CSHPM SCHPM

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

**University of British Columbia**
**1–3 June 2008**

## Sunday June 1, 2008

9:00 Welcome: Duncan Melville (Vice-President, CSHPM), in MacLeod 254

**Regular Session 1 - MacLeod 254** Chair: Rob Bradley

> 9:30 Duncan Melville (St. Lawrence University)
> Mathematics at Nippur
>
> 10:00 Liz Burns (University of Toronto)
> Frames of Reference: Ptolemy's *Almagest* and *Planetary Hypotheses*
>
> 10:30 Ed Cohen
> Chinese and Japanese Calendars

**Joint Session with CSHM – MacLeod 254** Chair: Larry D'Antonio

> 11:00 Tabitha Marshall (Memorial University of Newfoundland)
> Debating Smallpox Inoculation in the Revolutionary Period
>
> 11:30 Roger Stanev (University of British Columbia)
> HIV/AIDS Activism and the Challenges in Designing and Monitoring Clinically Relevant Trials

12:00-2:00 Lunch

12:00-1:00 CSHPM / SCHPM Executive Council Meeting

**Parallel Session 2A - MacLeod 254** Co-Chairs: Mike Molinsky and Duncan Melville

2:00 Lisa Mullins (University of Cambridge)
Mathematics of God, King and Country: Fontenelle's éloges at the Académie Royale des sciences

2:30 Roger Godard (Royal Military College of Canada)
Early Examples of Duality and Applications to Mathematical Programming

3:00 David Bellhouse (University of Western Ontario)
De Moivre's Knowledge Community: An Analysis of the Subscription list to the *Miscellanea Analytica*

3:30 Chris Baltus (SUNY College at Oswego)
Euler: Continued Fractions, Functions, and Divergent Series

4:00 Larry D'Antonio (Ramapo College)
Carl Jacobi and the Sums of Squares Problem

**Parallel Session 2B, in MacLeod 410** Co-Chairs: Robert Thomas and Sylvia Svitak

2:00 Audrey Yap (University of Victoria)
Dedekind's Conception of Set

2:30 Greg Lavers
Mathematical Ontology

3:00 Elaine Landry (University of Calgary)
Reconstructing Hilbert to Construct Category-Theoretic Algebraic Structuralism

3:30 Emerson Doyle (University of Western Ontario)
An Objection to Intuitionistic Mathematics

4:00 Nicholas Fillion (University of Western Ontario)
The Kolmogorov-Gödel Translation of Classical Arithmetic into Intuitionistic Arithmetic

## Monday, June 2, 2008

**Parallel Session 3A - MacLeod 254** Chair: David Bellhouse

9:00 Robert Bradley (Adelphi University)
Cauchy's Analysis: A Break with the Past?

9:30 Josipa Petrunic (University of Edinburgh)
Textbook or Manifesto? W.K. Cliffford's *Elements of Dynamics* (1878) as an Atheistic Refurbishing of P. G. Tait's 'Science of Energy'

10:00 Tom Archibald (Simon Fraser University)
Research Programmes in Integral Equations 1900-1910: Local and Universal Knowledge in Mathematics

**<u>Parallel Session 3B - MacLeod 410</u>** Chair: Tom Drucker

9:00 Robert Thomas (University of Manitoba)
Doing Mathematics is Not Playing a Game

9:30 Corey Mulvihill (University of Waterloo)
Logical Necessity and Constructive Semantics in Wittgenstein's *Tractatus*

10:00 James Overton (University of Western Ontario)
Higher Isomorphism: Philosophical Issues in the Definition of Weak *n*-Categories

10:30 Jonathan Seldin (University of Lethbridge)
Curry's Opinion of Karl Popper

11:00-12:00 CSHPM / SCHPM Annual General Meeting, in MacLeod 254

12:00-2:00 Lunch

**<u>SPECIAL SESSION - TRIGONOMETRY AND ITS APPLICATIONS – MacLeod 254</u>**
Chair: Tom Archibald

2:00 Kenneth O. May Lecture
Glen van Brummelen (Quest University)
In Search of Vanishing Subjects: The Study of Trigonometry Before "Trigonometry"

3:00 Janet Beery (University of Redlands)
'Ad Calculum Sinuum': Thomas Harriot's Sine Table Interpolation Formulas

3:30 Joel Silverberg (Roger Williams University)
Napier's Rules of Circular Parts

4:00 Bruce Burdick (Roger Williams University)
Spherical Trigonometry in 17th-Century Mexico: Enrico Martínez and Carlos de Sigüenza y Góngoru

# Tuesday, June 3, 2008

**<u>Regular Session 5 - MacLeod 228</u>** Chair: Chris Baltus

9:00 David Orenstein (Toronto District School Board)
An 18th-Century Conics Course Manuscript From the Seminaire de Quebec

9:30 Andrew Perry (Springfield College)
The Explosion of American Mathematics Textbooks, 1830-1850

**<u>Joint Session with CSHPS: Infinitesimals – MacLeod 228</u>** Chair: Jean-Pierre Marquis
Funded by: Canadian Federation for the Humanities and Social Sciences /
Fédération canadienne des sciences humaines

10:00 Amy Shell-Gellasch (Pacific Lutheran University)
Pierre Fermat's Integration Techniques

10:30 Richard Arthur (McMaster University)
Leibniz's Archimedean Infinitesimals

11:00 Tom Drucker (University of Wisconsin-Whitewater)
Finding Room for Infinitesimals

11:30 John Bell (University of Western Ontario)
Infinitesimals and the Continuum in Smooth Infinitesimal Analysis

12:00-2:00 Lunch

During the lunch break, in MacLeod 202:
12:15-2:00 Greta Regan (University of King's College)
Situating Science Cluster Update: Presentation and Discussion

**<u>Regular Session 6 - MacLeod 228</u>** Chair: Pat Allaire

2:00 Janet Martin-Neilsen (University of Toronto)
The Mathematization of Natural Language Syntax: 1957-1968

2:30 Miriam Lipshutz (Rutgers University)
Dwight Bollinger's Take on Speech Intonation: Syntax vs Affect

3:00 Marina Vulis (University of New Haven)
Luca Pacioli's Contributions to Accounting

3:30 Lane Olson (University of Alberta, Camrose)
Personal Background to the Riemann Hypothesis

# Abstracts – Alphabetical by Author
## CSHPM Annual Meeting
**June 1-3, 2008**

**Tom Archibald**
Simon Fraser University

Research Programs in Integral Equations 1900-1910: Local and Universal Knowledge in Mathematics?

