

## **Measuring: Practices, Publics, and Politics in doing History of Mathematical Practices**

**Workshop, January 23-24, 2020 ETH Zurich, Switzerland**

### **Abstracts of Presentations**

#### **A critical approach of the contextualisation and standardisation of measuring units in the śulbasūtras, a historiographical and historical analysis.**

**Agathe Keller (CNRS and Laboratoire SPHERE, Paris)**

The oldest mathematical texts that have been handed down to us from South Asia were written in Sanskrit. Some of the measuring units they use will be subsequently used in all the following Sanskrit mathematical literature. The historiography has much discussed the people who have composed these composite set of texts- named collectively «the śulbasūtras» or «rope aphorisms»-, and those who may have derived the mathematical knowledge that they contain. In this paper I hope to critically highlight the ways in which measures of length and surface and different types of bricks have been employed to contextualize these texts. I will also argue that the śulbasūtras have different ways of integrating measuring units in their mathematical practices, different ways maybe of standardising their measuring units in relation to mathematics. I thus hope thus to contribute to the larger reflection on questions of contextualisation of sanskrit mathematical texts on the one hand and on a history of the processes of standardisation of measuring units in mathematical contexts on the other.

#### **Muttuk Kaṇakku: measuring pearls in South India**

**Prakash V. and Babu G., French Institute of Pondicherry**

Gulf of Mannar which lies in between Southern India and Sri Lanka was popular for pearl oysters for centuries. Historically the *parawars* was the only community involved in pearl fishing in this region before the advent of *Maraikkayars*. But we don't have any historical and concrete evidence of measurements used by these two coastal communities for trade. Against this background, we came across an unpublished text *Muttuk Kaṇakku* probably written by Subramaniyan which deals with measuring pearls in order to classify and value them based on size, quality and type. This paper will discuss the history and social background of the pearl fisheries in Thoothukkudi region and think about historical transformations and standardization in measuring practices of pearls with the help of colonial reports, manuals and other relevant studies.

References:

Hornell, James, Report to the Government of Madras on the Indian Pearl fisheries in the Gulf of Mannar, 1905.

Sastri, Nilakanta K.A., The Pandya Kingdom – from the earliest times to the sixteenth century, 1972.

Deckla S., Maritime history of the pearl fishery coast with special reference to Thoothukkudi, doctoral thesis, Manonmaniam Sundaranar University, October 2004.

### **Different Measurement Practices in the Kanakkatikaram**

**Roy Wagner, ETH Zurich**

The *Kaṇakkatikaaram* is a genre of practical/recreational arithmetic treatises in Tamil and Malayalam, probably emerging around the 15th century. After the opening invocations it presents numbers, measurement units, followed by problems on topics such as interest calculation, gold refinement, area and volume measurements and trade problems. The surviving versions present many problems: the language is often corrupt, the presentation of measurements is impractical and inconsistent and the context of use is unclear. Still, in terms of the numbers of surviving copies, it stands out as the most popular Malayalam practical mathematics genre. In the presentation, I will present some of our findings, and try to suggest possible explanations for the problems that this genre presents us. (joint work with Arun Asokan and Vrinda PM)

### **Measurement practices and standardization in the ancient Greek and Roman worlds**

**Serafina Cuomo, Department of Classics and Ancient History, Durham University**

I will present a methodological paper about measurement practices and standardization in the ancient Greek and Roman worlds, where I will start from metrological artefacts, survey the ways in which they have been traditionally analysed, and then offer some reflections on why many (most) of them do not seem to be 'accurate' or 'to standard'. I will examine the ways in which measurement and standardization are presented in some textual sources, and, by drawing on recent work by Johnstone and Riggsby, argue that measurement systems and measurement practices diverge in ways which we can explore.

For discussion on sources, I should be able to have a couple of sources (one of them an artefact) which are relevant to my paper, and which we can investigate together.

### **Networks of Money and Measurement in the Roman Empire**

**Melissa Kutner, Ancient Studies, University of Maryland at Baltimore**

My project examines technologies of value in the Roman Empire with a focus on practice: I am interested in who determined various aspects of economic value and how. As evidence, I use coins, measuring instruments, and written documents such as loans and accounts. So far, written documents have provided the most insight. The evidence shows numerical and measuring practices to have been at times quite fragmented, even within single communities. Among other things, this means that relationships of power often had a strong impact on transactions.

I would like to bring and discuss two sets of documents. One group consists of a few tablets from the Roman fort of Vindolanda, particularly accounts from the commander's household and from traders in the fort. These accounts date to a fairly narrow time range but use different formats and notation systems, in particular for fractions and monetary denominations. I want to discuss why these different systems are used and what it might indicate about training, practice, power relationships, and the people at the fort.

