BRITISH SOCIETY FOR THE HISTORY OF MATHEMATICS

Research in Progress

Saturday 2 March 2024 in the Shulman Auditorium, The Queen's College, Oxford

Programme

10:00–10:20	Registration	
10:20–10:30	BSHM	Welcome
10:30–11:00	JASON YIP Middlesex University	*Cultural Echoes in Mathematical Discourse: The Unique Style of Ancient Chinese Treatises*
11:00–11:30	DAVID VIRGILI Universitat Politècnica de Catalunya	*Antonio Hugo de Omerique, A Modern Geometer with Classical Roots*
11:30–12:00	Refreshment break	
12:00–12:30	SAŠA POPOVIC University of Rijeka	*Poincaré's Double Mistake and the Reception History of Veronese's* Fondamenti di Geometria
12:30–13:00	PAUL-EMMANUEL TIMOTEI SPHERE, Université Paris Cité	*The Reduction of Singularities between Max Noether and Georges-Henri Halphen: What did a more geometric approach mean?*
13:00–14:00	Lunch in the auditorium foyer	
14:00–14:30	AOIFE KEARINS Independent scholar	*Place, Space, and the Mathematical Imagination: Resituating George Gabriel Stokes in Ireland*
14:30–15:00	KATE HINDLE University of St Andrews	*Placing D'Arcy Thompson in the History of Mathematics*
15:00–15:15	Comfort break	
15:15–15:30	ELEANOR BRITTAIN University of Cambridge (BSHM Undergraduate Essay Prizewinner)	*Whipple Museum Object 1754: A Window into the Crossing of Mathematics, Religion and Art in the 17th Century*
15:30–16:00	CLÉMENT BONVOISIN SPHERE, Université Paris Cité	*Across Disciplinary Boundaries and State Borders. How Restricted Mathematical Knowledge Traveled from New Jersey to Moscow through an Engineering Textbook (1953–1956)*
16:00–16:30	FREDERIKE LIEVEN Paris Sorbonne Université	*"Shattering the Traditional Framework of Mathematical Instruction": Teaching "New Math" in a Modern Society*
16:30–17:00	Refreshment break	
17:00–18:00	REBEKAH HIGGITT National Museums Scotland	Invited lecture: *Metropolitan Science and Mathematical Practice*
18:00	Close of meeting	

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Abstracts

Clément Bonvoisin (SPHERE, Université Paris Cité)

Across Disciplinary Boundaries and State Borders. How Restricted Mathematical Knowledge Traveled from New Jersey to Moscow through an Engineering Textbook (1953–1956)

In this talk, I will focus on *Engineering Cybernetics*, a monograph published in 1954 by Chinese engineer Tsien Hsue-shen (1911–2009). The book was published in the United States during the McCarthy era. When he wrote it, Tsien was living in California, under house arrest and constant surveillance of the FBI. Nonetheless, he built a chapter of his book out of a military-sponsored PhD dissertation in mathematics. The dissertation had a restricted distribution policy that theoretically did not allow Tsien, as a foreigner, to get access to it. This is all the more interesting considering the circulation of the book in the Soviet Union. There, the monograph allowed some mathematicians to use the restricted results to formulate a general principle with military uses.

I will build on this case to discuss two facets of the circulation of knowledge during the Cold War. First, I will consider the circulations of restricted knowledge within the United States, and from the United States to the Soviet Union. I will argue that restriction policies relied on a variety of practices of secrecy in different sites of knowledge. As I will show, this allowed for restricted knowledge to circulate beyond intended limits, both at national and transnational scales. Second, I will turn to what effectively circulated by focusing on the adaptations of knowledge across the disciplinary boundary between mathematics and engineering. Here I will show how an engineer transformed knowledge according to his priorities, and how this adaptation shaped its subsequent uses by mathematicians.

