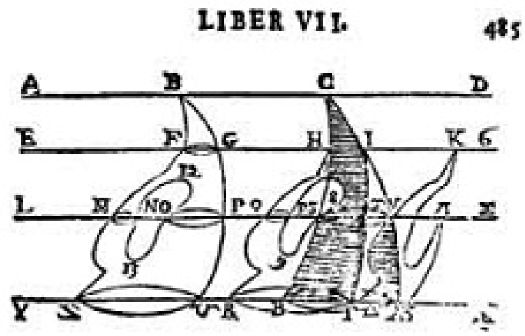
CSHPM



SCHPM

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

Annual Meeting / Colloque annuel
Brock University
St. Catharine's, Ontario

Programme

Sunday, May 25/ dimanche le 25 mai

9:00 AM **Welcome/ Bienvenue** President Glen Van Brummelen

Session I Biography
Earp Residence – Fireplace Lounge

Presider: *Larry D'Antonio*

9:15 V. Frederick Rickey , Professor Emeritus, West Point, Theodore J. Crackel, Editor-in-Chief emeritus, The Papers of George Washington, and Joel Silverberg, Professor Emeritus, Roger Williams University
Reassembling Humpty Dumpty Again: Putting George Washington's Cyphering Books Back Together Again

9:45 Craig Fraser, University of Toronto
J. C. Fields as a Public Advocate of Mathematics and Science

10:15 **Coffee Break**
Parallel Session II-A Philosophy
Earp Residence – Student Lounge 100

Presider: *Jean-Pierre Marquis*

10:30 Parzhad Torfehnezhad, Université de Montréal
Carnap's Analysis of Probability versus Subjective and Frequentist Interpretations

11:00 Emerson Doyle, University of Western Ontario
Understanding Carnap's Mathematical Conventionalism

Parallel Session II-B Useful Mathematics
Earp Residence – Fireplace Lounge

Presider: *Glen Van Brummelen*

10:30 Christopher Baltus, SUNY Oswego
Is mathematics to be useful? The case of de la Hire, Fontenelle, and the epicycloid

11:00 Nicholas Fillion, Simon Fraser University and David Bellhouse, University of Western Ontario
Discovering the concept of minimax solution: Montmort, Waldegrave and Bernoulli

11:30 Ed Cohen, Ottawa
Babylonian and Athenian Calendars

12:00 – 2:00 ***Lunch Break***
Executive Council Meeting

Session III
Earp Residence – Fireplace Lounge

SPECIAL SESSION/SESSION SPÉCIALE Early Scientific Computation

Presider: *Maria Zack*

2:00 Joel Silverberg, Professor Emeritus, Roger Williams University
The Rise of "the Mathematicals ". The invention and popularization of Plain Scales, Gunter's Scales, and Sectors : Putting Mathematics in the Hands of Practitioners

2:30 Amy Ackerberg-Hastings, University of Maryland University College
Early Modern Computation on Sectors

3:00 Larry D'Antonio, Ramapo College of New Jersey
Computing the Ellipticity of the Earth

3:30 ***Coffee Break***

Session IV Philosophy
Earp Residence – Fireplace Lounge

Presider: *Greg Lavers*

3:45 Jean-Pierre Marquis, Université de Montréal
The purity of mathematics: a not so clean history

4:15 Dirk Schlimm, McGill University
Forms of reasoning and geometric content

4:45 Elaine Landry, University of California, Davis
Plato was <u>not</u> a Mathematical Platonist

5:15 Robert Thomas, University of Manitoba,
The judicial analogy for mathematical publication

End Sunday Program

Monday, May 26/lundi le 26 mai

Session V Applications of Mathematics
Earp Residence – Fireplace Lounge

Presider: *Amy Ackerberg- Hastings*

9:15 Maria Zack, Point Loma Nazarene University
Rebuilding Mathematically: A Study of Lisbon and London

9:45 Tom Archibald, Simon Fraser University
Textbooks, Lectures, and the Mathematical Canon: Applied Mathematics in Britain in the early 20th Century

10:15 ***Coffee Break***

Session VI Logic and Cryptography
Earp Residence – Fireplace Lounge

Presider: *Craig Fraser*

10:30 Deborah Bennett, New Jersey City University
Venn-Euler-Leibniz Diagrams

11:00 Chuck Rocca, Western Connecticut State University
Cryptomenysis: The Cryptology of John Falconer

11:30 Francine Abeles, Kean University
The Influence of Arthur Cayley and Alfred Kempe on Charles Peirce's Diagrammatic Logic

12:00 – 2:00 ***Annual General Meeting (Lunch provided)***
Earp Residence – Fireplace Lounge

