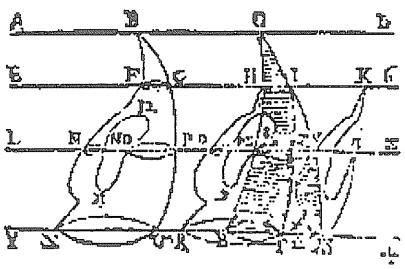
BULLETIN
CSHPM/SCHPM

November/novembre 1998 Number/le numéro 23

WHAT'S INSIDE



Canadian Society for History and Philosophy of Mathematics

Société canadienne d'histoire et de philosophie des mathématiques

ISSN 0835-5924

ABOUT THE SOCIETY

Founded in 1974, the Canadian Society for the History and Philosophy of Mathematics/ Société canadienne d'histoire et de philosophie des mathématiques (CSHPM/SCHPM) promotes research and teaching in the history and philosophy of mathematics. Officers of the Society are:

President: **Jim Tattersall**, Mathematics Department, Providence College, Providence, RI 02918, USA, <tat@providence.edu>

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The Society's Web page, designed and maintained by Glen Van Brummelen, is at www.kingsu.ab.ca/~glen/cshpm/home.htm

New members are most cordially welcome; please contact the Secretary-Treasurer.

Special Election Report

The results of the general election appear in the minutes of the general meeting. It was announced at that meeting that a special election would be held to fill a vacancy on the council which occurred when Fred Rickey was unable to serve. Rebecca Adams, an assistant professor of Mathematics at Southern California College, Costa Mesa, California, was then nominated for the position. A call for further nominations was sent to the membership. No additional nominations were made. Ballots were sent, resulting in the election of Rebecca by a vote of 55 yes and one abstention. It might be noted that all but four of the ballots were received by email, one of which was a hard copy of the email ballot.

A Message from the President

Jim Tattersall

The *Bulletin* editors have been kind enough to ask me to offer a few words concerning the activities conducted by and relating to the Society, what may be viewed by some as a State of the Society address. Let me begin by thanking the membership for their support and encouragement in the recent election. I am grateful and honored to serve as your President and will do everything in my power to promote the Society.

In June, I was delighted to see so many familiar faces at our 1998 annual meeting at the University of Ottawa. The meeting included a joint session with the Canadian Society for the History and Philosophy of Science and was part of the first "Canadian Congress of Social Sciences and Humanities", formerly the Congress of Learned Societies. The talks at our sessions were interesting and informative, and stimulated lots of conversation. Kudos go to Glen Van Brummelen, our peripatetic Secretary-Treasurer, for organizing a chronological general session and to Fran Abeles for organizing a special session on late-nineteenth-century mathematics. We are grateful to Ed Cohen for seeing to the local arrangements. Besides the camaraderie and the presentations, those in attendance took advantage of the wonderful opportunity to meet and listen to our featured speaker, Volker Peckhaus, from the Institut für Philosophie der Universität Erlangen-Nurnberg. His lecture on "Nineteenth-century logic: between philosophy and mathematics" was superb. In addition, each afternoon he joined us as we walked to Ottawa's colorful Byward Market area for dinner. Whether you plan to socialize or to present your latest research, I hope that you will join us at next year's annual meeting.

This summer, I also attended and spoke at the Northeastern Section of the Mathematical Association of America at Keene State College in New Hampshire. In July, along with several other CSHPM members, I attended the MAA "Mathfest" at Ryerson Polytechnic in Toronto. The meeting was full of interesting and intriguing talks, good opportunities to buy books at discount prices, and a host of social events. For me, the highlight of the meeting was the invited address "Bourbaki's Choices" by Liliane Beaulieu of our Society and of the Université de Montréal.

Mark your 1999 calendar. Next summer we will hold our annual meeting jointly with the British Society for the History of Mathematics at the Institute for the History of Science and Technology at the University of Toronto, July 15-17. As a consequence, we will not be meeting with the HSSFC at the 1999 Canadian Congress of Social Sciences and Humanities at Bishops University and Université de Sherbrooke in June. Craig Fraser has graciously agreed to help organize the meeting, whose theme will be historical perspectives on applied mathematics at fin de siècle. There will be ample opportunity to present contributed papers at the meeting. Toronto is an exciting place to be at any time of the year, but especially in the summer. Plan to attend the 1999 annual meeting and reciprocate the hospitality the BSHM provided us at the first joint CSHPM/BSHM meeting at Oxford in the summer of 1997. For more details on the 1999 annual meeting see the article on page 18 below.

