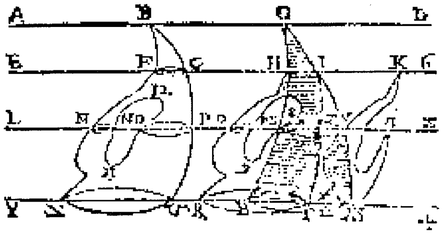

Canadian Society for History and Philosophy of Mathematics

Société canadienne d'histoire et de philosophie des mathématiques

History of Mathematics at the Dawn of a New Millennium
Programme 2000 — McMaster University, Chester New Hall 104, June 10-12, 2000

SATURDAY, JUNE 10

11:15-12:00 *Rüdiger Thiele, University of Leipzig*: **On Hilbert's 24th Problem**

At the end of the year 1899 David Hilbert was invited to make one of the major addresses at the second International Congress of Mathematicians in August 1900 in Paris. Hilbert hesitated and at last decided to lecture on some open mathematical problems, but he decided so late (in July) that his talk ``Mathematical Problems" was only included in the History section instead of the opening session. However, Hilbert's problems have proved to be central in the 20th century and became famous. All in all he discussed 23 important problems, although he did not present all of them in his address. Furthermore, he had even cancelled a problem on proof theory. The talk will give a short prehistory of Hilbert's famous talk and then a short overview of the problems Hilbert published in the Proceedings. I will go into some detail on the 23rd problem and on the (cancelled) 24th problem.

12:00-2:00 **BREAK**

2:00-2:30 *Tom Drucker, Modern Logic:* **Language, Truth, and Logic in Russell's Mathematics**

Bertrand Russell's distaste for ordinary language philosophy was often expressed, and he sought a language with which to express mathematics in an incorrigible fashion. This talk will look at Russell's idea of mathematical truth in the first decade of the 1900's and the forms of linguistic expression this truth could take. His views will be viewed against the background of the algebraic tradition in logic as well as the subsequent model-theoretic lines of research.

2:30-3:00 *Nicholas Griffin, McMaster University:* **Russell's Logicism is Not "If-Thenism"**

At the beginning of *Principles of Mathematics* Russell defines pure mathematics in terms of a special set of conditional statements. This remark, together with other things he says about geometry and rational mechanics, have led many people to suppose that his logicism is a type of "if-thenism" — that is, that the theses of his logicism are all of the form "if p then q" where p is a logical axiom and q a mathematical theorem. I show that this is not the case and that the conditional form that Russell insists on at the beginning of the Principles is imposed for quite different reasons, having to do with the unrestricted nature of the variables.

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3:00-3:30 *David Laverty, University of Western Ontario*: **Kit Fine's Theory of Variable Objects...**

In his *Cantorian Abstraction: A Reconstruction and Defense*, Kit Fine argues that if we treat the units resulting from a Cantorian abstraction as 'variable objects' we avoid the traditional problems associated with Cantorian abstraction and we are left with an account of number which rivals the competing accounts of Zermelo/von Neumann on one side, and Frege/Russell on another. According to Fine, the Zermelo/von Neumann account has the advantage of being representational, but suffers from being arbitrary, whereas the Frege/Russell account, while not being arbitrary, nonetheless is not representational. Fine's reconstruction of Cantor, however, provides us with an account that combines both advantages. We are given an account of number that is both representational and nonarbitrary. In this paper, I argue that the benefits gained from a representational account are, however, greatly outweighed by the costs involved in adopting Fine's Theory of Variable Objects.

3:30-4:00 *Albert Lewis, Indiana University:* **The Contrasting Views of Charles S. Peirce and Bertrand Russell on Cantor's Transfinite Paradise**

Russell and Peirce were opposites in many ways, but both saw great philosophical significance in Georg Cantor's theory of transfinite numbers. Russell thought Cantor's notions invalid at first but by 1900 came to unreserved acceptance of them. Peirce, the American pragmatist, in the same year more readily accepted their mathematical validity but regarded them as products of a curtailed view of the continuum. Is it possible a century later to evaluate which view has better stood the test of time?