2:00 – 3:00 PM Kenneth O. May Lecture
Earp Residence – Fireplace Lounge

Speaker: Michael Williams, University of Calgary
John Napier, his life and work

Session VII
Earp Residence – Fireplace Lounge

Presider: *Christopher Baltus*

SPECIAL SESSION/SESSION SPÉCIALE Early Scientific Computation

3:15 Glen Van Brummelen, Quest University
Trigonometry, Before and After Logarithms

3:45 David Bellhouse, University of Western Ontario
Analysis of the Errors in Napier's 1614 Logarithm Tables

Session VIII Mathematics in Situ
Earp Residence – Fireplace Lounge

Presider: *David Bellhouse*

4:15 David Orenstein, University of Toronto
History And Philosophy Of Mathematics At The International Mathematical Congress, Toronto 1924, In Context

4:45 Eduardo Noble, Université de Montréal
Some historical remarks on the Analytical Society of Cambridge

5:15 Charlotte Simmons, University of Central Oklahoma
"Gőttingen is Here": The Courant Institute and American Mathematics

End Monday Program

Tuesday, May 27/mardi le 27 mai

Session IXa Philosophy and Concepts of Mathematics
East Academic 305

Presider: *Dirk Schlimm*

9:15 Nicholas Ray, University of Waterloo
Frege and Neo-Logicism

9:45 Gregory Lavers, Concordia University
Gödel and mathematics as the syntax of language

10:15 **Coffee Break**

10:30 Bruce J. Petrie, University of Toronto
The Geometric and Algebraic Classification Rules of the Transcendental in Early Modern Mathematics

11:00 George H. Rousseau, formerly of the University of Leicester
Some More History of the Quadratic Reciprocity Law

11:30 ***Closing Remarks***

Session IXb Topics in Mathematics
East Academic 307

Presider: *Chuck Rocca*

9:15 Roger Godard, Royal Military College of Canada
Émile Borel and Henri Lebesgue: HPM

9:45 Sylvia M.Nickerson, University of Toronto
Mathematics for the World: Publishing Mathematics and the International Book Trade, Macmillan and Co. 1870-1910

10:15 **Coffee Break (in East Academic 305)**

10:30 Jean-Philippe Villeneuve, Cégep de Rimouski
The Hidden Properties of the Real Numbers in the Development of the Integral in the 19th Century

11:00 Mariya Boyko, University of Toronto
Mathematics Curriculum Reform in the USSR (1960s, 1970s) and Pedagogical Innovations of Professor Kolmogorov

11:30 ***Closing Remarks***

End Tuesday Program and 2014 CSHPM/SCHPM Annual Meeting

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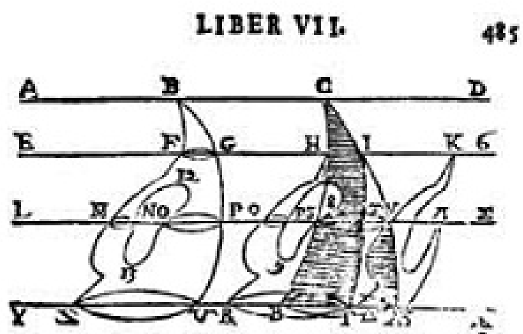

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ABSTRACTS

The Influence of Arthur Cayley and Alfred Kempe on Charles Peirce's Diagrammatic Logic

Francine Abeles
Kean University

This paper is dedicated to the memory of Irving Anellis and represents joint work on the historical sources of Charles Sanders Peirce's (1839-1914) diagrammatic logic. Arthur Cayley (1821-1895) and Alfred Bray Kempe (1849-1922) contributed to the logic of relations and its applications to geometry and foundations of geometry. I shall discuss their diagrams and analytical trees which were inspirational for Peirce's development of his existential graphs.

Early Modern Computation on Sectors

Amy Ackerberg-Hastings
University of Maryland University College

Before slide rules entered wide use in the 19th century, European military architects, surveyors, navigators, and other mathematical practitioners performed calculations on sectors. These mathematical instruments have two arms that are joined by a hinge and marked with various proportional, numerical, trigonometric, and logarithmic scales. The user employed a pair of dividers to transfer distances between the sectors and a drawing and to measure distances on the scales, effectively creating a series of similar triangles or proportional relationships. Sectors were independently invented on the Italian peninsula and in England at the turn of the 17th century; a third version emerged in France by late in the 17th century. I will give a brief overview of the three main forms and how they were used; discuss a few famous (and not-so-famous) names, including Galileo Galilei, Edmund Gunter, Nicolas Bion, and George Washington; and connect sectors with other calculating instruments. The talk is illustrated with examples from the Smithsonian's National Museum of American History mathematics collections.

