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Plenary Agenda Report for Research Group D-III-2

The Epistemological Dynamics of Early Writing: Spatiality and Perception

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Abstract: With our point of departure in the concept of *cultural technology/ technologies*, the work of our research group strives *first* to gain an understanding of the conditions under which the description and representation of spatiality are possible within particular modalities of communication (geometric, algebraic, verbalized, as well as in drawings, models, and ›diagrams‹), and *secondly*, to analyze the role of the recording medium (in this case textuality) in these processes. Bearing in mind the focus of Research Group D-III the problematic of research group D-III (*Spatial Models and Spatial Thinking*) and that of Area D (*Theory and Science*) in the broadest terms, we seek on the basis of concrete case studies to describe the earliest instances of textuality, both the interdependence of materiality and object-form as well as the influence of textuality on the shaping and development of analytical thinking and the systematic acquisition of knowledge. The material focus is on documenting the cuneiform cultures of the Ancient Near East.

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1 Issues and Results

1.1 The Overarching Cognitive Interest

We begin by assuming that human conceptualizations of space and the mastery of space represent a cultural achievement which can be localized — among other things — on the level of cultural technologies. The term »cultural technology« in this context refers to not only inculcated techniques that are directly associated with objects or tools, but also to particular steps or phases in these techniques that emerge within a symbolic equivalent to these techniques in the consciousness of both individuals and groups. These symbolic equivalents allow for the virtual use of these techniques so as to critique and otherwise reflect on their usefulness without actually carrying out the technique in material form. Through this process, it becomes possible to append a pure conceptualization of space — one which may indeed be highly precise — to the mastery of space in the sense of predictable transformations. The objective of these investigations as a whole is to investigate the connections between cultural technologies and concrete achievements vis-à-vis the mastery of space on the basis of available evidence and records, in particular concerning the constitution of this symbolic aspect. The focus is first on questions pertaining to the arrangement of characters and to the information conveyed in the text layout, and secondly on the aggregate of (proto)-mathematical knowledge. The object of this investigation was the corpus of Mesopotamian cuneiform texts, which is to say, textual material (in the broadest sense) deposited on clay tablets from the central cultures of the ancient Near East in the Sumerian or Akkadian languages. In an attempt at an initial survey of these materials, and bearing in mind the problematic formulated above, we defined structured perspectives which characterize our research interests with greater precision: our concerns are (1) spatiality and knowledge: materiality and representation as constituents of mathematical thinking. Interconnected in this perspective are the mathematical aspects of (2) the understanding and conceptualization of space in Mesopotamia and (3) the epistemological aspects of writing (and) the role of metapragmatics in the cuneiform writing in textual culture. This perspectivization was accompanied by the development of a model which describes the societal function of cultural technologies and the conditions of their respective historical characteristics. This model makes possible a comparative analysis of various cultures in the framework of their respective cultural, socioeconomic, political, religious features — and in this instance specifically with regard to their systematic involvement with spatiality. In this way, the model deliberately counterposes relativistic characterizations against the kinds of conventionalist absolutist valuations which have been carried out on the basis of standards calibrated according to modern (and for the most part Eurocentric) values.

1.2 The Model

Considerable difficulties arise when we attempt to reconstruct the connection between techniques as such and their cultural symbolization due, above all, to the total absence of any explanations accompanying notations in the early history of Mesopotamia. Metatexts or reflective discourses in a broader sense, commenting on particular phenomena, have not survived, and presumably never assumed written form. Insights into the degree of consciousness (with respect to the nature and scope of the medial extensions achieved via textuality) can only be attained, then, inductively: by examining the findings from the

