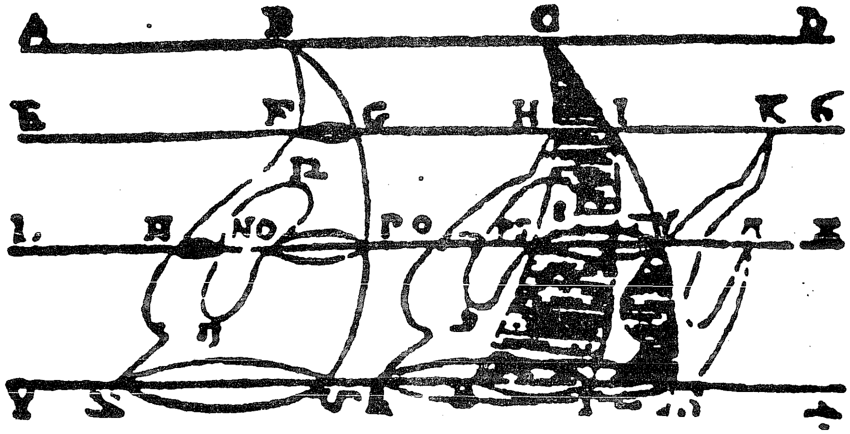
Canadian Society for History and Philosophy of Mathematics



Société Canadienne d'Histoire et de Philosophie des Mathématiques

PROGRAMME

20E CONGRÈS ANNUEL
8 JUIN - 10 JUIN 1994

20TH ANNUAL MEETING
JUNE 8 - JUNE 10, 1994

UNIVERSITY OF CALGARY, CALGARY

PROGRAMME
WEDNESDAY, JUNE 8
All sessions will be held in MacEwan Hall, Room 317

8:45 *Thomas Archibald, President CSHPM/SCHPM*
Welcome

REGULAR SESSION/SESSION ORDINAIRE
Presider, Morning: Thomas Archibald

9:00 *William S. Anglin*
Introducing Jean Prestet

9:45 TEA AND COFFEE — THÉ ET CAFÉ

10:00 *Katherine Hill*
Oughtred's Clavis Mathematicae and the Introduction of Algebra into England

10:30 *James Tattersall*
The Early History of the Lucasian Chair

11:00 *Louis Charbonneau*
James Hume: Was he really a follower of Viète?

11:30 *Jacques Lefebvre*
Noël Durret's Contribution (1644) to the Diffusion of Viète's Analytic Art in France

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12:00 LUNCH — DÉJEUNER
(COUNCIL MEETING) — (RÉUNION DU CONSEIL)

Presider, Afternoon: Israel Kleiner

1:30 *Gregory H. Moore*
The Origins of Vector Spaces and Modules

2:00 *Craig Fraser*
The History of the Multiplier Rule in the Calculus of Variations

2:30 *R. Godard*
Sur l'évolution de la rigueur dans les séries de Fourier et leurs applications

3:00 *Abe Shenitzer*
Remarks on the Evolution of Set Theory

4:00 DEPARTURE BY BUS FOR MOUNTAIN BARBECUE

PROGRAMME
THURSDAY, JUNE 9
All sessions will be held in MacEwan Hall, Room 317

REGULAR SESSION/SESSION ORDINAIRE
Presider, Morning: Hardy Grant

9:00 *Thomas L. Bartlow*
Errors in History of Mathematics Textbooks - The Case of the Petersburg Paradox

9:30 *Sylvia M. Svitak*
Cyril Burt, I.Q.'s, and the Development of Factor Analysis

9:45-10:30 ~~10:00~~ *Sharon Kunoff and Barbara Bohannon*
Mathematical Origins of Chaos and Dynamical Systems

10:30 TEA AND COFFEE THÉ ET CAFÉ

11:00 *Glen Van Brummelen*
From Drudgery to Invention: Astronomical Computation in Medieval Islam

11:30 *Edward L. Cohen*
The Hebrew Calendar Simplified

12:00 LUNCH DÉJEUNER
ANNUAL MEETING RÉUNION ANNUELLE

Presider, Afternoon: Abe Shenitzer

2:30 *Erwin Kreyszig*
Topological Ideas in Analysis

3:15 TEA AND COFFEE THÉ ET CAFÉ

3:30 *Israel Kleiner*
Paradoxes in the History of Mathematics

4:00 *Hardy Grant*
What is "Modern" about Modern Mathematics

4:30 *Sunoy Sanatani*
On the Applicability of Mathematics

5:00-7:00 PRESIDENT'S RECEPTION - THE OLYMPIC OVAL

PROGRAMME
FRIDAY, JUNE 10

The afternoon session with CSHPS on Hermann Weyl will be held in SH278.
All other sessions will be held in MacEwan Hall, Room 317.

