CSHPM SCHPM

Canadian Society for the History and Philosophy of Mathematics
Société canadienne d'histoire et de philosophie des mathématiques

Annual Meeting / Colloque annuel
Wilfrid Laurier University & University of Waterloo/
L'université Wilfrid-Laurier et L'université de Waterloo
Physics Building, University of Waterloo
Waterloo, Ontario

Programme

Sunday, May 27/ dimanche le 27 mai

9:00 AM Welcome/ Bienvenue President Jean-Pierre Marquis

Session I HISTORIANS
Room PHY 150

Presider: *Daniel Curtin*

9:15 Duncan Melville, St. Lawrence University
After Neugebauer. Developments in the historiography of Mesopotamian mathematics

9:45 Scott Guthery, Docent Press
Raymond Clare Archibald and the Provenance of Mathematical Tables

10:15 ***Coffee Break***

Session II GEOMETRY
Room PHY 150

Presider: *Glen Van Brummelen*

10:30 Gregg De Young, The American University in Cairo
Euclidean Geometry in Two Medieval Islamic Encyclopedias

11:00 Joel Silverberg, Independent Scholar and Professor Emeritus, Mathematics, Roger Williams University
Fathers of American Geometry: Nathaniel Bowditch and Benjamin Peirce of Salem, Massachusetts

11:30 Craig Fraser, University of Toronto
Analysis, geometry and visualization in the early nineteenth century

12:00-2:00 ***Lunch Break***
***Executive Council Meeting (*Room PHY 150)**

Session III
SPECIAL SESSION/SESSION SPÉCIALE MATHEMATICS AND COMPUTER SCIENCE
Room PHY 150

Presider: *Sylvia Svitak*

2:00 Patricia R. Allaire, Queensborough Community College, CUNY
Antonella Cupillari, Pennsylvania State University−Erie, The Behrend College
The First 486 Decimal Digits of $\sqrt{2}$

2:30 Jonathan P. Seldin, University of Lethbridge
Curry's Work on Computers in the Early Days of Computing

3:00 Amy Ackerberg-Hastings, University of Maryland University College and Smithsonian's National Museum of American History
Slide Rules as Computers and on Computers

3:30 ***Coffee Break***

Session IV STATISTICS; ASTRONOMY
Room PHY 150

Presider: *Duncan Melville*

3:45 Roger Godard, Royal Military College of Canada
A tutorial history of least squares: influential points and influence functions

4:15 David R. Bellhouse, University of Western Ontario
A Synoptic Huygens

4:45 David Orenstein, University of Toronto
M-251 from Quebec City: A Multiply Connected Early Canadian Manuscript in the Mathematical Sciences

End of Sunday Program

Monday, May 28/lundi le 28 mai

Session V PHILOSOPHY
Room PHY 150

Presider: *Thomas Drucker*

9:15 Jean-Pierre Marquis, Université de Montréal
Ways of Math-Making: the uses of the axiomatic method in 20th century mathematics

9:45 Francine Abeles, Kean University
Nineteenth Century British Logic on Hypotheticals, Conditionals, and Implication

10:15 ***Break***

Parallel Session VI−A ASTRONOMY
Room PHY 150

Presider: *David Bellhouse*

11:00 Paul R. Wolfson, West Chester University
Newton, Inverse Squares, and Elliptical Orbits

11:30 Glen Van Brummelen, Quest University Canada
A Survey of the Mathematical Sciences in Medieval Islam, 1995-2011,
Part II: Astronomy, Algebra, Arithmetic

Parallel Session VI−B MATHEMATICAL WORKS
Room PHY 235

Presider: *Amy Ackerberg-Hastings*

10:30 Michael Molinsky, University of Maine at Farmington
Mathematics in the Library of Congress: 1800-1815

11:00 Dale McIntyre, Grove City College
Ten Mathematicians Who Recognized God's Hand in their Work

12:00-2:00 ***Annual General Meeting (Lunch provided)***
Room PHY 150

Session VII
SPECIAL SESSION/SESSION SPÉCIALE MATHEMATICS AND COMPUTER SCIENCE
Room PHY 150

Presider: *Hardy Grant*

2:00 Maryam Vulis, Norwalk Community College and USMMA
Russia: History of Computing

2:30 Sylvia Svitak, Queensborough Community College, CUNY
Mathematical Proof and Computer Science

3:00 Allan Olley, University of Toronto
Automating Mathematics before the Computer:
Some of the early work of Wallace J. Eckert

3:30 Thomas Drucker, University of Wisconsin Whitewater
Le rêve de Turing, ce n'est qu'un cauchemar de Leibniz

4:00 ***Break***

STILLMAN DRAKE/KENNETH O. MAY LECTURE

Andrew Hodges, Wadham College, Oxford University
What does Alan Turing tell us about the history of science?