Moritz Epple, in a 2004 paper on knot invariants, proposed an analogue for mathematics of the analysis by Rheinberger in the history of the experimental sciences. Epple's proposal to distinguish different local mathematical cultures via attention to what he terms their "epistemic resources" seems to provide a nice tool for investigation of certain kinds of transition in the course of mathematical knowledge production. In this paper I will discuss Epple's approach in the context of the varied research programs that emerged following Fredholm's 1900 paper on integral equations. Particular attention will be paid to differences between the German tradition around Hilbert and more applied Italian work of the same period. The paper is based on joint work with Rossana Tazzioli (Catania).

**Richard Arthur**
McMaster University

Leibniz's Archimedean Infinitesimals

Leibniz's theory of infinitesimals has often been charged with inconsistency. For example, characteristic formulas such as 'x + dx = x' appear to be in straightforward violation of the law of identity. In this paper I offer a defense of Leibniz's interpretation of infinitesimals as fictions, arguing that with it Leibniz provides a sound foundation for his differential and integral calculus. In contrast to some recent theories of infinitesimals as non-Archimedean entities, Leibniz's interpretation was fully in accord with the Archimedean Axiom: infinitesimals are fictions, whose treatment as entities incomparably smaller than finite quantities is justifiable wholly in terms of variable finite quantities that can be taken as small as desired, i.e. syncategorematically. In this paper I explain this syncategorematic interpretation, showing how Leibniz used it to justify the calculus.

**Chris Baltus**
SUNY College at Oswego

Euler: Continued Fractions, Functions, and Divergent Series

Euler's continued fraction approach to divergent series illuminates broader concerns, including computation, functions, and series. It is perhaps a surprise that the association of a series with a continued fraction first received full development in the case of the divergent series $1 - x + 2x^2 - (2)(3)x^3 + (2)(3)(4)x^4 - \ldots$, reflecting a formal treatment of series in which the distinction between convergent and divergent series was relatively loose. The talk will center on the birth of this connection, during Euler's correspondence with Nicholas Bernoulli, 1742 to 1745. The continued fraction appeared in the postscript to Euler's letter of 17 July 1745; it provided a more accurate and more secure value for the series when $x = 1$.

**Janet L. Beery**
University of Redlands

"Ad Calculum Sinuum": Thomas Harriot's Sine Table Interpolation Formulas

In about two dozen scattered, undated manuscript sheets, each headed "Ad Calculum Sinuum," Thomas Harriot (1560-1621) developed finite difference interpolation methods specifically for sine tables. Harriot shared these methods with his friend, William Lower, sometime before Lower's untimely death in 1615. Although Harriot would present more general interpolation formulas in 1618 or later in his unpublished manuscript treatise, "De numeris triangularibus et inde de progressionibus arithmeticis: Magisteria magna", his work on sine table interpolation was an important part of his interpolation project. In particular, it illustrates very clearly how he generalized from interpolating three values to interpolating $n$ values between successive table entries. In this presentation, we show how Harriot developed and used finite difference interpolation formulas for sine tables.

**John Bell**
University of Western Ontario

Infinitesimals and the Continuum in Smooth Infinitesimal Analysis

In my talk I will describe the framework of smooth infinitesimal analysis. Particular attention will be paid to the way in which the smooth continuum is generated by the domain of infinitesimals.

**David Bellhouse**
University of Western Ontario

De Moivre's Knowledge Community: An Analysis of the Subscription List to the *Miscellanea Analytica*

In 1730 Abraham De Moivre published *Miscellanea Analytica*, a book containing research results in several areas of mathematics, but especially in probability theory. Subscribers to the book were identified from the subscription list and personal information about these individuals was collected and stored in a database. Once data collection was completed, the data were retrieved, graphed and analyzed to look for connections among the subscribers. Based on the connecting links that we found, De Moivre's career as a tutor has been partially reconstructed and some of his relationships within the Royal Society have been established. It was found that the heart of De Moivre's knowledge community and support is based on Whig political connections combined with aristocratic family connections. A reconstruction is suggested for how De Moivre was able to develop this knowledge community beginning in about 1689.

**Robert Bradley**
Adelphi University

Cauchy's Analysis: A Break with the Past?

Augustin-Louis Cauchy is usually credited with revolutionizing analysis, beginning with his *Cours d'analyse*. Although he left plenty of open questions for the next generation, his were arguably the first steps towards the modern, rigorous conception of analysis. But to what extent was his work a complete break with the past? Through a critical reading of the *Cours d'analyse*, we seek to distinguish where Cauchy follows the eighteenth century paradigm and to what extent he represents a truly new direction.

**Bruce S. Burdick**
Roger Williams University

Spherical Trigonometry in 17th Century Mexico: Enrico Martinez and Carlos de Sigüenza y Góngora

In 1606, Enrico Martínez authored and printed his *Reportorio de los Tiempos* on his own press. It resembles an extended almanac, with calendars, chronologies, and tables. In several places, he employs trigonometry to make a calculation illustrating some astronomical point. This makes him the first person in the New World to explicitly use a trigonometric function in print.

