BMC History Workshop, Programme, Speakers and Abstracts
11-14 June 2019, University of St Andrews

Monday 11	15.40	Ursula Martin
	16.20	Kevin Tracey
Tuesday 12	15.30	Brigitte Stenhouse
	16.10	Edmund Robertson
	16.50	Jane Wess
Wednesday 13	14.00	Tony Mann
	14.40	Amirouche Moktefi
	15.20	Rosemary Bailey

Rosemary Bailey (St Andrews)

Latin squares: Some history, with an emphasis on their use in designed experiments.

In the 1920s, R. A. Fisher, at Rothamsted Experimental Station in Harpenden, recommended Latin squares for agricultural crop experiments. At about the same time, Jerzy Neyman developed the same idea during his doctoral study at the University of Warsaw.

However, there is evidence of their much earlier use in experiments.

Euler had made his famous conjecture about Graeco-Latin squares in 1782. There was a spectacular refutation in 1960.

I shall say something about the different uses of Latin squares in designed experiments. This needs methods of construction, of counting, and of randomization.

Fisher and Neyman had a famous falling out over Latin squares in 1935 when Neyman proved that use of Latin squares in experiments gives biased results. A six-week international workshop in Boulder, Colorado in 1957 resolved this, but the misunderstanding surfaced again in a Statistics paper published in 2017.

Tony Mann (Greenwich)

Mathematics instructors at the Royal Naval College, Greenwich

The Royal Naval College, which opened at Greenwich in 1875, employed a very distinguished sequence of Professors of Mathematics, including William Burnside and Louis Milne-Thompson. This talk will investigate rather some of the mathematical instructors who supported the Professors, including John Knox

Laughton, who later achieved eminence as a naval historian, and Richard Wormell, a future President of the Association for the Improvement of Geometrical Teaching.

Ursula Martin (Oxford)

The rise of modern patronage, the social, and the impact of mathematics

The mid-twentieth century saw the humanistic approach of mathematics as an intellectual endeavour pursued for its own sake, increasingly challenged by an instrumental view of the discipline as contributing to the nation. State funders, seeking more than Vannevar Bush's forceful arguments that unfettered intellectual curiosity gives rise to unpredictable and useful discoveries, now look for evidence of return on investment. Such evidence is collected in the UK in a standard format, allowing analysis of how research in mathematics gives rise to impact, going beyond more usual patents or start-up companies, to capture impacts on policy, and influence, and in turn, inform new models of government and corporate patronage.

Close analysis of these shows that the mathematics community have been right all along in challenging narrow instrumental views, and that the impact of mathematics is brought about largely through long term relationships, interdisciplinarity and the skills of mathematicians themselves in exploring new problems and finding new collaborators. Peversely, the richer such an ecosystem of mathematics and users of mathematics, the easier it is to find apparent linear chains leading to impact, but the less representative these become.

Amirouche Moktefi (Tallinn University of Technology)

Playing by the rules: Venn *versus* Carroll

The role of diagrams in mathematical proofs is disputed. Yet, diagrams have long been used in various mathematical disciplines. In logic, they knew a golden age after their popularisation by Leonhard Euler in his *Letters to a German Princess* (1768). By the end of the nineteenth century, several schemes were in existence, and to some extent, in competition. In this talk, we will expose and compare two diagrammatic methods introduced by British logicians John Venn and Lewis Carroll. Both were invented to handle logic problems known as elimination problems which consist in finding what information regarding any combination of terms follows from a set of premises. For the purpose, Venn published in 1880 a scheme offered as an improvement over Euler's well-known circles. The method consisted in representing the complete information contained in the premises on a single diagram, then to see 'at a glance' the conclusion regarding specific terms. An inconvenience of this scheme, as pointed out by Louis Couturat (1914), is that it does not really tell how

the conclusion is to be 'extracted' from the diagram. A rival scheme, published in 1886 by Lewis Carroll, demands that information is transferred from the premises-diagram to another diagram that would depict the conclusion. This transfer is achieved by following rules which are explicitly defined and strictly applied. Although both Venn and Carroll introduced diagrammatic methods for the problem of elimination, they differ in their practices and demands on how a diagram ought to be manipulated. Venn appealed to imagination to work out the conclusion with a single diagram while Carroll applied rules on a diagram to derive other diagrams. The former method was said to lack rigor, but the latter may be accused of lacking naturalness and economy. This difference of practices, and the philosophical views that they embody, will be shown to resurface in the recent debates on the role of diagrams in mathematical practice.