7:30 Call H

SPECIAL SESSION/SESSION SPÉCIALE
History of Mathematics in the United States and Canada
Presider, Morning: Craig Fraser

8:45 *Craig Fraser*
Introduction of Guest Speaker

9:00 *Karen Parshall*
The Emergence of the American Mathematical Research Community 1876-1900

10:15 TEA AND COFFEE THÉ ET CAFÉ

10:30 *Thomas Archibald*
Some Highlights of the History of Mathematics in Canada prior to 1945

11:00 *Louis Charbonneau*
De l'École polytechnique de Montréal au département de mathématiques de l'Université de Montréal (1873-1920)

Ray

11:30 LUNCH DÉJEUNER

REGULAR SESSION/SESSION ORDINAIRE
Presider, Afternoon: Sharon Kunoff

1:00 *Darcy Cutler*
Etchemendy on Tarski's (1936) "Definition" of Logical Consequence

1:30-2 Call H.

Rajagopal

1:30 *M.A. Malik*
Mathematization of Motion from Ancient to Renaissance Times and the Beginning of the Calculus

2 PM Griffiths

2:00 TEA AND COFFEE THÉ ET CAFÉ

2:30 *R. Rajagopal*
Indian Mathematics after Islamic and British Occupations

3:00 *A.K. Ray*
Reminiscence: Applied Mathematics: Calcutta and Göttingen

3:30 *Peter L. Griffiths*
Can an Understanding of Old Babylonian Mathematics Benefit our Students?

JOINT SESSION/SESSION COOPÉRATIVE WITH THE CANADIAN SOCIETY FOR THE HISTORY AND PHILOSOPHY OF SCIENCE

Hermann Weyl and the Philosophy of Mathematics and the Natural Sciences

Presider, Robert DiSalle

Room SH278

2:00-5:00 SPEAKERS: Herbert Korte (Regina), John Bell (UWO), Darcy Cutler (UWO)

ABSTRACTS/RÉSUMÉS

SPECIAL SESSION ON THE HISTORY OF MATHEMATICS IN THE UNITED STATES AND CANADA

Thomas Archibald *Acadia University* **Some Highlights of the History of Mathematics in Canada prior to 1945**

Louis Charbonneau *Université du Québec à Montréal* **De l'École polytechnique de Montréal au département de mathématique de l'Université de Montréal (1873-1920)**

Lors de la fondation en 1920 du département de mathématiques de l'Université de Montréal, l'un des premiers professeurs est Elzéar-Victor Beaupré qui enseigne alors à l'École polytechnique. De même, lors de la fondation à Montréal en 1923 de la Société mathématiques et d'astronomie du Canada, quatre des six membres du comité de direction viennent de cette même école. La vie mathématique à Montréal avant 1920 semble donc s'organiser, du moins du côté francophone, essentiellement autour de l'École polytechnique. Nous examinerons dans notre communication la place des mathématiques dans l'enseignement à cette école, depuis sa fondation en 1873 jusque vers 1920.

Karen Parshall *University of Virginia* **The Emergence of the American Mathematical Research Community: 1876-1900**

This will be a look at the book that Karen Parshall and David Rowe have finished and which should come out some time in the summer.

CONTRIBUTED PAPERS

W.S. Anglin *Luther College* **Introducing Jean Prestet**

Jean Prestet was a seventeenth century mathematician whose carefully written textbook contains a couple of original results in Number Theory. In this talk we give a summary of Prestet's textbook, and the many interesting glimpses it offers of his life and times.

Thomas L. Bartlow *Villanova University* **Errors in History of Mathematics Textbooks - The Case of the Petersburg Paradox**

It is no easy matter to write a history of mathematics textbook. One difficulty is deciding which mathematical topics to cover and in how much detail to cover them. Another problem is getting the historical details right. A case in point is the Petersburg Paradox. Some texts don't treat it. Those that do discuss it briefly and include erroneous information about the origin of the problem.