Textbooks, Lectures, and the Mathematical Canon: Applied Mathematics in Britain in the early 20th Century

Tom Archibald
Simon Fraser University

The relationship between what became the standard repertoire for undergraduate and graduate mathematics in various realms seems highly dependent on a rather small set of lecture courses, some encoded as textbooks, others as circulated notes. In this talk we will look at work by AEH Love, H Lamb, and ET Whittaker as reflective of a nascent set of practices in applied mathematics in the period 1880-1930. This rather long period reflects the longevity of the influence of works by these men both nationally and internationally. We will discuss content, audience, and what it meant for the establishment of basic knowledge in a variety of fields now associated with the applied mathematics label.

Is mathematics to be useful? The case of de la Hire, Fontenelle, and the epicycloid

Christopher Baltus,
SUNY Oswego

The epicycloid is the path of a point on a circle rolling on another circle. Philippe de la Hire (1640 -1717) developed mathematical properties of the epicycloid in a 1694 work. Further, according to Bernard de Fontenelle's *Eloge de M. de la Hire,* where the shape of gear teeth had earlier been "abandoned to the fantasies of workmen," M. de la Hire showed "that these teeth, in order to have all the perfection possible, should be in the form of an arc of the epicycloid." We'll look at this Eloge and the views of Fontenelle and de la Hire on the role of science and mathematics.

Analysis of the Errors in Napier's 1614 Logarithm Tables

David Bellhouse
University of Western Ontario

Numerical errors can creep into published mathematical tables. The study of these errors is carried out through the residuals, which are the differences between the tabular values and values that are obtained through correct calculation to the same level of precision as in the table under study. There are at least five sources of error in mathematical tables: (1) typographical errors in the printed tables; (2) transcription errors in the original source that are copied into the published tables; (3) round-off errors in calculation; (4) calculation errors made by the calculator; and (5) errors due to approximations used by the calculator to ease the burden of calculation.

The numbers that appear over 90 pages of Napier's 1614 *Mirifici logarithmorum canonis* were compared to modern calculations using the programming language R with the program library Rmpfr in order to obtain accuracy to the several decimal places that occur in Napier's tables. There were no apparent calculation errors in the tables. I did find, however, approximation errors, round-off errors and typographical (or possibly transcription) errors in his tables. These errors are analyzed to obtain a better understanding of Napier's calculations and the printing process in 1614.

Venn-Euler-Leibniz Diagrams
Deborah Bennett
New Jersey City University

Having remained unpublished for over two hundred years, the 1686 manuscripts of the universal genius Gottfried Wilhelm Leibniz illustrated the four types of Aristotelian propositions and all of Aristotle's valid syllogisms through the use of drawings of groups of circles. In 1761, the much-admired master mathematician Leonhard Euler used the same diagrams for the same purpose without reference to Leibniz. One hundred and twenty years later, John Venn ingeniously altered what he called "Euler circles" to become the diagrams that we now attach to Venn's name. This talk will explore the history of the Venn diagram, created by Leibniz.

Mathematics Curriculum Reform in the USSR (1960s, 1970s) and Pedagogical Innovations of Professor Kolmogorov
Mariya Boyko
University of Toronto

During the 1960s the USSR faced a major education reform initiated by the Soviet government. Andrei Kolmogorov, professor of mathematics at Moscow State University, was involved in restructuring the mathematics curriculum and was appointed as head of the mathematics committee of the Scientific Methodological Council of the USSR in 1970. He aimed to merge rigorous and non-rigorous ways of mathematical thinking in the minds of the students. Kolmogorov introduced a collection of pedagogical innovations that emphasized set theory, a deductive logical approach and pre-calculus in the new curriculum. He also proposed a number of pedagogical strategies for working with children who were gifted in mathematics, physics and physics. Kolmogorov's contributions to mathematical pedagogy included attempts to increase the awareness of the importance of equity in education. For instance, a boarding school for gifted children from geographical periphery was formed by Kolmogorov in the early 1960's. We will discuss the benefits and the shortcomings of Kolmogorov's ideas, consider their intellectual, political and social context and outline his pedagogical legacy.

Babylonian and Athenian Calendars
Ed Cohen
Ottawa

The Babylonian calendars commence around 3000BCE although not much is known about the calendars at that time. We begin about 747BCE where much is understood mainly because of the cuneiform inscriptions left behind. The Babylonian astronomers knew about the difference between the lunar year and the solar year (approximately 11 days) and left an important legacy on most of the calendars to follow.