4:00-4:30 **BREAK**

4:30-5:00 *Gregory Lavers, University of Western Ontario:* **Gödel, Carnap and Friedman on Analyticity**

Michael Friedman, in his paper "Analyticity and Logical syntax: Carnap vs. Gödel"', admits that his previous argument concerning the success of Carnap's project in *The Logical Syntax of Language* was mistaken. He admits, as well, that although he developed this argument independently it is essentially the same argument that Gödel put forward in the paper that he wrote for, but was not included in the Schlipp volume on Carnap. However, he maintains that the Gödelean argument, although not in itself fatal to Carnap's program, can be used to point out what is viciously circular in this program. In this paper I show that Gödel's argument does point to a flaw in Carnap's project, if one is willing to accept Gödel's somewhat mystical presuppositions. I then show that Friedman's case against Carnap, which can be seen as a demystification of Gödel's argument, fails to address Carnap.

5:00-5:30 *Agnes Kalemaris, SUNY Farmingdale:* **Grace Murray Hopper was a Mathematician**

Grace Murray Hopper (1906-1992) had justly received recognition for her pioneering work in computer science. However, she began her career as a mathematician, earning a bachelor's degree in mathematics and physics at Vassar in 1928, and a masters and Ph.D. at Yale in 1930 and 1934, respectively. This paper will discuss some of her accomplishments in mathematics and her unconventional methods of teaching it.

5:30-6:00 *Ariane Robitaille, Université de Nantes:* **Can We Learn Something About Combinatorics from Review Journals?**

Mathematical review journals, such as *Mathematical Reviews* and *Zentralblatt für Mathematik und ihre Grenzgebiete*, are full of clues helping us to put in a global perspective a particular mathematical subject seen as a whole within Mathematics. We can do a quantitative analysis of the number of articles published about the subject, look where those articles have been published, scrutinize the evolution of the classification systems used, *etc.* Armed with all that material, we can establish a tentative periodization that will need a deeper look, and we can make a comparison with the rest of mathematics. In my talk, I will discuss my work done with review journals in the case of combinatorics.

SUNDAY, JUNE 11

8:30-9:00 *Daryn Lehoux, University of Toronto*: **The Zodiacal Days in the Geminus and Miletus Parapegmata**

The Geminus and "Miletus I" parapegmata are astronomical instruments that give day-by-day predictions for the annual risings and settings of the fixed stars. In the Geminus parapegma these stellar 'phases' are tied to daily weather predictions as well. In both parapegmata the stellar phases are organized according to the sun's motion through the zodiac. Thus, for example, Geminus has "On the first day of Leo, Sirius appears, according to Euctemon; the hot weather begins." The zodiacal days ("first day of Leo, second day of Leo," *etc.*) have been interpreted as betraying the existence of a special Greek (astronomical) zodiacal calendar. I will argue that this interpretation is untenable. Instead we should see the zodiacal days as being a kind of extra-calendrical calibration mechanism for these instruments, which would allow the Greeks to use the same parapegma from year to year and in different cities, in spite of the vagaries of the various observational lunar calendars in use.

9:00-9:30 *Craig Fraser, University of Toronto:* **Hilbert's *Grundlagen der Geometrie* and its Relation to Euclid's *Elements***

Hilbert's *Grundlagen der Geometrie* (1899) is widely regarded as a canonical work of modern mathematics. Howard Eves and Carroll V. Newson write, "By developing a postulate set for plane and solid geometry that does not depart too greatly in spirit from Euclid's own, and by employing a minimum of symbolism, Hilbert succeeded in convincing mathematicians, to a far greater extent than had Pasch and Peano, of the purely hypothetico-deductive nature of geometry" (*Foundations and Fundamental Concepts of Mathematics* (1966, p. 94), my emphasis). The origins and historical influence of Hilbert's book have been explored in the writings of Michael Toepell and Leo Corry. The purpose of the present paper is to provide a comparative study of the *Grundlagen* and *Elements* I-VI in order to elucidate points of similarity and difference in approach, concept and outlook between the two works. The paper also explores the meaning of deduction in the modern mathematical tradition.

