

Visual Construction of Writing in the Medieval Book

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The links which connect the nature of the medium to the methods of access and to the objects of knowledge, relationships between form and content, are a broad continuum whose interlinked facts require a transdisciplinary study.¹

Nowadays, attempts to discern these links seem to concern two central groups of *correlations*, which have been analysed from the perspective of different disciplines.

In the foreground of correlations we find the relationship between the material characteristics of the mediums and the methods of access to their contents; in this field of *cultural technologies*, the history of verbal language is punctuated first by the 'invention' of writing and its different systems, then by a series of transformations of manuscripts and the printed word, and finally by electronic communication. In the study of this first relationship, the history, psychology and physiology of reading establish a relationship between several parameters: on the one hand, the system of signs and spaces in the organization of the written code, and on the other hand, the methods of appropriation of this code by the reader (both reading aloud and silent reading), linear progression or freedom of selection of the contents, degree of speed, amount of information, habits of memorization, etc.

At a second level of correlations, anthropology speculates about the differences between methods of thought which conditions of production and reproduction of thought imply; it associates the aforementioned methods of reading and access to verbal language with the cognitive capacities of the individual and ways of conceiving reality; it also approaches the symbolic interactions between technologies and culture.

The history of texts and medieval philology – stimulated by the technological changes of the present and influenced by anthropological investigations into the implications of orality and writing in distant cultures – have renewed a twofold interest in the last two decades: on the one hand, in the characteristics of oral literature, and on the other hand, in the relationship between the development of writing and the different ways of reading which have been known to western man since Antiquity.

We will concentrate here on the medieval book and, in particular, the first level of connections mentioned above. The material facts which we interrogate are the non-alphabetical signs, that is to say the blank spaces, punctuation and the other auxiliary signs: three modest features which form the different anchorages of alphabetical writing in the space on the page.

The study of the reading process by observing the nature of graphic signs implies a methodological assumption: the certainty that research can be successfully concluded by means of deduction, since there exist direct connections between the traditions of writing and the ways of reading.

This presupposition might run the risk of encouraging the practice of a certain unreliable 'archaeology' of words, by virtue of which we are able to construct a history which may not actually be *inscribed* in the texts of the past. Does a page from Antiquity or the Middle Ages still retain traces of the way in which the Ancients read? Do traces of their ocular or vocal activity remain? The answer to these questions demands caution. However, it so happens that, since Antiquity, there have indeed been some grammarians, translators and writers who have passed down to us a great many accounts of the correlation which they saw between forms of writing and mastery of the art of reading.

Whilst recalling these accounts, we will attempt to illustrate the hypothesis which links alphabetical writing without auxiliary signs to the practices of reading aloud as a dynamic vocal activity. A premise such as this leads to the discovery that rapid silent reading by the individual is an achievement of our civilization which resulted from the development of a whole system of graphic signs, amongst which blank space itself is a sign of prime importance.

Blank spaces

In the culture of Latin Antiquity, reading was characterized by two features: it was seen as expressive reading aloud, whilst it was based on a reduced graphic notation of alphabetical writing in which the words were separated by a dot or a blank space, or even run together, like the *scriptura continua* which the Greeks had practised throughout the ages (Desbordes 1990, p. 227).

Some theoretical Latin texts deal with the problems of reading which this *scriptio continua* caused. Fluent reading of a text which had never been read before was difficult, because the reader first had to decipher what had been written before he could then read it out loud. This reading aloud was helped by recollection of the text, when the reader knew it already. Latin peoples were trained in rapid reading; this exercise was part of the education of a grammarian.

For example, Quintilian (first century), in his *Institutio Oratoria*, laid down the classical principles for a correct acquisition of reading skills, as the basis for the education of an orator: *Superest lectio: in qua puer ut sciat ubi suspendere spiritum debeat, quo loco uersum distinguere* (Liber I, 8, 1). 'It is through the practice of reading that the child will learn where he should breathe, and where he should separate each line.' The expression *uersum distinguere* – which means 'to cut the line' if the text in question is in prose, or else 'to separate the verses' if it is a poem – implies that the written text used to teach reading contained neither hierarchical organization nor separation of the units of discourse.