In 1690, Carlos de Sigüenza y Góngora was finally able to publish his *Libra Astronómica*, which he saw as his contribution to a literary duel between himself and the missionary, Eusebio Francisco Kino. This was the tail end of a small eruption of comet books in Mexico which came out after the Great Comet of 1680/1, known elsewhere as Newton's Comet. In order to establish his authority, Sigüenza included a great many trigonometric calculations, becoming the first person in the New World to employ decimal fractions and logarithms in print.

These two writers appear prominently in, for example, José Miguel Quintana's *La Astrología en la Nueva España en el Siglo XVII*, but this book is not widely available outside of Mexico. We report on what has been said about these two figures and on our own observations concerning the two texts.

**Elizabeth Burns**
University of Toronto

Frames of Reference: Ptolemy's *Almagest* and *Planetary Hypotheses*

Claudius Ptolemy, the second century A.D. astronomer, describes the motion of the Sun, Moon and Planets using a different frame of reference in the *Almagest* than he does in his later work, the *Planetary Hypotheses*. In the *Almagest* Ptolemy describes the motion of each planet by breaking it down into two different mathematical components: the motion of the epicycle around its eccentric circle and the motion of the planet around its epicycle. Conversely, in the *Planetary Hypotheses*, Ptolemy changes his frame of reference and presents the motion of the planet around its epicycle and the motion of the epicycle around its eccentric circle as one combined motion. According to this second approach, Ptolemy calculates the planetary motions and combines them into one single movement. This forces Ptolemy to take the numbers from the *Almagest* and readjust and recalculate them for the *Planetary Hypotheses*. In this paper I will discuss the two different reference points Ptolemy uses and explore the benefits of each, as well as offer explanations for Ptolemy's change in approach. In addition I will examine how each approach conforms to the objectives of Ptolemy's works in order to obtain a more comprehensive understanding of both the *Almagest* and the *Planetary Hypotheses*.

L'évolution d'un cadre de référence : l'Almageste et le Livre des hypothèses de Ptolémée

Claudius Ptolémée, astronome au 2e siècle A.D., décrit le mouvement du soleil, de la lune et des planètes dans l'Almageste en utilisant un cadre de référence différent de celui employé dans son Livre des hypothèses publié plus tard. Dans l'Almageste, Ptolémée décrit la trajectoire de chaque planète en la séparant en deux composantes mathématiques distinctes : la motion de l'épicycle sur son cercle excentrique et la motion de la planète sur son épicycle. Inversement, dans le Livre des hypothèses, Ptolémée modifie son référentiel et présente la trajectoire de la planète sur son épicycle et la trajectoire de l'épicycle sur son cercle excentrique comme un seul mouvement combiné. Selon cette dernière approche, Ptolémée détermine les composantes du mouvement d'une planète et les réunit en une seule trajectoire. Ceci oblige Ptolémée à prendre les données de l'Almageste et à les réajuster afin de les recalculer pour le Livre des hypothèses. Dans cet essai, je discute des deux référentiels utilisés par Ptolémée et je considère les avantages de chacun. De plus, je propose des raisons pour laquelle Ptolémée aurait pu modifier son cadre de référence. Finalement, j'examine comment chacune des deux approches conforme aux objectifs de l'œuvre de Ptolémée, afin d'obtenir une appréciation plus compréhensive de l'Almageste ainsi que du Livre des hypothèses.

**Ed Cohen**

Chinese and Japanese Calendars

China: There is evidence of a lunisolar calendar in the fourteenth century BCE that, although much changed, persists until now.

Japan: Before 1873 a lunisolar calendar adapted from the Chinese calendar was in use. Since 1873 Japan has also used the Gregorian calendar.

**Larry D'Antonio**
Ramapo College

Carl Jacobi and the Sums of Squares Problem

Girard and Fermat considered the problem of determining which integers are the sums of two squares. Euler provided the first proof of Girard's Theorem that primes of the form 4n+1 are the sum of two squares. Euler also worked for many years on the problem of showing that all positive integers are the sum of four squares, the proof being first supplied by Lagrange. This work can be seen as a jumping off point for Jacobi's calculation of the number of representations of a positive integer as a sum of two or four squares. In this talk we consider the derivation of Jacobi's calculation as found in his 1829 treatise Fundamenta Nova Theoriae Functionum Ellipticarum. We examine the influence of Jacobi's approach, using theta functions, on future work on the general problem of the number of representations of a positive integer as a sum of k squares.

**Emerson Doyle**
The University of Western Ontario

An Objection to Intuitionistic Mathematics

Between 1944 and 1955, G.F.C. Griss presented a series of articles challenging the foundations of traditional intuitionism as developed by Brouwer and Heyting. His criticism amounts to a rejection of the use of negative properties in the development and proof of mathematical theorems. One cannot, for example, demonstrate the absurdity of a square circle by first assuming one to exist and then deriving a contradiction from that assumption, for Griss contends that assuming the construction in intuition of such a logically impossible entity is nonsensical. Although Griss' project garnered attention when initially introduced, this attention was confined to the technical aspects and development of his program. A more philosophical evaluation of his criticism and system remains largely unexplored. Focusing on possible replies from the traditional intuitionist programs, I argue that Griss' objection poses a serious challenge to those views.

**Thomas Drucker**
University of Wisconsin-Whitewater

Finding Room for Infinitesimals

One of the triumphs of nineteenth-century analysis was banishing infinitesimals from the foundations of the calculus. When Abraham Robinson introduced infinitesimals once more as the foundation of non-standard analysis, it might have seemed as though the calculus had just taken a large step backwards. Robinson prided himself on having produced a justification for Leibniz's original foundation by twentieth-century means. The development of mathematics in the direction of abstraction and axiomatics in the intervening century helps to explain why the reintroduction of infinitesimals was not a relapse into mathematical superstition. The subsequent history of infinitesimals, however, such as the reception accorded H.J. Keisler's nonstandard calculus text, suggests that the step may not have been uniformly seen as mathematical progress.