tablets and the characteristics of representations of spatial contents in (proto)-mathematical contexts. It seemed to us advisable, then, to base our attempts at a reconstruction of these metatextual relations on a model which has proven its usefulness with regard to a wide range of cultures of various historical epochs, and one that makes as few assumptions as possible about the details of the research method being used. This model was developed in BRÜNING 2008, and applied for the first time in BRÜNING 2010. Together with Tomasello (cf. TOMASELLO 2002), we regard the essential mechanism as the capacity of human groups to generate so-called »joint attentional frames« which make it possible to focus the attention of a number of participants unreservedly and for extended periods of time on specific matters. This potentiality seems to be based on the ability, achieved in the framework of such a constellation, of each member of the group to adopt the point of view of any other member, so that in such a situation, a condition of identity between all of the participants exists momentarily with regard to the conditions which are posited by the joint attentional frames. This phenomenon has been studied on a large scale in small children, as well as in cross-cultural contexts, so robust results are available from which we can extrapolate.

A second fundamental element is our conviction that the collecting of objects for the most diverse purposes represents a fundamental aspect of life (i.e., not just of human life), and moreover one which takes place in shorter or more extended cycles, and whose continuous repetition leads to optimal results. (This nexus is presented comprehensively in a forthcoming publication by BRÜNING.)

1.3 ccc: *communitas, corpus, codex*

In the following, we understand by the term »culture« a group of closely cooperating individuals who are linked to one another by common interests and by intensive collective communication. The original impetus of such a group was purely biological in nature, namely the procurement of sustenance and propagation; other »higher« interests may be superimposed on these basic functions only when there exists a surplus of sustenance for the group as a whole, one capable of supporting certain activities which benefit the group but which do not directly serve basic functions, or if so only indirectly, but which have important long-term effects. It is only then that subcultures may emerge from which certain professions in turn may develop, which may be regarded as the bearers of activities whose social value is recognized for extended periods of time, i.e. encompassing many generations, thereby ensuring the sustenance and propagation of the group.

We take as our point of departure the processes that engender these kind of professions, whose determinants we have traced back to the components named in our title. To begin with, then, a group or *communitas* is present, whose members for specific reasons – considered individually, they may be quite numerous and even thoroughly fortuitous – share a common interest. In our view, this interest is bound up with a *corpus* of material objects which serve as the focus for any number of joint attentional frames in the sense of long-term reference points. These objects are converted into a collection to the extent that they are collected, ordered, and shaped into a suitable configuration, and to the degree that this procedure is repeated with a certain regularity. The derivation of symbolic functions from this nexus, in turn, may have divergent roots which can be located in the collecting process itself (that is to say: in the discovery and compilation of desirable objects), or else

in the ordering process itself, since the object's retrieval must be governed by an abstract model as soon as the number of objects surpasses a certain, presumably not especially high, minimum number. The third part of the collecting cycle – the above-mentioned shaping aspect – is already a symbolic act in itself, one rooted in the fact that, for any given set of objects that are meaningful to the members of a group, a symbolic equivalent must be discovered in the form of a word, or even a gesture (or both together). This *codex*, finally, must signify the totality of symbolic constructions which are bound up with the group's behavior. The behavior associated with the collection can be divided into a technical aspect, one that operates without being linked to any vital or active function of consciousness, and a symbolic aspect: the first aspect is associated here with the *corpus*, and the second with the *codex*. It must however be understood that some overlap must be ignored in order to prevent the argumentation from becoming excessively complex.

To the extent that we take this model as our basis, we investigate within the specific contexts of the research project the *communitas*, the *corpus*, and the *codex of the early textual culture of Mesopotamia*, and in so doing, we define the main parameters of our model. In the early high cultures of the ancient Near East (and beyond this in most early literate cultures), the scribes were as a rule members of the *communitas* under consideration. The material *corpora* – which is to say, the textual entities (which in the case of the ancient Near East also included clay tablets, among other types) which were produced by scribes, but also the associated instrumentarium and systematics – have not always survived, at least not to the extent that they were made of easily degradable materials such as wood or consisted of ephemeral phenomena such as verbal discourse. Nonetheless, it is often possible to draw conclusions about them, for example concerning the use of a pair of compasses, whose indentations remain inscribed in the clay, or concerning linguistic conceptualizations and their corresponding denotations. Furthermore, the surviving texts and material traces mark out the coordinates of the context within which every reconstruction must be adjusted; here, the heuristic principle of the greatest possible simplicity has proven a useful precept.