Scriptura continua – which in effect just recorded the continuous flow of the words in spoken language – demanded more time to decipher than our writing requires of us today; in addition, it needed vocalized reading, pronouncing aloud. The consequences that the notation technique had on the physiology of reading have been fully analysed by Paul Saenger (1997), from the writings of Latin Antiquity and the Middle Ages. This author has examined a recurrent element in reading methods in the European West and several other civilizations: the relationship between a tendency to vocalized reading and the time span of cognitive activity necessary to access the words. In other words, when a reader does not, at first glance, distinguish boundaries between words, this lack of

clarity has two consequences: it slows down reading and encourages vocal activity. Insofar as the writing is dense and devoid of 'distinguishing signs', the time taken to decode it is considerable and the decoding tends to rely on vocalization.

If, as skilled silent readers, we try ourselves to read for the first time a fragment of text written in upper case in which the words are run together, we will very often catch ourselves, if not actually vocalizing, at least subvocalizing, in the search for syntactic units which make sense. Contemporary poets and novelists know how to exploit this constraint when, by deliberately publishing texts without punctuation, they hope to attract the readers' attention: reading these texts demands a certain articulation of the text, even if it is internal and silent, and thus becomes more active and measured, since it requires participation and individual activity in addition to distinguishing between the units. It is the reader who contributes to the full linguistic realization of the text.

For Saenger, in times past reading aloud in public, or else in a whisper in private, was a habit and a requirement of the dense graphic nature of *scriptio continua*; likewise, the history of the transformations in the format of western writing is parallel to the evolution of neurophysiological processes of reading, that is, to the ability to decode.

The separation of words by dots, which can still be seen in inscriptions in churches, had disappeared from books, documents and Latin inscriptions before the end of the second century of the Common Era. In the sixth century, all manuscripts were still copied in *scriptura continua*, and it was not until between the sixth and eighth centuries that the separation of words was progressively introduced into all Latin manuscripts. Between the sixth and seventh centuries, Irish monks began to introduce the blank space as an aid to reading, since their mother tongue had nothing in common with Romance languages and understanding Latin texts was consequently less easy for them than for speakers of neo-Latin languages.

This Anglo-Saxon practice, which from the tenth century spread widely on the Continent, was of crucial importance. Separation of the words ceased to be a cognitive function of the reader and became an analytical and scriptorial activity of the copyist. This signalling system in alphabetical writing freed the intellectual faculties of the reader, thus encouraging silent reading and, in this way, faster reading since the eyes inevitably read more quickly than the vocal chords.

Consequently, we can ask this question: from the linguistic point of view, what does this advance in the technology of material preservation of words involve?

The vocal materiality of human speech is a continuum of sounds, which occur within each syntagm and each sentence articulated after the respiratory break. The voice emits a continual flow of words; on the other hand, *language* – *langue* in Saussurian terms – is a discrete system of discontinuous units and hierarchically arranged syntactic structures.

The use of dots or blank spaces to separate distinct units, *words*, constituted an analysis of the first articulation of the abstract system of *language*. Writing which includes a separation of the words is not just a reproduction or graphic 'recording' of the spoken word. As Claude Hagège (1986, p. 102), the French linguist said: 'writing is a linguistic analysis in various degrees of awareness'.

The consequences of the separation of words in the practice of rapid silent reading occur at the first level of interlinking, which we referred to above. As far as the second level of implication is concerned, the question is one of knowing to what extent this way of reading forms the basis of certain changes in mentality.

Contemporary anthropology has measured the interdependence of the ways and means of thought. For example, Jack Goody (1977) has studied contemporary oral cultures and the birth of written cultures in Mesopotamia and Egypt. He has demonstrated how writing does not just reproduce the flow of speech, but also allows it to be analysed. The written text itself generates a much more acute knowledge of the structures of language, syntactic as well as semantic, that is to say, structures of grammar as well as those of category-specific systems.

Some of the facts from Goody's work on the subject of the birth of written culture have quite probably been overtaken by more recent research on the history of writing. Nevertheless, his basic argument remains fresh and rooted in the foundations of research into writing throughout history, for he was able to investigate just how far writing allows a decontextualization of knowledge which entails a capacity for abstraction and analysis which oral cultures do not promote.

We will return later to these implications with reference to the culture of the medieval book, after touching on other chapters in the history of writing.

