Seminar in the History of the Exact Sciences

All Souls College, the Hovenden Room

Hilary term 2018: Wednesdays at 5.00p.m.

Convenors: Philip Beeley, Christopher Hollings,
Yelda Nasifoglu and Benjamin Wardhaugh

17 January

Christopher Hollings (University of Oxford)
'"Black strokes upon white paper": changing attitudes towards symbolic algebra from the nineteenth into the twentieth century'

During the first half of the nineteenth century, a debate took place amongst British mathematicians concerning the nature of the symbols used in algebra: did they necessarily stand for numbers, or could they simply be manipulated according to specified rules, with interpretation (if any) coming later? Critics of the former point of view decried the restriction that would thereby be placed upon the use of algebra, whilst those of the latter saw it as being ill-justified and often too far removed from concrete examples. For a range of reasons, both educational and philosophical, a fully abstract 'symbolical algebra' never appeared in nineteenth-century British mathematics; 'abstract algebra' as we now know it derives from largely German sources at the end of the century. Nevertheless, as the abstract point of view came gradually to dominate algebra during the early decades of the twentieth century, similar debates took place to those of a century earlier. This time, however, the abstract approach was received more sympathetically. In this talk, I will contrast these changing attitudes towards abstract/symbolic algebra, and address the question of why this approach became more acceptable in the twentieth century.

24 January

Ralf Krömer (Bergische Universität Wuppertal)
'Justification of axioms: a neglected topic in the history of mathematics?'

In joint work with Hans-Niels Jahnke (Universität Duisburg-Essen), we investigate the issue of justification of axioms in mathematics, from ancient Greek geometry to current debates on set theory, category theory and the foundations of mathematics. The aim of the talk is not to give a complete history of the phenomenon but to highlight its relevance (not sufficiently taken into account in the existing literature, in our opinion) by focussing on some particular cases. We take a look at Proclus's discussion of Euclid's axioms and postulates (especially, but not exclusively, the parallel postulate), at how Archimedes and much later Klein discuss the archimedean axiom, and finally at Penelope Maddy's account of axioms of set theory, inspired by Zermelo's remarks on the axiom of choice. The last case leads us to similar considerations concerning the role of category theory in the foundations of mathematics.

31 January

Katharina Habermann (Georg-August-Universität Göttingen)
'Gauss's diary, Riemann's Hypothesis, and Klein's letters: the central archive for mathematics bequests in Göttingen'

The Central Archive for Mathematics Bequests was established in 1992, based on an agreement between the German Mathematical Society and the Göttingen State and University Library. It was built upon the rich inventory that was created from collections of documents, manuscripts, and other archival resources, donated as bequests (Nachlässe) to Göttingen's university library. For example, the

Nachlässe of Abraham Gotthelf Kästner, Tobias Mayer, Carl Friedrich Gauss, and Bernhard Riemann as well as the so-called Mathematiker-Archiv, an archival collection of papers of notable mathematicians started by Felix Klein, were already present in Göttingen. Today, the archive houses a vast collection of documents and archival material of more than 60 mathematicians.

In this talk, I will address present activities at the archive and will provide some examples in order to give an impression of the value of the vast collection for the history of mathematics. Moreover, I will share some ideas on future projects.

7 February

Emmylou Haffner (Bergische Universität Wuppertal)

'Insights into the long "genesis" of Dedekind's lattice theory'

In two papers published in 1897 and 1900, Richard Dedekind presents and studies a new notion, the *Dualgruppe*, which corresponds to what is today called a "lattice". This concept was the result of a long and, as Dedekind tells us, strenuous research process that lasted around twenty years.

Not only is it possible to identify, in Dedekind's published works, the major steps of his work towards the notion of *Dualgruppe*, we also can follow the research process in his – rich and well-preserved – *Nachlass.*

Indeed, in Dedekind's *Nachlass*, one can find several hundred pages of research, notes and computations leading to the slow, progressive elaboration of the notion of *Dualgruppe.* These computations and the stepwise generalization of the concept largely disappear from the published exposition of the theory, which appears to be very general and abstract. The drafts highlight the working process and Dedekind's exploration, through computations, tables, half-written papers...

