CSHPM SCHPM

Annual Meeting

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

May 28–30, 2006

SUNDAY MAY 28 SPECIAL SESSION
Room CB 115 -- Chemistry Building

8:45 AM Welcome and Opening Remarks *President Rob Bradley*

9 – 10:30 AM ***<u>Mathematics, Politics, Society, and Education</u>***

Presider: *Sylvia Svitak*

9:00 Thomas L. Bartlow, Villanova University
Mathematics and Politics: Apportionment of the United States Congress

9:30 Amy Ackerberg-Hastings, University of Maryland University College
John Playfair and the Culture of Mathematics: From Enlightenment to Romanticism

10:00 Jonathan Seldin, University of Lethbridge
Thoughts on Teaching Elementary Mathematics

30 MINUTE BREAK

11 AM –Noon **<u>KENNETH O. MAY LECTURE</u>** (*Introduced by Rob Bradley*)

SPEAKER: Chandler Davis, University of Toronto

If It's Real How Can It be Certain

Noon – 1:45 PM LUNCH

1:45 PM ***Mathematics and Art***

Presider: *Hardy Grant*

1:45 Hugh McCague, York University
The Mathematics of the Canon of Polykleitos, an Exemplar of Greek High Classical Sculpture and Western Culture

2:15 Paolo Palmieri, University of Pittsburgh,
Motion and Stasis in Galileo and Cigoli

2:45 Dr. Alejandro R. Garciadiego, Mexican National University
Mathematics and Art at the Main Campus of the Mexican National University: A work of Díaz, a recent acquisition

15 MINUTE BREAK

3:30 – 5:00 PM ***Mathematics, Music, Literature, and Philosophy***

Presider: *Patricia Allaire*

3:30 Michael Molinsky, University Of Maine at Farmington
Mathematics in Detective Fiction

4:00 Jozsef Hadarits, University of Toronto
Music of the Circles: pi and John "Longitude" Harrison's musical system

4:30 Byron Wall, York University
Why John Venn Stopped Thinking about Probability and Logic at the End of the 19th Century

15 MINUTE BREAK

5:15 – 6:15 PM ***Mathematics and its Relationship with the Sciences***

Presider: *Patrica Allaire*

5:15 Chris Bissell, Open University
Math? What Math? How mid 20th Century Information Engineers Subverted Mathematical Formalism

5:45 Thomas Drucker, University of Wisconsin – Whitewater
Quantification and the Loss of Certainty: The Case of Social Science

6:30 – 7:30 PM EXECUTIVE SESSION (MEETING ROOM TO BE ANNOUNCED)

END OF SUNDAY PROGRAM

MONDAY MAY 29

PARALLEL GENERAL SESSIONS MORNING ONLY

8 AM – Noon PARALLEL SESSION A ***Problems Old and New***
Room CB 115 -- Chemistry Building

Presider: *Jim Tattersall*

*8:*00 Carlos Bovell
A Right Angle is A Right Angle, Right? Musings On Euclid's Fourth Postulate

8:30 Christopher Baltus, SUNY Oswego
The Conics of Apollonius: Book 1 for Beginners

15 MINUTE BREAK

Presider: *Francine Abeles*

9:15 Jim Tattersall, Providence College, (and Shawnee L. McMurran, Cal. State San Bernardino)
Indian Contributions to the Educational Times 1876-1918

9:45 Antonella Cupillari, Penn State Erie, (and Kate E. Overmoyer, Bowling Green University)
Of Square Fields, Circular Islands, And Other Peculiar Probabilities

10:15 Andrew Perry, Springfield College
Evolution of 19th Century American Elementary Algebra Textbooks

15 MINUTE BREAK

Presider: *Christopher Baltus*

17.*11:00* Joel Silverberg, Roger Williams College
Beyond the Sailings: The Birth of Modern Celestial Navigation

18. *11:30* Ed Cohen, University of Ottawa
Ancient Egyptian Calendars

END OF PARALLEL SESSION A: NOON

8 AM – Noon PARALLEL SESSION B ***<u>Modern Mathematics</u>***

Room CB 129 -- Chemistry Building

Presider: *Roger Godard*

8:00 Paolo Rocchi, IBM
Probability P(A); A Historical Excursus through Models for Argument A

8:30 Miriam Lipschutz-Yevick, Rutgers University
Postulates or Dogma

15 MINUTE BREAK

Presider: *Len Berggren*

9:15 David Orenstein, University of Toronto
Helen Hogg's Mathematical Methods for Variable Stars in Globular Clusters

9:45 Roger Godard, Royal Military College of Canada:
Orthogonality and Approximation: Chebychev to JPEG

10:15 Tom Archibald, Simon Fraser University
Integral and Integro Differential Equations to 1920

15 MINUTE BREAK

Presider: *Israel Kleiner*

11:00 Dirk Schlimm, McGill University
On the importance of asking the right research questions: Could Jordan have proved the Jordan-Hölder Theorem?

11:30 Abe Shenitzer, York University
Reading from his translation of a paper on Grothendieck

END OF PARALLEL SESSION B: NOON

Noon – 2:00 PM LUNCHEON AND GENERAL MEETING

2:00 – 3:30 PM GENERAL SESSION *Mathematics in Islam and Early Modern Europe*

Room CB 115 -- Chemistry Building

Presider: *Martin Muldoon*

2:00 Len Berggren, Simon Fraser University, and Nathan Sidoli,
Aristarchos from Greek to Arabic

2:30 Lawrence D'Antonio, Ramapo College
Al-Kashi's Method of Root Extraction

3:00 Barnabas Hughes, Cal State Northridge
Fibonacci's De Practica Geometrie

15 MINUTE BREAK

3:45 – 4:45 PM SPECIAL SESSION *Mathematics and War*

Room CB 115 — Chemistry Building

Presider: *Hardy Grant*

3:45 William W. Hackborn, University of Alberta
The Science of Ballistics: Mathematics Serving the Dark Side

