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Printing in the Early Modern Era -
A Media Revolution and its Historical Significance

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One of my studies bears the title "Printing in the Early Modern Era", and is sub-titled "An historical case technologies". This was, and is now, intended to draw attention, among other things, to the topically of this subject for us at the present time.
This is a subject that deserves a broader public beyond the circle of specialist scholars. It is of topical interest because we - like the people of the 15th and 16th centuries - are also currently experiencing a media revolution. The manner in which we obtain, store, process and transmi information is being changed by the use of the computer. New forms of human collaboration and doubtless also social life are coming into being; the linking of electronic equipment and files raises problems, e. g. those of data protection and the preservation of the private sphere, which lead to violent discussions. Arguments for and against the new media are exchanged on TV and in books; there is hardly anyone who is not involved in speculation as to how these media will alter our lives in future.
So far, however, we have only very limited experience in estimating the consequences of the implementation of information and communication technologies. Furthermore, there are many indications that our ability to foresee the future of more complex social and technica movements is restricted.
In such a situation, it would see to be called for first of all to collect experience on the connection between changes in culture and the media by the investigation of historica phenomena. One such phenomenon is doubtless the introduction of printing. This offers itsel particularly because here, in contrast, for example, to the introduction of writing - now seen as a complex information technology - we possess excellent sources. Furthermore, this media revolution took place 550 years ago. This distance in time should suffice to consider the positive and negative consequences with the necessary sobriety.
Among the large number of works dealing with the structures and effects of Gutenberg's invention, mine differs from the others by reason of its perspective based on communication- and information-theory. I conceive society as a system that obtains information, processes, reflects on and applies it, and in doing so is dependent on material media. The historical question then runs: "What happens when certain of the media or data stores, or even processors, are replaced or modified by new technologies?"
Space does not permit me here to trace the changes involved in the transition from the oral to the literate, and then on to the typographical culture. I should, however, like at least to explain the information cycle of the typographical culture, and in doing so indicate some of the innovations compared with the medieval communication situation.
The following diagram 1 provides a survey of the most important stages of the informati cycle in the European cultures influenced by printing.

The author functions as the sensor of the information system. He observes the environment, processes his experiences and records them in manuscripts. The typographeum, i.e. the printing workshop with all of its various equipment, receives the written texts (or drawings). This already shows that the typographical civilization is dependent on the older manuscrip techniques and media, and integrates them into its system. There was never more writing b hand, and perhaps also talking, done than in this culture.
In the course of printing, the information is once again transformed. Page by page, the written text is set with leaden type, enclosed in frames, and then, together with the sheets of paper, pushed under the press. The use of metal is of significance from the point of view of the history of technology, since up to then machines, including for instance clocks, had almos