Edmund Robertson (St Andrews)

Mary Everest Boole: the first mathematical psychologist

Mary Everest Boole was only 32 years old in 1864 when her husband, the mathematician George Boole, died leaving her with five daughters to bring up. In this talk we will look at Mary Boole's life and her contributions to mathematics teaching. She published many books on teaching in general and teaching mathematics in particular, for example *Lectures on the Logic of Arithmetic* (1903) and *Philosophy and Fun of Algebra* (1909). We give quotes from her books to illustrate her ideas which, although over 100 years old, seem surprisingly relevant today.

Brigitte Stenhouse (Open University)

Embracing Nature in Formulae: The Hidden Mathematics of Mary Somerville

In the 1830's, after the publication of her first book *Mechanism of the Heavens*, Mary Somerville was known throughout the UK and continental Europe as an expert in analysis, and its applications to astronomy. Her next work centred on the theme of 'the physical sciences', which she claimed were united by the "bond of analysis" which would "ultimately embrace almost every subject in nature in its formulae".[1] However, these formulae are conspicuously missing from both this and all her future publications.

An unusual situation is made ever more peculiar by the existence of two unpublished manuscripts Somerville completed in 1834, both of which are explicitly mathematical and would have slotted in perfectly to her analytical agenda. In my talk I will outline and contextualise the content of one of these papers, and open the question of why mathematics vanished from Somerville's published works.

1. Somerville, M. *On the Connexion of the Physical Sciences.* John Murray, Albemarle Street, London 1834.

Kevin Tracey (Swansea University and the Science Museum, London)

Calculating Value: Reading the Scribal Technologies of Early Modern Mathematics

Comprised of some 3,300 volumes printed between 1486 and 1800, the Rare Books Collection of the Science Museum, London, contains a significant number of texts on astronomy, geometry, arithmetic, physics, and natural philosophy as printed and read in the early modern period. As such, the collection is a remarkable locus in which to explore how the contemporary readers of such texts used and understood their mathematical materials. Altered and adorned by signatures, annotations, corrections, and disputations, these material artefacts display evidence of users wrestling with the key mathematical concepts of their day at sites of practice including universities, shipyards, and marketplaces alike.

Drawing upon three uniquely-annotated texts, this talk situates early modern mathematics and its readers in their appropriate historical, methodological and philosophical contexts. It will move from a multi-edition *sammelband* used at the University of Wittenberg in the late sixteenth century to the European roots of the volvelles and paper instruments as presented in Thomas Blundeville's popular *Exercises* (1594). A detailed presentation of the use and preservation of John Seller's *Pocket Book* (1677) will then demonstrate how the transmission and reception of trigonometry and spherical astronomy were aided by early modern reading practices well into the eighteenth century.

Presenting the 'scribal technologies' utilised by early modern individuals, this paper seeks to shed further light on the intellectual methods such readers applied to their personal mathematical practice. Mathematics existed in the period as part of a wider continuum of print: one including instruments, maps, and globes alongside published texts. How such users 'read' their materials is therefore of significant value to our understanding of their intellectual and material interests, and furthermore, to the history of mathematics, the history of science, and the history of the book.

Jane Wess (Edinburgh)

'Maths and Maps: A comparison of Mathematical Theory and Cartographic Practice'

'The talk is a work in progress focussing on the long 19th century in Britain. It will look at three aspects of maps: projections, the representation of heights, and the four-colour theory. In each of the three cases the talk will ask what the theoretical situation was, what was happening at the Royal Geographical Society in London in

terms of what was published, discussed and acquired, and what has been done to compare theory and practice more generally.

It will argue that there was little or no engagement with mathematical theory in the 19th century with respect to projections. While the mathematical theory of projections was sophisticated by this time, map makers tended to adhere to tradition. A survey of projections in the collection of the Royal Geographical Society demonstrates the almost exclusive prevalence of Mercator's projection. Map makers were slow to adopt contour lines, even though isolines representing magnetic and barometric phenomena were popular. Map makers were either not aware of the four colour theory or did not consider it useful. Since studies of maps in the mid to late twentieth century the web has made it very much easier to undertake large scale surveys, but so far the situation is far from clear. Did the map makers not know or did they not care?

This paper forms part of an investigation into 'The Unreasonable Effectiveness of Mathematics' concept, first proposed in 1960 by Eugene Wigner. In the case of longitude it was found to be not applicable, in that the mathematics was so difficult it was beyond the abilities of the vast majority, so contributed nothing to advances in practice. These case studies will help to build up a clearer picture, but so far they point to a disconnect between mathematical theory and practice, which does not support Wigner's conjecture during the long 19th century.'