4:15 Maryam Vulis, Queensborough Community College, CUNY
The Work of Cryptographers Agnes Meyer Driscoll and Genevieve Grotjan During World War II

END OF MONDAY PROGRAM: 4:45 PM

MONDAY RECEPTIONS: 5 – 7 PM

PRESIDENT'S RECEPTION
RECEPTION WITH CSHPS AND CSTHA: 320 NORMAN BETHUNE COLLEGE

TUESDAY MAY 30
All talks in Room CB 115 -- Chemistry Building

8 – 9 AM SPECIAL SESSION *Mathematics ↔ History*

Presider: *Sylvia Svitak*

8:00 Ruth Whitmore, University of Wisconsin - Whitewater
Why Base-60? A Satisfying Account

8:30 Duncan Melville, St. Lawrence University:
Problems as Evidence

15 MINUTE BREAK

9:15 AM – Noon GENERAL SESSION: *Logic and Philosophy*

Presider: *Tom Drucker*

9:15 Glen Meyer, Austin Community College
The Instrumental Use of Continuous Orders: A Challenge for Hartry Field's Nominalization Program

9:45 Cyrus Panjvani, Ithaca College
Carnap, Conventionalism, and Consistency

10:15 Florence Fasanelli
Portraits of Euler

15 MINUTE BREAK

Presider: *Tom Drucker*

11:00 Francine Abeles, Kean University
Lewis Carroll's Diagrammatic Logic System as a Proof Method for Syllogisms

11:30 M. Serfati, Institut de Recherche sur l'Enseignement des Mathématiques, Université Paris VII-Denis Diderot
Symbolic practices and mathematical invention in Leibniz's mathematics

2 – 6:00 PM GENERAL SESSION *Newton to the 19th Century*

Presider: *Lawrence D'Antonio*

2: 00 Charles Rocca, Western Connecticut State University
The Cryptological Work of the Rev. John Wilkins

2:30 Ed Sandifer, Western Connecticut State University
Euler, Newton, and the Expulsion of the Geometers

3:00 Brian Hepburn, University of Pittsburgh
Was Euler a Newtonian?

15 MINUTE BREAK

Presider: *Ed Sandifer*

3:45 Israel Kleiner, York University
The Principle of Continuity: A Brief History

4:15 Craig Fraser, University of Toronto
The Concept of Analysis in 18th Century Mathematics

15 MINUTE BREAK

Presider: *Ed Sandifer*

5:00 Sandro Caparrini, Dibner Institute
On the Common Origin of Some of the Works on the Geometrical Interpretation of Complex Numbers

5:30 Rob Bradley, Adelphi University
Reflections on the Vibrating String Problem

END OF TUESDAY PROGRAM 6:00 PM

END OF 2006 CSHPM/SCHPM MEETING

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ABSTRACTS 2006

ANNUAL MEETING

YORK UNIVERSITY, MAY 28–30

Francine Abeles, Kean University fabeles@cougar.kean.edu

Lewis Carroll's Diagrammatic Logic System as a Proof Method for Syllogisms

In the ten years between 1886 when he published *The Game of Logic* and 1896 when he published Symbolic Logic, Part I, Charles L. Dodgson (Lewis Carroll) constructed a diagrammatic logic system that he used as a proof method for syllogisms. In this paper I will describe his method, show that it is sound and complete for the syllogisms Dodgson recognized, and trace its development during this period.

Amy Ackerberg-Hastings, University of Maryland University College
aackerbe@erols.com

John Playfair And The Culture Of Mathematics: From Enlightenment To Romanticism

As a Scottish scientist and mathematician who bridged the eighteenth and nineteenth centuries, John Playfair (1748-1819) could not help but be enmeshed in the wider culture. For instance, he served as secretary of the archetypically Enlightened Royal Society of Edinburgh, founded in 1783. He brought institutional politics to bear upon his 1772 appointment to assume his father's parishes as well as John Leslie's appointment in 1805 as his successor in the chair of mathematics at the University of Edinburgh. In the 1810s, he was stymied in several attempts to conduct geological studies on the Continent by the Napoleonic Wars. He socialized with colonizers of India, members of Parliament, and early Romantic poets and philosophers. He mentored a number of eighteenth-century gentlemen and sons of the expanding professional middle class. The paper will attempt to weave these threads back into the whole man Playfair understood himself to be. It will draw upon an ongoing effort to transcribe and annotate Playfair's correspondence.

Tom Archibald, Simon Fraser University tarchi@sfu.ca

Integral and Integro-Differential Equations to 1920

Following Ivar Fredholm's 1900 application of integral equations to the proof of existence theorems for boundary-value problems, there was a rapid and widespread effort to master and extend this theory. The perceived importance of the results is indicated by the large number of introductory works on the subject that appeared within a few years. It likewise became the focal point of research efforts with both a pure and applied focus at centers in France, Germany, Italy and the U. S. In this paper we discuss this rapid reception, the high expectations for the theory, and its interest for both established researchers and those just beginning their careers. Examples of the latter include the work of Maria Gramegna, a student of Peano whose work has recently been translated from Peano's arcane notation by Erika Luciano; and Hu Ming Fu (胡明复) a student of M. Bôcher at Harvard who appears to have been the first Chinese mathematician to receive the Ph. D.

Christopher Baltus, SUNY Oswego baltus@oswego.edu

The Conics of Apollonius: Book I for Beginners

I believe that the absence of an elementary presentation of the work of Apollonius has essentially left him out of the standard junior-level History of Mathematics course. This deficit, in turn, undervalues ordinate geometry, and so makes difficult a reasonable appreciation of 17th century contributions to coordinate geometry. Recent publications in English have made Apollonius available for scholars. I will distribute my version of Book I for Beginners and discuss the structure of the book and issues that arise in presenting it to students, particularly the transformation of axes.