Line

The scholars who took charge of the correct and exact transmission of texts from the past showed a very specific interest in the relationships between the techniques of writing and mastery of reading. One famous account is that of St Jerome. Even though, in his day, the office of reader had the status of an ecclesiastical order, in practice, readers of the fifth century were not always well educated in the grammatical distinctions which the Latin masters had established as an aid towards a correct oral reading of texts.

To remedy this situation in the transcription of the Bible, St Jerome reinstated a system of writing which Latin peoples had already used: writing *per cola et commata*, in contrast to writing texts in uninterrupted lines. This copying technique consisted of dividing the sections of the written text into 'members' or syntactical units. No 'member' could take up more than a line and the Scriptures had to be copied in columns and divided into chapters and verses.

This 'aeration' of the page and exploitation of blank spaces was intended to make reading aloud easier: *quia per cola scriptus et commata manifestiorem legentibus sensum tribuit*, 'writings established *per cola et commata* will have a clearer sense for the readers' (*Praefatio in Ezechielem*).

Making the sense 'clearer' and more 'obvious' by means of appropriate breaks between the syntactical units is an approach which forms part of the history of the correlation established by Paul Saenger. Isolation of the syntactical unit makes use of a specific distribution of graphic space; thus, if we define this technique by means of a formula, we can say that the more blank space is adjusted to the units of language – words or parts of sentences – the less time will be needed to identify them and reading will thus be effected more easily.

It seems obvious that if the reader cannot pinpoint where he has to finish a sentence or maintain intonation in the space of the page, his articulation will be suspect and less than appropriate, which will be extremely damaging to the sense of what he is reading. Experimental work in psycholinguistics on the retention of what is read, spoken and

written demonstrates that 'subjects reading quickly retain better than those who read slowly', that is to say that there exists an indisputable relationship between reading, speed and memory (Richaudeau 1969, p. 52). Thus a concrete relationship can be observed between the speed of reading, either aloud or silently, and immediate memory span in contemporary literate individuals.

It has to be admitted that results of some research on the history of reading may vary according to the authors of the investigations and their hypotheses; and yet, taken as a whole, this work highlights the relationship between the organization of graphic signs and the degree of understanding and memorization of the content.

Punctuation

As well as blank space, punctuation constitutes a collection of signs which help reading in the writing systems of modern languages.

The Latin peoples called the punctuation signs which they had inherited from the Greeks *distinctiones*, since they played the role of signals and graphic visualizations of the distinctions of the grammatical order. They used a dot, which could be used at three different heights on the line, to indicate three types of pause: brief, medium or long.

In spite of the preservation of numerous theoretical texts from Antiquity on punctuation, the Latin system was ignored during the Middle Ages in the copying of the first texts written in the Romance languages. The first literature, composed in verse and destined for public recitation or chanting, rather than private silent reading, has come down to us in copies which contain hardly any punctuation. The *Cantilène de sainte Eulalie*, composed and copied around 880 in the oldest preserved manuscript in the French language, and the Oxford manuscript of the *Chanson de Roland*, from the beginning of the twelfth century, give us texts in which the only punctuation used is a dot placed at the end of each line of poetry. If we compare these manuscripts with texts published by philologists, we see that the latter add a whole series of punctuation marks which did not exist within the original lines of poetry and which are there as an aid to our reading habits. Editing a medieval text consists on the whole of transposing a work from a pre-typographical context into printed pages according to our typographical customs. The use of our punctuation system in these editions is designed to facilitate our rapid reading.

If we compare the austerity of the original with the discursive distinctions marked by modern punctuation, we see that standards today help the immediate interpretation of the different 'voices' which occur in the narrations, amongst other things.

Our punctuation is an interpretation of the text, in that it attributes the discourses of each speaker, by means of quotation marks and dashes, and marks the procedures for defining interrogation or exclamation. In effect, punctuation just exteriorizes and marks by visual means the syntactic, semantic and discursive relationships between the words.

As far as the attainment of legibility and relationships between the writing and its decoding are concerned, we can enlarge on Saenger's theory and go beyond the interpretation of the blank space. Every sign, black or white, which exteriorizes the abstract system of language (the word unit, a syntactic or semantic relationship, etc.) is a means of realizing that language in discourse.

A text without any punctuation defining the discourse remains, from the linguistic point of view, an 'open' text, which calls for its realization to be completed. Obviously, this can be brought about in two ways: one oral, the other written.