4:30 – 5:30 PM

Auditorium PHY 145

Introduced by
Jean-Pierre Marquis, President CSHPM
Kathleen Okruhlik, President CSHPS

End of Monday Program

Tuesday, May 29/mardi le 29 mai

Session VIII ALGEBRA
Room PHY 150

Presider: *Robert Bradley*

9:00 George P. H. Styan, McGill University
An illustrated introduction to magic squares from India

9:30 Daniel J. Curtin, Northern Kentucky University
Girolamo Cardano argues that minus times minus is minus, not plus.

10:00 Maria Zack, Point Loma Nazarene University
Through the Looking Glass: Dodgson's View of Determinants

10:30 ***Coffee Break***

Parallel Session IX−A PHILOSOPHY
Room PHY 150

Presider: *Gregory Lavers*

10:45 Daniele Molinini, Equipe Rehseis UMR 7219, Université Paris 7
What's the Matter with the Deductive Nomological Model?

11:15 Susan Vineberg, Wayne State University
Locating Mathematical Depth

11:45 W. Jim Jordan, University of Waterloo
Much Ado about Something: Husserl and Frege on the Concept of "Number"

Parallel Session IX−B HISTORY AND THE TEACHING OF MATHEMATICS
Room PHY 235

Presider: *Michael Molinsky*

10:45 Bruce Burdick, Roger Williams University
Military Matters in the Printed Mathematical Works of Colonial Latin America

11:15 George Rousseau, formerly of the University of Leicester
Some History of the Quadratic Reciprocity Law

11:45 Diana White, University of Colorado Denver
What are the potential benefits of incorporating the history of math into classroom teaching of mathematics?

12:15-2:00 ***Lunch Break***

Session X GEOMETRY
Room PHY 150

Presider: *Maria Zack*

2:00 Robert E. Bradley, Adelphi University
Burning Ambition and Reflected Glory: de l'Hôpital and Bernoulli on Caustics

2:30 Christopher Baltus, SUNY at Oswego
Brook Taylor in Perspective: Perspective Drawing as a Central Collineation

Session XI PHILOSOPHY
Room PHY 150

Presider: *Jean-Pierre Marquis*

3:00 Gregory Lavers, Concordia University, Montreal
Carnap on the existence of abstract objects

3:30 Michael Cuffaro, The University of Western Ontario
Kant's Views on non-Euclidean geometry

4:00 ***Closing Remarks***

President's Reception/Réception de la présidente
University of Waterloo Physical Activities Complex
5:00– 7:00 PM

End of Tuesday Program and 2012 CSHPM/SCHPM Annual Meeting

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Abstracts

Nineteenth Century British Logic on Hypotheticals, Conditionals, and Implication
Francine Abeles
Kean University

Modern logicians ordinarily do not distinguish between the terms hypothetical and conditional. Yet in the late nineteenth century their meanings were quite different and their tie to the implication relation was unclear. In this paper, I will first present George Boole's ideas, then explore the views of three prominent but relatively unknown British logicians of the period, W. E. Johnson, J. N. Keynes, and H. MacColl on these and related issues.

Slide Rules as Computers and on Computers
Amy Ackerberg-Hastings
University of Maryland University College and Smithsonian's National Museum of American History

The Smithsonian Institution is in the process of making its 137 million objects, artworks, and specimens freely available online via the website collections.si.edu. As a small part of this massive project, the presenter is updating the catalogue descriptions of the approximately 200 slide rules in the mathematics collection of the National Museum of American History. Using these instruments as illustrations, this talk has three aims. First, it locates the history of the slide rule within the history of computing. Second, it points out some highlights of the collection. Finally, it reflects on the methodological lessons learned in the process of writing descriptions designed to appeal simultaneously to the general public, slide rule enthusiasts, and professional scholars.

The First 486 Decimal Digits of $\sqrt{2}$

Patricia R. Allaire, Queensborough Community College, CUNY
Antonella Cupillari, Pennsylvania State University−Erie, The Behrend College

Some people find numbers to be very fascinating and feel the need to manipulate and investigate them as a personal quest. One of these individuals was Artemas Martin (1835-1918), an amateur mathematician from Pennsylvania who was employed as a (human) computer for the American government in 1885.

