ICHM Co-Sponsored Special Sessions on the History of Mathematics

Joint Mathematics Meetings, Denver, Colorado (USA)

17-18 January 2020

This set of lectures comprised a two-day Special Session on the History of Mathematics at the Joint Meeting of the American Mathematical Society and the Mathematical Association of America held in Baltimore, Maryland, USA. The session was organized by Sloan Despeaux (Western Carolina University), Jemma Lorenat (Pitzer College), Daniel Otero (Xavier University) and Adrian Rice (Randolph-Macon College), and featured 24 speakers from the United States, Canada, the United Kingdom, Israel, Denmark, Czechia, and Japan. The three sessions included talks on a great variety of subjects and time periods.

The following talks, with their abstracts (which include the dates the abstracts were received before the meeting) were presented at the meeting:

Ancient Greek Mathematics as Philosophy.
Jacqueline Feke, University of Waterloo

Scholars tend to assume that, just as mathematics and philosophy are distinct disciplines today, so were they in antiquity. From the fourth century B.C.E. onward, mathematicians and philosophers did differentiate themselves. They criticized each other's work and, in some areas of the Greek world, strong rivalries developed between mathematicians and philosophers. I will argue, however, that the distinction between mathematicians and philosophers did not entail that their fields of inquiry were distinct. This talk re-examines the distinction between the mathematical sciences and philosophy from the perspective of ancient Greek mathematicians. I will argue that some mathematicians viewed the relationship between these fields of inquiry as more complex, where the mathematical sciences are not only in relationship to but, even stronger, forms of philosophy in the broadest sense. The mathematical sciences are types of the love of wisdom that seek to answer some of the most fundamental questions of philosophy: e.g., how to obtain knowledge, how to form a just society, and how to attain the good life. (Received September 12, 2019)

Erudition and Algebraic Practice at the End of the Sixteenth Century.
Abram Kaplan, Society of Fellows, Harvard University

The last two decades have seen new research on the role of erudition in early modern European science. In this talk I argue for a central role for erudition in the emergence of symbolic algebra at the end of the sixteenth century. This role is twofold. First, traditions of classical scholarship are shown to play an important role in François Viète's epochal interpretation of Diophantus as an algebraist. I illustrate this role by comparing Viète's interpretation of Diophantus to the pedagogical aims of sixteenth-century French algebra. Second, I show that Viète's interpretation of his own mathematical practices owed much to traditions of erudite empiricism. I evidence this interpretation through examination of a particular theorem in Viète's writings. Time permitting, I will indicate some seventeenth-century instances of mathematical erudition that my reading of Viète can help explain. (Received September 17, 2019)

Standing on the Shoulders of Scripture.
Thomas Drucker, University of Wisconsin--Whitewater

What is seen as an odd mixture of religion and science in the mind of Isaac Newton has played a role in many recent biographical accounts. While this mixture may be a puzzlement for those looking at Newton as mathematician, the theological side has not usually been connected with Newton's mathematical motivations. In Rob Iliffe's recent volume on the religious worlds of Newton, he has gone through Newton's theological writings in great detail to understand what led Newton to pursue science and mathematics. He argues that there is a theological basis for Newton's scientific pursuits and documents the case scrupulously. In this talk the case will be made that mathematics also supplied an internal appeal to Newton that went beyond the motivation he had from religious sources. (Received September 16, 2019)

How to "strain at a Gnat and swallow a Camel:" `The Analyst Controversy' Reconsidered.
Julia C Tomasson, Columbia University

Bishop George Berkeley's (1685-1753) *The Analyst; Or, A Discourse Addressed to an Infidel Mathematician* (1734) lives on in the history of mathematics in infamy and ridicule. Berkeley's incendiary tract was met with immediate, yet lasting, censure and is often glossed as follows: infinitesimals are nothing more than "Ghosts of departed Quantities" making the calculus incoherent at best and a metaphysical fraud at worst. In this paper I will not try to vindicate Berkeley's critique of fluxions or metaphysical claims about infinitesimals. Nor will I exculpate him from his mathematical errors—which are as clear then as they are now. Instead, I ask a set of questions about the conditions which made the ensuing, and notably catalytic, controversy possible. I claim *The Analyst* as a text has been misunderstood; *The Analyst* was turned into a text about "Ghosts of departed Quantities" masking the true pretensions of the text in acceptable anti-Newtonian garb. I conclude that at the heart of this controversy is an image of mathematics in England post-Newton and pre-Cauchy in which mathematicians (experienced and amateur) are deeply concerned with if and when exactly they get to play by their own rules. (Received September 17, 2019)