9:30-10:00 *Erwin Kreyszig, Carleton University:* **"Modern" Starts**

This paper concerns the roots and the early period of "modern mathematics", a short term for the mathematics of the twentieth century, as opposed to the "classical mathematics" of the nineteenth century. It explores the principal reasons for the main differences of modern mathematics from classical, in both form and content. This includes advances in formalization, axiomatization, and the emphasis of structures, as well as the appearance of totally new areas, mainly topology (general as well as algebraic), functional analysis and algebra (as in van der Waerden'[s classic and beyond). We shall concentrate on the first two of these three areas and show their closely related evolution, whose systematic beginnings are usually considered to be marked by Volterra's work on special functionals in 1887, Poincare's introduction of combinatorial complexes in 1895, and Frechet's and F. Riesz's (independent) works on abstract spaces in 1906. It will be shown that the period from 1880 to 1915 (roughly) had transitional character in the sense that areas and their problems, mainly in the calculus of variations, spectral theory, and integral equations, that motivated and paved the way in functional analysis, were developed by means of classical analysis.

The title of the paper is borrowed from a contemporary exhibition in the Museum of Modern Art in New York City, and the paper will be concluded with a few comparative remarks on analogies and differences.

Adrian Rice, Randolph-Macon College: **TBA**

10:00-10:30

BREAK

10:30-2:00

2:00-2:30 *Duncan Melville, St. Lawrence University*: **Third Millennium Mathematics: A Brief Survey**

While many people are aware of the origins of mathematics in tokens in the Near East and its flowering into a powerful technical discipline in the Old Babylonian period, few except specialists study the history linking these two points. In this talk, we shall give a brief survey of how mathematics developed in the crucial third millennium. We will pay particular attention to the development of cuneiform and the famous place-value sexagesimal system of scientific computation.

2:30-3:00 *Hardy Grant, York University:* **Greek Mathematics in Cultural Context**

In classic Greece the claims of various pursuits, including mathematics, to the status of an "art" or a "science", with the attendant prestige, were much in the air. I shall try to set mathematics in this context by considering its possible influences on, and influences from, its rivals in the competition — two such rivals in particular.

3:00-3:30 *Sharon Kunoff, Long Island University:* **A Commentary on the First Hebrew Geometry and its Relationship to the First Arabic Geometry**

In 1932 Solomon Gandz published a version of the *Mishnat Ha Middot* containing a fragment which had recently come to light. This new data enabled him to date the text c. 150. The Geometry of Al-Khowarizmi C. 820 contains much of the same facts, with some additions. In this paper we will look at some material from each and compare the results. We will also consider the practical nature of the material, seeing how it was written to demonstrate how to do various geometric computations, rather than as a theoretical theorem-proof geometry.

3:30-4:00 *Glen Van Brummelen, Bennington College:* **Sin 1°: From Ptolemy to al-K▣sh✚**

Trigonometric tables were fundamental to the work of practicing astronomers from Hipparchus onward; poorly-computed values could compromise almost all predictions of the positions of the heavenly bodies. Geometric considerations permit the computation of 1/3 of the values in a typical sine table; a good estimate of sin 1° is needed to determine the remaining sines. Ptolemy's estimate of the (almost equivalent) chord of 1° in the *Almagest* is well-known; Jamshid al-K▣sh✚'s early 15th-century iterative scheme is almost as famous. We shall emphasize intervening accomplishments, including the history behind al-K▣sh✚'s little-known original method and its eventual use in Ulugh Beg's monumental sine table. Other techniques that might have been used to generate the thousands of entries in these tables will be presented. This paper represents joint work with two undergraduate researchers: Abe Buckingham (The King's University College) and Micah Leamer (Bennington College).

4:00-4:30 **BREAK**

4:30-5:00 *Jim Tattersall, Providence College:* **Vignettes from Gerbert's Mathematics**

Gerbert d'Aurillac (940-1003) distinguished himself as scholar, mathematician, and cleric. He was an avid proponent of the Hindu-Arabic system. We investigate several interesting geometric and number theoretic problems proposed in his treatises and correspondence.