Louis Charbonneau *Université du Québec à Montréal* **James Hume: Was he really a follower of Viète?**

In 1636, James Hume, a Scottish mathematician and astronomer then living in Paris, published a book entitled *Algebre de Viète, d'une methode nouvelle, claire, et facile. Par laquelle toutes l'obscurité de l'inventuer est ostée, & ses termes pour la pluspart inusités, changez ès termes ordinaires des Artists.* This title seems to indicate that the author is a follower of Viète. In my talk however, I will show how, in Hume's book, the relative importance of analysis, arithmetic and geometry does not correspond with the general economy of Viète's algebra. These fundamental differences may nevertheless be related to the fact that Hume's book seems clearly aimed at a public of practitionners.

Edward L. Cohen *University of Ottawa* **The Hebrew Calendar Simplified**

The Hebrew calendar is complex. Gauss presented an algorithm for Passover dating, which may be turned into a method for determining how any type of Hebrew year is calculated in the Gregorian calendar.

Darcy Cutler *University of Western Ontario* **Etchemendy on Tarski's (1936) "Definition" of Logical Consequence**

In The Concept of Logical Consequence (1990), John Etchemendy argues that Tarski (1936) is an analysis of the "commonplace" or "naive" notion of logical consequence. According to Etchemendy, Tarski wants the consequence relation he defines to match the "naive" relation of logical consequence in both extension and intension. Etchemendy argues that Tarski's definition fails to capture the intension of the intuitive notion because it does not capture a modal property that we commonly ascribe when we say that a conclusion is a logical consequence of a set of premises: that the conclusion must be true if the premises are true or that the conclusion cannot possibly be false if the premises are true. Etchemendy distinguishes between representational and interpretational approaches to semantics. He argues that Tarski's definition fails because it follows the interpretational approach. Etchemendy holds that only a consequence relation based in a representational semantics can possess the requisite modal property.

I will argue that we cannot straightforwardly conclude that Tarski meant his definition of logical consequence to be an analysis of the "naive" notion. Rather, we should see it as a mathematically precise replacement for the naive notion. The virtue of the replacement notion is that its formulation is precise enough that it can have place in rigorous mathematical proofs. It is to be judged by the proofs it makes possible and not by how well it comports with "naive" usage. Even if Tarski does see his definition as a analysis of the naive notion, I would argue that its real value lies in its replacement of that notion in mathematical contexts. If we regard the definition as a replacement for the naive notion then there is no reason to expect it to provide the modal property that Etchemendy finds lacking. Finally, I argue that, in any case, Etchemendy's "representational" semantics fairs no better than Tarski's "interpretational" semantics on this score.

Craig G. Fraser *University of Toronto*

History of the Multiplier Rule in the Calculus of Variations

In 1886 Adolph Mayer published a paper in the Mathematische Annalen in which he noted some difficulties in the traditional demonstration of the multiplier rule in the calculus of variations. Using ideas that originated with Weierstrass and Scheeffer he attempted a new demonstration of the rule. His paper is regarded as an important contribution to the calculus of variations.

A closer examination shows that Mayer's proof is entirely fallacious. It is surprising that there had been no critical notice of this fact in either the research or the historical literature in the calculus of variations. In 1896 B. Turksma published a quite different proof of the multiplier rule and in 1906 Hilbert published yet another demonstration. In contrast to the work of Mayer the researches of Turksma and Hilbert are both original and sound.

Further approaches to the multiplier rule along new lines were contained in articles of Johann Radon and Gilbert Bliss from the 1920s. Their work provided the basis for the treatment of the multiplier rule in the most recent textbooks of Paul Funk and L.A. Pars.

The paper provides a survey of the remarkably diverse work on the multiplier rule from Mayer to Bliss.

Peter L. Griffiths

The Old Babylonians (c. 1700 BC) had achieved an Understanding of the Foundations of Mathematics; Can the original as well as the rediscovered versions of these Achievements be of Benefit to our Students?

1. The Old Babylonians (unlike the early Greeks and Romans) worked with a proper system of numbers, whereby values corresponded with the number of digits, and so were able to leave a permanent record (on cuneiform tablets) of mathematical achievements more advanced than those of the early Greeks (up to 100 AD).
2. The Old Babylonians knew the formula for solving quadratic equations.
3. The Old Babylonians knew the Iteration procedure for finding roots, and so were almost certainly aware that the coefficient of the second term of a binomial expansion was the power of the original binomial.
4. Old Babylonian tablets contained successive powers of a given number, and so the Old Babylonians were able to solve compound interest problems by interpolation.
5. The Old Babylonians were able to add constant amounts raised to successive powers in a series, and so knew of a version of the present value formula.
6. The Old Babylonians know that the sum of squares of successive integers up to 10^2 could be expressed by the formula
$$(\frac{2}{3}n+\frac{1}{3})[\frac{n(n+1)}{2}].$$
7. The Old Babylonian cuneiform tablet Plimpton 322 was an attempt to record trigonometric tables from 30° to 45° in fifteen rows.
8. Can the original as well as the rediscovered version of the Old Babylonian achievements be of benefit to our students?