Thomas L. Bartlow, Villanova University thomas.bartlow@villanova.edu

Mathematics and Politics: Apportionment of the United States Congress.

The U.S. Constitution (Article I, Section 2) specifies that, "Representatives and direct taxes shall be apportioned among the several States which may be included in this Union, according to their respective numbers," but does not specify how this should be done. Over the years several mathematical procedures have been characterized as conforming to the plain meaning of the Constitution, and mathematical arguments has been invoked and ridiculed. Persons involved in this debate have ranged from some of the most famous names in American history such as Thomas Jefferson, Alexander Hamilton, and Daniel Webster to obscure figures like James Dean. This talk will focus on the role of mathematician Edward V. Huntington.

Lennart Berggren, Simon Fraser University berggren@sfu.ca and **Nathan Sidoli**

Aristarchos from Greek to Arabic

Aristarchos of Samos was a Greek astronomer who worked in the early third century B.C. His *On the Magnitudes and Distances of the Sun and the Moon* is the earliest treatise we have of Hellenistic applied mathematics that involves serious numerical computation. The inequalities he obtained and his derivation of them were studied in later centuries by aspiring astronomers from Central Asia to Western Europe, despite the fact that the intervening developments in trigonometry and astronomy had long rendered his methods and parameters obsolete. In this talk we shall discuss a number of puzzling features of the Greek text and the modifications that text underwent when, 1200 years after its composition, it was translated into Arabic.

Chris Bissell, Open University c.c.bissell@open.ac.uk

Math? What math? How mid 20th century information engineers subverted mathematical formalism

During the first half of the twentieth century information engineers developed the fundamental theory of electronic circuit and filter design, telecommunications, signal processing, and control engineering. Much of this theory was rooted in linear differential equations, complex variable theory, and Fourier and Laplace transforms. Yet when it came to practical design, engineers developed a range of techniques that enabled them to exploit the power of the mathematical models underpinning their technological devices and systems without recourse to the classic formalism of the mathematics. Many of these techniques were graphical in nature, such as: the normalised time and frequency response curves of linear systems; the Bode Plots, Nichols Charts and pole-zero plots used in circuit and control system design; the Smith Chart and signal constellation diagrams used in telecommunications; and so on. These methods led to engineers talking a new language based on the characteristics of the graphical representations. Rather surprisingly, the humble decibel, originally a simple logarithmic expression of sound intensity, proved a particularly useful measure in this new graphical world.

This paper will demonstrate how these quintessentially engineering tools freed designers in the information engineering field from having to solve differential equations or deal with the niceties of complex variable theory. Perhaps rather surprisingly, most of these techniques have recently achieved a new lease of life as part of the interface between modern computer-aided design tools and designers themselves.

Carlos Bovell carlosbovell@yahoo.com

A right angle is a right angle, right? Musings on Euclid's fourth postulate

In my paper, I set out to elucidate the meaning of Euclid's fourth postulate. In order to do so I a) inquire into what the postulates qua postulates were intended to do and b) go through the motions of a proof-attempt of the fourth postulate to illustrate some of the issues that can arise with respect to right angles in Euclidean geometry.

My thesis is twofold: 1) Proclus' excursus on the fourth postulate in the context of proposition 13 is much more useful for its understanding than often supposed; and 2) the fourth postulate is not postulated to primarily establish the homogeneity of space, but rather to ensure that to be equal to two right angles is, on a very important practical level, the equivalent of being two right angles.

Rob Bradley, Adelphi University bradley@adelphi.edu

Reflections on the Vibrating String Problem

The disagreement between Euler and d'Alembert concerning initial conditions for the wave equation was the last in a series of disputes between these two mathematicians. Unlike those that preceded it, there was real substance to this debate. The issues involved would ultimately lead, among other things, to a revision in the understanding of the nature of a function. We will examine the work of Euler and d'Alembert, as well as Daniel Bernoulli and Lagrange, with regard to this problem.

Sandro Caparrini, Dibner Institute for the History of Science and Technology
sandroc@MIT.EDU

On the Common Origin of Some of the Works on the Geometrical Interpretation of Complex Numbers

The geometrical interpretation of complex numbers was discovered independently by at least six different mathematicians: Wessel (1799), Buée (1806), Argand (1806), Mourey (1828), Warren (1828) and Gauss (1831). To the list must be added the names of others, who in some measure contributed to the establishment of this result: the unknown D. Truel (1786), cited by Cauchy, the brothers Français (1813) and the Italian G. Bellavitis (1832). This is indeed an extraordinary state of affairs, and it is difficult to believe that it happened by pure chance. In fact, it can be argued that the major impetus for the development of a vectorial view of complex numbers came from the discussion of the logical status of negative and imaginary numbers in Lazare Carnot's "Géométrie de position" (1803).

Ed Cohen edcohen@sympatico.ca

Ancient Egyptian Calendars

Civil and lunar calendars in ancient Egypt are discussed. Apparently several knowledgeable authors have different ideas about how many of these there were. We try to sort that out. As well, the Coptic Christian calendar is examined.

Antonella Cupillari, Penn State Erie-The Behrend College, axc5@psu.edu and
Kate E. Overmoyer, Bowling Green University

Of Square Fields, Circular Islands, And Other Peculiar Probabilities...

In the late 1800's people from all over North America and from very different social backgrounds were submitting mathematical problems and their solutions to Artemas Martin, editor and publisher of The Mathematical Visitor and The Mathematical Magazine, in Erie, PA. The probability problems published in these journals covered a variety of topics and some of them required the use of quite advanced mathematical skills. More than a century later we can still enjoy the challenge they pose and share them with our students.

