BRITISH SOCIETY
FOR THE HISTORY
OF MATHEMATICS

Research in Progress

Saturday 27 February 2021

To take place via Zoom: recorded lectures will be available online 24 hours before the meeting, and then also played via Zoom on the day, followed by live Q&A at the end of each session.

Programme

09:15–09:30	SARAH HART BSHM President	Welcome
09:30–10:30	CLEMENCY MONTELLE University of Canterbury, New Zealand	Invited lecture: *An Ocean of Knowledge: Exploring the History of Mathematics in India*
10:30–10:45	Break	
10:45–12:15	ALISON MAIDMENT The Open University	*'An unparalleled spring of knowledge': Edmund Taylor Whittaker as a Historian of Science*
	BRITTANY CARLSON University of California, Riverside	*Math Anxiety (Re)mediation Practices of the Nineteenth-Century Mathematician*
	PAUL FELTON The Open University	*The Popularisation of Mathematics in Britain during the 19th Century*
	NATASHA BAILIE Queen's University, Belfast *BSHM Undergraduate Essay Prizewinner*	*Quantifying the Unquantifiable: The Mathematicisation of Philosophy during the Scottish Enlightenment*
12:15–13:30	Lunch break	Zoom break-out rooms to be available 12:45–13:15
13:30–15:00	BENJAMIN WILCK Humboldt-Universität zu Berlin	*The Order of Definitions in Euclid's* Elements
	MEREDITH HOULTON University of St Andrews	*Navigating Euclid: A Table from William Sanders'* Elementa Geometriae
	ELENA SCALAMBRO Università degli Studi di Torino	*Gino Fano's Contribution to the Classification of a Special Class of Threefolds*
15:00–15:30	Break	Zoom break-out rooms to be available
15:30–17:00	DOMINGO MARTÍNEZ VERDÚ Universidad de Murcia	*Use of Infinity in the Calculation of Logarithms. The Analytical Procedures in Works by Benito Bails (1731–1797)*
	ANUSHA BHATTACHARYA Chennai Mathematical Institute, India	*Generalized Theory of measures: An Attempt to Unite Contrasting Notions of Sizes*
	KEVIN BAKER University of Oxford	*Mathematics and Certainty*
17:00–17:30	Break	
17:30–18:30	History of Mathematics Quiz	

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Abstracts

Kevin Baker (University of Oxford)

Mathematics and Certainty

A central theme of my research on Isaac Newton's *Principia Mathematica* is how the validity of its mathematical methods had to be negotiated with its readers. When studying his unusual, idiosyncratic book, Newton's contemporaries urged him to rewrite, restructure and reformulate many of his arguments. Just as mathematicians have done throughout history, Newton's peers argued about what constituted an acceptable proof.

However, many historians of the Scientific Revolution appear to assert as a matter of principle that this cannot possibly have happened. It is a standard trope in the secondary literature that mathematics had "a privileged reputation for certainty" (Peter Dear). While empirical knowledge was provisional and revisable, mathematical knowledge "compelled absolute assent" (Steven Shapin and Simon Schaffer). Because mathematics "exerts something like an irresistible compulsion on those that are held to comprehend it" (Rob Iliffe), the only barrier to its acceptance is the ability to understand it; the reception of a mathematical text therefore comprises beleaguered readers "struggling to become its master" (Andrew Warwick). The possibility that a piece of mathematics might be understood but disputed is explicitly denied: "geometry yielded irrefutable and incontestable knowledge" (Shapin and Schaffer).

So does a misplaced faith in the absolute certainty of mathematics cause historians of science to misrepresent its nature? In this talk I will argue that it does, before inviting the audience to share their views on the nature of this problem, if indeed they think it exists.

Natasha Bailie (Queen's University, Belfast)

Quantifying the Unquantifiable: The Mathematicisation of Philosophy during the Scottish Enlightenment

The reception of Newton's *Principia* in 1687 led to the attempt of many European scholars to 'mathematicise' their field of expertise. An important example of this 'mathematicisation' lies in the work of Irish-Scottish philosopher Francis Hutcheson, a key figure in the Scottish Enlightenment. This talk aims to discuss the mathematical aspects of Hutcheson's work and its impact on British thought in the following centuries, providing a case in point for the importance of the interactions between mathematics and philosophy throughout time.

Anusha Bhattacharya (Chennai Mathematical Institute, India)

Generalized Theory of measures: An Attempt to Unite Contrasting Notions of Sizes

We introduce two generalizations of measure theory and see how they connect three historically important advances of mathematics, namely Cantor's and Euclid's notions of size and probability theory. With the existing theory of measures, one can express Euclid's notion of size (Lebesgue measure) which occur in various forms in our daily lives, probability theory (probability measure) and the notion of counting finite number of objects (counting measure).

The first generalization is done by defining countable sum of cardinals and by modifying the measure axioms to extend the counting measure for including Cantor's notion of size. The second generalization uses surreal numbers to extend the co-domain of measures to some object having similar properties as reals. Some results from measure theory hold here with appropriate modifications.