Martin, who had taught himself advanced calculus and number theory, enjoyed performing very lengthy calculations and searching for faster methods. Some results of his work regarding extensions of Fermat's Last Theorem were presented at the International Mathematical Congress that was part of the World's Columbian Exposition in Chicago in 1893. Others results, like the accurate calculations of large numbers of decimal digits in the extraction of roots of whole numbers, appeared in The Mathematical Magazine, which was one of the first American mathematical journals and was edited by Martin himself. To carry on these calculations, Martin and the other human computers looked for efficient patterns and employed only calculus tools (e.g. series) and endless patience.

Brook Taylor in Perspective: Perspective Drawing as a Central Collineation

Christopher Baltus
SUNY at Oswego

Although practical methods for perspective drawing developed in fifteenth century Italy, the mathematical treatment emerged slowly. Major steps in that directions were G. J.'s Gravesande's *Essai de Perspective* (1711) and Brook Taylor's *Linear Perspective: or a new method* . . . (1715). Their methods rotated the "picture plane" onto the "ground plane," so that images could be constructed by what we now recognize as a central collineation. The topic permits a limited look at the relation between perspective drawing and projective geometry three centuries ago. The geometry is elementary and very pretty.

A Synoptic Huygens

David R. Bellhouse
University of Western Ontario

There are at least four English translations of Christiaan Huygens' 1657 treatise on probability *De Ratiociniis in Ludo Aleae*, three from the period 1690 – 1715 and one modern one. The modern one, by Edith Dudley Sylla in 2006, is a very literal translation while the others either take some liberties with the text or merely put their own style on the English rendered from the Latin. I have placed these translations side by side to obtain a synoptic version of Huygens' work with a view to examining the variation among mathematicians concerning how they viewed, and possibly interpreted to their own benefit, the subject of probability in the early eighteenth century.

Burning Ambition and Reflected Glory: de l'Hôpital and Bernoulli on Caustics

Robert E. Bradley
Adelphi University

The study of caustics – curves that are the envelopes of a family of reflected or refracted rays – was initiated by Tschirnhaus in 1682. Soon afterwards, the new differential calculus provided powerful tools that Jakob and Johann Bernoulli exploited to enrich and extend this branch of mathematics. In 1696, de l'Hôpital published *Analyse des infiniment petits*, the first textbook of the differential calculus. It contained two chapters on caustics and a further chapter on other kinds of envelopes. These chapters included considerable quantities of Johann Bernoulli's unpublished research which, because of a financial arrangement he had entered into with Bernoulli, de l'Hôpital presented without attribution. In this talk, we examine de l'Hôpital's elegant exposition of caustics and its sources in the work of Johann Bernoulli.

Military Matters in the Printed Mathematical Works of Colonial Latin America

Bruce Burdick
Roger Williams University

The eighth book with mathematical content to be printed in the Americas was Diego García de Palacio's *Dialogos Militares*, Mexico City, 1583. The book discusses artillery, perspective, the mixing of gunpowder, surveying, and the formation of squadrons.
García de Palacio followed this in 1587 with *Instrucción Náutica*, which treats the use of the astrolabe, prediction of the tides, and astronomy in general.

Both of these books are available in modern Spanish editions and the second one has been translated into English. Use of these in the classroom could enliven a mathematical lesson in geometry, arithmetic, algebra, or trigonometry by tying it to applications that were important in history, and in the right classroom this could provide a multicultural experience as well. Particularly curious is the lengthy treatment of the formation of squadrons. This topic was also taken up by works printed in 1649, 1660, and 1675. Typically, a problem would propose that a given number of soldiers must stand in ranks and files with some property. The solution would often be illustrated by using type to stand for soldiers. We will offer a guess as to why such problems received this much treatment for so long.

Kant's Views on non-Euclidean geometry

Michael Cuffaro
The University of Western Ontario

Kant's arguments for the synthetic a priori status of geometry are generally taken to have been refuted by the development of non-Euclidean geometries. Recently, however, some philosophers have argued that, on the contrary, the development of non-Euclidean geometry has confirmed Kant's views, for since a demonstration of the consistency of non-Euclidean geometry depends on a demonstration of its equi-consistency with Euclidean geometry, one need only show that the axioms of Euclidean geometry have 'intuitive content' in order to show that both Euclidean and

non-Euclidean geometry are bodies of synthetic a priori truths.

