BRITISH SOCIETY FOR THE HISTORY OF MATHEMATICS

Research in Progress

Saturday 29 February 2020 in the Shulman Auditorium, The Queen's College, Oxford

Programme

09:30	Arrival and registration	
09:50	MARK MCCARTNEY BSHM President	Welcome
10:00	BRIGITTE STENHOUSE The Open University	*Conjuring the 'Spirit of Laplace'; The Analytical Works of Mary Somerville (1780–1872)*
10:30	JAN MAKOVSKÝ Czech Academy of Sciences	*Learning Mathematics in XVIIIth and Early XIXth Century Bohemia*
11:00	GIANLUCA LONGA Université Clermont Auvergne	*"The Hidden Analysis": On the Spread of the Analytic Method in Greek Geometry*
11:30	Coffee	
12:00	MEREDITH HOULTON St Andrews University	The Elements of Geometry*, by William Sanders*
12:15	NICOLAS MICHEL Université de Paris, SPHERE	*Zero will tear us apart: Negative Numbers, Geometrical Exactness, and the Applicability of Algebra in 19th-century French Mathematics*
12:45	ALISON MAIDMENT The Open University	*The Edinburgh Mathematical Laboratory and E. T. Whittaker's Role in the Development of Numerical Analysis in Britain*
13:15	Lunch in the Magrath Room	
14:00	TOBIAS SCHÜTZ Johannes Gutenberg-Universität Mainz	*Albert Einstein and Projective Geometry*
14:30	JOSEPH BENNETT Maynooth University	*Grand Prix des Sciences Mathématiques, 1882*
15:00	EDUARDO DORREGO LÓPEZ Universidad de Sevilla	*A Glimpse of the Different Phases in the Development of the Mathematical Concept of Transcendence*
15:30	Tea	
16:00	ALICE JENKINS University of Glasgow	Invited lecture: *Euclid in Victorian Literature*
17:15	Close of meeting	

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Abstracts

Joseph Bennett (Maynooth University)

Grand Prix des Sciences Mathématiques, 1882

In February 1882, the Irish-born mathematician Henry John Stephen Smith FRS (1826–1883) was surprised to see, in the *Comptes Rendus*, that the subject proposed by the French *Académie des Sciences* for its *Grand Prix des Sciences Mathématiques* was the theory of the decomposition of integer numbers into a sum of five squares. The competitors were directed to the results announced, without demonstration, by Eisenstein (1847). However, no mention was made of Henry Smith's own memoir dealing with the same subject in the *Proceedings of the Royal Society* in 1867, some fifteen years earlier. Following guidance from Charles Hermite, a member of the Commission of the French Academy, Henry Smith submitted his complete memoir, in French, by the required deadline. The announcement by the Commission which followed revealed Henry Smith would posthumously share the *Grand Prix des Sciences Mathématiques* of 1882 with a young Hermann Minkowski. In this talk I will consider the reports of the Commission of the Academy relating to this curious episode along with some mathematical details of Henry Smith's prize memoir.

Meredith Houlton (St Andrews University)

The Elements of Geometry*, by William Sanders*

William Sanders was appointed to the Chair of Philosophy at the University of St Andrews in 1672. When James Gregory left St Andrews for the University of Edinburgh, Sanders was appointed in 1674 to the Regius Chair of Mathematics. During his period as Regius Professor of Mathematics, Sanders published *The Elements of Geometry*, in 1686.

My research is focusing on *The Elements of Geometry* (*Elementa Geometriae*) written by William Sanders. I will be looking at how Sanders' *Elements* compares textually and pictorially to other versions of Euclid's *Elements* available at the time. I will also be looking at the content of the text and assessing in what ways Sanders may have intended for the text to be used. Additionally I am assessing the provenance information of all known copies of the text — from where and from whom were existing and currently catalogued copies of the text acquired? This data will give some insight into the history of the text, by whom it was read and collected, and may indicate that the book had some popularity and longevity. I will also be looking at other publications written by Sanders as well as any documents available at Special Collections pertaining to Sanders. This research about William Sanders will aim to give insights not only into his persona as an educator, a mathematician, and Regius Chair of Mathematics at St Andrews succeeding Gregory, but also insights into the nature of mathematical education and mathematical texts in Scotland in the late seventeenth century.

Alice Jenkins (University of Glasgow)

Invited lecture: *Euclid in Victorian Literature*

What can we learn if we look at mathematics as part of the history of cultural production? Do a period's approaches to mathematics have any connections with its approaches to literature, for example? In this lecture I will explore the asynchronous example of Victorian fiction and Euclidean geometry, asking how each accommodated and responded to the other.

In many ways, Euclidean geometry and Victorian literary high-mindedness were perfectly complementary. Literature imagined geometry as a model of all that was most earnest, self-denying, diligent, methodical, and, for these reasons, beautiful. It was also available to everyone, at least in principle; so it could be understood as promoting the cultural unity which, though largely imaginary, was nonetheless crucially important in relieving contemporary fears about the effects of education on non-elite groups. The reason why geometry and Victorian earnestness were complementary, of course, is that Victorian writers remade geometry for their own times, taking up a long legacy of admiration and adaptation of Euclid and broadening and diversifying it to fit the cultural imperatives of the age of mass literacy, utilitarianism and imperialism. This lecture will explore how fiction of the period linked itself to Euclideanism in order to borrow some of its cultural prestige, and how it paid back this debt with interest.

