



The Cluster of Excellence Understanding Written Artefacts at the Centre for the Study of Manuscript Cultures (CSMC) cordially invites you to the workshop

Mathematical Notes: Materiality and Epistemology

Thursday, 6 February 2025, 9:30 am – 7:00 pm CET Friday, 7 February 2025, 9:30 am – 1:00 pm CET

Warburgstraße 26, 20354 Hamburg

Organised by Matthias Schemmel (University of Hamburg) and Stefano Farinella (University of Hamburg)

> Registration: https://www.csmc.uni-hamburg.de/register/workshop65

The study of notes written in mathematical language has long been an indispensable ingredient of a wider history of the mathematical sciences. Thus, the analysis and interpretation of the notes of prominent figures such as Galileo, Newton, Hilbert and Einstein have provided us with important insights into research processes and scientific thinking. At the same time, mathematical notes and notebooks have generally not been appreciated as objects of study in their own right, namely as constituting a particular category of written artefacts. The aim of the workshop is to strengthen this perspective by bringing together studies on manuscripts and artefacts from different historical periods and cultural realms that bear mathematical notes produced in different contexts or belonging to different disciplines. We thereby encourage an approach that focuses on the interplay between the materiality of the artefact on one hand and the study of its contents on the other, thus furthering the study of mathematical notes as a category of written artefacts in their material, cognitive and social dimensions.

CLUSTER OF EXCELLENCE UNDERSTANDING WRITTEN ARTEFACTS







Programme

Thursday, 6 February 2025, 9:30 am – 7:00 pm

Chair: Matthias Schemmel (University of Hamburg)		
9:30 - 9:45	Welcome and introduction	
9:45 – 10:25	Senthil Babu (French Institute of Pondicherry) Memory and the Material Culture of Learning Mathematics in Early Modern South India	
10:25 – 11:05	Robert Middeke-Conlin (Max Planck Institute for Geoanthropology) Notes on Texts, Notes on Tablets: Mathematical Notes in Iraq during the Old Babylonian Period (2000–1600 BCE)	
11:05 – 11:40	Coffee break	
11:40 – 12:20	Stefano Farinella (University of Hamburg) Shipbuilding Manuscripts and Early Modern Science	
12:20 – 1:00	Damian Moosbrugger (ETH Zurich) The Personal Origin of Logarithms	
1:00 – 2:30	Lunch break	
Chair: José Maksimczuk (University of Hamburg)		
2:30 – 3:10	Stephen Clucas (Emeritus Professor of Birkbeck, University of London) 'Characterism in his height': The Meanings of Early Modern Notation	
3:10 – 3:50	Tian Miao (Institute for the History of Natural Sciences of the Chinese Academy of Sciences) <i>tba</i>	
3:50 - 4:20	Coffee break	







4:20 - 5:00	Angela Axworthy (University of Milan) and Michael Friedman (Tel Aviv University) On Jungius' Phoranomica: From the First Lecture Notes to the 1691 Published version
7:00	Dinner

Friday, 7 February 2025, 9:30 am – 1:00 pm

Chair: Stefano Farinella (University of Hamburg)

9:30 – 10:10	Stefano Furlan (University of Utrecht) The Storehouse of Imagination: John Wheeler's Notebooks, ~1950–1990
10:10 – 10:50	José Ferreiros (University of Seville) The Mathematical Manuscripts of Richard Dedekind
10:50 — 11:25	Coffee break
11:25 – 12:05	Jeroen van Dongen (University of Amsterdam) Stephen Hawking and the History of Black Hole Radiation
12:05 - 12:45	Lizzy Rieth (University of Amsterdam) From Scribbles to Science: The Role of Notes in Theoretical Physics Research
12:45 – 1:00	Farewell address
	Optional lunch (self-paid)







Abstracts and Contributors

Angela Axworthy (University of Milan) and Michel Friedman (Tel Aviv University)

On Jungius' Phoranomica: From the First Lecture Notes to the 1691 Published Version Thursday, 6 February 2025, 4:20 pm – 5:00 pm

On 2 February 1624, the German natural philosopher, mathematician, logician, and philosopher Joachim Jungius (1587–1657) held his inauguration speech at the University of Rostock. The speech, which may be titled *De Mathematicarum disciplinarum praestantia*, presents an attempt for a systematization of the disciplines falling under the field of *mathesis*. One of these disciplines is termed by Jungius "phoranomics" (phoranomica). The term comes from the Greek root $\varphi \epsilon \rho \omega$ (to carry, transfer, lead), related to $\varphi o \rho \dot{\alpha}$ (carrying, motion); both terms were often used by ancient mathematicians to express kinematic processes in geometry. But as Jungius quickly emphasizes in this speech, while geometry is "pure or abstract", phoranomics is considered as a "mixed" or "concrete" science. While there were certainly attempts on the part of mathematicians during the previous centuries to integrate motion in their research on geometry, it seems that Jungius was the first to state that this field of research should be considered as a distinct discipline. During the years that followed, Jungius' research on phoranomics was written down in several manuscripts, drafts, non-published reflections and lecture notes; these were circulating among various colleagues and eventually were extensively edited by Heinrich Sivers posthumously during the second half of the 17th century, and published in 1691 under the title Phoranomica, id est de motu locali.