Friedman has argued that this defence presumes a polyadic conception of logic that was foreign to Kant. According to Friedman, Kant held that geometrical reasoning itself relies essentially on intuition, and that this precludes the very possibility of non-Euclidean geometry. While Friedman's characterization of Kant's views on geometrical reasoning is correct, I argue that Friedman's conclusion that non-Euclidean geometries are logically impossible for Kant is not. I argue that Kant is best understood as a proto-constructivist and that modern constructive axiomatizations (unlike Hilbert-style axiomatizations) of both Euclidean and non-Euclidean geometry capture Kant's views on the essentially constructive nature of geometrical reasoning well.

Girolamo Cardano argues that minus times minus is minus, not plus.

Daniel J. Curtin
Northern Kentucky University

When students wonder why a minus times a minus is a plus, they are struggling to understand the nature of numbers. It may reassure them that even the great mathematicians of the past struggled too. Cardano, who wrote in the mid 1500s, a time when the nature of negative numbers was still unclear, recognized the possibility that a negative number could be the solution to an equation. Yet his attempts to explain what this meant in terms of positive solutions were tortuous. Then, his solution of the cubic equation suddenly made it necessary to handle negatives under square roots in order to get to solutions as simple as 4. In response he developed a surprising concept that appears in *De regula aliza*, a little-studied work with a reputation of impenetrability. Chapter 22 contradicts most people (including Cardano himself, previously), asserting that a minus times a minus should be a minus. Here and in his later *Sermo de plus et minus*, Cardano presents both mathematical and philosophical reasons for this contrarian view. My paper will discuss his arguments and the perplexity they widely evoked.

Euclidean Geometry in Two Medieval Islamic Encyclopedias

Gregg De Young
The American University in Cairo

The tenth century Persian philosopher, Ibn Sīnā, included an epitome of Euclid's *Elements* in his massive Arabic encyclopedic treatise, *Kitāb al-Shifā'*. Avicenna also prepared a summarized version of his encyclopedia in Arabic (*Kitāb al-Najāt*) and another summary in Persian (*Dānishnāme*). In this paper, I review some of the distinctive features of Ibn Sīnā's Euclidean epitome in *Kitāb al-Shifā'* and discuss its relation to the primary transmission of the *Elements* in Arabic, and offer a few remarks about its possible influence both in later Arabic and Latin transmissions. Avicenna's *Kitāb al-Shifā'* will be briefly contrasted with another Islamic scientific and philosophical encyclopedia from the thirteenth century that also included a summary of Euclidean geometry – the Persian *Durrat al-Tāj* of Quṭb al-Dīn al-Shīrāzī. These two examples illustrate how Euclidean geometry was treated by two scientific and philosophical encyclopedists in medieval Islam. These examples also reveal a shift in Euclidean discourse between the tenth and thirteenth centuries – a shift away from reliance on the primary transmission of Euclid as it came from the Greek to focus instead on a canonical text of the secondary transmission.

Le rêve de Turing, ce n'est qu'un cauchemar de Leibniz

Thomas Drucker
University of Wisconsin Whitewater

Some have seen the work of Alan Turing as the fulfillment of Leibniz's dream. While the technical accomplishments of Turing's work could have promoted the goals that Leibniz had for the mechanization of thought and argument, that was far from Turing's own goal. The uses to which Turing wished to put the computer were contrary to what Leibniz had in mind. If anything, von Neumann's approach to the computer was closer to that of Leibniz. The latter fact is enough to demonstrate that the differences between Turing's vision and Leibniz's cannot be explained by the passage of 250 years. This talk will examine the basis for some of those differences in Leibniz's and Turing's views of matters well beyond machines.

Analysis, geometry and visualization in the early nineteenth century

Craig Fraser
University of Toronto

In the writings of Euler and Lagrange there was a concerted attempt to free analysis from any reliance on diagrams or geometric modes of representation. This point of view was widely held by mathematical researchers in the late eighteenth and early nineteenth centuries. It is evident in the work of such prominent figures as Pierre-Simon Laplace and William Rowan Hamilton. Even in subjects such as celestial mechanics and geometrical optics, where spatial and visual elements were fundamental, there was a very limited use of diagrams or illustrations. This conception of analysis was reflected in a more general way in the ideas of such philosophers as Auguste Comte. The historical character of large parts of mathematical analysis during the period was to a very considerable degree defined by its rejection of geometric visualization and methods of representation. At the same time counter currents were developing within mathematics. Argand's representation of complex numbers, Cauchy's method of contour integration, Cauchy's work on foundations of calculus and Gauss's theory of curves and surfaces were all developments strongly shaped by an increasingly geometric point of view.