Modern day editors use the second solution when they add our modern punctuation to an ancient text. This allows rapid visual identification of the specifics of definition and avoids useless pauses for verifying the attribution of discourses.

The second method of completing this realization of discourse is to articulate it and to complete through pauses and intonation the divisions which do not appear in the manuscript. It is this observation which supports the hypothesis that the medieval text was not punctuated since it was but the written version of a work which was still passed on orally. According to this hypothesis, we can establish a correlation between the absence of punctuation and the reading aloud of medieval texts in the Romance language.

Of course, a premise such as this must not be interpreted as an absolute relationship between cause and effect. First of all, this is because this connection does not imply a contrary relationship in any way: we cannot say that all systems of punctuation were linked exclusively to visual consultation of books. The scribes of the Middle Ages kept up the classical system of punctuation with three different pause lengths for Latin texts, and this system was used for centuries, precisely as a notation indicating where to breathe, as an aid to reading aloud, both for poetry and for prose.

Furthermore, it seems certain that we can find medieval Romance texts in verse, which are punctuated, and that there are also texts without punctuation which were designed for individual silent reading. The first collections of printed poems, for example, have preserved the ancient lack of punctuation of medieval manuscripts, although they were designed for personal and private use.

In spite of this, it seems obvious that all signals from blank spaces or various signs contribute to freeing the eye from the need to vocalize and, consequently, aid the acquisition of speed whilst reading.

Text

The history of reading practices in the Middle Ages is presented as a gradual transition from reading aloud to the individual and silent habitual reading of books. Those who specialize in the history of reading – such as Cavallo and Chartier (1997), in their important summary of this history – have described these changes as real 'revolutions' in civilization. Nevertheless, they all stress the gradual and progressive character of these revolutions.

Brian Stock (1990, p. 105), for example, reminds us in his essay on reading in Europe in the eleventh and twelfth centuries, that the change in mentality generated during that period was just the culmination and accumulation of a succession of barely noticeable transformations whose beginnings go back to late Antiquity.

The concept of 'reading as a model' defined by Brian Stock is based on a clear differentiation between 'reading technique' and 'reading as a means of conceptualization'. These are, by and large, the two types of correlation which we distinguished between earlier. He stresses that the historian must be cautious when interpreting them:

Generally, direct links between the specific practices of reading and changes in mentality are rare. Normally, the relationship between the means of communication and individual or collective ideas is indirect. The historian studying these relationships must, in my opinion, resist falling into the trap of a new determinism, which makes a change of the mental structure into the image of a change of the communications network (*ibid.*, p. 104).

Having taken every precaution, Stock examined the way in which the history of interiority was linked, in the Middle Ages, to the history of reading, and how the concept of *Christian interiority*, an idea which had flourished well before the age of silent reading, was associated, from the eleventh century on, with the activity of reading. It was actually this which favoured the awakening of individual consciousness and a renaissance of rationality at that particular moment.

In his essay on the historical ethology of reading, Ivan Illic (1991) stated that this 'era of reading', which began three centuries before the invention of printing, had passed through an extraordinary phenomenological change in the twelfth century. Illic looked for the impact of writing technique on the interpretation of human action beyond the observation or 'discovery' of silent reading and the transition from a voiced relationship with the page to a silent one.

According to Illic, a 'scribal revolution' (*ibid.*, p. 138) occurred during the transition from monastic reading, as a 'physically dynamic activity' which was predominantly oral, to scholastic reading, as visual and individual access to written knowledge which flourished towards the middle of the twelfth century. This revolution lies in the dissociation of the text from the material nature of the book as an object; it gave rise to the age of book-reading and a conception of the text which has continued until the present day, that of the text as 'a fiction hovering over the surface of the book, which takes flight towards an autonomous existence' (*ibid.*, pp. 138–142).

A scribal revolution such as this, and the new behaviour patterns to which it led, are based on a collection of techniques, materials and conventions of writing which developed in the twelfth century (and which are well known to us thanks to the work of palaeographers and historians of medieval books and culture; see Martin and Vezin 1990; Benson and Constable 1991; Parkes 1976, 1992): these were new types of writing, use of paper, indexes for visual consultation of the contents, different techniques for structuring the page in paragraphs and chapters, etc., all techniques which contributed to the creation of this bookish idea of the concept of 'text'.