Lawrence A D'Antonio, Ramapo College ldant@ramapo.edu

Al-Kashi's Method of Root Extraction

In his work, the Miftah al-hisab (Key to Arithmetic), the 15th century Persian mathematician Ghiyath al-Kashi developed a sophisticated method of approximating an arbitrary root of a given number. We present al-Kashi's method and its relation to earlier root finding algorithms and its anticipation of the Ruffini-Horner method.

Chandler Davis, University of Toronto davis@math.toronto.edu

If It's Real How can It be Certain?

The central question in philosophy of mathematics is the source of certainty of mathematical truth. The question is posed in a somewhat altered form here, and although its difficulties are not escaped, I try to deal with them in a way which respects mathematicians' practice.

Thomas Drucker, University of Wisconsin – Whitewater druckert@uww.edu

Quantification and the Loss of Certainty

There is a tradition of a particular sort of certainty adhering to mathematics that distinguishes it from other forms of human inquiry. One reason that the social sciences in the nineteenth century and beyond were eager to take on the mantle of mathematics in some of their pronouncements was to benefit from the reputation of mathematics. A consequence of the use of mathematics and statistics in the social sciences has been the readiness to dismiss areas like statistics as liable to manipulation in a way that mathematics is not. This talk will look at the ways in which the pride of association with mathematics on the part of the social sciences has had results for the reputation of mathematics that might not have been foreseen.

Florence Fasanelli ffasanel@aaas.org

Portraits of Euler

Surely tens of images in sketches, woodcuts, oil paintings, and statues of Leonhard Euler were made during his lifetime as a result of his fame as well as the places where he lived and the people he knew and those who knew and were related to him. Distinct images made during this mathematician's lifetime will be analyzed as artifacts along with their creators, the provenance and what, if anything, we can learn about Euler, the person, from these portraits.

Craig Fraser, University of Toronto cfraser@chass.utoronto.ca

The Concept of Analysis in Eighteenth-Century Mathematics

Although there was great interest in the classical method of analysis during the early modern period, after about 1750 explicit methodological and foundational discussions of this method appeared much less frequently in the writings of mathematicians. Analysis came to mean simply all calculus-related parts of mathematics and basic questions centered on the nature of the function concept, the properties of infinite series, the existence of integrals and the representation of functions. When foundational investigations picked up at the end of the nineteenth century, they concerned the place within mathematics of logic and set theory and the role of the axiomatic method. As Michael Mahoney has observed, during this later period the subject of Greek analysis had become the object of historical inquiry and evaluation. The paper reflects on the place of analysis in the eighteenth century, a time that was intermediary between the early modern period, when notions of analysis rooted in Greek antiquity occupied a vital place, and the nineteenth century, when these notions were seemingly only of historical interest.

Alejandro R. Garciadiego, Facultad de Ciencias, UNAM gardan@servidor.unam.mx

Mathematics and Art at the Main Campus of the Mexican National University. A work of Díaz, a recent acquisition.

Some of the buildings located in the original main campus of the Mexican National University, built during the early 1950s, portray works, among others, of an artistic group known as the 'muralists'. A new section of the same campus, developed in the late 1980s and where the new research institutes of humanities are located, illustrate the abilities, sensibility and interpretation of a contemporary generation of young artists. These murals and sculptures are recognized, visited and admired by locals and tourists. Among these pieces of art, there is one that invariably escapes from the scrutiny of the eyes of the visitors: An iron gate; that, when installed, there were political reasons to keep it under low profile. But, this is not just another gate. Through a long process of frustrations and difficulties, its artistic design eventually emerged. The main idea originated from an old mathematical pastime. The goal of this talk is to unveil such an artistic and mathematical journey.

Roger Godard godard-r@rmc.ca Royal Military College of Canada

From Chebychev to JPEG: Orthogonality and Approximation

This paper is a review of the Approximation Theory from Chebychev to JPEG (around 1980), but mainly from a point of view of discrete Mathematics. In 1858, Chebychev published his astonishing article : «Les fractions continues», where he introduced the concept of discrete generalized Fourier series. The convergence in the mean was discussed by Fisher and Riesz in 1907. These concepts, linked to other transforms such as the cosine transform, the Haar transform, the Hadamard transform and the Walsh transform are the basis for modern digital imagery. We close this communication with the genesis of JPEG.

William W. Hackborn, University of Alberta hackborn@augustana.ca

The Science of Ballistics: Mathematics Serving the Dark Side

Although mathematicians have often denigrated the mathematics associated with the technology of war—G. H. Hardy, for example, wrote in his *Apology* that ballistics and aerodynamics are "repulsively ugly and intolerably dull; even Littlewood could not make ballistics respectable"—mathematicians from Galileo and Newton to Veblen and, yes, Hardy's long-time collaborator, Littlewood, have made essential contributions to the science of ballistics. This paper will consider some of these mathematicians and their work.

Jozsef Hadarits, University of Toronto/Royal Ontario Museum hadarjoe@yahoo.com

Music of the Circles

Traditionally, the connection between mathematics and music has been theoretized in terms of ratios of integers, or - as in Euler's case, for instance - in terms of prime factors of natural numbers. However, by Charles Lucy's 1986 rediscovery of John "Longitude" Harrison's musical theory from the 18th century, an irrational number appeared on the horizon of mathematico-musical interest: pi.

In his pioneering work titled '*An Account of the Discovery of the Scale of Musick'* (cca. 1773-1776), Harrison used pi as the generator for his musical system.

Since Harrison did not provide too many details about that how he got his results, this fact leaves quite a number of questions wide open: Was he influenced by the method of geometrical constructs which supplemented most of the musical treaties since Ptolemy's time? Did the previous century's calculations on pi made any effect on him, or Harrison's assumptions were based only on his own experiments and his contemporaries' musical practice? And, what are the broader consequences of this new-old hypothesis that maps music in 3D spirals rather than in sine waves? The aim of this presentation is to attempt to answer some of these questions.