What was the nature of Jungius' mathematical notes over the centuries? In our talk we would like to examine not only the mathematical content as well as the historical, philosophical and cultural context of Jungius' investigations, but also and mainly consider such notes not necessarily as leading to a finished, final, published book, but rather as what represents the idiosyncratic way of Jungius' work methods, displaying at the same time traits – both material and mathematical – that point towards more general practices concerning the treatment of such (mathematical) notes.







Senthil Babu (French Institute of Pondicherry)

Memory and the Material Culture of Learning Mathematics in Early Modern South India Thursday, 6 February 2025, 9:45 am – 10:25 am

The practice of recollective memory remained central to the cultivation of learning numbers in the elementary learning institutions of south India during the early modern period, if not earlier. The practice, facilitated a movement between the concrete and the abstract, transforming the measure into a number so that further processes of abstraction, in the context of calculation becomes possible. I will discuss the material culture of this practice, through loud recital and simultaneous writing in these school, which prepared the students to deal with the everyday work in certain occupations such as the accountant. What would be the idea of proficiency and professional virtue that such practice imagined? How did the pedagogic context and the techniques come together? How do we relate to the social dynamics of such a practice? These are some questions that we can reflect upon, using the materials that were produced in these early modern elementary institutions in south India.

Stephen Clucas (Emeritus Professor of Birkbeck, University of London)

'Characterism in his height': The Meanings of Early Modern Notation Thursday, 6 February 2025, 2:30 pm – 3:10 pm

The late sixteenth and early seventeenth century was a very innovative period in the history of mathematical notation. This paper examines the place of notation in the intellectual milieu of the 'Northumberland circle' (focusing on Henry Percy, 9th Earl of Northumberland, and his clients Thomas Harriot and Walter Warner) and its place in the wider field of 'characterism' in the early modern period. As mathematicians, Harriot and Warner developed new forms of notation (or 'literal schematisms') in their mathematical practice and (in the case of Warner) reflected on the nature of notation in mathematics. Their patron Henry Percy also reflected on the function of the 'character' in mathematics and cryptology. By means of this focused case study, I will reflect on the new awareness of the power of symbolic notation to compress, simplify and functionalise concepts in early modern Europe.







Jeroen van Dongen (University of Amsterdam)

Stephen Hawking and the History of Black Hole Radiation Friday, 7 February 2025, 11:25 am – 12:05 pm

Stephen Hawking's key result, the evaporation of black holes, celebrates its 50th anniversary this year. Hawking and the effect named after him, as key figure and result of twentieth century physics, have now become the subject of historical study. At the same time, the effect's notorious corollary, known as the information paradox, has become a focal point in philosophical debate on modern physics, and has remained a key element in studies of quantum gravity by today's physicists. In this talk, we present a source-based reconstruction of how the result that black holes evaporate was attained, and reflect upon what it tells us about Hawking's scholar-ship and its place in late twentieth century physics. Finally, we discuss the nature of the available historical sources in the case of Hawking, who gradually lost the ability to write (based on joint work with Klaas Landsman).

Stefano Farinella (University of Hamburg)

Shipbuilding Manuscripts and Early Modern Science Thursday, 6 February 2025, 11:40 am – 12:20 am

The topic of the influence of artisans and practitioners in the birth of modern science has been the subject of discussion and research for more than a century. Historians of science have defended a variety of different opinions and produced much valuable contributions, but to this day this issue still requires further concrete examples and a better theoretical framework. In this talk, we investigate this problem using the shipbuilding notes of Early Modern English mathematician Thomas Harriot (c. 1560–1621) and his contemporary Mathew Baker (c. 1530–1613), one of the most renowned Tudor shipwrights. Using the unifying language of external representations of knowledge, we present the different roles of these notes as tools of knowledge communication, knowledge production, and as tools in the literal sense of the word. This allows us to reconstruct the shared knowledge of Early Modern shipbuilders, and to show instances of knowledge exchange between scholars and practitioners. Our investigation, and a comparison with the case of Galileo Galilei (1564–1642), will shed light on the collaborations and exchanges of knowledge between artisans and scholars, and on the topic of the mathematization of practice and its relationship with science.







José Ferreirós (University of Seville)

The Mathematical Manuscripts of Richard Dedekind Friday, 7 February 2025, 10:10 am – 10:50 am

The *Handschriftenabteilung* of the Göttingen University Library takes care of the remaining manuscripts of many relevant mathematicians – Gauss, Riemann and Hilbert among them. Indeed, it serves as the Central Archive of German *Nachlässe* of mathematicians. One of its rich funds is the Nachlass Dedekind, noteworthy among other things for the correspondence he carried with many relevant mathematicians (Georg Cantor being the best-known case). We will consider some of Dedekind's unpublished manuscripts as an example of relevant scientific notes of the 19th century. The study of such manuscripts offers a perspective on the scientist's "workshop", the "back shop" normally unseen – where research materials are gathered and organized, processed and reprocessed, notations are invented, new concepts and methods are introduced. Our prime example will be the drafts that eventually led to the publication of Dedekind's path-breaking *Was sind und was sollen die Zahlen*? in Dec. 1887.