(*Sunday programme continued, over*)

5:00-5:30 *Hugh McCague, York University*: **The Mathematics of Building and Analysing a Medieval Cathedral**

The designing and building of a medieval cathedral applied mathematics in a variety of ways. The main application was practical geometry. A master mason could adeptly and repeatedly apply a few simple geometric tools and operations to produce a myriad of sophisticated designs as attested by the cathedrals themselves, by extant late medieval design manuscripts, and by full-scale drawings still etched on church floors and walls. Another applied mathematical element that worked hand in hand with the geometry was the use of measurement units, such as the English royal foot and perch. The rediscovery of the mathematical schema employed at a specific church, such as Durham Cathedral, is a challenging problem within architectural history. This issue is beginning to get much needed assistance from recent statistical methods including circular data analysis and bootstrapping techniques. The meaning and symbolism of the cathedral also applied mathematics through such means as the mathematical schema of the Heavenly Jerusalem which was the key dedicatory identification for the church. Further, stonemasonry was reverently known as the Art of Geometry, and was one of the mechanical arts which in complement with the liberals arts formed the means for the human's attainment of wisdom. Like Creation, the building of a medieval cathedral was to follow the law of Wisdom 11:21: "Thou madest all things in measure, number and weight."

5:30-6:00 *Roger Godard, Royal Military College:* **Interpolation Theory at the Dawn of a New Millennium: An Historical Approach**

This paper comments on the old interpolation problem, and particularly, the contribution of the twentieth century. However, we shall start our study with Lagrange (1792-1793). Here we emphasize the mathematical, numerical, and philosophical problems, and the evolution of proofs linked to interpolation. After the discovery of the Runge phenomenon (1901), the problem of approximation of equidistant data by polynomials was better understood (de la Vallée-Poussin, Bernstein, Montel). In this work, we also present trigonometric interpolation, which represents efforts towards the development of orthogonal functions and generalized Fourier series, and certain classes of functions, which can't be developed in Taylor's series. We reexamine the tools of the Fourier transform in the interpolation theory, and the sampling theorem (Wiener, 1934; J. M. Whittaker, 1935; Shannon, 1950) which is also a global interpolation formula. Schoenberg (1946) tried to divide the problem of interpolation into two categories. He distinguished the case where the ordinates belong to known analytical functions and the case where the ordinates come from empirical observations. In the later case, he suggested the spline interpolation.

This truly empirical approach was to be extremely fruitful for the Theory of Approximation, Schoenberg did not realize that he transformed the problem of interpolation into a problem of linear algebra, where the results are obtained by the numerical solution of a sparse system of linear equations, which is very stable.

MONDAY, JUNE 12

8:30-9:00 *Donna Spraggon, McMaster University*: **Felix Klein's "Elrlanger Programm" and its Influence**

Acting on his belief that the study of geometry had become too fragmented, Klein distributed his bold exposition *Vergleichende Betrachtung ueber neuere geometrische Forschungen* on December 17, 1872 at his inaugural address at Friedrich-Alexander-Universitaet in Erlangen, Germany. This pamphlet suggested that the use of algebra, or more specifically the group theory of the time, to classify all of the known geometries. The influence of the contents, more commonly referred to as the *Erlanger Programm* (EP), has been subject to debate by many historians of mathematics. Although Klein's unifying concept had not been developed to its full potential, one may gain an appreciation for its significance. To this end, it is necessary to approach the analysis of the influence in several different ways. We will examine the years 1872-1889, the influx of republications of the EP, the effects on the Italian School of geometry, Riemannian geometry, Relativity theory and the influence on the teaching of geometry. In considering these factors, this paper exposes a clear, yet complex, look at the influence of Felix Klein's *Erlanger Programm.*

9:00-9:30

Gregory Moore, McMaster University: **Editing Mathematicians: Bertrand Russell and Kurt Gödel**

This talk discusses editing the collected papers of the two mathematicians mentioned above (both of whom were philosophers as well), particularly in regard to their mathematical logic. Questions as to what unpublished materials to include in the respective volumes are central to this talk. In Russell's case, the use of his evolving logical symbolism in dating previously undated manuscripts and in determining which order manuscripts were composed will be treated in some detail. The speaker was one of six editors for two volumes of Gödel's works, has previously published one volume of Russell's and is now completing a second. For the two Russell volumes, he is the sole editor.