Brian Hepburn, University of Pittsburgh brh15+@pitt.edu

Was Euler a Newtonian?

In this talk I plan to outlay the beginnings of my research into how the invention, development and use of the calculus in the mid-18th century influenced the conception of mechanical properties as physical objects, not just mathematical ones. I will focus on Euler's discussion of the vis viva controversy and how his argument for the dissolution of that debate was based on his understanding of differential quantities.

Barnabas Hughes, California State University, Northridge
barnabashughes@hotmail.com

The DE PRACTICA GEOMETRIE of Fibonacci, a Unique Compilation of Arabic and Greek Mathematics

In 1220 Leonardo da Pisa, aka Fibonacci, completed DE PRACTICA GEOMETRIE. While it received nominal attention in various histories of mathematics, its full value has until this time not be addressed, much less appreciated. In short, it is a careful compilation of Arabic and Greek Mathematics, the best that he could gather for the practitioner (read: surveyor) and theoretician of geometry. I shall offer an overview of its contents, a detailed list of his sources, his competence in gathering such a collection, comments upon my sources, and several interesting items from the treatise.

Israel Kleiner, York University kleiner@rogers.com

The Principle of Continuity: A Brief History

The Principle of Continuity was a very broad law, often not explicitly formulated, but used widely and importantly in the 17th, 18th, and 19th centuries. It says, broadly speaking, that what holds in a given case also holds in what appear to be like cases. At various times it implied one or another of the following assertions: What is true for positive numbers is true for negative numbers; what is true for real numbers is true for complex numbers; what is true up to the limit is true at the limit; what is true for finite quantities is true for infinitely small and infinitely large quantities; what is true for polynomials is true for power series; what is true for circles is true for other conics; and what is true for ordinary integers is true for (say) Gaussian integers. Each of these assertions was used by mathematicians at one time or another. Moreover, such purported analogies, even when they failed to materialize, were often starting points for fruitful theories. In this talk I'll give several examples to illustrate the Principle of Continuity "in action".

Miriam Lipschütz-Yevick, Rutgers gandmyevick@rcn.com

Postulates Or Dogmas

Some forty years elapsed since the time that Bolyai wrote to Gauss (1825) that Euclid's fifth postulate could not be deduced from those that preceded it, until the time Non-Euclidean geometries were accepted as legitimate. Gauss begged him not to let this view, which he already had entertained himself, get around. "Mathematics represents reality and the universe is Euclidean, so only Euclidean geometry can be part of mathematics;" was the generally held conviction. Hilbert's *Foundations of Geometry* established the axiomatic foundation of Euclidean geometry. Hilbert then proposed as his sixth problem to treat in the same manner, by means of axioms, those physical sciences in which mathematics plays an important part, most readily mechanics and probability. Von Neumann, a student in Hilbert's course (1926) on the *Mathematical Foundations of Quantum Mechanics,* wrote a book by the same title in 1932. He established these foundations on a set of postulates from which he derived the conclusion that quantum mechanics was necessarily statistical. David Bohm proved (1952) that a non-statistical interpretation of quantum mechanics could equally explain the experimental observations. The response to his interpretation was generally hostile..

Some thirty years had elapsed when John Bell (1964) produced a counterexample defying Von Neumann's claim. He achieved this by deleting a postulate of Von Neumann which (unbeknown to Bell) had previously been questioned by Grete Hermann(1935) and independently (1938) by Albert Einstein as not necessarily realized in the physical world..

Kolmogorov's rigorous axiomatic foundations for probability theory have not eliminated the fundamental question about the interpretation of the notion of probability in its practical statistical applications. There have been many attempts to bend the Kolmogorov axioms to "save the phenomena" of quantum mechanics. The use of mathematical postulates to lend credence to such statements as "The Universe Evolves Probabilistically" (as for instance Greene Brian in *The New York Times*, April 8, 2005, A27) or "The World is Euclidean" is to bestow on these postulates the force of dogmas.

Hugh McCague, York University hmccague@yorku.ca

The Mathematics of the Canon of Polykleitos, an Exemplar of Greek High Classical Sculpture and Western Culture

The Canon of Polykleitos was a treatise, written during the Greek High Classical period, on creating and proportioning sculpture. The text combined both a prescriptive set of instructions and a theoretical justification for its practical procedures. The Canon also referred to the "Doryphoros" (c.450-440 B.C.), an accompanying exemplary work of sculpture by Polykleitos. The treatise and original sculpture have not survived, but quotes, paraphrases and comments on the Canon are extant from antiquity, as well as Roman copies of the original statue. In the history of Western culture, the Canon of Polykleitos became an exemplar for accuracy and the harmonious relations of the constituent parts to the whole in wide-ranging endeavors in art, medicine, science and engineering.

Of special interest to the history of mathematics, the key elements of the prescriptions of the Canon were proportions and numbers. Further, the literary testimonia on the Canon and the Roman sculptural copies indicate a combined application of contemporary Hippocratic surgical texts, close empirical observation of the human body, and Pythagorean philosophy and mathematics. From the viewpoint of the history of mathematics, this paper examines and offers various insights and possibilities on the detailed mathematics 1) applied in the Canon and 2) needed for its potential rediscovery. Commensurability, the decad, types of means and ratios, progressions, figurate numbers, symmetry and asymmetry, and *symmetria* (the harmonious relations and proportions of the parts to the whole) are mathematical topics of relevance to the study of the Canon. While the challenges in recovering the exact proportioning scheme of the Canon are formidable, much has been inferred about its nature that establishes a distinguished place for the Canon of Polykleitos in the history and cultural influence of mathematics.

Duncan J. Melville, St. Lawrence University dmelville@stlawu.edu

Using Word Problems as Evidence in History

Word problems are constrained to artificiality by the mathematical procedures they are to illustrate. On the other hand, problems use content that is relevant to the students as a way of holding their interest. The tension between artificiality and relevance makes word problems difficult texts to evaluate in reference to their cultural milieu. We illustrate some of the possibilities and pitfalls with a case study of an Old Babylonian problem involving construction of siege ramps.