I also would like to bring some documents from the other end of the empire: loans and leases from Roman Egypt. These loans and leases often take place in kind and specify the terms of measurement. The latter vary widely, suggesting little standardization in measuring units. But during certain periods there is a high reliance on performing the process at the public granary. This suggests, first of all, that standardization was as much about process (quality of the grain, leveled or heaping, etc.) as units, and second, that choosing to use the public granary for private transactions could help to create a certain level of standardization that was not entirely imposed by the government. However, I am not sure if this standardization was a general benefit or worked mostly in favor of more powerful parties in a transaction.

**Shaping metrological systems: historiographical and historical considerations  
Christine Proust (CNRS and Université de Paris, Laboratoire SPHERE)**

The measurement units used in administrative and mathematical cuneiform texts are represented in modern publications (including mines) in the form of tables or diagrams. These representations suggest that the measurement units form coherent, complete and uniform systems. In this presentation, I would like to draw attention to some of the implicit assumptions that these representations convey. I will then show some tablets from different periods (4th, 3rd and 2nd millennia BCE) that show the diversity of historical contexts and processes during which sets of measurement units have been shaped or reconfigured to produce what is nowadays perceived as 'systems'.

**Is looking for standard notations a historiographic trap? A perspective from ancient Chinese sources**

**Karine Chemla, SPHERE (CNRS—Université de Paris (former: Université Paris 7 Paris Diderot))**

This talk focuses on the light that fractions, as they were introduced in the mathematical cultures of ancient China, shed on the issue of standardization of mathematical notation and procedures. I have argued elsewhere that general fractions were introduced in China as results of division executed in a certain way and with the intention that divisions yield exact results (Chemla 2013). Mathematical sources yield evidence for linguistic expressions of fractions, for which we can analyze processes of standardization. However, they do not give much evidence on the 'notation' of fractions on the calculating surface on which numbers were written with counting rods, and computations carried out. In fact, the evidence we have refers to how operations were executed,

and in this context, sometimes clues are given on how fractions are inscribed *as operands*. These clues show that, if we look for ‘notations,’ fractions were ‘noted’ differently, depending on the operations carried out and the nature of the operands (Chemla 1996). But is it meaningful to refer to these inscriptions as ‘notations of fractions’? I will rather argue that in the contexts under study, inscriptions of numbers were only supports of computation. Accordingly, the issue of standardization is meaningful for processes of computation rather than for the ‘notation of fractions.’ Recent studies have brought to light that the available sources give evidence about different cultures of computation in ancient China, and in these various contexts operations involving fractions were executed in very different ways (Zhu 2016, and Forthcoming). It is within these different contexts that the issue of standardization can be addressed.

## References

Chemla, Karine. 2013. Shedding some light on a possible origin of the concept of fraction in China. Division as a link between the newly discovered manuscripts and The Gnomon of the Zhou [dynasty]. *Sudhoffs Archiv* 97:174-198. Link: <https://halshs.archives-ouvertes.fr/halshs-01138465>.

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Zhu Yiwen 朱一文. 2016 (Available online 23 April 2015). Different cultures of computation in seventh century China from the viewpoint of square root extraction. *Historia Mathematica* 43:3–25. DOI:doi:10.1016/j.hm.2015.03.002.

Zhu Yiwen 朱一文. Forthcoming. Another Culture of Computation from 7th century China. In: *Cultures of computation and quantification in the ancient world*, eds. Chemla, Karine, Agathe Keller, and Christine Proust. Dordrecht: Springer.

## ***Tonalpohualli*: calendric accounts and medicine practices of the Aztecs**

**Ana Díaz, Institute for Research in Aesthetics (IEA), National Autonomous University of Mexico (UNAM)**

The chronological system employed by the Nahuas of Central Mexico (14<sup>th</sup>-16<sup>th</sup> centuries) has been characterized in modern literature as an Aztec calendar, a temporal construction which followed the same cosmological principles of the calendars inherited from Classic civilizations. In this exposition I will question this assumption.

By the 16<sup>th</sup> century, Christian cosmography merged knowledge from different cronographical traditions, most of them based on astrological conceptions of time. I want to show that the essential principles that operated in New World's chronological knowledge were not of astrological origin –even when this system permit to count the duration of different astronomical cycles--. In contrast, the *tonalpohualli* (the original Nahua name of the chronological system known as Aztec calendar) seem to respond to a biological-arithmetical logic that has not been properly discussed and analyzed. By contrasting the data written in colonial manuscripts with those registered in pre-Hispanic codices, I want to show the process by which the complexity of the ancient Nahua account of time (a knowledge that regulated different practices, including medical, cosmological and historical ones) was simplified in order to transform the *tonalpohualli* into a "proper calendar". This process was necessary to give it comprehensibility in terms of Christian epistemology, allowing to find equivalences between measures of time, and making possible the correlations between Christian and Nahua dates.