, cinema, or phonograph.

The transition we're witnessing is therefore not just the transition from 'old' analog media to 'new' digital media, from storage and transmission to processing, from the durable and the portable to the processible. It is the transition of the processible itself, on the most fundamental level—the transition from one digital state to another, from one processible form to another, an event occurring millions or even billions of times every second in the chips of PCs, set-top boxes, MP3 players, smartphones, digicams and camcorders, etc., bringing texts, sounds, and images into as yet unforeseen configurations. The transition of the processible brings all media into transition.

Notes

[1] I would like to thank Ruth Tuschling, Philipp Stucki, and Anna Tuschling who have read and commented on early versions of this paper.

[2] The English translation of *Aufschreibesysteme* as 'Discourse Networks' (*Discourse Networks*) in my opinion doesn't convey the unusualness of the German term nor the accent it puts on the technology of writing.

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