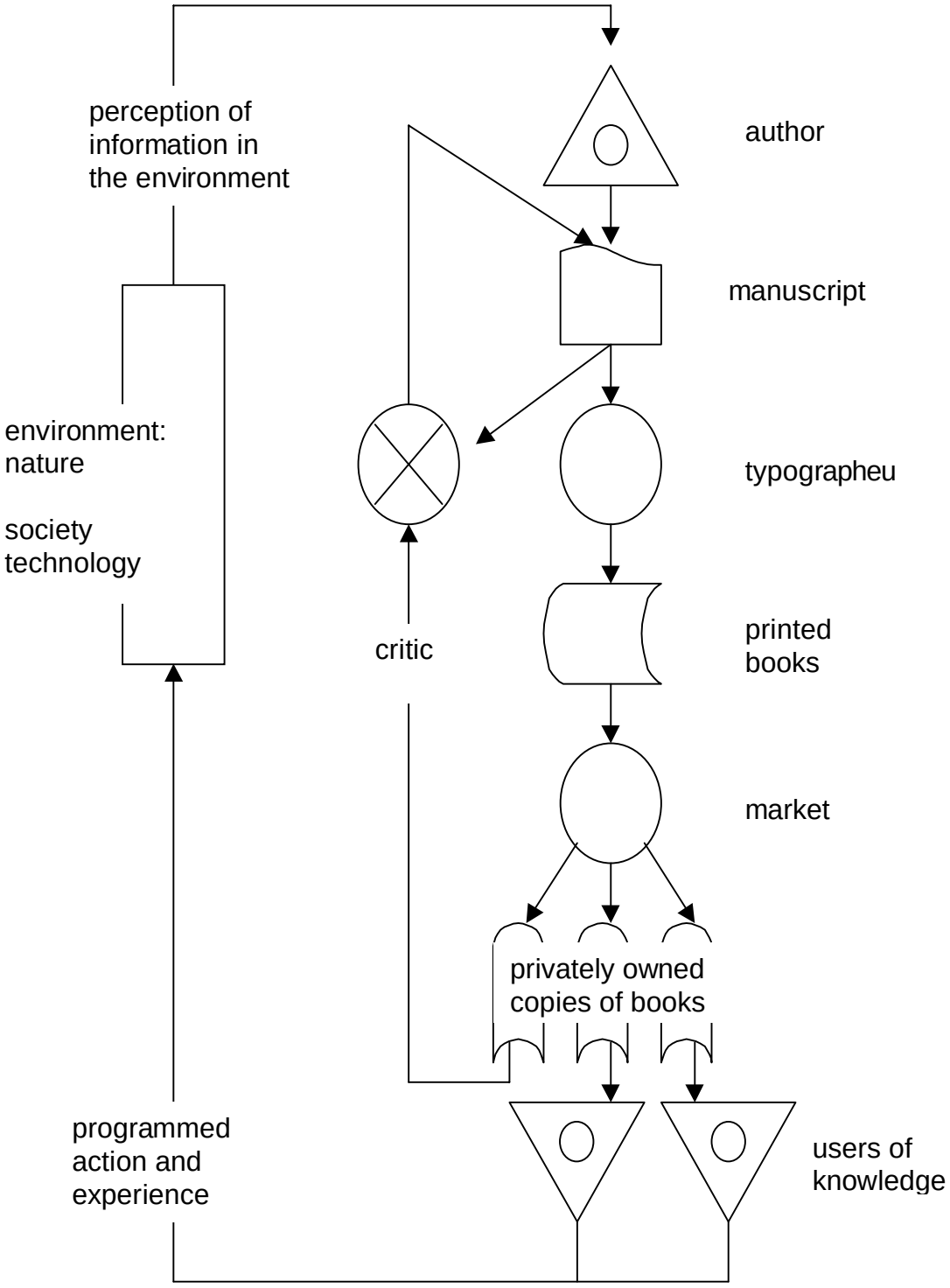

Diagram 1: The information cycle in the European cultures

exclusively been made of wood. With printing, the triumph of metal in "mechanica engineering" began - as did that of mass production, of course. Gutenberg's technolog permits the production of identical workpieces, with a precision typical of the industrial age, but not of course of preceding forms of production.

From the point of view of information-theory, the typographeum rendered possible the parallel processing of information: one and the same text could be read simultaneously, by reason o the reproduction. Contemporaries experienced this phenomenon as the 'acceleration' of the exchange of information, and for the most part emphatically welcomed this. In 1488, i.e. barel 50 years after the first brief works had come off Gutenberg's printing press, the monk W. Rolevinck was already praising the printing press as "the art of arts, the science of sciences" . He continues (in his chronicle "Fasciculus Temporum", Strasbourg 1488, f. 89v): "Thanks to the rapidity with which it is used, it is a desirable treasury of wisdom and knowledge, for which all yearn with a natural longing, which as it were springs from a profound, dark hiding-place and both enriches and illumines this world, which is in a parlous state. The huge quantity of books once available in Athens or Paris or other seats of learning, or in religious libraries, only to a very few scholars, is now, thanks to this art, spreading everywhere, through every tribe and people, nation and language, so that we verily see fulfilled what is written in the 1st chapter of the "Wisdom" (i.e. of Solomon): 'Wisdom preaches out side and lets its voice echo in the streets.' "

