History and Philosophy of Mathematics
Histoire et philosophie des mathématiques
(Org: **Tom Archibald** (SFU) and/et **Alexander Jones** (Toronto))

TOM ARCHIBALD, Simon Fraser University, Burnaby, BC, V5A 1S6
Integral Equations: a "Revolution" in Mathematics in the early 20th Century?

When, in 1900, Ivar Fredholm introduced his method for reformulating boundary-value problems as integral equations, it provoked a flood of interest internationally. On the one hand, it promised a theoretical approach that would provide for the first time a unified theory of partial differential equations, what Hilbert termed a "unified approach to *Schwingungslehre*". On the other, it seemed to give a means of actually solving boundary-value problems that were of physical interest, most notably in elasticity and fluid mechanics. An international stampede of activity at the research and teaching levels followed, reminiscent of the surge of interest in catastrophe theory in the 1960s and 1970s, or in fractals and chaos somewhat later. In this paper we look at the reasons for this "fad", and discuss what distinguishes really finding mathematical gold from a flash in the pan.

The paper describes joint work with Rossana Tazzioli (Lille).

DAVID BELLHOUSE, University of Western Ontario, Department of Statistical and Actuarial Sciences, Western Science Centre, London, Ontario N6A 5B7
The Engravings in Euler's Introductio

Euler's 1748 *Introductio in Analysin Infinitorum* contains three engravings that deliver a message to the reader through the use of emblematic representations that have been standard from the time of the late Renaissance into the eighteenth century. An interpretation of these engravings is given. One engraving is probably the publisher's advertisement of the quality of the book and its author. The other two engravings show the importance that Euler attached to the results given in the *Introductio* and his devotion to his family.

STANLEY BURRIS, University of Waterloo, Waterloo, Ontario
Creation of the Algebra of Logic in the 19th Century

This talk looks at the Zeitgeist and key issues confronted in the development of the Algebra of Logic in the 19th century. In particular we look at the state of algebra prior to Boole's *Mathematical Analysis of Logic* and De Morgan's *Formal Logic*, both published in 1847, and how the subsequent development of the Algebra of Logic was intertwined with the development of Equational Logic.

BRENDA DAVISON, Simon Fraser University, 8888 University Drive, Burnaby, BC, V5A 1S6
Changes to the Foundations of Mathematics in Britain circa 1900

The early 20th century was a time of great change in British mathematics, particularly in areas concerned with rigour and foundational issues in analysis. Both G. H. Hardy and W. H. Young played a role in this transformation, with Hardy, in particular, publishing an influential textbook in the first decade of the 20th century.

Hardy's 'A Course of Pure Mathematics', published in 1908, and Young's 'The Theory of Sets of Points', published in 1906, both brought ideas from France and Germany to British mathematics. In this paper I discuss the content of these books, concentrating on a comparison to contemporary English-language books.

In particular, I will show that Hardy provided a clear, rigorous introduction to the theory of logarithms and exponentials and also provided a rigorous, comprehensive, constructive definition of the real numbers. Young's text made Cantor's work on set theory available to an English- speaking audience and was published during the time when Hardy published his only papers on set theory. What most sharply divides Hardy's work from a modern text is a lack of set theory throughout his book. I will briefly examine possible reasons why Hardy did not use a set-theoretic approach in 'A Course of Pure Mathematics', despite the availability of Young's work.

ROBERT DAWSON, Saint Mary's University
Complex-Number Slide Rules

During the middle of the twentieth century, various designs of slide rule to multiply and divide complex numbers were invented, and in some cases even produced commercially. Inherent limitations on the design prevented them from ever becoming very widespread, however. This talk will describe the history of these devices.

FLORIN DIACU, University of Victoria
Celestial mechanics in spaces of constant curvature

This talk will discuss the history of the attempts to extend the n-body problem of celestial mechanics to spaces of constant curvature starting with Bolyai and Lobachevski in the 1830s.

CRAIG FRASER, University of Toronto, IHPST, Victoria College, Toronto, Ontario, M5S 1K7
De Moivre's Proof of De Moivre's Identity

In his work *Miscellanea Analytica* of 1730, Abraham De Moivre provided a detailed derivation of the following result. If x is the cosine of an arc and l is the cosine of an arc n times this arc then x and l are related by the identity

$$x = \frac{1}{2}\sqrt[n]{l + \sqrt{l^2 - 1}} + \frac{\frac{1}{2}}{\sqrt[n]{l + \sqrt{l^2 - 1}}}. \tag{1}$$

It is evident that De Moivre possessed a knowledge of what is known today as DeMoivre's identity

$$(\cos\theta + i\sin\theta)^n = \cos n\theta + i\sin\theta. \tag{2}$$

De Moivre had presented (1) without proof in 1707 in an article in the *Philosophical Transactions*. We provide an account of De Moivre's 1730 derivation, focusing on a critical evaluation of the proof. De Moivre's intent was to ground the proof in the nature of the calculus as it was understood at this time, which was as a set of algorithms and operations on variables that enabled one to relate and to calculate various geometric quantities associated with the curve. He was uneasy with procedures involving the integration of imaginary expressions. Viewed formally in terms of operations and transformations, such procedures were feasible and led to useful results. Nevertheless, they lacked any interpretation within the established geometric formulation of the calculus. De Moivre desired a deduction that was grounded in known foundational conceptions, and the end result was the unusual derivation presented in the *Miscellanea Analytica*.