**Nicolas Fillion**
The University of Western Ontario

The Kolmogorov-Godel Translation of Classical Arithmetic into Intuitionistic Arithmetic

The goal of this paper is to evaluate intuitionism as a foundation for mathematics in the light of the Kolmogorov-Godel embedding of classical arithmetic into intuitionistic arithmetic -- and this in a fairly non-technical and accessible way. More precisely, as long as logic and arithmetic are concerned, it will be shown that: (1) It is possible to characterize the opposition between finitism and intuitionism in a purely formal way, and finitism is strictly more constructive than intuitionism. (2) It is impossible to characterize the opposition between logicism and intuitionism in a purely formal way. Epistemologically speaking, they are simply variations on the same theme; moreover, this variation is an informal one. Finally, if there is a difference between logicism and intuitionism that is to make a genuine difference, intuitionists have to analyze their informal semantics by adopting a non-classical formal semantics.

**Roger Godard**
Royal Military College of Canada

Early Examples of Duality and Applications to Mathematical Programming

Duality has important applications in linear and non-linear programming. In optimization theory, the dual of “minimization” is “maximization”. Our purpose is to present some early examples of duality in Mathematics, which may have had implications in optimization theory.

La dualité a des applications importantes en programmation linéaire et non-linéaire. En théorie d'optimisation, le dual de "minimization" est "maximization". Notre objectif est de présenter quelques exemples anciens de dualité qui ont pu avoir des implications in théorie d'optimisation.

**Elaine Landry**
University of Calgary

Reconstructing Hilbert to Construct Category-Theoretic Algebraic Structuralism.

Recently Shapiro has used the Frege-Hilbert debate to argue that category theory cannot be used to frame the position of the algebraic structuralist. More generally, he argues that one cannot be a structuralist all the way down; either, like Frege, one is forced to accept the existence of an assertory background theory, or, like Hilbert, one is forced to appeal to "philosophy". In this paper I argue that this dichotomy is false. One can rationally reconstruct the components (conceptual, logical and contentual) of Hilbert's structuralism in a way that shows that one can be a structuralist all the way down. Using category-theory to then frame the position of the Hilbert-inspired algebraic structuralist, one can use the various category axioms to mathematically analyze the concepts of mathematics, one can use various categorical logics to logically analyze the "criterion of acceptability" for axiom systems themselves, and one can use various category-theoretic structures and methods to analyze the content (semantic, proof-theoretic, or finitistic) of mathematical reasoning itself. Thus, one need not appeal to either an assertory, meta-mathematical, background theory or to "philosophy"; one can use category theory itself to frame the position of the algebraic structuralist.

**Gregory Lavers**
Concordia University

Mathematical Ontology

In this paper I argue against both a naturalistic and a strongly realistic approach to ontological questions in mathematics. I argue that a more promising way to address questions concerning the existence of abstract objects is given in section 62 of Frege's *Grundlagen*. Here Frege argues that in order to explain how we could have knowledge of the existence of abstract objects, we need only clearly outline their truth conditions. I then argue that if this course is followed we end up with a (quite un-Fregean) form of ontological relativism. Finally, I argue that such relativism may prove to be more acceptable than it may first appear.

**Miriam Lipschutz-Yevick**
Rutgers University

Dwight Bolinger's Take on Speech Intonation: Syntax vs Affect

The distinction between the two approaches to intonation, the syntactic rule driven one and the other embedded in affect and metaphor has a bearing on the notions of formality and meaning as understood in formal logic.. The first one operates with sets of elements, linguistic primes, on which rules operate to determine accent placements such as the position of the nucleus, the primary accent; the latter view considers intonation as a (self referential? My question.) system which is presentative rather than representative, i.e. a symptomatic part of that on which it reports. The distinction also manifests itself in that the left-to right processing atomism that is appropriate to syntax will not do at all for intonation; before the intonational meaning of an utterance can be identified it must be scanned in its entirety. The duality in our modes of linguistic expression, the global intonational*)* and the sequential logico-grammatical, suggests, perhaps, a kinship with our two "Languages of the Brain', two modes of thinking: the deductive computational and the global holographic.

Bolinger's transparent notation displaying the pitch accents and obtrusions primed by the tensions and relaxations and expressions of power or interest, the glides, the rises and falls, the monotones and so on, engages the reader to easily "hear" and experience the shifts in affective meanings with even small changes in the shapes of the intonation profiles and contours. He illustrates with a plethora of clear counter-examples that the semantic logical categories such as intonation of "contrast", of "factuality", of "entailment", of "denial", of "formality", etc may intersect with but are not determining of intonation as claimed by the grammarians' mechanical accent placement rules. He thereby rejects the imposition of truth functional logic on intonation and the imposition of computation where none is necessary. The dichotomy invites us to delve further into a different dimension of meaning, distinct from one based on truth-value or derived from formal structural rules.