Ulrich Han, Johannes Trithemius, Polidorus Vergilius, and many others after them praised the new miracle machine for the fact that "one could print more in a day than one had previously been able to write in a year". Vergilius wrote in 1499 that "there is no longer any book that any man, of however modest means, must do without." Gutenberg's invention appeared to bring within reach many a long-cherished social dream. Sebastian Franck was convinced tha "the never sufficiently praised art of printing has opened up and brought to light the precious treasures of written art that have for so long lain hidden in the tomb of ignorance. Would God that this art had, by divine favor, been discovered earlier, in which case doubtless many books, including the best of Pliny and Livy, would not have been lost. Through this art of printing, the long-dosed spring of divine and ineffable wisdom and art is made available of all." (Chronica, Strasbourg 1531). Oblivion, which had always threatened all oral cultures, but clearly also those in possession of the art of writing now lost its terrors. In the early modern era, people were convinced that they had discovered in this machine a means for the eternal preservation of knowledge and the general enlightenment of the people.

And in fact this optimism continued up to the most recent past; now, however, people consider that they require new wonder-machines to master the flood of data.

At that time, there were a number of other innovations that were required to render possible the triumph of the new technology. For if the printed books had been distributed just as the medieval manuscripts had been, the cultural consequences of Gutenberg's invention would have been much more modest. This is no mere conjecture: we have here a precedent - printing in South-East Asia. Printing took place there at the latest from the early 8th century, to begin with a block printing process, then later on with individual letters made of clay, and from the 13th century also with copper letters made in a sand casting process. This technique was inferior to that of Gutenberg, particularly with regard to precision - we do not find in Asia any instrument comparable to the hand-casting instrument - but at any rate long texts were printing in editions of hundreds. Thus works of religious teaching or building regulations are known with an extent of over 1000 pages.

In spite of this, printing in China and Korea did not lead to the profound changes that mark Europe in the modern era. One reason for this is (that the printing presses, just like the scriptoria, were run as "state" institutions and their products distributed according to a centra

plan according to the interests of the administration, as was the case with the majority o manuscript texts in feudal Europe.
This communicative situation changed with the advent of printing. Gutenberg himself ran his printing works as a commercial enterprise; the books printed became a commercial good like any other, and were accordingly aggressively advertised. Anyone with money could have works printed and buy printed products. Thus the printing trade was integrated in Europe into the free enterprise system that was just in the course of development, and reinforced it. For the distribution of the typographical information, the networks used were no longer the institutional ones, but above all and primarily those of the market economy. It was only by this means that printed information acquired its public, social character, which separated it so clearly from experience only passed on m writing.
Such written records had, as a rule, no communicative function. They served, like the copies of authoritative texts, recipes, tables or diary entries, to relieve people's memories and develop individual ideas and business. The writer explicated them to third parties in a lecture or conversation. And the scriptographic medium has preserved this cognitive function and its role as handmaiden of speech up to the present.
Furthermore, the scribes in older times possessed only limited possibilities to make their ideas generally accessible. This was not only because suitable techniques of reproduction were no yet available, but also because of the lack of suitable forms of distribution.
The process complementary to the process of publication is the privatization, or rather re-privatization, of the information, which takes place by the acquisition of the books by the "users of book knowledge". This brings us, in our survey, to the 'effectors ' of the informati system. And here there appears a further fundamental problem that had to be over come in order for the new technology to become a force to change society. For in order that readers and buyers could make use of the printed books, the information transformations brought about by the sensors - i.e. the authors - had to be comprehensible and repeatable. For instance, a printed travel guide only makes sense to the readers when they recognize the towns, roads, and sights seen and described by the authors. As a rule, the specialist literature merely points out that an adequate literacy rate in a society is the basic condition for the functioning of the typographical cycle. But as a comparison easily shows, this is a short-sighted view.
Of course the computer user must be able to read the letters on the keyboard, but it i furthermore necessary that he knows the programs according to which the information is stored and processed in the machine. Similarly, the reader of books must be acquainted with the programs according to which the author obtained and represented his information. It seems to me that the solution to this - which one could refer to as a "software problem" - is the most unrecognized basic reason so far for the success of the art of printing. Since the sensor and effector, author and user of the book knowledge are different persons, their modes of perception must be equalized to a sufficient extent that similar identifications of environmenta facts can take place. Since the sensors and effectors do not come into immediate contact with one another, these programs must be laid down in language, also in the typographical medium. As long as descriptions were made only for personal use, or at most explained orally to third parties, there was hardly any need for intersubjectively comprehensible programming of the processing of present-day technology, there are for printing various programs that regulate the obtaining, processing and using of information. However, I consider the most important program, without which the whole of the descriptive specialist prose of the modern era is quite unthinkable, that complex of rules, maxims and also technical aids known then and now as "perspective". From the 13th century on, Italian artists, above all, formulated these norms and tested them in their work; in the 16th century they then acquired their lasting typographica form in the works of Albrecht Dürer.