Glen E. Meyer, Austin Community College meyersv1@yahoo.com

The Instrumental Use of Continuous Orders: A Challenge for Hartry Field's Nominalization Program

In equilibrium statistical mechanics, a well-ordered and discrete structure of physical quantities is assumed to be continuous for the purpose of applying the calculus. I argue that this assumption presents serious difficulties for Hartry Field^Òs nominalistic account of applied mathematics since this account requires that significant parts of the rich mathematical structures used in physical theories be described by intrinsic reformulations of these physical theories.

Michael Molinsky, University of Maine at Farmington michael.molinsky@maine.edu

Mathematics in Detective Fiction

Modern detective fiction can be traced back to the writings of Edgar Allan Poe, and mathematical ideas and methods have made numerous appearances in the short stories and novels of the genre. This talk will consider some examples of the use of both mathematics and the history of mathematics in the plots of various authors from this field.

David Orenstein, University of Toronto david.orenstein@utoronto.ca

Helen Hogg's Mathematical Methods for Variable Stars in Globular Clusters

Helen Sawyer Hogg (1905-1993), a career astronomer at the University of Toronto's David Dunlap Observatory, had a lifelong project: the variable stars of the globular star clusters of the Milky Way Galaxy. Thanks to an extensive archive, 17 running metres, over 50 years of applying mathematics to a single astronomical problem can be traced.

Her essential problem was, as precisely as possible, to find the brightness of a star as a function of time. The typical precision is 10^-6 days for the period of variability. By calibrating for the mean apparent magnitude, amplitude, and period, together with the underlying physics of the variability, Hogg was able to determine the actual distance of the globular clusters. When extended to clusters in external galaxies. this was an important step in determining the distance scale of the cosmos.

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Carnap, Conventionalism, and Consistency

According to Gödel's Second Incompleteness Theorem, we cannot prove internally the consistency of a formal system containing arithmetic. We must invoke further mathematical principles, external to the formal system in question, if we are to provide a proof of consistency. Carnap's conventionalism of logic and mathematics upholds that logic and mathematics are "nothing other" than the syntax of a language. Thus, insofar as the rules of syntax of this language comprise a formal system, then the consistency of this system of syntactical rules is not internally demonstrable (i.e., we must appeal to principles not captured by this system of syntactical rules for a proof of consistency). Therefore, assuming that it is necessary for us to establish consistency internally, mathematics cannot be reduced to a system of syntactical rules of a language. Moreover, since we must appeal to mathematical principles not captured in the rules of this formal system, Gödel contends, we cannot deny the use of intuition in recognizing the truth of these further mathematical principles.

I present Gödel's argument, in premise-conclusion form, and independently challenge two of the premises from the conventionalist's perspective of logic and mathematics. It is shown that one premise is unacceptable under a paraconsistent logic (for it presumes that anything can be made to follow from an inconsistent system), and since a conventionalism of logic must be open to alternative systems of logic, *a fortiori* including a paraconsistent logic, this premise begs the question against a conventionalism of logic. It is further shown that the conventionalist need not turn to a paraconsistent logic, or the possibility thereof, to fend off Gödel's argument. It is the main preoccupation of the paper to establish that a conventionalist of logic and mathematics, following Carnap, need not accept the further premise to the effect that the consistency of a system of syntactical rules of a language L must be demonstrable. Gödel's argument against Carnap mainly fails with this premise. The difference between Carnap and Gödel with respect to this premise, it is explained, comes down to their respective acceptance and rejection of the Principle of Tolerance. Gödel, who contends that Carnap must provide a consistency proof for mathematics as the syntax of a language, seeks justification where the Principle of Tolerance tells him none is to be had. And so, as long as Gödel rejects the Principle of Tolerance then he can claim that Carnap is incorrect. However, if the Principle of Tolerance is accepted, then although Carnap cannot claim he is correct (for reason that questions of correctness cannot then be framed), Carnap may claim that he cannot be shown to be incorrect by Gödel's argument.

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Motion and Stasis in Galileo and Cigoli

Galileo's processes of mathematical discovery have been the subject of interest of a few scholars, who have attempted to reconstruct his path towards the results published in the celebrated *Two new sciences* (1638). In this paper, I will suggest a radically new approach to Galileo's preliminary manuscripts related to the *Two new sciences* proofs. I will describe the rich processes underlying Galileo's search for new proofs concerning motion, which I propose to call "gestural mathematics". I will try to illuminate the power of "gestural mathematics", by comparing and contrasting it with contemporary drawing techniques in Lodovico Cigoli (1559-1613), a friend of Galileo's.

The best way to illustrate *gestural mathematics* is by analogy with *gestural drawing*, a technique which has long been practiced by visual artists and, as we shall see, was attempted by Galileo himself. A gestural drawing is so interesting because it preserves the myriad gestures that the artist performs while searching for a more stable final composition. Unlike the smooth appearance of an oil painting, a gestural drawing displays all the traces that shaped the search for its final state. The final form of a gestural drawing thus conglobates the rich process of its discovery. By the same token, unlike the "sanitized" form that Galileo's deductive proofs took when they were archived in *Two new sciences*, the manuscripts display some of the gestures that shaped their first expression.

In Galileo's mathematical practices, as well as in Cigloi's drawing techniques, creativity is an emerging phenomenon. Emergence is a relatively new subject in the understanding of how mathematics develops and changes over time. Indeed the phenomenon of emergence deserves further attention by historians and philosophers of mathematics.