There were several Greek calendars because there were several Greek states. Most of the books written upon these calendars were those of Athens; and we adhere to that. The period that is studied begins approximately in the first half of the fifth century BCE. Meton in 432BCE figured out that in 19 years with 7 intercalary months (235 months) -- the Metonic cycle -- the regularity of the system occurs. But this was not used. Instead, we have complicated Athenian schemes. Meton may have visited Mesopotamia (the Babylonian area) at least once."

Computing the Ellipticity of the Earth

Larry D'Antonio
Ramapo College of New Jersey

Maupertuis is well known for having established that the shape of the Earth is an oblate spheroid. The further problem of computing the ellipticity of the Earth was the motivation for looking at methods of best fitting data. In particular, this problem led to the development of the method of the minimum sum of absolute deviations, found in the work of Roger Boscovich, expanded upon by Laplace and the later development of the familiar least squares method developed independently by Legendre and Gauss.

Understanding Carnap's Mathematical Conventionalism

Emerson Doyle
University of Western Ontario

Understanding Carnap's Mathematical Conventionalism

Historically speaking, Carnap's mathematical conventionalism has oft been taken as an attempt to furnish a traditional *foundation* for mathematics, in the sense of justifying, generating, or explaining our access to mathematical concepts and truths. The prevalence of this interpretation is evidenced by a number of historical objections (from Quine, Beth, Godel, Potter, and others) which charge Carnap's program to be viciously circular on account of the strength of the mathematical resources necessarily presupposed at the meta-level in order to carry through an object-level reconstruction of classical mathematics. This technical situation is taken by such objectors to undermine the supposed Carnapian claim that purely formal linguistic stipulations can do the required foundational work without further appeal to intuition or experience. I contend that all such objections mistake the scope and intent of Carnap's mathematical conventionalism. A close reading of *Logical Syntax* and related works shows Carnap to be offering not a foundation, but an *explication* of classical mathematical truth. I argue that one goal of this explication is to support a *methodological argument* that a conventionalist account of mathematics is sufficient to recover the key characteristics of mathematics and its role in the practice of science. Thus Carnap is able to both sidestep certain historical objections, as well as offer genuine reasons other than his Principle of Tolerance for suggesting the adoption of classical notions.

Discovering the concept of minimax solution: Montmort, Waldegrave and Bernoulli

Nicholas Fillion
Simon Fraser University

David Bellhouse
University of Western Ontario

Part V of the second edition of Pierre Remond de Montmort's *Essay d'analyse sur les jeux de hazard* published in 1713 contains correspondence on probability problems between Montmort and Nicolaus Bernoulli. It concludes with the first mixed-strategy solution of a game (called Le Her), attributed to Waldegrave. Archives in Basel contain an additional 44 letters between them (and Waldegrave) discussing confusing aspects of their earlier discussion of the concept of solution to strategic games. We will describe this body of correspondence as it relates to the discovery of the concept of minimax solution and put it in its historical context.

J. C. Fields as a Public Advocate of Mathematics and Science

Craig Fraser
University of Toronto

J. C. Fields was a University-of-Toronto mathematician who is best known for his establishment of the Fields Medal for mathematical achievement. The abstract character of Fields' mathematical research work, its remoteness from applications, reflected the prevailing tenor of advanced mathematics of the period. It was somewhat at odds with public positions taken by Fields, who emphasized the utility of science and mathematics and their usefulness in industry in his appeals for government support of research. This contrast is also apparent in his organization of the 1924 International Mathematical Congress held in Toronto, where papers on pure mathematics were presented side by side with a range of topics in engineering, physics and economics. In his address to the congress Fields proclaimed that the congress brought together "the mathematician whose occupation it is to spin fine webs and elaborate beautiful configurations in the realm of the subjective and the applied man who takes all the risk of assuming that over against the subjective network presented by the mathematician there is something corresponding to the external universe." (Quoted in *Turbulent Times in Mathematics: The Life of J. C. Fields and the History of the Fields Medal* by Elaine McKinnon Riehm and Frances Hoffman (2011, American Mathematical Society and the Fields Institute), p.148.) The paper explores the relationship between Fields the mathematical researcher and Fields the public advocate for mathematics and science. The First World War is seen as a defining event that shaped government perception of the value of scientific research in Canada and its willingness to support such research.

Émile Borel and Henri Lebesgue: HPM

Roger Godard
Royal Military College of Canada

We discuss the first chapters of two books, 1) *Les fonctions de variables réelles et les développements en séries de polynômes*, written by Émile Borel in 1905, and 2) *Leçons sur les séries trigonométriques* by Henri Lebesgue in 1906. In 2), Lebesgue utilized an historical approach for the presentation of Fourier series. Both books were published by Gauthier-Villars in Paris who was the scientific editor at that time. Both books showed the state of mathematical knowledge and they represented an important pedagogical effort. They belonged to a collection directed by Émile Borel. We also comment upon some letters written by Henri Lebesgue to Borel around 1903-1906.