Eleanor Brittain (University of Cambridge)

Whipple Museum Object 1754: A Window into the Crossing of Mathematics, Religion and Art in the 17th Century

As with many objects now housed in museums, Wh.1754, a curious crucifix sundial, prompts more questions that its limited provenance can answer. However, through a close analysis of the sundial's materiality, as well as tentative suggestions of its origin and purpose, I advance the view that this sundial offers a window into the world in which it was commissioned, appreciated, and used. Indeed, a close examination of the object reveals enticing remnants of human touch and actual usage. Embracing the call of Liba Taub and others, that historians should take account of the broader contexts of scientific instruments beyond merely the 'scientific', an interdisciplinary approach is adopted. I explore the sundial's multiple dimensions, none of which take predominance. Its mathematical utility, religious significance, and artistic quality are intimately tied together through its shape, engravings, and material. Appreciating that contemporaries would not have conceptualised such distinct categorisations, at the core of this talk is a keen focus on discrediting the 'science versus religion' narrative. For whoever owned this sundial, it did much more than enable them to work out the time. Historians should recognise this and view Wh.1754 on their terms.

Rebekah Higgitt (National Museums Scotland)

Metropolitan Science and Mathematical Practice

The 'Metropolitan Science' project explored cultures of knowledge and practice in early modern London within and around productive institutional settings. These included a guild (Trinity House), a trading company (East India Company), and a government department (Office of Ordnance). The work of mathematical practitioners — as authors, instrument makers, teachers and examiners — has been shown to have been key to these institutions, allowing them to meet their core responsibilities and to innovate or transform in ways that ensured their survival or flourishing in a fast-changing city. This talk will share some insights from this research and consider the picture of London mathematical practice that emerges from it alongside that revealed by the Science Museum's 'Science City, 1550–1800' gallery, which was developed separately but in tandem with the research project. In doing this, the talk will also reflect on the challenges of displaying these histories in the museum.

Kate Hindle (University of St Andrews)

Placing D'Arcy Thompson in the History of Mathematics

D'Arcy Thompson (1860–1948), author of *On Growth and Form* (1917), one of the first major biomathematical texts, also held an interest into the study of the history of mathematics. This interest mainly came through in the study of Greek mathematics; he is universally recognised in the literature for his interest in ancient Greece, thanks to his father, a classicist scholar. Thompson also drew on the history of mathematics, and the history of science more generally, in his biomathematical works.

Thompson kept a correspondence with a wide array of academics, several of whom were historians of mathematics. These tended to be those interested in ancient mathematics, though inside of this interest there was a variety in background - Thompson was corresponding with big names like T. L. Heath, author of *A History of Greek Mathematics*, as well as lesser known historians such as J. K. Fotheringham, reader in ancient astronomy and chronology at the University of Oxford during the 1920s. This talk aims to compare Thompson with these peers by use of frameworks.

Aoife Kearins (Independent scholar)

Place, Space, and the Mathematical Imagination: Resituating George Gabriel Stokes in Ireland

This talk will make an argument for the importance of considering place and space as essential contributors to the development of mathematical thought and ideas. Rather than taking a typical history of science approach, where place and space is considered in the historical context of what science was understood to be in a given place at a given time, I instead put forward an argument for the specific relation between the scientific enterprise and its geography, showing that historical geography can change and decisively affect the particulars of science or mathematics done by the person in question. This talk will contextualise this question generally, using the broad existing scholarship in literary and cultural studies to draw comparisons between the notion of place and space as significant contributors to the inspiration for and thus creation of literary or artistic output, as opposed to scientific or mathematical ideas.

After making the case for drawing these comparisons across academic fields, I will consider a key case study of the applied mathematician George Gabriel Stokes. This portion of my argument will focus on providing examples of the influence of physical places on the work Stokes undertook, both in terms of subject matter choice, approach to problem solving, and occasionally even results. I then outline how Stokes's view of Ireland as depopulated nature was typical of the views of the Protestant Ascendancy in Ireland of the time, and explore how this political and social space Stokes occupied was extremely relevant to his scientific practice. Finally, I combine the evidence from Stokes's physical places and sociopolitical spaces to show why considering Stokes's Irishness is essential in understanding his scientific writing, and how considering this case study can provide a framework for acknowledging the influence of place and space in mathematical imagination.