The visual processing of information is normed by the theory of perspective from the point of perception to the artist's projections. Up to the beginning of the Renaissance there had been a similar reversibility-permitting software for the auditive reception of information, restricted to a small area, that is, the processing of human voices: we term this program alphabetic script. I shows how sounds can be translated into writing by one person so that other people who are appropriately "alphabetized" can produce functionally equivalent sounds according to these written symbols. From now on such systematic transformations were also possible for visual information. Only thus, and not, for instance, already by the introduction of phonetic writing, did books become independent media of communication. They now no longer required the accompanying oral explication by an expert. From them, one could, as was stated in the 16th century, "learn" on one's own account "oneself" "without the presence" of other persons.

With the aid of printing, writing emancipated itself from speech, and (communication fro interaction. The autonomy of the reader was reflected in that of the author. He too now underwent his experience independently, relying only on his own eyes. " What I have not observed and checked myself, I have not written down," it is stated in the Epistola with which Georg Agricola prefaced what is perhaps the most important technical work of the 16th century, "De Re Metallica" (Basle 1556), and here he is only expressing what many of his contemporaries thought. He is joined by Hieronymus Bock, the father of botany, who stated: "But I will write nothing of what is unknown to me!" (Strasbourg 1539). These scholars recognized no knowledge the evidence for which they had not seen themselves.

Books filled with information of the new type become useful programs by which one could orient oneself in many situations in life. Their influence was felt not only in institutional, but also everyday action. At the same time they standardized the actions and experiences of the 'ordinary man'. More and more people adapted themselves to the similar descriptions in the books.

The environment, altered in accordance with the book-supported programs, could in turn be observed by authors and described in books. Thus the typographical cycle described in m sketch was completed.

So far, I have omitted in my remarks the internal feedback control system in the typographica information system: here there are processors - whom I have termed "critics" - who correct the printed books, and to some extent also the manuscripts, and compare them with the existing stock of books with regard to novelty and compatibility, I will spend no further time on this feedback control system, and instead consider the whole scheme again from a quite different perspective.

Interpretation can be made not only systematically, but also from the point of view of the history of development. The instrument of hand casting, the printing press, the type-setting case - in short, what is ascribed to Gutenberg as his invention, only occupies only a modest space in the typographical information system. The typographeum is one element among others, but is it the one that has given the whole system its name.

This one-sidedness has an historical explanation. The printing works is indeed the element tha set the system described above going. In the first 40 years of printing, i. e. up to about the 1480s, the typographical media revolution was in fact restricted essentially to the introduction of the text processing and duplicating machine. It was incorporated relatively unproblematically into the existing communicative and social surroundings. And essentially only that was printed which had previously been passed on in manuscript form.