Plato was <u>not</u> a Mathematical Platonist

Elaine Landry
University of California, Davis

I will argue that Plato was *not* a mathematical Platonist. My arguments will be based on evidence found in the *Republic's* Divided Line metaphor and Book 7. Typically, the mathematical Platonist story is told on the basis of two realist components: a) mathematical objects, like Platonic Forms, exist independently of

us in some metaphysical realm and “the way things are” in this realm fixes the truth of mathematical statements, so that b) we come to know such truths by, somehow or other, “recollecting” how things are in the metaphysical realm. Against b), I have demonstrated (in Landry [2012]), that recollection, in the *Meno*, is not offered as a method for mathematical knowledge. What is offered as the mathematician’s method for knowledge, both in the *Meno* and in the *Republic*, is the *hypothetical* method. My aim in *this* paper will be to argue against a) by taking my evidence from the Divided Line metaphor and from Book 7 to show that since both the *method* and the *epistemic faculty* used by the mathematician are distinct from those of the philosopher, then so too must there objects be distinct, thus, mathematical objects and Forms be must distinct.

Gödel and mathematics as the syntax of language

Gregory Lavers
Concordia University

From 1953 to 1959, and through six drafts, Gödel worked on what was intended as a contribution to the Library of Living Philosophers volume on Rudolf Carnap. Since the publication of two these drafts, almost twenty years ago now, much attention has been paid to Gödel's argument from his second incompleteness theorem to the negative answer to the question of whether mathematics is logical syntax. While this argument has its flaws, it is only part of a larger argument which, I will argue, correctly diagnoses serious problems with Carnap's position in The Logical Syntax of Language. Gödel, however, did not wish his arguments to apply exclusively to Carnap's position of 1934, but wanted to rule out Carnap's more recent views as well. The problem, I will argue, is that the various problems correctly identified concerning the earlier position do not apply to Carnap's later work.

The purity of mathematics: a not so clean history

Jean-Pierre Marquis
Université de Montréal

The expression "pure mathematics" has at least two different meanings. The first one refers to the methods of proof, the purity of methods as it is often called. It focuses on the idea that a proof of a given result uses solely methods inherent to the domain of the objects under scrutiny. The second one opposes "pure" to "applied", mathematics for its own sake to mathematics for other disciplines. We

will sketch both histories underlying these usages and contrast some of the epistemological resemblances and differences between them. I will end by suggesting that the distinction might become irrelevant in a certain sense in the near future.

Mathematics for the World: Publishing Mathematics and the International Book Trade, Macmillan and Co. 1870-1910

Sylvia M.Nickerson
University of Toronto

Victorian publisher Macmillan and Co. published a large number of mathematical authors. This list includes G. Boole, J. Venn, I. Todhunter, C. Dodgson, W. Spottiswoode, W. K. Clifford, P. G. Tait, W. Thomson, J. C. Maxwell and G. G. Stokes. Besides academic books on mathematical subjects, Macmillan published mathematical textbooks for schools and colleges. Although Alexander Macmillan once remarked, in reference to a book about particle dynamics, that books on “high” subjects made no money, ``low" books on geometry, algebra and arithmetic proved highly profitable for the company.

This paper looks at how Macmillan selected, produced, advertised and sold their mathematical books, and examines how financially successful these books were for their authors and the publisher. Macmillan's most successful textbooks on mathematical subjects were produced into the hundreds of thousands, even millions of copies, and distributed to English speaking markets in the United Kingdom, Canada, the United States, Australia, India and elsewhere. Not only did the sale of these books profit their publisher, but the image of mathematics contained in them spread a specific impression of the subject to students in several countries around the world.

Some historical remarks on the Analytical Society of Cambridge

Eduardo Noble
Université de Montréal

In 1813 a group of students from the University of Cambridge organized a student society to discuss the analytical methods used by Continental mathematicians and to disseminate them among other students. The society was named “the Analytical Society”. It is well known that the Analytical Society promoted the use of Leibnizian differential notation, which contributed to the renewal of mathematical studies in Cambridge. However the works that Herschel and Babbage produced at this period reveal the Analytical Society to have a much more general interest in mathematical notations than merely the Leibnizian symbols. In this talk I will discuss how the German combinatorial school influenced Herschel’s and Babbage’s conception of mathematical notations, and I will show how their ideas about algebra were determined to a great degree by this influence.