Elsewhere in the *Bulletin* you will see an article on the CSHPM bylaws. The Executive Committee is proposing two constitutional changes. One will entitle the editor of the *Proceedings* and the editor(s) of the *Bulletin* to membership on the Executive Committee. The other outlines a procedure (currently there is none), for replacing elected Council members.

The HSSFC is soliciting information on important contributions made by humanists and social scientists. They would like from you a few paragraphs focusing on your research results and how they contribute to the understanding of ourselves and our place in the world. Many of us historians and philosophers tend to be shy and unassuming, but it is important to let others know what we are doing to make the world a more

interesting and better place to live. Please communicate the information to Chad Gaffield at <fedcan@hssfc.ca>.

There has been a reorganization in the Office of HSSFC. Specifically, the position of Director of the Aid to Scholarly Publications Programme has been eliminated and the responsibilities of this position have been reassigned to the Executive Director. The HSSFC Executive Committee expects that this reorganization will be the last step in the restructuring that began with the merger of the former Canadian Federation for the Humanities and the Social Sciences Federation of Canada in response to the new financial constraints of the 1990s. It is not known at present whether this move by the HSSFC will affect us.

We have been informed that the Aid to Scholarly Publications Programme, established in 1942, remains a major component of the Federation. The HSSFC Executive Committee is committed to providing complete administrative support to the outstanding scholars who devote so much time and expertise to the peer-review evaluation of manuscripts submitted for publication. The HSSFC Executive Committee expects that, under the leadership of the Executive Director of the Federation, Dr. Louise Robert, the administrative staff will fully support these scholars and continue the ASPP's tradition of excellence of contributing to the publication of the finest academic books in Canada.

Here is some food for thought. We would like very much to learn your opinion concerning our program for the year 2000 (Y2K). The Third Annual Meeting of the Canadian Congress of Social Sciences and Humanities will be held at the University of Edmonton from May 23 to June 3, 2000. We have tentatively asked to meet either May 25-27 (Thursday-Saturday), Memorial Day weekend in the States, or June 1-3 (Thursday-Saturday). Y2K has been designated World Mathematical Year and the Canadian Mathematical Society has asked the CSHPM (and other related organizations) if we would like to run a joint special session at either their summer meeting at McMaster University (in Hamilton, Ontario) in June or at the University of British Columbia (in Vancouver) in December. There is also the possibility of holding our annual meeting in June with CMS instead of with HSSFC. We should decide soon which option we wish to pursue. The Executive Committee is open to suggestions and would like to hear from you.

I have recently become associated with a group that considers meeting sites for national meetings of the American Mathematical Society and the Mathematical Association of America. What a tough job! Since joining the group I have traveled to San Antonio, Honolulu (*somebody* had to go), Providence (twice!), University of California at Los Angeles, and San Jose State University. It's an interesting job, but I have seen more hotel rooms and convention center facilities than I ever would have imagined or desired.

It is a pleasure to report that the history of mathematics is alive and well at joint meetings of the American Mathematical Society and the Mathematical Association of America. The next such meeting will be held January 13-16, 1999 in San Antonio, Texas. John Fauvel of the Open University will give an MAA invited address on the history of mathematics and its future. Robin Wilson of the Open University and his friends will offer a dramatic presentation on the mathematics of Lewis Carroll. The play will highlight Carroll's views on logic, algebra, and geometry and his attitudes to teaching. Florence Fasanelli of the College-University Resource Institute, and Fred Rickey of the United States Military Academy are organizing a session on the use of history in the teaching of mathematics, sponsored by the MAA Institute on the History of Mathematics and its use in Teaching. Karen Parshall of the University of Virginia and Victor Katz of the University of the District of Columbia, are organizing a two-day joint special session on the history of mathematics. Many years ago very few, if any, activities at the joint meetings related to the history of mathematics, but now such activities are among the most popular and well- attended events.
(See **President** page 11)

Historical Threads for "Seeing" in a Curved Space

Barry Davies

The idea of curved space is to us what the idea of the round earth was in ages past. The round earth was, and curved space is, familiar to, and accepted by, many in the scientific community while remaining completely alien to the practical experience of just about everyone else. I have been working on a Web-based project whose goal is to enable people to "see" in a curved virtual space. The project has several historical threads which I will try to present. One particular thread requires me — in order to follow it — to find mathematics historians with whom to collaborate. Consequently, my aim in this article is to begin to find these collaborators. I invite readers to check out my site, at http://www.uvw.com/ppr. The executive summary you will find there is quite similar to this article and provides links to work samples, to more bibliography, and to a mathematical exposition (in pdf files).