**Tabitha Marshall**
Memorial University of Newfoundland

Debating Smallpox Inoculation in the Revolutionary Period

This paper will examine the use of smallpox inoculation in both the British and American armies during the American Revolution, and the impact of such policies in the post-war civilian sphere. In a recent article, Ann Becker suggests that General Washington's implementation of a widespread inoculation policy by 1777 contributed to the improved health of the Continental Army. Such a policy was unpopular among many, and Washington encountered significant opposition. My research reveals that the British adopted a (nominally) voluntary inoculation policy much earlier in the war in 1775. British military authorities such as Bennett Cuthbertson had already recommended inoculation in the mid-18th century. What explained the difference between the initial American and British attitudes towards inoculation? How did the widespread inoculation of soldiers affect practice and policy in Britain and in the United States following the

Revolution? In order to answer these questions, I will first outline the different policies adopted by the two armies. Second, I will examine the debate surrounding inoculation on both sides of the Atlantic at the start of the Revolutionary War. Finally, I will discuss the different responses to military inoculation during and after said conflict. My sources for this work include military and medical treatises, reports and correspondence from officers and physicians in the field, and debates regarding inoculation following the war. In addition, I will employ secondary literature regarding inoculation in the American army in comparing the British and American experiences. My paper will suggest that the British army was influenced by previous service (especially in the Seven Years War) and by familiarity with, and exposure to, the disease at home. The initial reluctance of American commanders was, as Becker suggests, motivated primarily by the fear of mass contagion among their largely non-immune troops. While the apparent success of smallpox inoculation during the Revolution convinced some of its utility, significant resistance to inoculation and vaccination persisted in both Britain and America into the nineteenth century and beyond.

**Janet Martin-Nielsen**
University of Toronto

The Mathematization of Natural Language Syntax, 1957-1968

In 1957, Noam Chomsky revolutionized American linguistics with the introduction of a new mathematical structure for natural language syntax: transformational grammar (TG). In the following years, several alternative mathematizations of natural language syntax were proposed including, most notably, Charles Hockett's conversion grammar (CG). Despite the many merits of Hockett's CG, it was Chomsky's TG which won the allegiance of the American linguistics community. This paper presents and analyzes these two competing formal grammars in their mathematical, historical and philosophical contexts. I argue that CGs are mathematically more robust than TGs, and that the linguistic value of CGs comes precisely from their mathematical structure. By tracing the evolution of ideas such as well-definedness, linearity, and ordering in Chomsky's and Hockett's work between 1957 and 1968, I show that the two linguists had different understandings of how mathematical concepts could, and should, be applied to natural language. Finally, I argue that the dominance of Chomskyan linguistics in America is due not to the technical superiority of TG, but to ancillary philosophical and socio-professional factors.

**Duncan Melville**
St. Lawrence University

Mathematics at Nippur

Old Babylonian Nippur was renowned as a scribal center, and nineteenth century archaeological excavations uncovered thousands of scholarly tablets. Among them were some 800 mathematical ones, which languished unstudied for many years, split between collections in Philadelphia, Istanbul and Jena. Eleanor Robson has published much of the Philadelphia collection and more recently Christine Proust has published the Istanbul texts and surveyed the complete corpus. I report on what can be said with some confidence about the teaching and learning of mathematics in Old Babylonian Nippur and what murky areas remain.

**Lisa Mullins**
University of Cambridge

Mathematics for God, King, and Country: Fontenelle's éloges at the Académie Royale des sciences

On 6 April 1701, during the Parisian Académie Royale des sciences' fifth public meeting, an éloge was read for the recently-deceased Daniel Tauvry. Part biography, part science lesson, part panegyric, and part moral lesson, this short text was written and delivered by the Académie's perpetual secretary, Bernard le Bovier de Fontenelle (1657-1757). Fontenelle would go on to write sixty-eight other éloges, inventing a literary genre and creating an influential institutional practise that still exists today. In this paper, I explore Fontenelle's éloges of the Académie's mathematicians in the first forty years of the eighteenth century, focusing on how Fontenelle's literary manipulations and personal intellectual convictions impacted the presentation of the mathematical work and reputation of some of Europe's finest mathematicians.

Fontenelle used the éloges to raise the social status of the Académie, individual academicians and their work, and specific academic disciplines. Natural philosophy, including mathematics, was by no means an integral part of French government or culture, nor was it a particularly distinguished pastime; more than any other practice, these éloges changed the reputation of those engaged in the study of nature and their work. However, these short texts are also complex narrative accounts of mathematical initiation, discovery, and methodology. I argue that by embedding mathematical knowledge in a biographical narrative, Fontenelle changed the context of the knowledge presented, and thus changed the meaning of and value ascribed to that knowledge. Specifically, I argue that Fontenelle's manipulations transformed all mathematical work into applied or 'mixed' mathematics, whether the application was to physics, State problems like engineering works and military matters, or to matters of faith and soul. Fontenelle's desire to raise the overall reputation of the Académie by stressing its utility distorted the pure mathematical work of Bernoulli, l'Hôpital, Varignon and others. In writing the éloges, Fontenelle was writing new mathematical texts, for specific audiences.

**Corey Mulvihill**
University of Waterloo

Logical Necessity and Constructive Semantics in Wittgenstein's *Tractatus*

When people think of the semantics of Wittgenstein's *Tractatus* they are likely to think of the classical truth functional semantics presented in the truth table schema in 5.101. However in this paper I investigate how Wittgenstein's view of logical necessity in the *Tractatus* can be used to reflect upon the similarity between his operational theory language and the constructive semantics most often connected with non-classical logics. I will show how both his constructive approach to arithmetic in the *Tractatus* and later comments by Wittgenstein referring to the *Tractatus* give us good evidence that there is a constructive aspect to Tractarian semantics.

**Lane Olson**
University of Alberta, Camrose

The Personal Background to the Riemann Hypothesis

In 1859 Bernhard Riemann proposed his famous hypothesis in the paper "On the number of primes less than a given quantity". In the five years prior to the release of Riemann's paper he was exposed to a series of hardships including the loss of his heroes, family, and home. However, in this time span Riemann also produced his most significant and well known works. In this talk, I will consider how the hypothesis came to exist, how it may have been affected by Riemann's personal life, and why it is still significant to aspects of today's society.