History And Philosophy Of Mathematics At The International Mathematical Congress, Toronto 1924, In Context

David Orenstein
University of Toronto

When the University of Toronto hosted the International Mathematical Congress in August 1924, the prime organizer, University of Toronto mathematician John Charles Fields (1863-1932) insisted the papers cover a wide range of mathematical topics: algebra, analysis, astronomy, engineering, statistics and even our own field: HPM.

The Communications of Section VI covered History, Philosophy and Pedagogy of Mathematics. There were in total 13 papers: seven full Communications and six Abstracts. Five were historical, six philosophical and only two pedagogical.

The American algebraist G. A. Miller (1863-1951) looked at "The History of Several Mathematical Concepts" including "the unknown" and "permutations", going back to the ancient Egyptians and Greeks. Miller also presented in Toronto on algebra, looking at commutativity in Abelian subgroups. The great Italian logician Giuseppe Peano (1858-1932), who had also presented in Zurich in 1897 at the IMC and then in Cambridge in 1912, spoke in simplified Latin "De Aequalitate", On Equality. The Swiss educator Henri Fehr contributed to the pedagogical progammes at four other IMCs (1904, 1908, 1908 and 1932), focusing in Toronto on university mathematics instruction.

What influence did these and other Section VI papers have both locally and further afield? Were they a steady part of mathematical internationalism or just a single occasion? How does HPM fit into the overall history of the International

Mathematical Congresses?

The Geometric and Algebraic Classification Rules of the Transcendental in Early Modern Mathematics

Bruce J. Petrie
University of Toronto

Comparing the classification rules of René Descartes and Leonhard Euler reveals the changing significance of nature to mathematical study. Early modern algebraic and transcendental classifications were intended to describe a mathematical object's nature. This nature was useful to determine which objects were appropriate for geometrical study especially when applied to curves. The development of calculus provided the tools necessary for algebraic analysis to uncouple the study of curves and geometry effectively removing the transcendental barrier. The geometrical purpose of the transcendental classification was rendered obsolete and was replaced by focusing on functional relationships between variables. The nature of mathematical objects inherited this algebraic purpose.

Frege and Neo-Logicism

Nicholas Ray
University of Waterloo

There is a thesis that Frege would have rejected neo-Fregean systems (e.g. Wright's $N^{=}$ or Boolos' *FA*) for their inability to identify the numbers with logical objects of lowest type. (Burge 1984; Ruffino 2003; Burgess 2005) I argue that this thesis is too strong. More specifically, Frege held two aims to be of equal importance to his philosophy of arithmetic: (1) the "*a prioricity* aim", or the aim of establishing the *a prioricity*, generality, and (if possible) the analyticity of arithmetic; and (2) the "logicist aim", or the aim of identifying the numbers with logical objects. Neo-Fregeanism would have been attractive to Frege for its ability to preserve (1) in light of the demise of (2) in a way that his later geometric (i.e. synthetic) approach did not. Furthermore, once we clearly delineate the first from the second aim, we can focus on developing criteria for assessing the relative merits of neo-Fregean reconstructions (or systems, interpretations, etc.) in the philosophy of mathematics. The Frege corpus lends some support, for example, that Frege would have favoured those reconstructions of his work that characterize Hume's Principle as an analysis of our concept of number, rather than as a stipulative definition.

Reassembling Humpty Dumpty Again: Putting George Washington's Cyphering Books Back Together Again

V. Frederick Rickey , Professor Emeritus, West Point

Theodore J. Crackel, Editor-in-Chief emeritus, The Papers of George Washington

Joel Silverberg Professor Emeritus, Roger Williams University

Soon after we began the study of George Washington's cyphering books we realized that some of the pages were out of order and that others were missing entirely. We shall describe some of the detective work that helped us in locating sources for Washington's mathematics and finding a few missing leaves. Along the way we shall describe some of the mathematics in the cyphering books, especially things that are not easily understood by the modern mathematician.

Cryptomenysis: The Cryptology of John Falconer

Chuck Rocca
Western Connecticut State University

John Falconer lived and worked during one of the most turbulent periods in British history. He was supposedly entrusted with the personal cipher of James II and died in exile in France with James. We will examine his work "Cryptomenysis patefacta, or, The art of secret information disclosed without a key," which was first published in 1685 and republished in 1692. In particular we will focus on the mathematics contained within it and which other works and historical events may have influenced it. We will also try to take a look at Falconer himself about whom little is known.

Some More History of the Quadratic Reciprocity Law

George H. Rousseau
Formerly of the University of Leicester

Continuing the search for simpler proof(s) of the QRL, through a study of its history, we consider on this occasion Zolotarev's 1872 proof. Zolotarev dispenses with Gauss's Lemma and uses the following result.