A tutorial history of least squares: influential points and influence functions

Roger Godard
Royal Military College of Canada

The least squares method created a tremendous wave in mathematics and its applications. We have selected seven clusters where least squares made a definitive impact. The first cluster is about minimization of residuals. The second cluster concerns the numerical solution of a system of linear equations. The third cluster is linked to the theory of errors. The fourth cluster is related to statistics. The fifth cluster is linked to the convergence in the mean, calculation of Fourier coefficients, the Gram-Schmidt orthogonalisation process, etc. A sixth cluster is about the history of applications.

We would like to present Chebychev's work on the fifth cluster with his polynomial regression by orthogonal polynomials. We also conclude the controversy between Cauchy and Bienaymé about least squares. Then, we comment the seventh cluster about robustness of least squares methods, the problem of influential observations, and the more modern concept of influence functions. The idea behind influence functions is to re-weight observations based on their residuals.

Raymond Clare Archibald and the Provenance of Mathematical Tables
Scott Guthery
Docent Press

Raymond Clare Archibald practiced what might be thought of as applied history of mathematics. His probative and scholarly researches into the provenance of mathematical tables bore direct and practical relevance to the utility of existing tables and the computation of new tables. Based on Archibald's many contributions to the journal *Mathematical Tables and other Aids to Computation* and on the table genealogies constructed by Archibald and others, this talk illuminates why history was such an integral and important part of the table maker's world.

What does Alan Turing tell us about the history of science? (Keynote Address)
Andrew Hodges
Wadham College, Oxford University

In 1936 Alan Turing published his famous paper 'On Computable Numbers....'. It created the concept of mathematical computability, defined the idea of a universal machine, and gave a new description of mental operations. Turing went on to play a leading part in wartime cryptography, and then to design an electronic computer, found the theory of Artificial Intelligence, and create a new branch of mathematical biology. While surveying the narrative of Turing's life, in this his centennial year, I will discuss his own observations about the nature of science and the place of the individual scientist. I will also highlight the difficulties of charting the progress of scientific ideas, illustrated by the question of how the Church-Turing thesis was originally formulated, and by the question of the origin of the digital computer.

Much Ado about Something: Husserl and Frege on the Concept of "Number"
W. Jim Jordan
University of Waterloo

Frege and Husserl both develop accounts of "number" in their philosophical works. The two accounts differ on a number of points, and Frege condemns Husserl's account for being, in part, "psychologistic." I set out the two accounts of number, identify the most significant differences between the two accounts, and show that these differences do not come down to psychologism, but to a different understanding of how to remove the psychological elements of human reasoning from the accounts of "number".

Carnap on the existence of abstract objects

Gregory Lavers
Concordia University, Montreal

This paper will focus on Carnap's views on existence claims with respect to abstract objects. I begin by pointing out a tension that existed at the time of *The Logical Syntax of Language*. Wittgenstein held that logic should say nothing about what exists. This thesis was maintained by Carnap at the time of Syntax, despite its fairly obvious inconsistency with the principle of tolerance. One cannot hold that in logic there are no morals and at the same time hold that there are certain things about which logic should say nothing. I then examine how Carnap's views on abstract objects evolve into the position he held in the early 1950s. Tarski's work on Semantics was certainly influential on Carnap's mature views. Also of central importance was his view on explication that Carnap developed in the late 1940s.

I will show that while Carnap explicitly rejects Platonism with respect to mathematical objects, his position has many features in common with various forms of realism. In fact, in the case of propositions, Carnap explicitly states that they are non-physical, extra-linguistic entities that are independent of human beings and their mental states. The kind of realist position that Carnap rejects as incoherent, is of such a strong form that few, if any, contemporary realists would take themselves to defend it. Finally, I relate this discussion to contemporary fictionalist positions on the philosophy of mathematics.

Ways of Math-Making: the uses of the axiomatic method in 20th century mathematics

Jean-Pierre Marquis
Université de Montréal

The axiomatic method has become a standard trick of the trade in modern mathematics. Of course, it goes back to Euclid and has been seen by many has having definite epistemological purposes, for instance stating truths upon which new, more problematic claims can be shown to rest. As has been already claimed by some, for instance Dirk Schlimm, in the 20th century, the axiomatic method was put to new, original usages and that it had different roles in the development of mathematics, many of which had nothing to do with truths. In this talk, I want to go further and explore how these usages evolved, particularly in the second half of the 20th century. I will quickly survey and comment on what I take to be revealing cases of these various usages: after a very brief clarification on Hilbert and his school, the American postulationists and the foundational movement, I will focus on the post-Second World War period where important shifts occur in the work of Eilenberg-Steenrod, Eilenberg-Cartan, Grothendieck and Quillen. In these cases, axioms are seen sometimes as norms, as ways of capturing large portions of mathematics and proving theorems otherwise inaccessible or as directives for developing various theories.