These theories include far reaching consequences of measure theory like the Poincaré recurrence theorem, which can be used to study the random movements like that of pollen grains in a water body as well as the crucial role played by measure theory in various decision-making and optimization strategies, thus showing the significance of generalised measures in binding three historically significant developments of mathematics and its ability to study several natural and artificial phenomena.

Brittany Carlson (University of California, Riverside)

Math Anxiety (Re)mediation Practices of the Nineteenth-Century Mathematician

The nineteenth-century ushered in a wave of professionalism in mathematics. Instead of religiously-based justifications of mathematics, the field shifted to develop its own language, practice, and professional protocol. With this shift, negative images of the professional mathematician emerged in many popular texts such as Sir Arthur Conan Doyle's Professor Moriarty and Bram Stoker's Malcolm Malcolmson in his short story, 'The Empty House'. These depictions, I argue, paint an unrealistic picture of mathematicians who were engaged in the mathematical discovery process. With the rise of puzzling and other popular, ephemerally-mediated mathematical pedagogy amongst children and adults, the mathematical discovery process often took place through experimentation. The learner experimented with the ephemera, made observations, narrativized those observations, and developed mathematical knowledge. Many nineteenth-century mathematicians, I argue, followed suit. In this presentation, I acknowledge the popular negative depictions of mathematicians then turn to G. H. Hardy's 'A Mathematician's Apology', J. J. Sylvester's 'A Plea For Mathematics', and Lewis Carroll's *Alice in Wonderland* and *Through the Looking Glass* to showcase the ways mathematicians used both the fictional and non-fictional narratives to mediate their anxieties about various developments in mathematics. I do this not only to uncover the prehistory of math anxiety in the nineteenth century but also to show how widespread math anxiety was. Their methods, I argue, are critical to dispelling both contemporary and Victorian myths about the objectivity of mathematics and instead highlights the humanistic aspects of the field.

Paul Felton (The Open University)

The Popularisation of Mathematics in Britain during the 19th Century

In the 19th century, it was commonplace for scientists, then known as natural philosophers, to popularise their research. This popularisation was directed towards people that were unlikely to be able to obtain formal teaching and towards those who preferred self-education and improvement. In the main, they were members of the working classes.

Historians have written a great deal on popularisation. However, they seem to have been reluctant to broach mathematics, even though important figures such as De Morgan and Lardner were actively involved in popularising their own work.

My project will investigate the people and methods that were involved in popularising mathematics. It will look at target audiences and consider the different types of communication such as books, magazines, journals and newspapers, along with exhibition catalogues and lectures. A major area of focus will be on the treatises and papers produced by the Society for the Diffusion of Useful Knowledge (SDUK). This society was founded at the instigation of Lord Brougham who, apart from being a lawyer and a British Statesman, was known to be an enthusiastic mathematician. In addition, the study will review the popularisation undertaken by Societies and Associations, Mechanics' Institutes and Museums and an appraisal of the role of recreational mathematics and popular fiction will also be undertaken. Finally, the project will provide a view on whether the overall popularisation approach was successful or not.

Meredith Houlton (St Andrews University)

Navigating Euclid: A Table from William Sanders' Elementa Geometriae

William Sanders was Chair of Philosophy at the University of St Andrews, beginning in 1672, and he was then appointed to the position of Regius Chair of Mathematics in 1674, succeeding the prominent astronomer and mathematician James Gregory. In 1686 Sanders published *Elementa Geometriae*, which has not previously been studied in-depth nor translated. The Early Modern mathematics book is written in Latin and consists of two parts: the first part covered geometry and the second part featured logarithms and trigonometry. This research aims to gain insights into the nature of mathematical education and texts in Scotland in the late 17th century. Of particular interest to this research is a table that Sanders included at the end of his book. From the table, readers can determine when and where Sanders referenced Euclid. The table compares Sanders' Elements with Euclid's Elements side by side. Readers can see not only what Euclidean material Sanders included, but the Euclidean material excluded can be determined as well. Questions will be explored such as: Why did Sanders include the Euclidean content which he included? Why did he exclude the Euclidean material which he excluded? Why was Sanders specific with Euclidean references but not specific when referring to other mathematicians throughout the book? What does the table show us about how Sanders was navigating and utilizing Euclid? Why did Sanders modify and rearrange Euclid the way he did?

Alison Maidment (The Open University)

'An unparalleled spring of knowledge': Edmund Taylor Whittaker as a Historian of Science

During a multifaceted career, mathematician, Edmund Taylor Whittaker (1873–1956), became a well-known historian of science, valued for his extensive knowledge of the subject. His first foray into historical exposition came in 1897, only two years after graduating from Cambridge, when he was invited to write a *Report on the Progress of the Solution of the Problem of Three Bodies* by the British Association. The *Report*, which took two years to complete, covered the years 1868–1898 and was described as exhaustive. Then, in 1910, his classic, *A History of the Theories of Aether and Electricity* was published, earning him international respect in the history of science. A second volume of *A History* was published in 1953, but with it came accusations that Whittaker was wrongly minimizing Einstein's role in the special theory of relativity. This tainted Whittaker's reputation, yet he remained in demand as an obituary author, even writing one for Einstein. In this presentation I will investigate Whittaker's historical writings, how he came to produce such detailed work and to what extent they leave a continuing legacy.