Zolotarev's Theorem (ZT).
If a is an integer not divisible by the odd prime p and Z = {0,1,2,..., p-1}, then the mapping which takes each x in Z to a.x modulo p is a permutation of Z. This permutation is even if a is a quadratic residue mod p and odd if a is a quadratic non-residue. In symbols,

$(a|p) = \mathrm{sgn}(x \mapsto ax \bmod p)$.

Zolotarev uses ZT to establish the QRL, relying on basic group theory (even and odd permutations, etc). The result is a simple and natural proof, which, in the author's opinion, is suitable for teaching undergraduates.

For an interesting connection with the famous "Fifteen Puzzle" popularised by Sam Loyd, the reader is referred to Mathematical Intelligencer vol. 14, No. 3 (1992) p. 64. (Whereas the Fifteen Puzzle has a 4 x 4 board, the "p x q - 1 Puzzle" has a p x q board, p and q being distinct odd primes.)

Forms of reasoning and geometric content

Dirk Schlimm
McGill University

In the course of the 19th century geometry underwent a radical transformation that culminated in Hilbert's famous metamathematical investigations. How these developments are related to model-based and formal reasoning and how they changed the understanding of geometrical content is discussed with reference to the work on projective geometry by Poncelet and Gergonne, the treatises on non-Euclidean geometry by Bolyai and Lobachevsky, the interpretations of Beltrami and Klein, and the axiomatic work of Pasch and Hilbert.

The Rise of "the Mathematicals ". The invention and popularization of Plain Scales, Gunter's Scales, and Sectors : Putting Mathematics in the Hands of Practitioners

Joel Silverberg
Professor Emeritus, Roger Williams University

Following Napier's invention of logarithms in 1614, the remainder of the sixteenth century saw an explosion of interest in the art of mathematics as a practical and worldly activity. Mathematics was no longer the exclusive realm of scholars, mathematicians, astronomers, and occasional gentlemen. Teachers of

mathematics, instrument makers, chart makers, printers, booksellers, and authors of pamphlets, manuals, and books developed new audiences for the study of mathematics and changed the public's perception of the status and aims of mathematics itself.

We explore the ways in which the creations of mathematical instrument makers facilitated the rapid expansion of sophisticated mathematical problem solving in areas as diverse as navigation, surveying, cartography, military engineering, time-keeping, and astronomy.

“Gőttingen is Here”: The Courant Institute and American Mathematics

Charlotte Simmons
University of Central Oklahoma

As many as 144 German-speaking mathematicians have been listed who were forced to leave their positions at German institutions following the 1933 Law for the Restoration of the Professional Civil Service. The “great migration of the 1930’s” is said to have shifted the center of the mathematical world from Germany to the United States. Numbered among these emigrants is Richard Courant, who was “absolutely inexhaustible” and relentlessly pursued his dream of building an institute for advanced training in mathematics at New York University for nearly two decades. By 1958, the Courant Institute, which began as a suite of rooms in a girls’ dormitory, was described as the “national capital of applied mathematical analysis.” In this talk, we will discuss Courant’s efforts to bring his experience in Gőttingen to bear upon the state of science in America, as well as how he and other immigrants impacted mathematics in America during this important chapter in our history.

The judicial analogy for mathematical publication

Robert Thomas
University of Manitoba

Having criticized the analogies between mathematical proofs and narrative fiction in 2000 and between mathematics and playing abstract games in 2008, I want to put forward an analogy of my own for criticism. It is between how the mathematical community accepts a new result put forward by a mathematician and the proceedings of a law court trying a civil suit leading to a verdict. Because it is

only an analogy, I do not attempt to draw any industrial-strength philosophical conclusions from it.

Carnap’s Analysis of Probability versus Subjective and Frequentist Interpretations

Parzhad Torfehnezhad
Université de Montréal

The goal of this paper is to evaluate what, in today’s literature, are considered to be two incompatible interpretations of probability, namely the frequentist and subjective interpretations, with respect to Carnap’s probability theory, in particular, and his linguistic analysis, in general. In conclusion, it will be shown that, contrary to popular belief, and according to Carnap’s analysis they not only are not incompatible but also complement each other in delivering the whole meaning of probability.

Trigonometry, Before and After Logarithms

Glen Van Brummelen
Quest University

Although solutions of all triangles were readily available early in the 16th century, trigonometry nevertheless underwent major changes prior to 1614, both theoretically and especially in terms of applications. Napier's invention of logarithms, intended specifically for trigonometric calculations, transformed how trigonometry was used, making it more efficient and practical in a wide variety of contexts. We shall explore the major innovations, both before and after 1614.