R. Godard *Royal Military College* **Sur l'évolution de la rigueur dans les séries de Fourier et leurs applications**

"Selon Hilbert, l'histoire enseigne la continuité du développement des mathématiques et nous savons que chaque époque a ses propres problèmes que l'époque suivante résout ou met de côté parce que non-profitable puis les remplacer par de nouveaux." (Collette, Histoire des Mathématiques, p.339)

Les séries de Fourier sont une illustration frappante de l'esprit de synthèse de Hilbert. On essaie de suivre ici, dans le temps, les questions que se sont posés les mathématiciens sur les problèmes d'existence des solutions, les différents types de convergence des séries de Fourier, de la solution d'équations différentielles partielles au traitement numérique du signal.

Hardy Grant *York University* **What is "modern" about modern mathematics?**

Many characterizations of modern mathematics have been offered, and I shall not try to add to their number. Rather, I shall try to show that certain frequently cited contrasts between ancient and modern mathematics have deep parallels in other spheres of western culture, and similarly that mathematics can be seen to have participated in the one great cultural sea-change which, arguably, best defines the difference between ancient and modern sensibility. I shall raise the question whether in these respects one can make out causal connections, in either directions, between mathematical developments and the wider milieu.

Katherine L. Hill *University of Toronto* **Oughtred's Clavis Mathematicae and the Introduction of Algebra into England**

William Oughtred's (1574-1660) *Clavis Mathematicae* was one of the most influential mathematical texts in England from its publication in 1631 until John Wallis began to publish his researches at Oxford in 1657. Although Oughtred was the rector of Albury, he had many young men come into his home to learn mathematics. His *Clavis* began as a treatise on algebra employed to instruct the Earl of Arundel's sons. It contained in a condensed form the essentials of arithmetic and algebra as known at that time. Compared to other contemporary works the *Clavis* utilized extensive symbolism and treated numbers in a sophisticated fashion. For example, Oughtred gave an explanation of decimal fractions and how to operate with them. He accepted as well the idea of irrational numbers and that they could be approximated with infinite decimal expansions and continued fractions. He also included and exposition of logarithms. Thus in Oughtred's work we can see the beginnings of a new concept of number and an introduction of algebraic techniques into England.

Israel Kleiner *York University* **Paradoxes in the History of Mathematics**

I will present examples of paradoxes from several periods in history and from various areas, and indicate their role in the evolution of mathematics. (I will use a rather broad notion of "paradox".)

Erwin Kreyszig *Carleton University* **Topological Ideas in Analysis**

This nontechnical talk concerns the evolution of topology in connection with analysis from 1847 to about 1950. The first period of this development extends from 1847, the year of the appearance of the topological studies by Listing (who also suggested the term 'topology', earlier used by Leibniz, but in a different sense), to 1887, the year of publication of Volterra's notes on functionals. This period is characterized by the influence of complex analysis (Riemann), set theory (Cantor), and variational calculus (Weierstrass). During the next period 1887-1932, topology and functional analysis developed jointly, an a process of mutual give-and-take. Highlights during that period include the publications of basic works of Lebesgue (1902), Fréchet (1906), Hilbert (1906), F. Riesz (1906, 1909, 1910, 1916), Hausdorff (1914), Hahn (1927), and Banach (1932). Around 1932, both topology and functional analysis were established as independent fields of their own. From the remaining period after 1932 we select a few typical events illustrating the development of topological methods arising from problems in analysis.

Sharon Kunoff and Barbara Bohannon *LIU and Hofstra University* **Mathematical Origins of Chaos and Dynamical Systems**

Fast calculators and inexpensive P.C.'s seem to have changed the nature of mathematics. It is now possible to consider mathematics as a laboratory science with experiment and proof. We are all aware that some well-known theorems have succumbed to "proof by computer." The study of Chaos and Linear Dynamics has certainly been advanced by the technology. However most writers are quick to acknowledge that the subject begins with Poincaré. We will explore some of the ideas credited to Poincaré and how lack of technology caused these ideas to lie fallow for so long.