Gianluca Longa (Université Clermont Auvergne)

"The Hidden Analysis": On the Spread of the Analytic Method in Greek Geometry

This talk is a contribution to our understanding of ancient Greek geometric analysis. According to Descartes "[...] the geometers of antiquity employed a sort of analysis which they went on to apply to the solution of every problem, though they begrudged revealing it to posterity" (PW, I, 16–17). This statement is further strengthened in the *Second Replies*: "The ancients had such a high regard for [analysis] that they kept it to themselves like a sacred mystery" (PW, II, 110–11). Recent literature maintains this old assessment: both historians (Knorr 1993, Behboud 1994, Netz 1999) and philosophers (Hintikka and Remes 1974, Gardies 2001) agree upon the scarcity of sources on geometrical analysis. By applying the philological approach originally conceived by Mugler (1958) and further developed by Acerbi (2010) and Acerbi and Vitrac (2010), my talk will show that this proposal is wrong: the extant analytic arguments are relatively well-represented in the Greek geometrical *corpus*. The identification of a clear analytic-proving format, characterized by the use of specific formulae, and the construction of rigid syntactical structures, leads in fact to the following result: over a hundred demonstrations apply the method of analysis. In comparison with the practice of other methods (exhaustion, reductio), geometrical analysis reveals indeed a similar distribution frequency. Thus, the Cartesian 'sacred mystery' seems to be more an inherited prejudicial assessment than the result of consistent historical research.

References

PW = *The Philosophical Writings of Descartes*, 3 vols., translated by John Cottingham, Robert Stoothoff, and Dugald Murdoch (Volume 3 including Anthony Kenny), Cambridge: Cambridge University Press, 1988.

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Eduardo Dorrego López (Universidad de Sevilla)

A Glimpse of the Different Phases in the Development of the Mathematical Concept of Transcendence

In this talk, we will give a survey of the different phases of the concept of transcendence, by taking a look at some landmark mathematical works. As is well known, the term came into being with Leibniz contemporaneously with the increasing use of analytic methods, but with an ambiguity in meaning that would continue across the next two centuries. Its use in an arithmetical framework put the focus on the expressibility of certain quantities (like π) rather than the impossibility of being roots of algebraic equations, but the underlying identification between radicals, irrationals and surds, suggests an implicit acknowledgement of the modern meaning of transcendence. We will also see how the first explicit appearance of this modern term in one of J. H. Lambert's works was not sufficient to banish the old idea of expressibility, owing to the limited influence of Lambert, particularly with regard to his work on irrationality-related issues. The turn of the century brought new mathematical results like that by Ruffini, Abel, or Liouville, giving rise to a (slow) change in the theoretical framework from "to be expressed" to "to be a root", moving closer to the current understanding of the concept of transcendence.

Alison Maidment (The Open University)

The Edinburgh Mathematical Laboratory and E. T. Whittaker's Role in the Development of Numerical Analysis in Britain

In 1912 Edmund Taylor Whittaker, a Cambridge graduate, moved from Dunsink Observatory, where he had been Royal Astronomer of Ireland, to Edinburgh to take up the chair of mathematics. The following year, motivated by his experiences in Ireland and the example of Runge in Germany, as well as his association with several actuaries in Edinburgh, he opened his mathematical laboratory, the first of its kind in Britain, and the setting for the "the practical instruction in numerical, graphical, and mechanical calculation and analysis". In 1913, the laboratory played host to a 5-day series of lectures by Whittaker as part of the inaugural Edinburgh Mathematical Colloquium. The laboratory was the stimulus for several textbooks on various aspects of numerical analysis, most notably Whittaker & Robinson's *The Calculus of Observations* (1924). It also had a direct influence on the establishment of other mathematical laboratories and publications both in Britain and in the United States.

In this talk I will discuss the laboratory in detail, as well as examine its impact on the development of numerical analysis.

Jan Makovský (Czech Academy of Sciences)

Learning Mathematics in XVIIIth and Early XIXth Century Bohemia

The general aim of our talk is to explore the interplay between institutional changes and changes in the teaching and learning of science, especially mathematics. In particular, we are interested in the effects that the suppression of the Society of Jesus in the Habsburg empire, in 1773, had on the teaching and learning of mathematics in Bohemia and in Prague, where the Jesuits had monopolized a segment of the university teaching for more than a century. Until the first half of the 18th century the Jesuit teaching of mathematics in Bohemia was traditionally organized around the *ratio studiorum*, the curriculum of studies developed by the Jesuits at the end of the 16th century. However, from the mid-18th century, the traditional Jesuit curriculum yielded to the pressure of internal and external factors, and was eventually modified on several occasions. All changes aimed at increasing the role of empirical sciences to the detriment of Aristotle, and at stressing the importance of mathematics in the curriculum by increasing the number of university chairs devoted to different branches of mathematics. This process, however, was by no means linear and orderly. Until the suppression of the order, for instance, modern scientific disciplines, such as the infinitesimal calculus, were included in the more traditional architecture of the *ratio studiorum*, while new textbooks were written, which aimed to present a balance between modernity and classicism. By exploring this rich, but little known literature, as well as other types of documents, such as a manuscript containing the written exams for the chair of elementary mathematics which took place in 1804, we aim to assess whether the official death of an institution such as the Society of Jesus actually implied that the forms and contents of the education it imparted were also disestablished.