Ten Mathematicians Who Recognized God's Hand in their Work

Dale McIntyre
Grove City College

Scottish philosopher David Hume (1711-1776) once observed that "Whoever is moved by faith to assent to [the Christian religion], is conscious of a continued miracle in his own person, which subverts all the principles of his understanding, and gives him a determination to believe what is most contrary to custom and experience."

Evidently Hume's sober pronouncement did not apply to Euler, Cauchy, Cantor, and other profound thinkers who believed God had commissioned and equipped them to glorify Him in their pursuit of truth through mathematics – And based on their extraordinary achievements their understanding doesn't appear to have been subverted too badly!

Leading mathematicians of past generations commonly affirmed that God created and sovereignly rules the universe and that He providentially sustains and nurtures His creatures. Despite Hume's assertion, history teaches us that faith often informs rational inquiry and vice versa. In many cases Christian commitment stimulated intellectual activity; sometimes mathematical understanding led to spiritual insight. In this paper, ten of history's most influential mathematicians express the role faith in God and religious conviction played in their lives and work in their own words.

After Neugebauer. Developments in the historiography of Mesopotamian mathematics.

Duncan Melville
St. Lawrence University

When Otto Neugebauer (1899—1990) began studying Old Babylonian mathematics in the late 1920s, little was known about the subject. He produced a flood of papers culminating in the three volume *Mathematische Keilschrift-Texte* published in 1935 and 1937. After his 1945 book, *Mathematical Cuneiform Texts*, he appeared to find his work completed. Although he stayed interested in mathematical astronomy for the rest of his life, he essentially abandoned mathematics. While Neugebauer's translations have stood the test of time, new generations of scholars have brought new insights and questions to bear on the subject, and the current view of Mesopotamian mathematics is quite different from that of the 1940s. In this talk I will sketch some of the most significant developments in our understanding of Mesopotamian mathematics.

What's the Matter with the Deductive Nomological Model?

Daniele Molinini
Equipe Rehseis UMR 7219, Université Paris 7

The philosophical discussion about mathematical explanation has inherited the very same sense of dissatisfaction that philosophers of science expressed, in the context of scientific explanation, towards the famous deductive-nomological model. This model is regarded as unable to cover cases of mathematical explanations and, furthermore, it is largely ignored in the relevant literature. Surprisingly enough, the reasons for this ostracism are not sufficiently manifest among philosophers of mathematics. In this paper, I consider a possible extension of the deductive nomological model to the case of mathematical explanations in science and I claim that there are at least two good reasons to judge the deductive-nomological picture of explanation as inadequate in that context: it cannot deal with mathematical operations or procedures which play a key role in explanatory practices but which do not come under the form of statements; it is not a sufficiently good indicator of the intuitions coming from the scientific practice, thus imposing a picture of explanation which is not authentic. The analysis I propose is based on the observation of mathematical and scientific practice and is a plea for philosophy of mathematics to (seriously) consider historical and pragmatic factors in the investigation of the notion of mathematical explanation.

Mathematics in the Library of Congress: 1800-1815

Michael Molinsky
University of Maine at Farmington

Although the Library of Congress has played a role as national library of the United States for over a century, when it was created it was intended to serve only as a reference library for the United States Congress. This talk will examine the mathematical works that appeared in the library between its creation in 1800 and the addition of Thomas Jefferson's personal library to the collection in 1815.

Automating Mathematics before the Computer: Some of the Early Work of Wallace J. Eckert

Allan Olley
University of Toronto

The creation of the first electronic computers in the post-World War II period drew on many pre-existing elements. One of these was the existing practices for carrying out complex scientific calculations, using various calculating machines and teams of human operators. Organizing such calculating efforts required knowledge of numerical analysis, including how to avoid, detect and correct arithmetic error and how to transform complex procedures into steps that could be performed by the people and machines available. Astronomer Wallace J. Eckert was an early pioneer of the application of punched card accounting machines for scientific work in the 1930s. Eckert's work pushed into a new level of automation, reducing the scope for human error. In this paper I will discuss the role and scope of scientific calculation in the pre-computer era and the contingencies created by the specialized machines and skills associated with it. I will also describe some of Eckert's innovations in machine calculation and his own attitude towards calculating machines.