1.4 The Dynamics

The model sketched here concerning an emerging subculture or profession is only tenable within temporal scales in which distinct developments can be detected, largely in the form of sweeping changes. For longer periods of time, the dynamics of this process – including its disintegration and eventual disappearance – must be taken into consideration as well. Even where a cultural technology has roots reaching far into the past and traditions are maintained for extended periods, we can say with certainty that various phases of development are nonetheless detectable, each of which has its own parameters and implements the model in a quite different way. Certain consequences of the dynamics involved in such a model result from the gradual collection of the corpus. For a continuously growing collection quickly encounters logistical limits; regardless of how the resultant problems are solved, a markedly augmented collection will necessarily fail to accomplish the same objectives on the basis of a joint attentional frame as it did originally, as the excitement of new beginnings yields to more stable tendencies which can be associated with genuine professionalization. New object classes and/or fundamentally new interpretations, however, have the capacity to dissolve potential ossification, and even to precipitate renewed periods of upheaval.

1.5 Applications

The roles of spatiality and materiality were investigated with greater precision on the basis of two different yet interdependent constellations of cuneiform transmissions, namely in the realms of mathematical thinking and of early textuality respectively. Quantifying and/or verbalized definitions of given spaces were facilitated by various representational systems, to which another was added toward the end of the 4th millennium through the development of writing. It is a mistake to regard »textuality« merely as an alternative to the ephemeral character of the speech act. The early phase of cuneiform writing – referred to by some as »proto-cuneiform« – does not in fact take the form of a registering or transcription of spoken language; assembled here in a very basic ideography is information whose prescribed verbal equivalent is not prescribed (CANCIK-KIRSCHBAUM forthcoming b). Only an entire series of contingent factors – for example the problem of occasional ambiguity or unclarity or the difficulty of representing complex contents or proper names in this medium – led increasingly to the conceptualization of writing systems as having a 1 : 1 relation to speech. But even then, textuality would still be more than the material transformation of a verbal performance (cf. the introduction to KRÄMER – CANCIK-KIRSCHBAUM – TOTZKE, forthcoming). In fact, the materiality of writing opens up new potentialities whose utilization does not merely characterize and influence the subsequent development of textuality, but also activates epistemological processes which ultimately influence mathematical thought. The space-generating procedures of Mesopotamian mathematics are also recognizable in the medium of the graphic representations of concrete or abstract spaces. These consist first of all of the types of drawings which can be associated with mathematical or astronomical texts or those related to surveying techniques (topography, floor plans, street maps), and secondly those which are identifiable immediately and directly with intellectual contexts (for example mathematics in the narrower sense). On the other hand, there are also drawings which cannot be assigned to their own context in this way, and whose themes or internal structures allow us to identify reflections of the above-named characteristics of mathematical thought. As examples, we could cite a drawing with various knotted snakes from the Early Dynastic period (VAT 9130, ca. 2600 BCE; see JOHNSON forthcoming b and BRUNKE forthcoming b), the depictions of space-filling ribbons published in 2000, as well as sequences of variations of structurally related geometrical patterns of varying complexity.

Crystallized here are similarities between manifestations of early mathematical thought and other explications developed within the space of the written surface, which lead to structured spatiality on a different level. Referred to here is the organization of the writing surface as such, or more precisely: the organization of textuality within and on the surface. This level must be distinguished categorically from those processes – described at the outset – which provide access to and apprehend space. The interplay of text and image – specifically the addition of drawings which are less illustrative and instead explicative and informative in character, as described above – can be conceptualized as a level which involves depictions or representations of spatiality. In this context, it is immaterial whether this ›representation‹ is exact or instead only imprecise, and whether it is executed to scale or only figuratively: it contains informational content which was apparently regarded as adequate by its ancient authors. In contrast, a certain epistemic potential is inherent in the organization of the writing surface, since a decisive role is played by the ›layout‹ – by the arrangement and structuration of the characters (of the text, the writing) on the surface (CANCIK-KIRSCHBAUM – MAHR 2005). On the one hand, these forms