The quantitative spread of printing technology up to the end of the 15th century then forced the final adaptation to new forms of communicative linking. The more than 1100 printing works in over 250 places in Europe came into contact with each other and with the buyers via the free market. Only in this second phase did a new, lasting type of communication system

come into being, the national communication community linked by the typographical medium. Publication now took place for the "use of the German nation" or the "German fatherland" dealing by means of this formula with the problems of legitimization that arose when the manuscript arkana were opened up.

It was only in a third phase, which reached its zenith in Germany in the 1530s, that the above-mentioned software problems were solved, and completely new text varieties were created. Authors and readers subjected themselves to the new programs of perception and representation, and this led to a general change in mentality. Only now was the book marke able to expand explosively, and conquer new strata of buyers. The broad political situati from the mid-century onwards then favored a phase of consolidation in which the various components of the information system were developed and above all increasingly inter linked with each other. Does this finding now permit us to draw conclusions about the course of the current media revolution? Certainly not definite ones, for the future in general is not ours to see. But it may be permitted to place the scheme of the course of the implementation o Gutenberg's technology in a strategic game in relation to the present introduction of computer technology. The emphasis with which printing was praised at the time as a medium of popular enlightenment, the saving of human information collection and the solution of all informative and communication problems as such is at any rate matched by the attitude of adherents of the new media today.

In making such a comparison, we must presumably proceed from the assumption that we are at most at the beginning of the second phase: the individual computers are in the process o being interlinked, and the attempt is being made to construct supra-institutional communication systems corresponding to the potential of the new technology. Clearly, in contrast to printing, fixed built-in wiring is indispensable. Whether the market mechanisms can be adopted as a distribution principle for the new links appears more than questionable. This would presuppose that the accessibility of the information can be controlled by the "sellers". Such optimism appears to me comparable to that with which many people in the early modern era believed that the ancient secrets of the trade and the arcane knowledge of the church could be protected from the incursion of printing.

Up to now, the electronic media essentially cover the same kind of knowledge that was alread laid down in language, indeed to a large extent already in writings and books. The process is restricted to the technicalization of the audio-visual procuring, storage and communication o information. The changes achieved in this field appear to us revolutionary enough. People must have felt similarly at the end of the 15th century, when the typographical coverage of the traditionally transmitted knowledge, already stored in linguistic form, was largely concluded. But the re-orientation from speech and the ear to the eye and printed matter in the obtaining and processing of information was at that time still ahead of them. Against this background, the question thus arises as to which sensory organs a future information and communication policy could concentrate on. A look at the past only shows, possibly, that changes hitherto and their extrapolations are not necessarily the (feared or aspired-to) new situation. In investigating this question, I was surprised how tradition-conscious the constructors of the new software in the information and cognitive sciences are in their approach. As far as I can judge, they keep to the visual sensors of the typographical paradigm and the epistemology and methodology developed there. Marshall McLuhan has much more radical views of the future, fed by a different critique of the deficiencies of the information policy of the book age. Over 20 years ago, he gave a vivid description of how typographical information processing had led to one-sidedness in the use of the human senses. It promotes, declares only that to be true which can be seen with the eyes; its adherents only account that "knowledge" which can be represented in the printed book. Other senses, by contrast, wither away when the individua

acts as author or reader. It is thus all the more necessary for culture to allow space for the mutual interplay of the senses.
Currently, we can only observe that many people wish once more to accord more scope and prestige to feeling, personal experience, smell, taste and touch and self-experimentation, orality and the immediate conversation in our society. This goal links the efforts of the women's movement, oriental meditation, the New Age and a number of critics of science. To the exten that they draw attention to those senses that have been neglected in the typographical culture, they can be regarded as a product of the self-criticisms of this very culture, and support their efforts for a balance of the various types of information and achievements of the senses. Man problems of our present life will only be susceptible of solution if/when we indeed make use of all the types of information that we can obtain with the whole variety of our sensory organs. Thus a multi-media information and communication policy appears to me a necessity.