The Hidden Properties of the Real Numbers in the Development of the Integral in the 19th Century

Jean-Philippe Villeneuve
Cégep de Rimouski

We will try to understand how some properties of the real numbers have been used in the proof and in the definition of the integral. These articles will be studied: Cauchy’s *Cours d’analyse* (1821) and *Résumé des leçons sur le calcul infinitésimal* (1823), Riemann’s *La possibilité de représenter une fonction par une série trigonométrique* (1854), Darboux’s *Mémoire sur les fonctions discontinues* (1875), Smith’s *On the Integration of Discontinuous Functions* (1875) and Peano’s *On the*

integrability of functions (1883). For instance, Cauchy introduced two properties of the real numbers (the convergence of the Cauchy sequences and the nested segment technique) and implicitly used another one (the existence of the least upper bound). Darboux used the nested segment technique and Smith, the existence of the least upper bound to prove that the upper Riemann sums (and lower Riemann sums) of a bounded function converge. Peano said “the existence of the integral of functions of one variable is not always proved with the rigour and simplicity desired in such questions”. Why Peano asserted that? How can we interpret the difference between Peano’s definition of the Riemann Integral of 1883 with Cauchy’s definition of the Cauchy Integral of 1823?

Rebuilding Mathematically: A Study of Lisbon and London

Maria Zack, Point Loma Nazarene University

In 1666, the City of London burned to the ground in what has become known as the “Great Fire of London.” In 1755, just 89 years later, Lisbon was destroyed by an earthquake, and the resultant fire and tsunami. Throughout this time period Lisbon and London were joined by extensive commercial ties and at the time of the earthquake, there was a sizable British community in Lisbon and in Porto. Both reconstruction processes were led by individuals deeply committed to modernization and the use of the scientific method as a part of reconstruction. The plans for these modernized cities included a change in the use of land and open space; construction techniques to prevent future destruction (earthquake or fire); and the design of significant new buildings. At the time of the 1666 London fire, calculus was emerging in Europe and there were early attempts to create mathematical models for the properties of materials. By 1755, the elasticity of beams was reasonably well understood and some of the first seismically engineered structures, the Pombaline buildings, were part of the rebuilding of Lisbon. This talk seeks to trace the advancement of the practical use of mathematics in architecture by comparing some specific examples drawn from the reconstruction of London and Lisbon.

Kenneth O. May Lecture

John Napier, his life and work

Michael R. Williams
University of Calgary

The year 2014 marks the 400th anniversary of John Napier's publication of *Mirifici logarithmorum canonis descriptio* in which he described how to use his invention of logarithms and gave a short table (his 1619, *Mirifici logarithmorum canonis construction*, in which he described how they may be calculated, was only published after his death).

Anniversaries of this magnitude would suggest that this is a good time to re-examine Napier's life and work. Many authors have mentioned that the concept of logarithms "…came like a bolt from the blue" and that they forever changed the face of mathematics. While this latter remark is certainly true, it is also the case that there were several antecedents (and even other claimants to the invention). Rather than discuss the mathematics of the various types of logarithms, I propose to present a survey of Napier's life and work. While best known for logarithms, he created a number of other calculating devices that have taken various forms over the years (including one in a modern digital computer). He also did some work in spherical trigonometry, dabbled in witchcraft, ran extensive estates and even published an early Scots work on biblical criticism that was translated into 8 European languages.

Time will not permit a close examination of each of these topics but I hope to present enough material in this illustrated talk to convince an audience that he was a very interesting individual, and that his work, while not always perfect, is certainly worthy of praise.

Biography of Michael R. Williams

Michael R. Williams graduated in 1964 with a BSc in Chemistry from the University of Alberta and in 1968 he obtained a PhD in Computer Science from the University of Glasgow. In 1969 he joined the University of Calgary, first in the Department of Mathematics then as a Professor of Computer Science. It was while working at Glasgow thaat he acquired a interest in the history of computing, something which has developed over the years into his main research and teaching interest.

He has participated in the publishing of 12 books, 92 articles, 58 technical reviews and 77 invited lectures and has been involved in the creation of 10 different radio, television, and museum productions. During his career he has had the opportunity to work for extended periods at several different universities and at the National Museum of American History (Smithsonian Institution) and as Head Curator at the Computer History Museum in Mountain View California.

Besides his work as Editor-in-Chief for the journal *The Annals of the History of Computing*, he has worked closely with the IEEE History Committee (serving as its chairman in 1994 and 1995), the IEEE History Center, is currently the Past President of the IEEE Computer Society, serves as a member of many different committees and boards of the IEEE including being a current director of the IEEE and is a member of editorial boards concerned with publishing material in the area of the history of computing.