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Evolution of Nineteenth Century American Elementary Algebra Textbooks

Nineteenth century algebra textbooks are surprising both in their similarities to today's textbooks and in their fascinating differences. Some excerpts of interest to today's reader will be presented, with special attention paid to clever mathematical techniques made obsolete by today's technology. The evolution of algebra pedagogy over that period (as reflected in textbooks) will be analyzed. Authors to be considered include John Bonnycastle, Charles Davies, E.E. Milne, Thomas Simpson, Samuel Webber and G.A. Wentworth.

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The Cryptological Work of the Rev. John Wilkins

We first touch on the high points of the life and works of John Wilkins (1614-1672). Then we outline the contents of his work "Mercury: or the Secret and Swift Messenger", paying special attention to the types of ciphers encountered.

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The Historical Origins of the Argument A of Probability P(A).

The present research deals with the historical origins of the probability argument, namely we shall examine the early modeling of A that is the argument of the probability $P(A)$. The idea that the probability argument is a point may be found in the letter addressed by Pascal to the Le Pailleur Academy that predicts the shape of the emerging probability calculus. Kolmogorov formalizes the set model A in his axiomatic theory and openly sanctions the Pascal conjecture.

The present historical excursus closes with the irreconcilable interpretations of the probability emerged in the first decades of the twentieth century that may be related to the theoretical model of A.

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Euler, Newton, and the Expulsion of the Geometers

Newton was a geometer. He explicitly told us that he used analysis for discovering things, but geometry for proving them, as in the Principia. Euler, on the other hand, claimed to be a Newtonian (the alternative was being a Cartesian, or as they were called in the 18th century, a Wolffian), and his claim has been fortified by Valentin Boss in his book "Newton in Russia." Yet Euler led the mathematical community away from geometry and towards algebra and analysis as the means of discovery, proof and exposition of new mathematics. We seek to reconcile Euler's Newtonian sympathies with his Cartesian methodologies.

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On the importance of asking the right research questions: Could Jordan have proved the Jordan-Hölder Theorem?

In 1870 Jordan proved that the composition factors of two composition series of a group are the same. Almost 20 years later Hölder (1889) was able to extend this result by showing that the factor groups, which are quotient groups corresponding to the composition factors, are isomorphic. This result, nowadays called the Jordan-Hölder Theorem, is one of the fundamental theorems in the theory of groups.
The fact that Jordan, who was working in the framework of substitution groups, was able to prove only a part of the Jordan-Hölder Theorem is often used to emphasize the importance and fruitfulness of the abstract conception of groups, which was employed by Hölder (see, for example, Wussing 1984, van der Waerden 1985, and Nicholson 1993).

However, as a little-known paper from 1873 reveals, Jordan had all the necessary ingredients to prove the Jordan-Hölder Theorem at his disposal (namely, composition series, quotient groups, and isomorphisms), despite the fact that he was considering only substitution groups and did not have an abstract conception of groups. Thus, I argue that the answer to the question posed in the title is "Yes." It seems that this fact has been overlooked by commentators on the development of group theory because of two reasons: First, Jordan's paper received only scant attention and reviewers did not even mention his use of quotient groups (see Netto 1875a). Second, Hölder's own proof indeed appears to rely essentially on the use of abstract groups. Nevertheless, later proofs of the Jordan- Hölder Theorem (e.g., in Weber 1896) rely only on conceptions that were available to Jordan in 1873. Thus, I conclude that it was not the lack of the abstract notion of groups which prevented Jordan from proving the Jordan- Hölder Theorem, but the fact that he did not ask the right research question that would have led him to this result.

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Thoughts On Teaching Elementary Mathematics

At a plenary lecture "How much mathematics can be for all?" at the 2005 annual meeting of CSHPM, which met with the CMS, Keith Devlin made the distinction between elementary mathematics, which he characterized as being presented in a way that builds incrementally on previous experience, and formal mathematics, which he characterized as being presented in the form of one or more definitions which can only be understood as a result of working with them. He suggested that some people are unable to learn formal mathematics. He suggested that formal mathematics begins with calculus.

It seems to me that this distinction is not about mathematics itself, but about the way it is presented, and that the fact that some mathematics is usually presented formally does not mean that it must be presented this way. And since a formal presentation of mathematics can be difficult for those students who are not used to it, it seems desirable that elementary mathematics should not be presented to students this way, at least not until they have had the opportunity to learn how to deal with such a presentation.

In this talk, I will make some proposals for presenting elementary mathematics through calculus in a way that avoids as much as possible a formal presentation, and I will also make some proposals for helping students who have studied calculus learn to learn from a formal presentation. I believe that these suggestions will amount to presenting some of the main steps in the historical development of modern mathematics. The point of using the history of mathematics here is mainly to help the students understand the process by which modern mathematics developed and its relationship to the wider culture of certain key periods and to other developments outside mathematics that had a major effect on its development.

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Symbolic Practices And Mathematical Invention In Leibniz's Mathematics.

This talk is devoted to Leibniz's practices -- whether rationalist or not -- with respect to mathematical invention and the creation of new mathematical objects. These two features were deeply rooted in the completely new mathematical symbolic writing, which had appeared at Leibniz's time. More precisely, they were organized around the (then new) possibilities of substitution within that symbolism. Detailed study brings to light an epistemological scheme involving two stages, substitution and control, which embody a tension between inventiveness and rationality. With respect to the establishment of mathematical symbolic writing, Leibniz' s role is specific. He did not invent the general structure of the symbolic apparatus : rather he inherited it from Vieta, Descartes and Newton -- even if he supplemented it with a lot of signs of his own -- but he was actually the first to grasp and exploit its outstanding power, and to develop, in a very modern fashion, some applications inconceivable for his predecessors The *Ars Combinatoria* in Leibniz involves two necessary stages, namely genesis and ratification. In the first stage, one produces automatically (literal) formulas without regard to their signification, a procedure Leibniz highly esteemed ; one recognizes here to what an extent he was methodologically opposed to Descartes. In the second stage, the author himself or, alternatively, the mathematical community, will afterwards ratify, decide, select or eliminate, having surveyed the “blind” productions coming from the combinatorial system.