En 1859, Bernhard Riemann publiait sa célèbre hypothèse de la fonction zèta, reliée à la distribution des nombres premiers. Pendant les cinq années précédant la publication de son article, Riemann vécu une série de drames personnels, incluant la perte de ses idoles, de sa famille et de son foyer. Malgré tout, c'est à cette époque qu'il a réalisé ses travaux les plus importants et les mieux connus. Dans cet exposé, je vais revoir la naissance de l'hypothèse de Riemann dans le contexte de sa vie personnelle et expliquer pourquoi cette conjecture demeure importante dans notre société contemporaine.

**David Orenstein**
Toronto District School Board

An 18th Century Conics Course Manuscript from Quebec City's Seminaire de Quebec

As part of the celebration of Quebec City's quadricentennial, I will present an early document from the history of Canadian mathematics. In 1791, the Recollet, Frere Felix Bossu (1770-1803), started the notebook in which he kept the notes for a short course in conic sections. This course was delivered by Pere Antoine-Bernardin Robert (1757-1826), a long-serving Superieur of the Seminaire de Quebec. We will look at the definitions, proofs and extraneous material in the manuscript while trying to reconstruct the missing diagrams. Bossu's notes will also be put in the context of the archival collection of mathematical and scientific manuscripts from the Seminaire and of the lives of Bossu and Robert.

**James A. Overton**
The University of Western Ontario

Higher Isomorphism: Philosophical Issues in the Definition of Weak *n*-Categories

Mathematics offers to other disciplines a range of useful concepts, each precisely defined. "Isomorphism" is one such concept, by which we can express the manner in which two objects, or a class of objects, share a degree of similarity. Category theory allows us to express such relations in a particularly flexible way. In particular, *n*-categories allows us to express isomorphisms between objects, their 1-morphisms, their 2-morphisms (morphisms between morphisms), and so on to the *n*th degree.

The last decade has seen a variety of proposals for a definition of a weak *n*-category, in which the isomorphism relations are allowed to become progressively weaker as *n* increases. There is potential here for a whole new range of useful concepts expressing progressively weaker degrees of similarity, still within a rigourous framework. However, the relative wealth of alternative definitions of a weak *n*-category has slowed progress in the field, since it is not clear in what way these definitions are equivalent to each other. Each definition generalizes from a slightly different view of what a category is, and so for the cases where $n > 2$ the resulting structures are not always compatible. The question of equivalence between definitions is complicated by the fact that each one defines its own notion of equivalence.

In this paper I explore the brief history of this debate and examine its philosophical implications.

Isomorphisme Supérieur : Points Philosophiques sur la Définition des *n*-Catégories Faibles

Les mathématiques offrent aux autres disciplines un éventail de concepts utiles, chacun étant défini avec précision. « Isomorphisme » est un de ces concepts, au moyen duquel nous pouvons exprimer la manière dont deux objets, ou classes d'objets, ont un degré de similarité. La théorie des catégories nous permet d'exprimer de telles relations de façon particulièrement flexible. En particulier, les *n*-catégories nous permettent d'exprimer l'isomorphisme de deux objets, leurs 1-morphismes, leurs 2-morphismes (morphismes entre les morphismes), et ainsi de suite jusqu'au degré *n*.

Une variété de définitions de *n*-catégorie faible a été proposé dans la dernière décennie, dans lesquelles les relations d'isomorphisme peuvent devenir progressivement plus faibles lorsque *n* augmente. Il y a potentiellement ici un éventail complet de nouveaux concepts utiles pour exprimer des degrés de similarités devenant progressivement plus faibles, tout en demeurant dans un cadre rigoureux. Cependant, la richesse relative des définitions alternatives de *n*-catégorie faible a ralenti le progrès de la discipline, puisqu'il n'est pas clair quelles sont les équivalences entre ces définitions.

Chaque définition généralise ce qu'est une catégorie d'une perspective légèrement différente, et ainsi les structures résultantes ne sont pas toujours compatibles pour les cas $n > 2$. La question de l'équivalence entre les définitions est compliquée par le fait que chacune définie sa propre notion d'équivalence.

Dans cette communication, j'explorerai la brève histoire de ce débat et j'examinerai ses implications philosophiques.

**Andrew Perry**
Springfield College

The Explosion of American Mathematics Textbooks, 1830-1850

The period 1830-1850 saw hundreds of new American mathematics textbooks coming to market, including approximately 510 of which the presenter is aware. The eminent Charles Davies published eleven titles during this time, including works on arithmetic, geometry, algebra, calculus and surveying. Joseph Ray, Frederick Emerson, Roswell Smith, and Daniel Adams were all prominent authors of the period.

This presentation will include a broad overview of American mathematics textbook publishing during this period as well as glimpses of some of the more notable books.

**Josipa Petrunic**
University of Edinburgh

Textbook or manifesto? W.K. Clifford's *Elements of Dynamics* (1878) as an atheistic refashioning of P.G. Tait's 'science of energy'

In his posthumous review of W.K. Clifford's work, *Common Sense of the Exact Sciences* (1885), P.G. Tait lauded the author's clarity and ingenuity in presenting difficult mathematical concepts to entry-level audiences. However, he wrote, *"especially in matters connected with the development of recent mathematical and kinematical methods, [Clifford's] statements were by no means satisfactory (from the historical point of view) to those who recognised, as their own, some of the best 'nuggets' that shine here and there in his pages."* (Pearson Papers 661) Tait argued that Clifford's earlier work in "kinematics" also suffered from this affliction. In other words, Tait was claiming plagiarism and the work to which he was referring was Clifford's *Elements of Dynamics, An Introduction to the Study of Motion and Rest in Solid and Fluid Bodies (Part I, Kinematics)* (1878) – penned only a few years after publications on the same topic were issued by Tait and William Thomson (later Lord Kelvin).