Frederike Lieven (Paris Sorbonne Université)

"Shattering the Traditional Framework of Mathematical Instruction": Teaching "New Math" in a Modern Society

In the 1960s, many countries undertook profound reforms in the teaching of mathematics, introducing new content such as set theory and algebraic structures. Sometimes referred to as a "revolution", these changes were accompanied and justified by a public discourse explaining the need for modernised mathematics education in a modern world. This discourse was articulated by mathematicians, mathematics teachers, but also by politicians, experts, economic actors and the media, and thus became ubiquitous.

An analysis of the assumptions made by the different actors allows us to understand how they perceived the post-war society in which they lived, and how this society defined itself and its needs. Indeed, mathematics education was supposed to provide children with the mathematical knowledge they would need in their professional and private lives.

Many sources refer to a "technical society", implying that technological progress is constant and changes people's living conditions. This argument is used to justify the growing importance of scientific subjects in schools. But the discourse also shows that people were aware that they lived in a world that was changing at an unprecedented rate. Schools therefore had to prepare children for a future that could not be foreseen. According to the reformers, only modern mathematics could teach children how to cope with any situation they might face in the future.

In this respect, the "new math" reform shows on the one hand a certain vision the post-war societies had of themselves as changing in an unpredictable way, but yet organised by underlying structures. On the other hand, it shows how mathematics was seen by society: as a tool of thinking which made it possible to understand an increasingly complex world.

Saša Popovic (University of Rijeka)

Poincaré's Double Mistake and the Reception History of Veronese's Fondamenti di Geometria

At the turn of the twentieth century, the Italian mathematician Giuseppe Veronese (1854–1917) introduced and elaborated his non-Archimedean geometry in a series of ground-breaking papers and books, especially in the *Fondamenti di Geometria a più dimensioni e a più specie di unità rettilinee* of 1891. Veronese's results were initially

widely discussed by leading mathematicians, as well as in mathematical encyclopaedias and lexicons of the time. In stark contrast to this initial burst of enthusiasm for Veronese's new geometry, today Veronese's results seem to be almost entirely unknown by contemporary mathematicians, philosophers and historians of mathematics alike. This *striking asymmetry* in the initial and final stages of the reception of Veronese's theory is at the heart of my research project. In the first part of the talk, I will outline the historical and mathematico-philosophical context within which Veronese introduced and developed non-Archimedean geometry. This will include the "crisis in intuition", the ensuing foundational debates, and the establishment of the so-called "Cantor–Dedekind academic dogma" in mathematics proper, as well as in the historiography and philosophy of mathematics. In the second part, I will focus on the factors which negatively impacted the reception history of Veronese's *Fondamenti*, with special emphasis on what I call *Poincaré's double mistake*, having to do with (i) a *priority dispute* concerning the question of who first introduced non-Archimedean geometry, Veronese or Hilbert, and (ii) the *misidentification* of the so-called Veronese numbers with Cantor's transfinite ordinals. In connection with (ii), I will also critically examine the alleged "proofs" against the possibility of infinitesimals proposed by Cantor and Peano. I will conclude by pointing out how even some contemporary historical accounts of the development of non-Archimedean mathematics are not immune to the Poincaré-style misinterpretations of Veronese and his non-Archimedean geometry.

Paul-Emmanuel Timotei (SPHERE, Université Paris Cité)

The Reduction of Singularities between Max Noether and Georges-Henri Halphen: What did a more geometric approach mean?

For the French translation of George Salmon's *A Treatise on the Higher Plane Curves* (the translation was carried out by O. Chemin and published in 1884), Georges-Henri Halphen (1844–1889) composed an appendix titled "Etude sur les points singuliers des courbes algébriques planes" ["Study of the singular points of plane algebraic curves"]. The third part of this appendix deals with questions regarding the reduction of singularities. Halphen presents a method that was new at the time, and that seems to be forgotten today. This method allows him to obtain the same result for the reduction of singularities of plane curves as the one Max Noether had published a few years earlier. This result, Halphen claims, can be generalized easily and allows him to obtain the following theorem:

> To any algebraic curve there corresponds point by point another curve, in such a way that all singular points of the former curve correspond to simple points of the latter, which itself has no singular points other than ordinary double points.