Nicolas Michel (Université Paris, SPHERE)

Zero will tear us apart: Negative Numbers, Geometrical Exactness, and the Applicability of Algebra in 19th-century French Mathematics

At the onset of the 19th century, negative numbers were perceived as a threat to both the social and epistemic order of mathematical knowledge across Europe. English mathematician George Peacock, for instance, famously developed his symbolical conception of algebra as a response to challenges from various Lockean mathematicians to the possibility of grounding certain knowledge on such unclear and indistinct notions.

In parallel, French savant and revolutionary Lazare Carnot proposed in his 1803 *Géométrie de Position* to completely do away with the metaphysics of positive and negative quantities. Instead, he introduced the so-called method of direct and indirect quantities: for a formula with positive quantities being obtained on a given geometrical figure, correlative formulas could be derived by transforming the figure and adding negative signs accordingly. In so doing, Carnot drove a wedge between geometrical problems as they are given and their equational form. In particular, Carnot bemoaned algebra's tendency to always give too much, by way of solutions that do not correspond to any actual quantity satisfying the problem under consideration. Chiefly among these 'foreign solutions' ranked those associated to negative quantities.

This criticism was soon rebuked by key figures of the first generation of '*Polytechniciens*'. In both Poinsot's number theory and Poncelet's geometry is invoked a sharp distinction between the exactness of algebra and that of the theory's subject matter — be it integers, or geometrical figures. This distinction, in turn, buttressed the claim that algebra did, in fact, give precisely what it was asked: the discrepancy pointed to by Carnot was merely the symptom of an imprecision introduced by the use of non-symbolic language in mathematics. At stake in the introduction of negative numbers and the debates it gave rise to were the redefinition of geometrical exactness and the reconfiguration of the epistemic status of algebra as employed and applied by the emerging class of *ingénieur-savants*.

Tobias Schütz (Johannes Gutenberg-Universität Mainz)

Albert Einstein and Projective Geometry

Although Albert Einstein is almost exclusively known as a physicist, he had a broad knowledge of mathematics as well. This is demonstrated not only by him attending courses and receiving good grades at the *Federal Polytechnic School* (ETH), but also by almost entirely unidentified and unknown documents. These documents are part of a batch of manuscripts containing some 1750 pages, which were found a long time after Einstein's death when they were discovered behind a filing cabinet in the 1980s. In my talk, I will show that some of these pages contain both calculations and sketches on projective geometry. Furthermore, I will argue that these pages were written in 1938 when Einstein worked on finding a *unified field theory*. At the time, Einstein tried to combine electromagnetism and gravitation by introducing a fifth dimension to the space-time of general relativity. I will also present further manuscripts and notebooks from other time periods. The questions I will share are: What was Einstein's knowledge of projective geometry and how did he put it to use in his research on unified field theory?

Brigitte Stenhouse (The Open University)

Conjuring the 'Spirit of Laplace'; The Analytical Works of Mary Somerville (1780–1872)

In the early 19th century, the need to increase the acceptance and utilization of analytical mathematics in Great Britain was keenly felt by a group of mathematicians, who saw it as a remedy to the perceived decline of British science.

Thus in 1826, Mary Somerville began preparing what was intended to be a translation of Pierre-Simon Laplace's *Mécanique Céleste* (printed in five volumes between 1799–1825). Published in 1831 under the title *Mechanism of the Heavens*, this work was received with great critical acclaim. There are, however, many key differences between the work of Somerville and that of Laplace. During the translation process, Somerville focused on preserving 'the spirit of Laplace' whilst making it both accessible and palatable to a British readership, through introducing diagrams and ideas of the sublime. Somerville treated but a small subset of the results found in the original work, but expanded and updated many sections by embedding relevant ideas from recent publications, all of which were notably developed outside of Britain.

Whilst the work was thus described as 'the most complete account of the discoveries of continental mathematicians in physical astronomy which exists in [English]' (*Monthly Notices of the Royal Astronomical Society*), it appears to have been commercially unsuccessful. Somerville's second attempt at encouraging the study and adoption of analysis was instead a qualitative survey of results, titled *On the Connexion of the Physical Sciences*. This book illuminated the fecundity of the so called analytical methods as applied to physical astronomy, without presenting the mathematics itself.

Through a comparison of Somerville's two works, I will demonstrate how the *Mécanique Céleste* was shaped and repurposed during its transition into the British scientific community, and thus identify what constituted this deeply desirable 'spirit of Laplace'.

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