of organization pertain to the format of a textual structure in the narrower sense (i.e. to the arrangement of paragraphs, lines, columns, system of reference, hypertexts, various character sizes), and on the other hand to complex formats based in essential ways on the orientation of the writing surface, for example multicolumnar presentations, as in charts, but also in diagrams of all kinds. In the area of cuneiform transmissions, systematic investigations into these aspects have for the most part not yet been undertaken (CANKIK-KIRSCHBAUM forthcoming a).

1.5.1 Lists

In this way, investigations into the significance of pattern-forming structures in mathematical thinking lead to new perspectives, for example those concerning the manifold forms and peculiarities of the textual genre of the list. Recognizable among other things in this context is the possibility of theorizing graphism in such a way that we arrive at a *theory of the list*. At the same time, this approach leads to the question of the epistemological potential of textuality, and more precisely that of the role of the spatiality of textual expositions not merely for the presentation of knowledge contents, but also for the generation of new knowledge (cf. CANKIK-KIRSCHBAUM 2010; CANKIK-KIRSCHBAUM forthcoming a). The significance of the forms which order and encompass space, the non-textual, visualization-based components of textuality, were highlighted by Charles S. Peirce in the context of the methods of modern science. Against this background, it is possible to reformulate the question of the role of textuality for the elaboration of systematized knowledge procedures in premodern societies.

Coming into view through this reference to »textuality« as such, that is to say, to the written constitution of contents, is a complex cultural technology that forms a connecting link between *codex* and *corpus*: For a long time, the historiography of writing and textuality has been dominated by the idea that all writing systems form parts of a single evolutionary sequence, one which culminates in a phonologically motivated alphabet (cf. CANKIK-KIRSCHBAUM 2010; CANKIK-KIRSCHBAUM forthcoming b). Largely within the branch of linguistic anthropology often referred to as »semiotic anthropology,« Michael Silverstein has attempted to integrate Roman Jakobson's notion of language function with Peirce's notion of triadic chains of semiosis. This theoretical matrix is important in our work, since it offers a framework for describing the relationship between object language and metalanguage. This is particularly important in work on writing systems, since the delimitation of fields and meaningful hierarchical relations between different kinds of fields such as lines, columns, headers, summations, and so forth is one of the central research topics for our group. In a very real sense, the hierarchical configuration of delimited surfaces within written documents predates all other mechanisms for linking words to functions and language to purpose. With regard to textual materials dating from the Late Uruk period (ca. 3300–3000 BCE), it can even be concluded that the structural division of the surface of the tablet and the presence of clearly delimited subordinate zones within it fulfilled the role of a syntax. Similar appeals to Peirce's semiotic are also currently being made within discussions of materiality, practice theory, and agency in archaeology.

1.5.2 The Configuration and Delimitation of Surfaces

One of the most fruitful areas of research has been our discussion of the divergent forces and models that configure and delimit the surface of a wide variety of documents and devices. One essential aspect of this work is the formulation of a new history of the clay tablet which includes all of the many diagrammatic and three-dimensional methods of representation which have tended to be omitted from previous descriptions of the writing system. In a sense, the work of our group, namely D-III-2, could be characterized as an attempt to historicize the processes through which the metalinguistic structures of particular textual genres were inscribed into the surfaces of clay tablets, as well as into objects already used previously as the bearers of notational inscriptions.