Jacques Lefebvre *Université du Québec à Montréal* **Noël Durret's Contribution (1644) to the Diffusion of Viète's Analytical Art in France**

In 1644, the French astronomer Noël Durret (1590-c.1650) published "L'algèbre effections géométriques et partie de l'Exegetique nombreuse de l'illustre F. Viète." This was one of a number of partial translations or adaptations in French of the analytical works of François Viète (1540-1603) by various authors over a span of fifteen years (see Vasset (1603), Vaulézard (1630), James Hume (1636)). This paper examines the choice of books made by Durret as well as the treatment he gives them, the respective roles of geometry and arithmetic, the mathematical level of difficulty, the mixture or succession of pure and applied mathematics, the fidelity to Viète and the presence of new tendancies. The uneven quality of Durret's book is considered *per se* and is compared with Viète's original latin texts, with texts of Durret's contemporaries and with some modern translations of Viète's analytical works.

M.A. Malik *Concordia University* **Mathematization of Motion from Ancient to Renaissance Time and the beginning of Calculus**

The beginning of calculus has its foundation in the study of motion. Though the interest in the study of motion has been since antiquity, calculus did not have its birth during the ancient Greek period but begins with Newton and Leibniz in the second half of the seventeenth century. It seems that the objective of study on motion itself underwent a change from ancient to renaissance time. The mathematics of motion in the ancient period did not warrant the ideas that could have led to the invention of calculus. The Copernican model of our universe suggested a different direction in the study of motion, in fact, in the mathematization of invisible motion which is a leading cause for the invention of calculus.

In this talk we discuss the history of calculus along this line and its suggested influence of the teaching of calculus courses. This talk may be regarded as a follow up of my communication presented at the Annual Meeting of the Society held at Kingston in 1991.

Gregory H. Moore *McMaster University* **The Origins of Vector Spaces and Modules**

The notion of vector space was first axiomatized by Peano in 1888, under the name of "linear system", in the context of Grassmann's work on geometry. But Peano's notion had little resonance outside of Italy, and the notion was rediscovered repeatedly--by Weyl in 1917, and then by Banach, Hahn, and Wiener independently around 1920. While Weyl's version had little effect, those of Banach etc. had much. Also in 1920 E. Noether independently formulated the notion of module over a ring, which is a generalization of that of vector space over a field. (The latter notion was slow to be studied, since it was vector spaces over the real or complex numbers that were of interest to analysts.) This talk explores the factors that led the notion of vector space to be rediscovered repeatedly and that kept it from taking hold in 1888 when first formulated.

P. Rajagopal *York University* **Indian Mathematics after Islamic and British Occupations**

Islamic invasion of India began in earnest at the end of the 10th century, and by about 1500 much of Northern India was under Islamic rule. As a result of the Islamic invasions and subsequent occupation of India mathematical scholarship went into a conserving mode from about 1200. Even in South India much of the work of the Madhava school was one of keeping alive the Aryabhata tradition.

Europeans began to set up trading companies from about 1600, and by 1750 the British had established themselves in India; in 1858 India was taken over from the East India Company by the Queen of England. Immediately after that there was a raging controversy, both in England and in India about the kind of education that should be instituted.

The role of mathematics in the new educational system is described. There were some attempts to graft calculus on to Indian algebra, but these were met with a combination of contempt and indifference (both in England and India). This paper will sketch this mathematical history and bring it up to the beginnings of this century.

A.K. Ray *Fundamental Research Institute, Canada* **Reminiscence: Applied Mathematics: Calcutta and Göttingen**

The department of applied mathematics of the university of Calcutta [India] started functioning from the year 1914 changing name from mixed mathematics [existed since later years in nineteenth century] to applied mathematics.

Some of the professors [in the early period] of the department were trained in Germany under professors like Max Planck, Albert Einstein, Arnold Sommerfeld, Max von Laue, Max Born, David Hilbert, Richard Courant, Ludwieg Prandtl and others.

The teachers [in Calcutta] taught the core subjects in applied mathematics zb:Mathematical theory of elasticity, Advanced hydrodynamics (including Aerodynamics and Fluid dynamics), Advanced dynamics, Geodesy and Geophysics, Probability and Statistics (including Numerical mathematics), Electricity and Magnetism, Thermodynamics and Statistical Mechanics, Mathematical theory of Relativity, Quantum and Wave Mechanics, Spherical Astronomy, Theory of Potential and others.