Using Dedekind's *Nachlass,* I will show how Dedekind gradually built his *Dualgruppe* theory through many layers of computations, often repeated in slight variations and attempted generalization. Insofar as these drafts were working tools for Dedekind, by studying the concealed strata of mathematics they contain, I wish to reveal and clarify the preliminary and intermediary states and steps of the mathematical research during the elaboration of the concept of *Dualgruppe.*

While focused on Dedekind's work, here, I also hope to stress the fruitfulness, for the history of mathematics, of taking into account the various notes and drafts left by mathematicians.

14 February

Natasha Glaisyer (University of York)

'Speaking, reading, writing and printing numbers in seventeenth- and eighteenth-century England'

In his seminal work on numeracy Keith Thomas noticed the different status of different forms of numbers. He quoted Gervase Markham's 1635 *Honest Husbandman* 'there is more trust in an honest score chaulkt on a Trencher, then in a cunning written scrowle, how well so ever painted on the best Parchment'. This paper begins to explore this issue Thomas raises by considering how speaking, reading and writing numbers was taught in seventeenth and eighteenth-century England. Most published arithmetics included numeration tables that were designed to help readers convert spoken numbers to written numbers and vice versa. The table played various roles in the explanations of place value; at times it was seen to be a substitute for a master, and in some contexts the language of the body was used to help readers navigate the table. A few authors were particularly keen to help readers understand very large numbers. Numeration tables also appeared in manuscript arithmetics and the last part of the paper looks at the heated controversies surrounding handwriting numbers in this period.

21 February

Karine Chemla (Université Paris Diderot)

'Forms of proofs for algebraic equations in medieval China'

How can diagrams account for the correctness of algorithms? Writings composed in China between the 11th and the 13th centuries and devoted to algebraic equations illustrate an unexpected answer to this question. They contain geometrical diagrams whose captions establish a specific connection between the diagrams and the algorithms in relation to which they are given. The talk will analyze the context in which these diagrams, in and of themselves, formulate an argument. It will further examine the form of algebraic proof in an algorithmic context that replaces these diagrams when later on, they disappear from writings devoted to algebraic equations.

28 February

Matthew Landrus (University of Oxford)

'Geometry and mathematics for the technical and visual arts at the turn of the sixteenth century'

Although an increasing number of printed books around 1500 assessed geometry and arithmetic, specific evidence of their applications in the visual and technical arts is difficult to locate. Ten percent of incunabula addressed *science*, and were consulted by readers of books on music, as well as the *artes techinae*. Luca Pacioli's *Summa* (1494) is an example of the developing mathematical discourse that taught argumentative reasoning and other practical and theoretical applications of mathematics in general. A century after Francesco di Giorgio's 1478 'Opusculum de architectura,' Ignatio Danti complained of the reduction of mathematical sciences among natural philosophers, such that "the little which remains to us is limited to some practical aspects learned from the mechanical artificers." The development of mathematical studies chiefly among artist/engineers was rooted in the traditions of intellectual 'omini pratici' dating back to the treatises of Lorenzo Ghiberti, Leon Battista Alberti, Filarete, Piero della Francesca, and Francesco di Giorgio. Followers of this scholarship, generally around 1500 in the region from central Italy to southern Germany, believed that the universal form and function of Necessity required proportional estimation and numerical definition. Thus, approaches to problems in statics and dynamics often relied on arithmetic and Euclidean geometry, at a time when mathematical solutions were also sought for ancient Greek problems rational numbers could only estimate (eg. doubling the cube, squaring the circle, trisecting the angle). I will use examples in the work of Leonardo da Vinci and his contemporaries as evidence of the central role of proportional geometry and arithmetic among artist/engineers for solutions in the natural sciences and practical arts.

7 March

Jeanne Peiffer (CNRS)

'Reading mathematics in the eighteenth century: Montesquieu and young d'Alembert'

Montesquieu, one of the major political philosophers of the Enlightenment, author of the famous *De l'esprit des lois* (1748), left copious marginal notes in a Cartesian textbook published by a mathematics teacher, Nicolas Guisnée, and entitled *Application de l'algèbre à la géométrie* (Paris 1705). Some years later, young d'Alembert studied and commented upon the same text, writing a continuous commentary, which is still unpublished. The focus of the talk will be on different reading practices of Montesquieu and d'Alembert, their motivations and the goals they might have pursued.