Halphen attributes this statement to Noether and adds:

> The analysis developed in Sections 58 and 59 [where the method he followed to reduce singularities is described] leads me to give M. Nöther's theorem a more geometric form.

What does Halphen mean with words *a more geometric form*? My talk will offer an interpretation. Moreover, I will address the following question:

> What allows Halphen to judge his approach to Noether's theorem more geometric?

To explore this issue, I will present Noether's and Halphen's method of reduction of singularities intuitively; I will discuss Halphen's training and Noether's knowledge about reduction/resolution of singularities as well as the interpretation of these different methods by their readers.

David Virgili (Universitat Politècnica de Catalunya)

Antonio Hugo de Omerique, A Modern Geometer with Classical Roots

The process of algebrization through the 16th and 17th centuries in what is now Spain has not been thoroughly studied yet, partly because of the prejudice among historians that Spain was disconnected from the scientific development that was taking place then. One remarkable mathematician from that period is Antonio Hugo de Omerique (1634–1705), whose "Analysis Geometrica" (1698), written in Latin and in an Euclidean style, made an important contribution to the dialogical development of analytic geometry in Europe, and was worthy of praise by Isaac Newton. As we will see, Omerique profits from his Jesuit education and studies the work of Josep Saragossà (1627–1679) and Grégoire de Saint-Vincent (1584–1667), and his work and symbolic algebraic notation is linked with the former local mathematical development. Omerique sometimes explicits the dual interpretation of his analytical resolution of the problems posed, formulating equations or systems of equations

whose resolution is equivalent to the known geometrical solution. Almost immediately upon the publication of his work, an anonymous review of the treatise with a selection of some of the problems solved is published in the *Philosophical Transactions* (1699). The review does not deepen fully in the innovations of Omerique and presents mostly examples of compositions of ratios, has some differences in the symbolical algebra used (including the dubitative use of the new "=" to replace Omerique's symbol to denote equality, "_ ∧ _"), and most interestingly, presents Omerique with an ambiguous attitude towards algebra, which might have caught Newton's attention.

Jason Yip (Middlesex University)

Cultural Echoes in Mathematical Discourse: The Unique Style of Ancient Chinese Treatises

The paper explores the philosophical and linguistic dimensions of the concise and poetic style in ancient Chinese mathematical treatises, contrasting it with Western mathematical traditions. Instead of following an axiomatic approach, Chinese mathematics focused on real-world applications, as exemplified in texts like *Jiu Zhang Suanshu*. Its unique characteristic lies in its concise and poetic manner of presenting problems and solutions, influenced by the cultural and historical contexts of the Chinese language.

In my talk, I will pay attention to the uniqueness of several key factors in Chinese mathematical writing, namely memorability, clarity, cultural significance, and aesthetic appeal. The linguistic analysis reveals the intricacies of Chinese mathematical texts, emphasising the role of morphemes, characters, and tone distinctions. The compact nature of Chinese characters allows for the embedding of meanings, with each character acting as a mnemonic device. Examples, such as the Nine-nine Multiplication Poem, illustrate the efficiency of knowledge delivery and its role in promoting education.

The linguistic exploration continues with an examination of morphemes, the smallest units of meaning in Chinese characters. The use of tone distinctions, as observed in Mandarin, adds clarity to pronunciation and meaning. The paper presents classical problems, such as the Chinese Remainder Theorem, highlighting how language is intricately woven into mathematical problem-solving. The poetic style in problem representation and solution adds aesthetic appeal, engaging readers and aiding memory.

This intersection of language and mathematics in ancient China reflects a distinctive approach, compared with its Western counterparts. The paper advocates for continued exploration of this rich historical legacy, inspiring curiosity and scholarly interest in the relationship between the two areas.

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