Hugues de Saint Victor's teaching on the art of reading in the twelfth century, admirably explained by Illic, represents the peak of a tradition which developed gradually over the centuries. The instructive works of Illic and Stock lead us to the conclusion that progress was slow and that different styles of reading co-existed in the Middle Ages.

As a sample of the vast ocean of history of individual reading of books still to be explored, and returning to the field of graphic signs, we may recall here an account by one of the great medieval 'encyclopaedists' dealing with the precautions taken by copyists in the process of producing a manuscript book.

In the seventh century, Isidore of Seville wrote a chapter in his *Etymologies* which illustrated the techniques and methods of 'word processing' and provided us with evidence of the private and visual habitual reading of books of medieval men of letters: copyists, translators, commentators, etc.

Under the title *De notis sententiarum*, Saint Isidore explained a list of twenty-six signs which had been used since Antiquity to make written texts clearer. These signs, which 'served to give an explanation of a word, a phrase or a line of poetry' represented the actual origin of the critical notes of modern philology. Saint Isidore became an authority on the subject and his teaching was quoted throughout the Middle Ages in Europe. Among the signs which he mentioned are:

The *astericus* (*), 'which is put in places where there has been an omission, so that, thanks to it (this sign), one can see as if illuminated by light; for, indeed, in Greek, *star* is written as *astér*, from which the name *astericus* is derived.

The *obolus* (—) is a horizontal line which we use for words or phrases which are repeated unnecessarily, or in places where we have noticed an erroneous reading. It is like an arrow that kills what is superfluous and crosses out what is incorrect. Indeed, the Greek for *arrow* is *obélos*'.

(...)

The *antigraphus cum puncto* (Y) is used when a translation may have several meanings.

(...)

The *alogus* (X) tells us that there is something which needs correcting.

(...)

One should also be able to recognize in books the other little signs which are put in the margins of the page, so that the reader may find them at the very beginning and can be directed to other parts of the same text to find out the meaning of the expressions or verses which share the same sign (*Etymologiae* XXI. *De notis sententiarum*).

These *notae sententiarum*, signs for the interpretation of texts, have been used for the correction of slips in copying, for dividing up works, for cross-referencing concepts within a codex; in conclusion, they have provided what was needed for both the material task of the manuscript production of the book and individual reading and study of texts.

Isidore of Seville's list, a link between the writings of Antiquity and the Middle Ages, is an excellent guide for interpreting a great many signs which we find on the manuscript page until the fourteenth and fifteenth centuries, a period which the Dutch historian, Johan Huizinga (1927) has named 'the autumn of the Middle Ages'. For him, the fundamental feature of the spirit of the time lies in its highly visual character. 'At that time,' he said, 'everybody thought through visual representations; everything that one wanted to express was embodied by a visual image.'

This blossoming of the visual which characterized the aesthetic sensitivity of people at the end of the Middle Ages found its counterpart in the specific area of page and text layout in the book. Besides punctuation marks with syntactical value (*positurae* in Latin), blank spaces and cross-references (*notae sententiarum*), a fourth category of graphical marks existed which occurs in the visual dividing up of texts, which make their appearance at the end of the Middle Ages: they mark discourses and different voices in a text by means of various procedures (headings with the names of speakers who occur there, coloured initial letters, etc.).

This type of marking, which did not exist in the manuscript tradition of literature in the Romance language, spread during the fourteenth and fifteenth centuries. In numerous copies of works as famous as the *Roman de la Rose*, the novels of Chrétien de Troyes or *Ovide Moralisé*, the scribes have reproduced the ancient narratives whilst introducing into them a whole new system of speech marks. These indications, designed to locate the

dividing up of works visually, are a contribution to the set of layout and page-ordering techniques which the printers had received, adapted and standardized.

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This brief outline of several chapters of the history of the book as a transmission medium for knowledge is intended to remind us that different models of reading co-existed throughout the Middle Ages, and well beyond the Modern Age, even though they have often been described as revolutionary.

Nobody could deny that the speed of change these days has no parallel whatsoever in the slow distillation of the ways of reading and the cognitive paradigms which European civilization has known. From now on, what History seems to bring us are nuances in the formulation of our questioning, rather than a reply to our questions on the nature of changes in the present.