I will use the legacies of Euclid and Riemann and Einstein.

There is no motion in Euclid's geometry [1], and there will be no motion in the geometry of my project. Consequently, changes we observe in our virtual space will be seen as due to its changing curvature. It is gratifying to use Euclid here to obtain an important point in a problem of Riemannian geometry. Riemann [2] begins the historical thread which I would like to follow with the collaboration of mathematics historians. The subsequent work of Christoffel [3], Lipschitz [4], Ricci, and Levi-Civita [5] produced the absolute differential calculus. I became aware of the sequence of papers just cited through biographical information on Ricci [14]. So far, I have carefully worked through parts of Christoffel's paper and parts of the *Commentatio* by Riemann. After studying books on tensor analysis written in the 1940s and 1950s, I can see — from the titles alone — that working through these papers would greatly deepen my understanding. However, I'll need help with obtaining copies, help with language, and help with historical context. I'd like to start an e-mail correspondence with any Society members who may be interested. Please get in touch!

Einstein used the absolute calculus to formulate his law of gravity [6], through which he said that curved space may be a physical reality. Testimony that curved space *is* a physical reality can be found in many places, and I would offer this from the journal *Science*: "[...] communication technology is getting close to the accuracy levels where general relativistic corrections must be considered. (The U.S. Army employed such corrections during the Gulf war; Einstein's main legacy lost its traditional pacifist purity.)" [7] Shortly after Einstein published his equations of gravity (late in1915), Schwarzschild published a solution which shows how space is curved outside a spherical, non-rotating, electrically neutral star [8]. I will use this solution [9], but the time part will be dropped — resulting in a curved three-dimensional space in which there is no motion.

To create a scheme for seeing things in this curved space, I'll use the work of Levi-Civita. In his 1923 book entitled *The Absolute Differential Calculus* [10], Levi-Civita presented mathematics that will enable us to use the same idea for visualization in curved space that we use for visualization in flat

space: we see things by looking along the straight lines which connect them to our eyes. Consequently, the idea of the straight line will be central in the project. In 1917, Levi-Civita had formulated a generalized idea of what it means for lines to be parallel in curved spaces [11], and in *The Absolute Differential Calculus* he pointed out — with reference to curved surfaces — that this involves an extension of Euclid's definition of a straight line. [12]

I intend this project to be visible on the Web as a work in progress. I'll use Mathcad and Mathematica for practical computation, but I also hope to undertake a Web-based study of the necessary analysis [13]. Consequently, a foundation will be presented for an attempt to prove that a solution exists and that the commercial software has found it correctly.

NOTES:

[1] For this I have both the word of a professional geometer, David E. Joyce — http://aleph0.clarku.edu/~djoyce/java/elements/bookI/propI2.html (see the first paragraph of the "Guide" section) — and my own conclusion: At the beginning of his commentary on Euclid's first definition (see http://hydra.perseus.tufts.edu/cgi-bin/text?lookup=euc.+1.Def.+1&vers=english;heath&filter=none), Sir Thomas Heath indicates that the Greek which is translated as "A point is that which has no part" has the meaning "A point is that which is indivisible into parts". Subsequently, in the first paragraph of the "Criticisms by Commentators" section, we find the following: "Is [Euclid's definition] sufficient, seeing that there are other things which are without parts or indivisible, e.g. the now in time, and the unit in number? Proclus answers [...] that the point is the only thing *in the subject-matter of geometry* that is indivisible." Consequently, since there is then no time in Euclid's geometry, there can be no motion in Euclid's geometry.

[2] B. Riemann, *Über die Hypothesen, welche der Geometrie zu Grunde liegen*, Abh. der Gottinger Ges. d. W. von Jahre 1867, Band XIII; and *Commentatio mathematica qua respondere tentatur quaestioni ab Illma Academia Parisiensi Propositae*, in *The Collected Works of Bernhard Riemann*, edited by Heinrich Weber, reprinted by Dover, 1953.

[3] E. B. Christoffel, "Über die Transformation der homogenen Differentialausdrucke zweiten Grades", *Crelle's Journal* 70 (1869), 46-70, 241-45.

[4] R. Lipschitz, "Untersuchungen in Betreff der ganzen homogenen Functionen von n Differentialen", *Crelle's Journal* 70 (1869), 71-102 and 72 (1870), 1-56; and "Entwichelung einiger Eigenschaften der quadratischen Formen von n Differentialen", *Crelle's Journal*, 71 (1870), 274-87, 288-95.