M-251 from Quebec City: A Multiply Connected Early Canadian Manuscript in the Mathematical Sciences

David Orenstein
University of Toronto

The archives from the Seminaire de Quebec harbour the manuscript resource M-251, a late 18th century notebook containing the writings of one of their teaching fathers, Pere Thomas-Laurent

Bedard (1747 -1795), on a variety of topics in the mathematical sciences. In addition to the detailed observation of the October 27, 1780, solar eclipse I reported on last time we were in Waterloo, there are shorter summaries of eclipse predictions dating from June 24, 1778, through August 27, 1783, and an astronomical latitude detreminatom on Mar 22-23. 1792. Furthermore there is a table of sunrise-sunset times calculated for Quebec, listing every day of 1796. There is also a short discourse on optics and a report on low and high tides at Quebec.

What can we read from this hard bound ledger sized notebook from its material, its construction or through its geographical, temporal and institutional location? What further archival traces are there of Pere Bedard? What were the sources in the distant British colony of Quebec / Bas-Canada for the high level of scientific and mathematical expertise displayed in M-251? There will be many answers and even more questions.

Some History of the Quadratic Reciprocity Law

George Rousseau
Formerly of the University of Leicester

An examination of the history of the QRL gives rise to several proofs much simpler and better motivated than those given in number theory textbooks. In particular we consider a proof by H. Schmidt (1893) and another by G. Zolotarev (1872). Suitably modernized, these proofs are, in the author's opinion, very useful pedagogically.

Curry's Work on Computers in the Early Days of Computing

Jonathan P. Seldin
University of Lethbridge

H. B. Curry is known primarily as a mathematical logician. But at the end of the academic year 1941-42, after the U.S. entered World War II, Curry took a leave of absence from the Pennsylvania State College to do applied mathematics for the U.S. Government. His work on the fire control problem eventually (in 1945) led him to the ENIAC project. There he worked on programming inverse interpolation for the ENIAC, which, in turn, led him to work on program composition. This work is studied in [1] and [2]. Less well known is the fact that at the end of 1945 and the beginning of 1946, he wrote a program to calculate digits of e, the base of the natural logarithms. This is an interesting example of programming before the days of programming languages. The program may never have been run.

[1] Liesbeth De Mol, Maarten Bullynck, and Martin Carle, "Haskell before Haskell. Curry's contribution to programming (1946-1950)", in F. Ferreirea, B. Lowe, E. Mayordomo, and L. Mednes Gomes (eds), Programs, Proofs, Processes, CiE 2010, LNCS 6158 (2008) pp. 108-117.

[2] Liesbeth De Mol, Maarten Bullynck, and Martin Carle, "Haskell before Haskell. An alternative lesson in practical logics of the ENIAC", LaTeX, January 21, 2011.

Fathers of American Geometry: Nathaniel Bowditch and Benjamin Peirce of Salem, Massachusetts

Joel Silverberg
Independent Scholar and Professor of Mathematics, Emeritus, Roger Williams University

Nathaniel Bowditch (1773 -- 1838) was one of the last, and most prominent, of a series of self-taught American scientists and mathematicians of the 18th century, while his protégé, Benjamin Peirce (1809 -- 1880) was among the first, and most prominent, of the university trained scientists and mathematicians of the 19th century.

Their work and careers intertwined repeatedly over the course of their lives. Both were deeply involved in the development of Harvard University -- Bowditch as a Fellow of the Corporation and Peirce as one of its most influential faculty members.

Their most well-known collaboration was on a four volume translation of Laplace's *Traité de mécanique céleste*. I will examine the details of a lesser known collaboration -- the development of a navigational method for determining one's latitude, based upon two observations of the solar altitude, together with the elapsed time between the two observations. Developed by Bowditch in his youth, it was published for the use of seamen in the 1825 edition of his *New American Practical Navigator*, while shortly before Bowditch's death, Peirce provided a detailed view of the methodology and mathematical derivations behind the method in his *Elementary Treatise on Plane and Spherical Trigonometry* (1836, 1840).