Taking stock of the last 30 years : a project to survey the cultural history of mathematics.
Thomas Archibald, Simon Fraser University

In 1972, Morris Kline's *Mathematical Thought from Ancient to Modern Times* presented a 1200-page survey of the history of mathematics. In 1994, Ivor Grattan-Guinness's *Companion Encyclopedia*, followed three years later by his own synthesis of that collective work *The Rainbow of Mathematics* revised and extended Kline's picture, with different emphasis and some important use of work done up to the early nineties. Since then, trends in history of science and mathematics have markedly altered, many classic studies have been critically rethought, and a large amount of research production has enriched our picture of mathematics around the world. This talk will describe a work-in-progress, the *Bloomsbury Cultural History of Mathematics*, slated to appear in early 2021 under the general editorship of David Rowe and Joseph Dauben. This 6-volume collection aims at undergraduates above all, aiming to elucidate the role of mathematics in human cultures, and its often-key position in interactions between different cultures.

The purpose of this paper is to discuss this 50-author project from the point of view of a co-editor of two of the volumes, with an emphasis on the historiographic problems and approaches that we hope to highlight. (Received August 23, 2019)

Notational Norms in Charles Sanders Peirce's Circle of Logicians.
David E. Dunning, Princeton University

From 1879 to 1884, Charles Sanders Peirce (1839–1914) taught logic at the recently founded Johns Hopkins University in Baltimore, where he and a small circle of graduate students collaboratively published influential research in mathematical logic. They formed a local community whose size and vibrancy was unprecedented in that fledgling field, which had so far developed through the published contributions of a few pioneers working at a distance from each other in Britain and Germany. I will explore the local culture of mathematical logic that Peirce and his students developed, with a focus on their approach to notation. We might expect a community working in close collaboration to share a single symbolic system; in fact the logicians of 1880s Baltimore tended to develop individual variations on existing notations. Whereas earlier mathematical logicians stubbornly defended their individual systems, Peirce and his circle of graduate students took a more flexible approach to symbolism, finding intellectual interest precisely in the range of notational possibilities presented by the new mathematical logic. (Received August 25, 2019)

Mathematics as Discourse: A Commognitive View of Late 19th-Century Algebra.

Janet Heine Barnett, Colorado State University - Pueblo

In *Thinking as Communicating* (2008), Sfard seeks to "change our thinking about thinking" by defining thinking as an intrapersonal form of communication, coining the term "commognition" to emphasize communication and cognition as "different manifestations of basically the same phenomenon" (p. 83). "Doing mathematics," at both the individual or community level, is then the act of participating in mathematical discourse, and "learning mathematics" that of becoming a full-fledged participant in a discourse community. Discourse here is an activity regulated by two types of rules: object-level rules reflecting regularities in the behavior of the discursive (e.g., mathematical) objects, and metadiscursive rules reflecting regularities in the activities of the discursants. In this framework, "studying the history of mathematical discourses and studying the evolving discourse of the child become different versions of the same endeavor" (Sfard 2008, p. 124). Thus, while motivated by quandaries about mathematical learning at an individual level, commognitive theory also offers historians a new historiographical lens. Drawing on works by Cayley, Dedekind and Hölder, this talk explores what this lens can reveal about the development of algebra in the late 19th century. (Received September 09, 2019)

Illustrating the Impact of the Mathematical Sciences: Opportunities in Mathematical Policy.

Michelle K Schwalbe, National Academies of Sciences, Engineering, and Medicine
Mark L Green, University of California, Los Angeles
Tamara Kolda, Sandia National Laboratories
Russel Caflisch, New York University

The successes of the mathematical sciences research enterprise are numerous, significant, and ubiquitous and mathematical innovations build upon hundreds of years of research. Yet, simple stories designed for general audiences that trace mathematical discoveries to their impacts are few and far between. This session will explore some of these mathematical stories, discuss the value of communicating mathematical research to a broader audience, and explore the important role for mathematical policy.