DEBORAH KENT, Hillsdale College
The Catenary on a Cone in Peirce's Analytic Mechanics

B. Peirce's 1855 treatise, *A System of Analytic Mechanics*, has been described as the most advanced mechanics text in English before Wittaker's *Analytical Dynamics* in 1904. In his text, Peirce aimed to summarize and streamline known European results and also to add some original work. Among other things, the text includes an expanded discussion of Peirce's results from an earlier paper investigating a catenary on a cone of revolution. Peirce claims as a major innovation his consideration of the "infinite part" of the catenary. Because Peirce's frequent publications seldom included actual mathematics, the overlap of mathematical exposition in both the article and the *Analytic Mechanics* provides a rare opportunity to analyze his assertion of novelty. This talk will consider Peirce's approach to the problem of the catenary on a cone of revolution and investigate both his techniques and related claims of innovation.

DUNCAN MELVILLE, St. Lawrence University
The role of problem texts in Old Babylonian mathematics

Much of our understanding of Old Babylonian mathematics is based on interpreting the abundant word problem texts in a curricular setting, with a secondary theme of developing a scribal *esprit de corps*. Recent detailed reconstruction of the scribal curriculum suggests that the latter reason: production, preservation and ownership of arcane knowledge, may have had precedence over curricular utility.

KIM PLOFKER, Union College, Schenectady, NY, USA
Greco-Persian geometry in seventeenth-century India

The Indo-Persian empires of the mid-second millennium CE in northern India fostered, both deliberately and accidentally, a great number of intellectual exchanges between Greco-Islamic science and the indigenous Sanskrit tradition. The anonymous *Hayata-grantha* ("Book on Spherical Astronomy"), a Sanskrit translation of the *Risāla dar hay'a* ("Treatise on Spherical Astronomy") by the fifteenth-century Samarqand astronomer 'Alī al-Qūshjī, bears witness to some of the philosophical adjustments that were required to fit the Persian version of traditional Euclidean geometry into the intellectual framework of Indian mathematics.

FREDERICK RICKEY, U.S. Military Academy, West Point, NY 10996, USA
Ferdinand Hassler's Fabulous Library

Ferdinand Hassler came to the United States in 1805 with a library of several thousand technical books. Sadly, poverty forced him to sell many of them. In 1825, the United States Military Academy Library purchased 405 books from him. Unfortunately, no list of those books has been found and he did not write his name in his books, so they cannot be definitely identified. By comparing library catalogs and correspondence for other book purchases, I will conjecture about which treasures in the West Point Library came from Hassler.

PAUL RUSNOCK, Department of Philosophy, University of Ottawa, Ottawa, ON, K1N 6N5
On Bolzano's concept of consequence

Though Tarski is generally credited with formulating the first satisfactory semantic definition of logical consequence, it is widely recognised that he was anticipated in this by Bernard Bolzano, who gave a similar definition in his *Theory of Science* of 1837. Some have claimed that Bolzano's definition is essentially equivalent to the substitutional definition Tarski considered, then rejected, in his well-known paper of 1936, and thus differs from Tarski's final definition mainly in that it is framed in terms of truth-making substitutions rather than in terms of the satisfaction of sentential functions. But there are other important differences between the two definitions, several of which do not appear to have been noticed by historians. In my talk, I will point out some of the unique features of the relation Bolzano defines and argue that on account of these, his consequence relation is not a mere historical curiosity, but an object of interest in its own right.

DIRK SCHLIMM, McGill University, 855 Sherbrooke St. W., Montreal, QC, H3A 2T7
Moritz Pasch's philosophy of mathematics

In his *Lectures on Newer Geometry* (1882), Moritz Pasch (1843–1930) gave the first rigorous axiomatization of projective geometry, in which he also clearly formulated the view that deductions must be independent from the meanings of the non-logical terms involved. In addition, Pasch also presented in these lectures the main tenets of his philosophy of mathematics, which he continued to elaborate on throughout the rest of his life. This philosophy is quite unique in combining an empiricist view with a deductivist approach to mathematics; his conception of axiomatic systems is rooted in the material tradition, which goes back to Euclid, but it also contains crucial aspects of modern, formal axiomatics. This talk presents Pasch's philosophy of mathematics and is intended as a contribution towards a better understanding of the radical transition mathematics underwent at the turn of the twentieth century.