An illustrated introduction to magic squares from India

George P. H. Styan
McGill University

We study magic squares from India starting in the 6th century AD and continuing through the 20th century. We begin with the order-4 magic square used by Daivajna Varahamihira (fl. 550 AD) to make perfume and it seems that he could have made as many as 172 different varieties of perfume this way. Our second oldest magic square, dating from the 12th century, is also order-4 and was found both in Dudhai (Jhansi district) and in Khajuraho. We continue with magic squares due to Thakkura Pheru (fl. 1300) and Narayana Pandita (fl. 1356). The Scottish mathematician Major-General Robert Shortrede (1800--1868), who served with The Great Trigonometric Survey in India, found an order-4 magic square dated 1483 in Gwalior. The Rajah of Mysore, Krishnaraj Wadiar (1790--1868), constructed the first order-12 semi-magic chess-knight's tour and displayed it on a silk hanging. We end with some magic squares constructed by ``The Man who knew Infinity," Srinivasa Aiyangar Ramanujan (1887--1920), while still a teenager at high school in India. We illustrate our findings with images of postage stamps and other philatelic items.

Mathematical Proof and Computer Science
Sylvia Svitak
Queensborough Community College, CUNY

The 1976 Haken/Appel/Koch proof of the Four Color Theorem, considered the first major theorem whose proof depended on the use of a computer, provoked considerable debate about the nature of mathematical proof and the legitimacy of computer generated proofs or components of proofs. This paper, using the 1976 proof as a reference point, begins a historical investigation into the relationship of mathematical proof and computer science.

A Survey of the Mathematical Sciences in Medieval Islam, 1995-2011, Part II: Astronomy, Algebra, Arithmetic
Glen Van Brummelen
Quest University Canada

The past fifteen years has seen a marked growth in research in the mathematical sciences in medieval Islam. This work has led to a growing awareness of the fluidity of boundaries, both between scientific disciplines related to mathematics and between sub-cultures within the Islamic world. Last year we surveyed developments since 1995 in the appropriation especially of Greek science, geometry, and disciplines allied to geometry. This year we shall explore topics related to astronomy, arithmetic, and algebra, as well as our increased perception of regional influences.

Locating Mathematical Depth
Susan Vineberg
Wayne State University

Maddy has recently argued that there are two ontological positions, Thin Realism and Arealism, which are open to the mathematical naturalist. Although Thin Realism takes mathematics to be uncovering truths and Arealism denies this, on both views mathematics develops in accordance with a common set of goals and objective conditions of correctness. At the core, these are linked to objective facts concerning mathematical depth. Although Maddy resists giving an analysis of what this consists in, I argue that a strong notion of mathematical depth is necessary for the claim of objectivity, and the adequacy of either view. The paper then takes up the question of how mathematical depth is to be understood. I propose that it is linked with certain kinds of mathematical explanation, and discuss how such an analysis provides the objective grounding that the naturalist requires.

History of Computing in the Soviet Union
Maryam Vulis
Norwalk Community College and USMMA

We will discuss the development of computer science in the Soviet Union and the contributions of the Soviet mathematicians to the field. Remarkably, this was not a straightforward affair, as the history of computing in the Soviet Union was closely related to the ideological climate of the time.

What are the potential benefits of incorporating the history of math into classroom teaching of mathematics?

Diana White
University of Colorado Denver

In traditional pre-college and undergraduate mathematics classes, the history of the mathematical topics covered often receive little if any attention. In this talk, we discuss a myriad of reasons why embedding additional historical information into these classes could impact student learning, enthusiasm for an interest in mathematics, and understanding of mathematics as an active discipline. Additionally, a variety of problem solving activities can arise naturally, as well as opportunities for students to articulate, in written and oral form, the development of historical mathematics. We survey some results from the educational literature on the topic, in particular benefits to teachers of learning about the history of mathematics, and suggest areas for further investigation.

Newton, Inverse Squares, and Elliptical Orbits

Paul R. Wolfson
West Chester University

In 1684, Edmund Halley visited Isaac Newton in Cambridge and asked him a question: what would be the path of a planet acting under the influence of an inverse square force of attraction? When Newton replied that the path would be an ellipse, Halley begged him for his calculation. Newton began his calculations anew, broadening and deepening them into what became the *Principia*. In this expository talk, I shall sketch the development of Newton's ultimate reply and discuss opinions about his success in answering the original question.

Through the Looking Glass: Dodgson's View of Determinants

Maria Zack
Point Loma Nazarene University

In his time at Oxford, Charles Dodgson (Lewis Carroll) wrote texts that assisted students in preparing for leaving exams. One of these texts, *Elementary Treatise on Determinants with the Applications to Simultaneous Linear Equations and Algebraical Geometry* (1867), contains a unique method of computing determinants. Though this is not the standard method taught to students, it greatly simplifies computations for large matrices. This talk discusses Dodgson's method and also the author's experience with using Dodgson's original text to teach undergraduate linear algebra students about both the computation and meaning of determinants.