The National Academies of Sciences, Engineering, and Medicine's Board on Mathematical Sciences and Analytics (BMSA) strives to provide mathematical advice to policy makers, strengthen connections between other domains and the mathematical sciences, support the health of the mathematical sciences ecosystem, and increase public awareness of the expanding role of the mathematical sciences. BMSA is conducting a study for the National Science Foundation to generate narratives and graphics for general audiences that demonstrate the fundamental role of the mathematical sciences in the U.S. economy, national security, health and medicine, and other science, engineering, and technology domains.

Learn more at: www.nas.edu/BMSA or www.nas.edu/IllustratingMath. (Received September 17, 2019)

Who Invented the Decimal Point?

Glen R Van Brummelen, Quest University

The question of the invention of the decimal point is vexed, with multiple interpretations and several different cultural claims. Within Europe, textbooks assert that decimal fractional notation was introduced in the late 16th century with Simon Stevin's *De Thiende*, and that the decimal point itself first appeared around the same time with Christopher Clavius or John Napier. These claims are mostly untrue. We shall explore the much older origin of the decimal point in European mathematical astronomy, and touch on some of the historiographic issues that arise when considering this issue. (Received September 02, 2019)

Quadrature, Rectification and the Cycloid.

Maria R Zack, Point Loma Nazarene University

Many well-known mathematicians of the seventeenth and eighteenth centuries studied the cycloid. These include Roberval, Descartes, Pascal, Wallis, Huygens, Fermat, Newton and Leibniz and more than one Bernoulli. This talk will consider the work done on the cycloid by a few of these individuals and examine how their work connects to the development calculus. (Received September 15, 2019)

Arithmetic in Sum.

Duncan J Melville, St. Lawrence University

Alexander Malcolm's *New System of Arithmetick* appeared in 1730, with Edward Hatton's *Intire System of Arithmetic* in 1731. DeMorgan's reviews of these works in his *Arithmetic Books* considered Malcolm's volume 'unusable' and Hatton's 'A sound, elaborate, unreadable work'. DeMorgan's criticism is not unjust, but misses the point for the modern historian. While these books are largely unreadable and doubtless also languished unread (although Hatton's was a second edition), the comprehensive nature of these massive tomes provide insight into how arithmetic was conceptualized by the intended audience and allow us to trace its perceived breadth and nature in the early 18th century. (Received September 14, 2019)

Indian mathematics and convergence of sequences and series.

Kim Plofker, Union College, NY

Ancient Greece is well known for its seminal contributions to the study of infinite series in the work of Archimedes—and for its distrust of the subject as a source of "paradox" in the philosophy of Zeno. Here we examine a different set of approaches to the notion of a convergent sequence or series emerging in Indian exact sciences in the first millennium CE. This talk will explore sources from early medieval mathematical astronomy up through the infinite series of the second-millennium Kerala school and some later developments. (Received September 16, 2019)

Divergent Series and Numeric Computation.

Brenda Davison, Simon Fraser University

In a paper published in 1856, G.G. Stokes (1819-1903) used a divergent series to compute many values of the Airy integral. Some of these values had been previously computed via a convergent series but this method was too laborious to make all of the desired calculations. This talk will examine how Stokes numerically computed a class of definite integrals, including the Airy integral, using divergent infinite series. Emphasis will be placed on what lead Stokes to use this method, what types of physical problems required these solutions, how Stokes justified using his method, and how the results obtained were verified. How, when and for what purpose did other mathematicians and physicists use this method during the mid-19th century, before divergent series were given a rigorous treatment, will also be discussed. (Received September 15, 2019)

Mr Mary Somerville, Husband and Secretary.

Brigitte Stenhouse, Open University, UK

As a nineteenth-century British woman, Mary Somerville's engagement with learned academies and polite scientific society was neither consistent nor straightforward. Whilst she was 88 before being elected a full member of any institution (the American Philosophical Institution, 1869), Somerville benefited from the resources and social networks cultivated in such spaces from as early as 1812.

Dr William Somerville, her husband, was a key mediator between herself, her scientific contemporaries, and the institutions of which he was a member. Indeed William provided Somerville with vital access to both actors and knowledge. Using the extensive correspondence held in the Somerville Collection, at the Bodleian Library in Oxford, we will investigate how William took on the roles of chaperone, secretary, and later literary agent for his wife. Moreover, we will consider how Somerville actively used her husband to liberate knowledge from behind the closed doors of learned societies, and to pursue a successful career publishing mathematical and scientific books. (Received September 04, 2019)

"A Senior Wrangler among Senior Wranglers": the mathematical education of Robert Leslie Ellis.