Domingo Martínez Verdú (University of Murcia)

Use of Infinity in the Calculation of Logarithms. The Analytical Procedures in Works by Benito Bails (1731–1797)

The Spanish mathematician Benito Bails (1731–1797) published a mathematical course *Elementos de Matemática* (*Elements of Mathematics*) that was composed of 11 volumes (1779–1802) and dedicated to providing a solid foundation and high level of education in mathematics to students of Fine Arts, particularly Architecture. In this work, Bails introduced the algebra of infinity (infinite series) in the calculation of logarithms. His proposal modernized, in a European key, the traditional thought of Spain 18th century based on purely arithmetic and geometric methods. He led a new way and, in that sense, we can consider Bails as "original and innovative". For example, Bails defined, like Leonhard Euler (1707–1783) in his *Introductio in Analysin Infinitorum* (1748), the logarithm of a number as the inverse operation of the exponential. Bails presented one of the most complete mathematical developments on logarithmic calculation methods of his time.

Our aim in this communication is to analyze how the algebraic analytical reasoning allowed Bails to obtain new infinite algorithms that converge more quickly to solve, in a more efficient way, the calculation of logarithms in any system or base. We will show how the number e appeared for the first time in a Spanish mathematical text of the 18th century.

Clemency Montelle (Invited speaker) (University of Canterbury, New Zealand)

An Ocean of Knowledge: Exploring the History of Mathematics in India

Mathematics on the Indian subcontinent has been flourishing for over two and a half millennia, and this culture of inquiry has produced insights and techniques that are central to many of our mathematical practices today, such as the base ten decimal place value system and trigonometry. Indeed, many of their technical procedures, such as infinite series expansions for various mathematical relations predated those that were developed with the advent of the Calculus in Europe, but notably in contrasting intellectual circumstances with distinctly different epistemic priorities. However, while many histories of mathematics have centered on the so-called 'western miracle' in their analysis of the ignition and flourishing of modern science, they have done so at the expense of other non-European traditions. This talk will highlight some of the significant mathematical achievements of India, and explore the work that remains to be done integrating them into more standard histories of mathematics.

Elena Scalambro (University of Turin)

Gino Fano's Contribution to the Classification of a Special Class of Threefolds

Gino Fano (1871–1952) is an outstanding mathematician and a prominent member of the Italian 'School' of algebraic geometry. His figure is inextricably linked to the study and the classification of smooth three-dimensional algebraic varieties V whose anticanonical system $|-K_V|$ is ample, today known as Fano threefold. In an effort to prove the irrationality of some of these threefolds, he deals with their classifications for over forty years, playing an important pioneering role. After his death the researches on Fano threefolds become an essential direction of algebraic geometry, culminating in their complete classification with modern methods, based on Mori theory.

However, this is not the only important achievement of Fano. During his last fifteen years of activity, he faces the study of a special class of three-dimensional varieties: the so-called Fano-Enriques threefolds (i.e., Fano threefolds whose general hyperplane section is an Enriques surface). Starting his research in a memoir of 1938, Fano gives some lesser-known — but truly original and innovative — contributions in this field. Though not bringing a complete classification of these varieties, his work strongly influenced several investigations in modern algebraic geometry and deserves to be examined in detail.

Thus, the aim of this paper is to analyse Fano's contribution from an historical-critical perspective, also in the light of their quite poor reception at that time and their rediscovery in the eighties.

Benjamin Wilck (Humboldt-Universität zu Berlin)

The Order of Definitions in Euclid's Elements

In the present paper, I argue that Heiberg's standard edition of the Greek text of Euclid's *Elements* needs to be revised in light of an analysis of the sequences of Euclid's definitions. Heiberg's text is the result of a comparison

between two extant Greek manuscript traditions. Several scholars to date have reproached Heiberg for neglecting the medieval Arabic and Latin traditions of translations of the *Elements*, which record alternative sequences of definitions. I argue that Heiberg indeed made some wrong choices in editing the *Elements*, but that these mistakes are not due to neglecting the extant Graeco-Arabic and Arabo-Latin translations. Rather, I maintain that, with respect to the sequence of definitions, Heiberg's mistakes concern only the differences found among the Greek manuscript traditions. My argument is based upon an analysis of the systematic order of the *Elements*' lists of definitions. By spelling out precisely what is implied by the sequence of Euclid's definitions according to each of the two Greek manuscript traditions on the one hand, and of the various medieval Arabic and Latin translations on the other, I conclude that the Greek manuscripts are more consistent with Euclid's overall regularities in ordering definitions than the Arabic and Latin translations. In turn, I show that in light of these regularities, Heiberg's preference of the sequence of definitions recorded in the manuscript *Codex Vaticanus graecus* 190 over the so-called Theonine tradition of manuscripts is unjustified, given that the latter tradition records a sequence of definitions that is consistent with Euclid's overall regularities, whereas the former is not.

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