9:30-10:00

Ram Murty, Queen's University: **Euclid, Brahmagupta, and ABC**

The purpose is to survey the problem of finding integer solutions (x,y) for $ax^n + by^n = 1$ with a, b given integers. Of course, for $n = 1$, this is Euclid (c. 300 B.C.). For $n = 2$, it is Brahmagupta (c. 600 A.D.) and for larger n, one needs the ABC conjecture of Masser and Oesterle (1980 A.D.) to solve it effectively. (In the latter case, there are only finitely many solutions.)

10:00-11:00

ANNUAL GENERAL MEETING

11:00-2:00

BREAK

2:00-2:30

Edward Cohen, University of Ottawa: **The Leap-Year Problem has not Gone Away**

In Julius Caesar's time (45 BCE), it was thought that the length of a year was 365 1/4 days; *i.e.*, Caesar made one leap year every 4 years or 100 years in 400 years. Pope Gregory XIII in 1582 changed that to 97 years in 400 years because the astronomers in his time had a more accurate picture of how long a period it took for the earth to go around the sun. This is more precise; however, in the year 2000CE, the Gregorian calendar overstates the length of the year by approximately 26 seconds. This means that in approximately 1582 + 3330 years, we would have to drop one leap year. Also, the length of the solar year is not a constant. This further complicates the situation. One of the first astronomers to consider the leap-year problem was Simon Newcomb (1835-1909). We try to state the problem as he saw it and consider how it might be solved.

2:30-3:00

Francine Abeles, Kean University: **Game Theory and Politics: A Note on C. L. Dodgson**

In 1884, C. L. Dodgson wrote *The Principles of Parliamentary Representation* where he showed, for the first time, that in an election if each of two political parties utilizes a maximin strategy in a two person zero sum game model, the result would be a "best" electoral system in the sense of providing the greatest degree of voter representation.

3:00-3:30 *Amy Ackerberg-Hastings, Iowa State University:* **The Semi-Secret History of Charles Davies**

Charles Davies (1798-1876) and his textbooks invariably show up in discussions touching on mathematics education in the United States in the nineteenth century. Yet, due to the generality, age, or inaccessibility of most of even the relevant secondary sources, many mathematicians and historians have been unable to learn the reasons why Davies exerted such a pervasive influence. Thus, this paper draws upon the first modern biography of Davies to outline his life and career. The paper will also note some of the perennial themes in mathematics education manifested in Davies' textbook series.

3:30-4:00 *Christopher Baltus, SUNY Oswego:* **Gauss's Algebraic Proof of the Fundamental Theorem of Algebra**

Gauss offered a second proof of the Fundamental Theorem of Algebra, some years after his 1799 proof, resting on 'purely analytic principles' — we would now call it algebraic — but avoiding the fundamental defect of previous proofs, the 'supposition that the function can be resolved into simple factors.' Gauss's argument has been interpreted in a variety of ways, including the claim by Bachmacova (1960) that he created a field of decomposition for the polynomial along lines that Kronecker would later follow. I propose to simply reexamine Gauss's original argument, in its original context.

4:00-4:30 **BREAK**

4:30-5:00 *Israel Kleiner, York University:* **Aspects of the Evolution of Field Theory**

I will discuss highlights of the evolution of field theory, including some of its sources and its emergence as a mature, abstract theory.

5:00-5:30 *Robert Thomas, University of Manitoba:* **Mathematics and Fiction: A Pedagogical Comparison**

Mathematics is often compared to music and poetry. Another comparison is presented here, that to simple stories. Most persons do not write either music or poetry, have no idea how, but do tell stories. Perhaps this comparison can help those not willing or able to learn mathematics to appreciate some of how the art of mathematics is practised.

5:30-6:00 *Mike Millar, Northern Iowa:* **TBA**