1.5.3 Contingencies of Sign Formation, Configuration and Distortion in UD.GAL.NUN

A highly labor-intensive and at the same time productive undertaking has been the investigation of a lengthy UD.GAL.NUN tablet housed in the Vorderasiatisches Museum (Museum of the Ancient Near East) of the Stiftung Preußischer Kulturbesitz (SF 37 and duplicates). UD.GAL.NUN was a cryptic (perhaps enciphered) writing system that systematically replaced standard Sumerian orthographies with other orthographies, presumably in order to prevent the uninitiated from reading these texts accurately. This writing tradition was never used outside of Mesopotamia proper, and with the exception of one short lexical list from the Old Akkadian period, did not survive the Early Dynastic period, ca. 2900–2350, (JOHNSON forthcoming). The importance of the UD.GAL.NUN orthography lies not, however, in its difficulty, nor in the motivations for its cryptography, but rather in the way in which the signs are configured within an individual case or line. Later texts (presumably under pressure from the newer Old Akkadian bureaucracy ca. 2300 BCE as well as its immediate, Semitic-speaking forerunners such as speakers of Eblaite) uniformly adopt a linear sequencing of the orthographic elements, while earlier texts such as the Late Uruk ca. 3300–2900 BCE materials group signs within individual cases in a hierarchical arrangement within the tablet's surface. During the ED IIIa period, however, when several signs are used to write a single word, the signs are »clustered« in proximity to one another. Earlier studies that argue for a »random« distribution of the signs within a case are mistaken (JOHNSON forthcoming b).

1.5.4 Allocation of Measurement Systems

An interesting example of the above-discussed ›symbolization‹ of the material *corpus* (of real of real objects and constellations) is the mode of assigning measures, which is to say of ›contents,‹ to various spatial entities. To begin with, these entities are components in real space, both of planes (i.e., fields) as well as of those conceptualized today as »three-dimensional« (i.e., piles of grain or buildings), but to an increasing degree also conceptual abstractions of such actual spatial entities, i.e. geometric figures and bodies.

Emerging quite early in Mesopotamia, and with a point of departure in the use of elementary figures such as square and rectangle, was the assigning of surface areas to complex planar structures – i.e. fields having irregular borders – as a consequence of a process which traced these (through analysis or recomposition) back to such elementary figures.

In this connection, we already encounter the method, so characteristic of Mesopotamia, of assigning values via the determination of mean values, for instance the calculation of the surface of a trapezoid as the product of the mean value of the parallel sides and the height. This assignment of values to a trapezoid, which also appears >correct< according to our modern understanding, was also transferred by a process of analogy onto three-dimensional objects, ones that could be traced back conceptually to the trapezoid by virtue of their formal attributes, as shown for example by a sequence of several lessons found in the ancient Babylonian mathematical text BM 85194.

Essential for our picture of conceptions of space in Mesopotamian mathematics is an understanding that this mode of attributing values is (despite its failure to supply values that coincide with modern notions) not erroneous, nor is it a question (as the literature so gracefully puts it) of rough approximations, but instead of a definition that stipulates conventional correspondences between specific objects and certain elementary geometrical forms and the attribution of value derived from these relationships.

Therefore Babylonian mathematics consistently used the value 3 for the calculation of circumference and surface area of the circle (today known as » π <) by linking the dimensions of the circle to the dimensions of a corresponding square. This practice may well have its origin precisely in these special correspondences, which were used to assign values to real objects. There is evidence to suggest that the value of a circular surface was determined to be the mean value of an inscribed and circumscribed square (BRUNKE forthcoming). This value of 3, therefore, is not an approximation of π , but instead the obligatory consequence of an essential aspect of the Mesopotamian conception of space.

1.6 Summary

With our point of departure in a model which identifies the capacity of human groups to constitute »joint attentional frames« and the compilation of collections of objects as central mechanisms of cultural symbolization, we are attempting on the basis of graphic and (proto)-cuneiform textual finds to trace the genesis and development of the comprehension of space and spatiality that was characteristic of Mesopotamian culture. Our particular interest is in the manifold determinations and reflexes of this conception of space in the sciences, and in this context mathematics in particular, and on the knowledge-generating potential of the special material-symbolic representation of knowledge which was based on this conception of space.

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3 Citation

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