June Barrow-Green, School of Mathematics & Statistics, The Open University, Milton Keynes, UK

Robert Leslie Ellis (1817–1851) was one of the most intriguing and wide-ranging intellectual figures of early Victorian Britain, his contributions ranging from advanced mathematical analysis to profound commentaries on philosophy and classics. His mathematical education began at home in Bath under the tutelage of Thomas Stephens Davies, later a mathematical master at the Royal Military Academy, Woolwich. At the age of 17, Ellis left home to prepare for Cambridge with the astronomer James Challis but his health broke down and his stay with Challis was cut short. After two further years at home he eventually went up to Cambridge in 1836 where he came under the guidance of George Peacock. Tutored in his third year by the famous coach William Hopkins, Ellis graduated as Senior Wrangler in the Mathematical Tripos of 1840. In this talk I shall examine Ellis's route to success in the Mathematical Tripos and consider to what extent he succeeded because of the Cambridge system or in spite of it. (Received September 02, 2019)

What's Happening with the Euler Archive?

Erik R. Tou, University of Washington Tacoma
Christopher D. Goff, University of the Pacific
Michele Gibney, University of the Pacific

In 2003, the Euler Archive (EA) was created by Dominic Klyve and Lee Stemkoski, both then at Dartmouth College, to raise awareness in the U.S. of the vast quantity of Euler's writings, and the small portion of which had been translated into English at that time. Some goals of the early project were to provide access to original versions of Euler's publications as well as to translations of those works into English or another modern language. The MAA took over web hosting duties from Dartmouth in 2011.

Now, the EA is undergoing a kind of renaissance. Many files have been moved to an academic repository, BePress's Scholarly Commons, hosted at University of the Pacific. In this presentation, current EA director Erik Tou (University of Washington Tacoma), Chris Goff (University of the Pacific), and Michele Gibney (University of the Pacific) will describe the details of their recent work to shore up the archive as well as their future plans for improving the generation of and access to modern translations of Euler's works. (Received August 24, 2019)

Olinde Rodrigues' contribution to Catalan numbers.

Johannes Familton, Borough of Manhattan Community College The City University of New York

Benjamin Olinde Rodrigues was born into an Iberian Jewish family in 1795 residing in France. Most mathematicians who heard of Rodrigues connect him with Rodrigues rotations, which were based in his PhD thesis, and a later paper that he wrote in 1840. Few mathematicians know that he also wrote three 'notes' on combinatorics. He specifically wrote two notes on Catalan numbers, and one on an elementary derivation, without using the Taylor series, of the expansion of binomial series. This presentation will focus on Rodrigues' 1838 contribution to Catalan numbers. This presentation will put this fascinating man's life in context with the two notes that he wrote about Catalan numbers. A brief history about what lead to the problem that Rodrigues tackled will be included. This will be followed by what Rodrigues pointed out and showed in his notes. This will include a summary of his first observation followed by a summary of a shorter proof' he later wrote of his original observation. (Received August 21, 2019)

Canonical Transformations and Hamilton-Jacobi Theory 1866--1920.
Craig Fraser, University of Toronto
Michiyo Nakane, Seijo University, Tokyo

In the second half of the nineteenth century, Hamilton-Jacobi theory provided important mathematical tools in celestial mechanics. One significant development concerned the use of canonical transformations—first introduced by Carl Jacobi—to integrate the equations of motion. In a canonical transformation of the variables of the system, Hamilton's equations remain valid in the transformed variables. One can obtain a canonical transformation from a generating function. If the generating function satisfies the Hamilton-Jacobi partial differential equation, one is led to a solution of the dynamical problem. The subject as it had coalesced by around 1910 resulted in analytical methods that were adopted by German quantum physicists in their investigation of atomic phenomena. Canonical transformations were also explored on a more abstract level in the work of mathematicians. (Received August 15, 2019)

Victorian London's Mathematical Culture --- Non-Euclidean Geometry as a Case Study.
Rosie Lev-Halutz, Tel-Aviv University

The history of nineteenth-century British mathematics has been a widely studied field within the history of mathematics. In the second decade of the century a novel mathematical center, alternative to the previously unrivaled mathematical center of Cambridge University, emerged at London and continuously gained prominence as the century progressed. My study pursues the hitherto disregarded story of this audacious mathematical community, the progressive set of values it advocated, and its impact on the broader British mathematical community. In this lecture, by the means of the illuminating case study of non-Euclidean geometry, I analyze how these values underlay the London-based mathematical activity, and inquire into the question of the impact this community had on the development of non-Euclidean research in Britain. (Received September 12, 2019)