However, Tait's claim should tempered by an analysis of the tense relationship that existed between Tait, an ardently faithful Protestant residing in North Britain, and Clifford, an unapologetic atheist who resided in the reformist London university setting. It is with this context of religious opposition in mind that I will analyse Clifford's *Dynamics* in order to demonstrate that Tait's commentary was, indeed, a reflection of social and political disagreements between the two mathematicians, as opposed to an objective review of Cliffordian plagiarism in mathematical or physical matters.

*Les Elements of Dynamics* (1878) de W.K. Clifford comme reconstruction athéiste de la « science de l'énergie » : manuel ou manifeste?

Dans sa revue posthume du travail de W.K. Clifford, *Common Sense of the Exact Sciences* (1885), P.G. Tait applaudit les efforts de Clifford pour clarifier des concepts difficiles et complexes à l'intention des étudiants débutants. Mais il ajoute qu'aussi bien dans cet ouvrage que dans les précédents, "*especially in matters connected with the development of recent mathematical and kinematical methods, [Clifford's] statements were by no means satisfactory (from the historical point of view) to those who recognised, as their own, some of the best 'nuggets' that shine here and there in his pages*" (Pearson Papers 661). En d'autres termes, Tait affirme que, dans son livre *Elements of Dynamics, An Introduction to the Study of Motion and Rest in Solid and Fluid Bodies (Part I, Kinematics)* (1878), Clifford a déjà plagié d'autres auteurs – notamment Tait, lui-même, et William Thomson (le futur Lord Kelvin) – en présentant de nouvelles conceptions scientifiques et mathématiques sans mentionner leur véritable origine.

A l'heure où les universités anglaises tendent à se séparer de l'anglicanisme, une telle affirmtion doit être resituée dans le contexte de son énonciation, celui d'une relation alors tendue entre Tait, fervent protestant écossais, et Clifford, apologétiste de l'athéisme à l'université réformiste de Londres. Une analyse elle-même recontextualisée de la *Dynamics* de Clifford permettra de faire apparaître le commentaire de Tait comme une réflexion spécifique sur les implications épistémologiques de leurs divergences d'ordre politique et social, plutôt que comme une analyse objective des actes de plagiat de Clifford en physique et en mathématiques.

**Greta Regan**
University of King's College

Situating Science Cluster Update: Presentation and Discussion

The SSHRC-funded Strategic Knowledge Cluster, Situating Science, is a seven-year project to promote new ways of bringing together leading Canadian and international scholars in the humanistic and social study of science and technology (historians, philosophers, sociologists, cultural theorists, etc.) and put them into contact with scientists, journalists, and policy makers interested in the broader social and cultural significance of science and technology within the public, private, and natural spheres. The Cluster is based on a partnership of the University of British Columbia, University of Alberta, University of Saskatchewan, York University, University of Toronto, McGill University, and Université du Québec à Montréal, coordinated from a centre at the University of King's College, and will exchange scholarship through networking, workshopping, and interfacing with the wider community, with the goal of establishing long-term stable foundations of encounter between humanistic scholars of science and the various publics in Canada.

**Jonathan P. Seldin**
University of Lethbridge

Curry’s Opinion of Karl Popper

H. B. Curry became aware of the work of Karl R. Popper as early as 1935, when Popper published his *Logik der Forschung*, and he continued to take note of Popper's publications and write notes on some of them for the rest of his life. He took particular note of Popper's papers on natural deduction, especially "New foundations for logic" (Mind, 1947) after *Mathematical Reviews* sent it to him for review. Curry was in the chair when Popper present his paper "Epistemology and scientific knowledge" at the Third International Congress for Logic, Methodology and Philosophy of Science in Amsterdam in 1967; this paper, published as "Epistemology without a knowing subject", was about Popper's _third world_. In this paper, I will use the results of a thorough search of Curry's notes to discuss Curry's opinion of Popper.

My first indication that this opinion might not be totally positive came immediately after Popper presented his paper at the Amsterdam logic congress in 1967: Curry told me privately that he thought Popper had made a big deal out of something that was obviously true and fairly trivial.

My next indication concerns a rule for natural deduction systems which, when added to the negationless fragment of intuitionistic propositional logic leads to the negationless fragment of classical propositional logic, namely

$$\frac{\begin{array}{c}[A \to B] \\ A\end{array}}{A}$$

Curry introduced this rule in his book *A Theory of Formal Deducibility* (1950), which is the publication of a series of lectures he gave at the University of Notre Dame in April, 1948, and it appears again in his later book *Foundations of Mathematical Logic* (1963). In the latter book, he inserted at the end of every chapter a fairly complete history of the material in the chapter, but there is nothing about this particular rule there. In the 1950 book, he notes in a footnote that the rule was stated by Popper in his paper from Mind in 1947 mentioned above, but there is no reference to that in the book of 1963. One wonders whether there is a reason for this incompleteness in Curry's history of the subject. In particular, one wonders if there could be any connection with the fact that Curry found a number of technical errors in Popper's 1947 paper when he reviewed it.

In this paper, I will seek to clarify this bit of history.

**Amy Shell-Gellasch**
Pacific Lutheran University

Pierre Fermat’s Integration Techniques

The standard teaching of the Integral Calculus introduces the integral as an area under a curve by the Riemann Integral. Georg Riemann used a sum of rectangles of width $\Delta x$ to approximate the area. Taking the limit as $\Delta x$ tends to 0 gives our modern definition of the integral. Prior to Riemann, several mathematicians were working on the problem of areas, know as quadrature, using similar techniques. In this talk I will outline the developments in quadrature using rectangles that predate Riemann. Special attention will be paid to the work of Pierre de Fermat in the 1650s. In particular I will explore his work on finding the area under the curve $x^{p/q}$ for integers $p, q$. I will conclude with some general comments about how Fermat’s method can be used in the teaching of integral calculus.