They started to hold weekly seminars at the Calcutta Mathematical Society in a manner mostly influenced by the German school.

In the present exposition, author traces briefly the history of the German school of mathematics as mostly initiated by Felix Klein of Göttingen and his associates and then elaborates its influence upon applied mathematics [in the early period] of Calcutta University.

References:

- Calcutta University: Department of Applied Mathematics: 1992, Platinum Jubilee, Calcutta [India].
- A.K. Ray: History of Applied Mathematics: Carl Friedrich Gauss: Proc. of the Canadian Society for the history and philosophy of mathematics, Vol.15 [18th annual meeting], 1992.
- A.K. Ray: Ein Ausblick in Angewandte Mathematik: Proc. First International Symposium, Klagenfurt, Verlag Johanes Heyn, Lkagenfurt, Austria, 1972.

Sunoy Sanatani *Laurentian University* **On the Applicability of Mathematics**

Mathematics is often characterized as a discipline which has extensive *applications* in other disciplines unrelated to mathematics. Mathematicians themselves would rather not see their *métier* as subservient to foreign disciplines, whose tenets and methodologies are principally derived from empirical observations. Apart from the question of pride of the mathematicians, there are deeper questions regarding the validity of *any* application of mathematics to the real world. It is true that one often cites examples of the close relationships between physics and mathematics to justify the application mathematics to *reality*. However, such examples, on critical scrutiny, do reveal certain assumptions on which the applicability of mathematics to *reality* is based. These assumptions are not accepted as *self-evident* by everybody and their validity has been questioned throughout the ages.

In this paper I present some of the thoughts on the intertwining nature of the relationship of dependence of a theory (represented by a set of axioms) to a *model* of the theory. Such a relationship could provide a justification for the applicability of a theory to a particular model. But the crucial problem, namely, how much of the *reality* could be interpreted as a model for mathematics, would still remain unanswered.

Abe Shenitzer *York University* **Remarks on the Evolution of Set Theory**

Cantor was led to the study of sets by a problem in Fourier series. This was about 1870. His set theory was accepted with enthusiasm. Then came paradoxes and problems such as the continuum hypothesis and the problem of wellorderedness of the continuum. The latter problem was solved by Zermelo's discovery that one could well order every set by using the axiom of choice.

The major attempts to eliminate the difficulties associated with set theory are Brouwer's intuitionism, Hilbert's formalism, and the Zermelo-Fraenkel axiomatic buildup of set theory.

In 1931 Gödel showed the impossibility of proving the consistency of Peano's axioms. In 1963 Cohen showed that the axiom of choice and the continuum hypothesis are independent of the remaining axioms of set theory. In a sense, there are now many mathematics.

Sylvia M. Svitak *Queensborough Community College* **Cyril Burt, I.Q.s, and the Development of Factor Analysis**

Cyril Burt's influence on the mathematical foundations of factor analysis, a method of investigation arising from problems in psychology, will be considered. In his controversial work in intelligence testing, he put forward his own set of classifying principles. Burt's contributions are philosophically significant and show an acute awareness of the mathematical issues and difficulties inherent in factor theory.

Jim Tattersall *Providence College* **The Early History of the Lucasian Chair**

In 1663 Henry Lucas, longtime secretary to the Chancellor of the University of Cambridge, made a bequest which was subsequently granted by Charles II to endow a chair in mathematics at the University. There were a number of conditions attached to the Chair but the most important required the Lucasian Professor to present to the Vice-Chancellor at the start of each Michaelmas Term a written copy of not less than ten lectures that he had delivered in the previous academic year. Many of the early Lucasian were diligent in carrying out their Lucasian responsibilities but, as history shows, such was not always the case.

Glen Van Brummelen *The King's University College* **From Drudgery to Invention: Astronomical Computation in Medieval Islam**

The business of producing handbooks covering every aspect of the complexities of Ptolemaic and other models of astronomy was tedious at best, and often punishing. The necessity to compute mathematically defined tables containing thousands of entries compelled many medieval astronomers to mathematical invention. These ranged from the mundane, such as variants of interpolation schemes, to some creative uses of trigonometry. I shall highlight a set of tables that I analyzed recently, computed by Kushyar ibn Labban in the late 10th century,