Stefano Furlan (University of Utrecht)

The Storehouse of Imagination: John Wheeler's Notebooks, ~1950-1990 Friday, 7 February 2025, 9:30 am – 10:10 am

The eminent American physicist John A. Wheeler (1911-2008), besides being himself an impactful scientist, was a relentless mediator and propagator of ideas between different generations, from that of Einstein and Bohr - his two greatest mentors - to the physicists who, in recent decades, contributed to drawing the current frontiers of theoretical physics. For the joy of the historian, Wheeler documented a rather large portion of all this in a series of notebooks that he kept for decades, annotating ideas, calculations, conversations, anecdotes, research plans, summaries of talks and conferences, excerpts from his correspondence, and so on. I will detail with examples how and why Wheeler began keeping a notebooks varied in different phases of his long and polyhedric career. Far from being simply a "goldmine", Wheeler's notes can also represent a slippery ground for the historian: I will thus conclude with a few considerations on the use of such archival material.







Robert Middeke-Conlin (Max Planck Institute for Geoanthropology)

Notes on Texts, Notes on Tablets: Mathematical Notes in Iraq during the Old Babylonian Period (2000–1600 BCE) Thursday, 6 February 2025, 10:25 am – 11:05 am

Mathematical notes in ancient Iraq during the Old Babylonian period can take many forms. These forms are sometimes difficult to recognize and difficult to define. Indeed, they can be very sparse – simple jotting down of numbers on the margins of a professional text such as an accounting text. They can appear similar to a school tablet: using the same tablet types that are commonly produced by students in the course of studies. Or we can sometimes understand the large tablets displaying mathematical thought as teacher's notes – a kind of syllabus used to aid in presenting classwork.

This presentation is exploratory. Its intent is to delve into the variety of mathematical notes found in Iraq during this period. It asks, how do notes appear? What do they contain? And why were they produced? Notes will be contextualized within the Old Babylonian period – a period of remarkable democratization in the scribal art with roots into the third dynasty of Ur, a massive and administratively oppressive kingdom of the last century of the third millennium BCE. The listener will become aware of mathematical notes as they appear in the Old Babylonian period and issues surrounding them.

Damian Moosbrugger (ETH Zurich)

The Personal Origin of Logarithms Thursday, 6 February 2025, 12:20 am – 1:00 pm

In 1620, the *Arithmetische und Geometrische Progress Tabulen* of the Swiss clock- and instrument-maker as well as mathematician Jost Bürgi (1552-1632) were printed. The tables constitute a logarithmic computational tool. As he developed it independently of John Napier's *Mirifici logarithmorum canonis descriptio* that was published six years earlier, Bürgi is considered one of the discoverers or inventors of logarithms.

In his handwritten foreword that accompanied his tables, Bürgi mentions the arithmetic of German *Rechenmeister* as a source of inspiration. Modern scholarship furthermore treats the method of *prosthaphaeresis* – a way of substituting the multiplication of trigonometric entities with additions and subtractions – as a forerunner of logarithms. They are both seen as responses to the tediousness caused by having to compute many-digit numbers by hand in early modern astronomical calculation.







In my talk, I wish to delve deeper into the question of how Bürgi came up with his logarithmic computational tool. There is in fact (only) one mathematical note of his, which has survived. It consists of a single page representing the calculation of the position of a planet on the celestial sphere, dating from 1590, when Bürgi was employed at the court of Kassel, where he was also engaged in astronomical observation My close analysis of this personal piece of mathematics reveals that the basic structural principle underlying logarithms might have originated from a specific procedural step inherent to his computational practice.

Lizzy Rieth (University of Amsterdam)

From Scribbles to Science: The Role of Notes in Theoretical Physics Research Friday, 7 February 2025, 12:05 am – 12:45 am

Note-taking is an essential part of generating new knowledge in the mathematical sciences, playing a key role from the first spark of an idea to final publication. Notes act as personal tools for tracking thought processes and as structured outputs for communicating results within the research community.

In this talk, I will explore how different forms of note-taking— e.g. scribbled calculations, dynamic sketches, and polished digital summaries—are adapted to various phases of research. Drawing on my experience as a theoretical physicist and common practices in the field, I will moreover show how revisiting, editing, and refining notes reflect the iterative nature of scientific research, helping to clarify ideas and reveal unexpected connections.

I will also explore the materiality of note-taking, contrasting handwritten and digital media, and the way individual styles interface with community conventions in physics and mathematics. By showcasing examples of notes at various stages of the research process, I aim to demonstrate how note-taking contributes to tackling complex problems. This perspective sheds light on the critical role that notes play in advancing our understanding of mathematical and physical phenomena, notably by navigating abstraction and fostering collaboration through shared ideas.