**Joel Silverberg**
Roger Williams University

Napier’s Rules of Circular Parts

Historians of mathematics recognize John Napier as the inventor of logarithms. Published in 1614, his *Mirifici Logarithmorum Canonis descriptio*, contains the first announcement of the concept of logarithms, the first use of the word logarithm (a word he coined), and the first table of logarithms. Less well known is the fact that this same publication introduced the concept of “natural and circular parts” and a pair of rules for using them to solve any right-angled spherical triangle, which became known as “Napier’s Rules.” Since any oblique spherical triangle can be described as either the sum or the difference of two right-angled spherical triangles, these rules provided a method for solving oblique spherical triangles as well. Unlike the use of the spherical laws of cosines, Napier’s Rules involve only products and quotients of trigonometric functions, and are thus custom made for logarithmic computation. For this reason his rules quickly became and remained the most common way of solving spherical triangles for three and one-half centuries.

With extremely rare exceptions, Napier’s rules have been described as mnemonic devices or memory aids for recalling a set of ten useful spherical trigonometric identities. However, the context of the *descriptio* shows that Napier’s rules of circular parts were not at all about algebraic formulas linking plane triangles with spherical triangles, but were instead geometric theorems about the relationships between right-angled spherical triangles and quadrantal spherical triangles. Consequently his rules could be seen an original and fundamental contribution to the theory of spherical trigonometry, as well as a groundbreaking advance in the ability to apply that theory to practical problems in astrology, astronomy, and navigation.

**Roger Stanev**
University of British Columbia

HIV/AIDS Activism and the Challenges in Designing and Monitoring Clinically Relevant Trials

The inability of expert communities to respond quickly enough to the AIDS epidemic in the 1980's spawned a credibility crisis surrounding the biomedical sciences, resulting in grassroots movements like the HIV/AIDS treatment activism (Epstein 1996). My paper focuses on changes in clinical trials brought about by this activism; most specifically, changes in pre-designated rules, such as stopping rules—when to stop a clinical trial.

Historically, antiviral drugs have required scientific testing prior to general usage. The standard method for testing has been clinical experimentation—a.k.a. clinical trials—attempts to test as scientifically rigorously as possible, the hypothesis of whether or not the new agent is more effective—as well as safer—than the placebo or standard treatment, often by randomizing subjects between test vs. control groups. Traditionally, clinical trials have been designed to restrict entry to a homogeneous group of patients, so that treatment effects could be measured more precisely; and pre-designated rules, such as stopping rules have always been planned as rigid and formal, so as to produce results as clean and complete as possible, in order to assess the evidential import of the trial outcome.

My talk looks at a case where the U.S.AIDS Clinical Trial Group decided to accept a data monitoring committee recommendation to stop a placebo-controlled trial of Zidovudine earlier than its pre-designated rules, on the grounds that it was thought unethical to continue the original trial, given the statistical significance of the observed differences, despite the challenges and problems of evidential interpretation that can arise with such change.

**Robert Thomas**
University of Manitoba

Doing Mathematics is Not Playing a Game

`A game played with meaningless symbols on paper' is a characterization of mathematics associated with a formalism espoused by almost no one near the beginning of the twentieth century. This outlandish notion has in it a germ of truth that rears its ugly head occasionally. The talk is intended to explore the germ of truth sufficiently to innoculate hearers. Using the ideal agents of Philip Kitcher and Brian Rotman, I intend to show that such playing by rules as is present in mathematical practice (and it is undeniably present) is not engaged in by the mathematical practitioner but rather by the ideal agent whose antics it is the mathematician's task to direct and observe. (E.g., in 'drop a perpendicular from A to BC', it is the ideal agent that is able, willing, and directed to perform the action, one the human mathematician cannot do even on a good day.)

**Glen Van Brummelen**

Quest University

KENNETH O. MAY LECTURE:
In Search of Vanishing Subjects: The Story of Trigonometry Before ‘Trigonometry’

The word “trigonometry” was coined by Bartholomew Pitiscus in his 1595 *Trigonometriae*. Yet the subject existed for so long prior that my recently-completed early history of trigonometry ends its coverage before Pitiscus ever arrives on the scene. Trigonometry has existed as a coherent body of knowledge for two thousand years; yet, while it is clearly mathematics, it seldom lived within the family of mathematics. Trying to identify the history of particular trigonometric results is as elusive as identifying the boundaries of the discipline itself: particular theorems may be found long before they are used in a trigonometric sense, and even then, it can be frustrating to make firm statements about their earliest appearance. Tracing these difficulties leads to significant historiographic issues that seem to be specific to mathematics, which we shall explore while chasing the shadows of a shadowy subject.

**Marina Vulis**
University of New Haven

Luca Pacioli’s Contributions to Accounting

Luca Pacioli was dubbed a father of accounting. His contribution to accounting was of great importance. Pacioli’s system of double-entry bookkeeping is based on the idea of ordered pairs of numbers, reminiscent of negative numbers and carries a group structure. This presentation will discuss the structure of his system and its role in mathematics and accounting.

**Audrey Yap**
University of Victoria

Dedekind's Conception of Set

In several of Dedekind's important mathematical works, he freely uses the completed infinite, which was an unusual device in mathematics at the time. This is often explained by the fact that he was an early supporter of Cantorian set theory---but this does not explain his epistemological justification for working with them. Cantor is frequently thought to be a mathematical Platonist; but Dedekind expresses no such view, instead being more closely associated with logicist or structuralist positions. This, however, leaves an open question about just what he thought *could* justify existence claims about completed infinite totalities. In this paper, I will argue that Dedekind's conception of set, and epistemological warrant for using infinite sets, is closely connected to the idea of a mapping, or function. Further, this basis can help alleviate some worries about the impredicativity in his use of those sets.