In view of contemporary thinking which interprets our current technological 'revolution' in terms of impoverishment – as, for example, in Sven Birkerts' *Gutenberg Elegies* – History shows us that every revolution in the past has in no way excluded, but rather reorganized, the role of each of its mediums.

The question that History asks us is aimed at the *balance* between the new space of global memory as represented by the internet and the methods of communication and knowledge which we have inherited: prayer committed to memory, writing for the law, the presence of a voice for education, the letter that is re-read, the poem that is experienced, etc.

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References

- Benson, Robert L. and Giles Constable (eds), *Renaissance and Renewal in the Twelfth Century*, Toronto-Buffalo-London, University of Toronto Press, 1991 (1st ed. Harvard University Press, 1982).
- Birkerts, Sven, *The Gutenberg Elegies: The Fate of Reading in an Electronic Age*, Boston-London, 1994.
- Cavallo, Guglielmo and Roger Chartier, *Histoire de la lecture dans le monde occidental*, Paris, Seuil, 1997.
- Desbordes, Françoise, *Idées romaines sur l'écriture*, Presses Universitaires de Lille, 1990.
- Goody, Jack, *The domestication of the savage mind*, Cambridge University Press, 1977 (French ed., *La raison graphique. La domestication de la pensée sauvage*, Paris, Minuit, 1979).
- Hagège, Claude, *L'homme de paroles. Contribution linguistique aux sciences humaines*, Paris, Fayard, 1986 (1st ed., 1985).
- Huizinga, Johan, *Herbst des Mittelalters*, 1927 (French ed., *Le déclin du Moyen-âge*, Paris, Payot, re-ed. 1967).
- Isidori *Hispalensis Episcopi. Etymologiarum sive originum libri. Liber I De grammatica*, apud W.M. Lindsay (ed.), Oxford, 1911.
- Illic, Ivan, *Du lisible au visible: La naissance du texte. Un commentaire du Didascalicon de Hugues de Saint-Victor*, Paris, Cerf, 1991.
- M. Fabius Quintilianus. *Institutiones oratoriae, Libri duodecim*. J. Cousin (ed.) 3 vols. Paris, Les Belles Lettres 1975, 1978, 1979.
- Martin, Henri-Jean and Jean Vezin, *Mise en page et mise en texte du livre manuscrit*, Paris, Cercle de la Librairie-Promodis, 1990.
- Nicolescu, Basarab, *La transdisciplinarité. Manifeste*, Paris, Éd. du Rocher, 1996.

- Nicolescu, Basarab, 'Transdisciplinarité cherche disciples', *Le Monde de l'éducation, de la culture et de la formation*, 252, 1997, pp. 48–49.
- Parkes, Malcolm B., 'The Influence of Concepts of *Ordinatio* and *Compilatio* on the Development of Book', *Medieval Learning and Literature: Essays presented to Richard William Hunt*. J.J.G. Alexander and M.T. Gibson (eds), Oxford, 1976.
- Parkes, Malcolm B., *Pause and Effect. An Introduction to the History of Punctuation in the West*, Aldershot, Scolar Press, 1992.
- Richaudeau, François, *La lisibilité*, Paris, Genthire-Denoël, 1969 (1st ed. 1967).
- Saenger, Paul, *Space Between Words. The Origins of Silent Reading*, Stanford University Press, 1997.
- Sancti Eusebii Hieronymi, 'Praefatio in librum Iosue', 'Praefatio in librum Isaias', 'Praefatio in Ezechielem', apud Migne, *Patrologie Latine* XXVIII, 462c; 771b 1–8; 938.
- Stock, Brian, 'Lecture, intériorité et modèles de comportement dans l'Europe des XI^e–XII^e s.', *Cahiers de Civilisation Médiévale* XXXIII, 1990, pp. 103–112.

Note

1. 'As the prefix *trans* indicates, *transdisciplinarity* concerns both that which is *between* disciplines, *across* the different disciplines and *beyond* all disciplines. Its aim is to understand the world of today, of which one of the imperatives is the unity of knowledge.' '*Multidisciplinarity* (the study of one and the same object by several disciplines at the same time) and *interdisciplinarity* (the transfer of the methods of one discipline to another) remain inscribed within the framework of disciplinary research, but they nevertheless constitute the early warning signs of the emergence of *transdisciplinarity*.' (Nicolescu 1997, pp. 48–49).