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Reading from a Translation, on Alexander Grothendieck

I would like to read parts of my translation of a Polish paper by Professor Piotr Pragacz (U. of Warsaw) titled "The Life and Work of Alexander Grothendieck."

Professor Pragacz's paper appeared in 2004 in the Polish journal "Wiadomosci Matematyczne" (Mathematical News). The complete English translation of this paper will appear in the Monthly (in the column "The Evolution Of...") later in 2006.

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Beyond the Sailings: The Birth of Modern Celestial Navigation

From the time of Columbus to the beginning of the nineteenth century, the primary means of keeping track of the location of a ship at sea was to maintain a dead reckoning, derived from measurements of the ship’s speed and direction of travel throughout the day. Observations of the altitude of the sun above the horizon when the sun was at its highest, together with tables recording the sun’s declination for each day of the year were used to determine the ship’s latitude which was then used to verify (or, if necessary, to adjust) the ship’s deduced position.

The growing importance of the exploration and colonization of the New World spurred an urgent need for enhanced navigational methods. The first steps in this direction took the form of a search for methods to determine a ship’s longitude. The hundred years between the 1660’s and the 1760’s witnessed the invention of accurate quadrants and sextants; the first published tables of lunar positions with respect to the sun, planets, and fixed stars; the invention of logarithms and logarithmic scales and tables; the development of the calculus; and the invention of accurate pendulum clocks for land use and chronometers for marine use. This paper will outline how these advances, combined with a deepening understanding of the connections between time and place, enabled mariners to employ celestial observations to determine their latitude and longitude at sea and will explore the origins and development of the mathematics that made these methods practical.

Recent books detailing the development of Harrison's chronometer have left many readers with the impression that this invention "solved the problem of longitude." Although a chronometer could indicate the apparent time at Greenwich, no clock can determine the local time if the observer has moved to a new meridian since the clock was set – local time is a function of position. Whether Greenwich time was determined by consulting a chronometer or by "taking lunar distances," the local time was obtained through a combination of "sun sights" at noon, "time sights" in the morning and afternoon, and dead reckoning advancing the noon sight. At the end of a long day of numerous observations and detailed calculations, the navigator determined a position for his vessel. These methods provided the primary means of navigation from the 1790's to the 1850's, but suffered from two limitations: the lengthy time needed to collect the data necessary for a positional determination, and the considerable sensitivity of longitudinal estimates to any errors in the latitudinal determinations on which they were based. The methods presented in this paper formed the foundation for, and were gradually supplanted by, more flexible, powerful methods for determining position from celestial observations, overcoming both of these limitations, which were developed between 1835 and 1885.

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Indian Contributions to the *Educational Times 1876-1918*

According to the English mathematician William Kingdon Clifford, *The Educational Times*, a monthly periodical devoted to pedagogy, did more to encourage original mathematical research than any other European periodical in the late nineteenth century. The journal contained a section devoted to mathematical problems and their solutions which was later republished in six-month installments as *Mathematical Questions and Their Solutions from the Educational Times*. Among the Indian mathematicians contributing to the problems section of *The Educational Times* were Ramaswami Aiyar who founded the *Journal of the Indian Mathematical Society*, K.J. Sanjana from Bombay who made 722 contributions to the journal, and S. Ramanujan. We discuss their and other Indian contributions to the *Educational Times.*

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The Work Of Cryptographers Agnes Meyer Driscoll And Genevieve Grotjan During World War Ii

Many women worked in cryptology during the war as civilians and enlisted personal. Their contribution to victory in the war was invaluable.

The Japanese Diplomatic Code PURPLE was used during World War II by the Japanese to carry out secret communications by the Japanese all over the world. The Japanese communications were successfully intercepted and decrypted; in fact the United States actually built the machine which was use to crack the Japanese code. This was one of the greatest achievements made by cryptographers.

This presentation will discuss the contributions of Agnes Meyer Driscoll and Genevieve Grotjan in solving the Japanese Code Purple.

Breaking the code was instrumental in the victory of allied forces in World War II. In particular, the role of cryptanalysis in the Battle of Midway will be discussed.

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Why John Venn Stopped Thinking About Probability And Logic At The End Of The 19th Century

The development of statistical theory and an algorithmic approach to logic were two of the more exciting developments in mathematics in the late 19th century, leading to tremendous developments in the 20th century. The foundations of both of these mathematical topics were researched by a handful of people pursuing different professions in and out of academe, many of whom did not see themselves as mathematicians. One of the most prominent was John Venn, a lecturer in the moral sciences at the University of Cambridge. Venn, known today primarily for his logic diagrams, had written seminal works in symbolic logic, inductive logic, and the foundations of probability theory. He was Cambridge's leading logician at the end of the 19th century. In 1897, Cambridge finally created a second professorship in philosophy, this one to be designated Mental Philosophy and Logic. Venn was the obvious candidate for the position, but in fact it went to a younger man, James Ward, who was a "mental philosopher" but did no work in logic or in probability theory. Venn was crushed by not obtaining the professorship and immediately turned his attention away from logic completely. Cambridge lost its leadership in both statistical theory and logic at the turn of the century.

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Why Base 60? A Satisfying Account

An outstanding question, in regard to Babylonian mathematics, is; "Why did the Babylonians, or their predecessors, use a sexagesimal numeration system?" Academic journals or books often give lists of proposals, because there has been no satisfactory solution. The very nature of this query invites conjecture, and thus, the question has most often been addressed in passing. To reduce speculation, research using artifacts, and our knowledge of the Sumerian language will be considered in this paper. These are our guides for critically analyzing any suggestion as to the origin of the sexagesimal numeration system, including the one proposed herein.