Polish Women Mathematicians in Secret Classes During World War II.
Emelie A Kenney, Siena College

After the Nazis occupied Poland in WWII, they forbade Poles from learning many subjects, including mathematics beyond counting to 500. Nevertheless, because of a large and complex underground, Poles began learning and teaching in classes held clandestinely, despite the threat of death or imprisonment in a concentration camp. Among those students and lecturers were many well-known mathematicians, including Sierpiński, Borsuk, Łukasiewicz, and Kuratowski, among others. But lesser-known mathematicians participated in underground education, as well. Here, we focus on the future achievements and careers of some of the women who were involved, either as students, instructors, or both. (Received August 29, 2019)

"Peculiarly accessible": Roles of postulate theory for different mathematical publics in E.V. Huntington's work.
Laura E. Turner, Monmouth University

In addition to publishing postulate-theoretic results directed at his research-oriented contemporaries, Harvard mathematician Edward V. Huntington (1874–1952) wrote a number of pedagogical and expository works in which he outlined the principles and aims of postulate theory, and pointed to certain roles it might serve in mathematics and well beyond. In this talk we explore some of these roles, focusing on his arguments for the pedagogical and practical value of postulate theory, and the reasons for which he sought to present this material to non-research and even *non-mathematical* publics in the first place. (Received September 16, 2019)

From Mathematical Programming to Convex Analysis: Duality as a driving force in history of mathematics.

Tinne Hoff Kjeldsen, Department of Mathematical Sciences, University of Copenhagen

The presentation will focus on the emergence of convex analysis in the 20th century in the context of mathematical programming with special attention to the significance of duality. More specific, we will look at duality in the history of mathematical programming from von Neumann's work in game theory to Fenchel's duality theorem in nonlinear programming and the role it played for the development of convex analysis. How did ideas of duality emerge in linear programming? What role did they play for the development of nonlinear programming? How did Fenchel introduce ideas of duality in nonlinear programming and how did his duality function as a driving force for the development of convex analysis? (Received August 30, 2019)

How differential geometry became (temporarily) obsolete in the life of Václav Hlavatý.

Helena Durnova, Masaryk University, Brno, Czechia

In January 1950, Oswald Veblen indicated to Václav Hlavatý that the differential geometry he used to do before WWII was no longer in fashion among mathematicians. It was before the first ICM after WWII, the previous one having been held in Oslo, Norway in 1936. The wish of any mathematician of the time to participate at the congress was understandable: even mathematicians from behind the recently appearing Iron Curtain wished to participate. However, the comparison of programs of ICM in Oslo (1936) and at Harvard (1950) shows that the focus has indeed shifted. The main topic of 1950 ICM at Harvard was a new invention: the computer. Four years later, in an interview conducted in 1954, Hlavatý would still speak of pencil and paper being best for doing mathematics. However, the arrival of the compute was not the only reason for the temporary falling out of fashion of differential geometry. In my talk, I will explore how the developments in physics influenced the agenda in this field of mathematics. (Received September 17, 2019)

Soviet Mathematics Curriculum Reforms (1958-1985): Redefining the Purpose of Mathematics Education.

Mariya Boyko, University of Toronto

The major mathematics education reforms that took place in the period of 1958-1985 in the USSR are referred to as Kolmogorov's reforms, after professor Andrei Kolmogorov. The reforms intended to bridge the gap between theoretical and practical skills and prepare students for entering postsecondary study and the workplace. Kolmogorov's view of practical mathematics education was different from the government's notion of practical. Kolmogorov believed the school mathematics needed to align with modern mathematics, while the government was interested in providing students with practical skills needed in the workplace. The Kolmogorov curriculum included the introduction of set theory, a deductive logical approach, and focused on the abstract character of mathematics. It resembled the new mathematics movement in American education in the 1960s. The Kolmogorov curriculum was fully introduced only in the 1970s. In the way in which it was implemented it turned out to be unsuitable for the broad range of students. Their grades declined. In the early 1980s the Kolmogorov reforms were replaced with counter-reforms, led by Ivan Vindogradov and Lev Pontryagin. The legacy of Kolmogorov's reforms endures in the form of a philosophical vision of mathematics education till this day. (Received September 03, 2019)