[5] G. Ricci, "Della derivazioni covarianti e del loro uso nella analisi applicata", in *Studi editi dalla Università Padovana a commemorare l'ottavo centenario dalla origine della Università di Bologna*, III (Padua 1888); "Sopra certi sistemi di funzioni" and "Di un punto della teoria delle forme differenziali quadratiche", in *Atti dell'Accademia nazionale dei Lincei Rendiconti*, 4th ser., 5 (1889) 112-18 and 643-51; "Résumé de quelques travaux sur les systèmes variables de fonctions", in *Bulletin des sciences mathématiques* 16 (1892),
(See **Davies** page 20)

Why we must teach the history of mathematics.

Bruce Cload

Introduction

In the 1997-98 academic year, I taught a full-year undergraduate course at Brock University in the history of mathematics from ancient to modern times. I approached this assignment with trepidation as I had very little preparation time and was completely unfamiliar with the subject. As the year progressed, however, I especially enjoyed teaching this course. My students were hard-working and enthusiastic, and the subject material enriched my mathematical knowledge.

When I was a student, my own undergraduate and graduate instructors placed little emphasis on mathematical history, often asserting the history of mathematics to be irrelevant to the teaching of modern mathematics. I, too, had espoused this opinion, but now firmly believe that the history of the subject should be an important part of any mathematics curriculum. It is the aim of this paper, then, not to present original research, but to describe one instructor's new-found appreciation of the importance of the history of mathematics and to demonstrate the significant advantages of a historical perspective in mathematics instruction.

I lectured for the first four-fifths of the year, and in the remaining time the students gave their presentations in class. In each lecture, a particular mathematician or problem was presented in a balanced format including historical overview, mathematical information and concepts, and interesting anecdotes. For the research project, each student chose a topic after consulting me. This paper presents some of the key ideas developed in the course and some of ways they impacted the students.

Number Systems

The most fundamental construct in mathematics is the number system. In modern times, we are fortunate to have a place-value decimal system which we often take for granted. At the beginning of term, therefore, I asked my students to form groups, forget our number system, and construct a new number system with three pennies. They were to find the largest integer N for which, using any markings on the Canadian pennies as symbols, they could represent all of the integers between 1 and N. The most common solution was permutation of symbols; for example, if H is heads and T is tails on a penny, then H could represent the number one, HH two, HHH three, T four, TH five, and so forth.

The cleverest answer was, perhaps, to use the Queen's head as the small hand on a clock, and thus represent the numbers 1,2,...,12. Analogously, the position of the maple leaf on the opposite side could represent the numbers 13, ..., 24. All three pennies together, thus, would constitute a base 24 place-value decimal system with maximal value 24^3. Although there are, of course, many variations on these solutions with higher maximal values, the point of the exercise was to appreciate the difficulties of constructing a good number system.

We then proceeded to examine the actual number systems of several ancient peoples, exemplifying each of the stroke, cipher, and grouping number systems. Without a doubt, the mathematics of a civilisation could be very restricted by the choice of numbering system. For example, try multiplying *DLXXVII* by *LXIX* without converting the Roman numerals, let alone taking the square root of *LXXXI* or solving a system of linear equations. I asked my class, "The base 10 place-value decimal system is certainly familiar, but is it the best? Why has this system survived and become universally used? Would a binary, hexadecimal, or sexagesimal system be better?"

In the ensuing discussion, students came to appreciate how artificial but notationally intrinsic the base-10 place-value system is to our mathematics. They thus began to separate abstract mathematical ideas from their concrete notation.

The Nature of Proof

After discussing with my class the development of the basis of proof from empiricism to logical deduction [12], as an exercise in what constitutes a proof we studied different methods of establishing the Pythagorean Theorem, including six different visual arguments from [14]. For these, I divided my class into six groups. Each group examined one of these arguments, deduced the workings of the proof algebraically, and then presented both the visual and algebraic arguments to the rest of the class. I then asked, "Would you accept any of these visual arguments as a proof for The Pythagorean Theorem? When can a theorem be proved with a picture?"

It is not surprising that my students were divided on this question given that contemporary mathematicians continue to debate the requirements for proof. To illustrate, therefore, how a proof is embraced - or not - by the mathematical community, I discussed with my class two significant problems which were recently solved: Fermat's Last Theorem and The Four Colour Problem.

For proving "FLT", Andrew Wiles won the admiration of the mathematical world. By contrast, on their presentation of the solution of the Four Colour Problem to several hundred mathematicians at the University of Toronto in 1976, Kenneth Appel and Wolfgang Haken, as Eves eloquently noted, were "rewarded with little more than a mildly polite applause." [8] Both these problems are important, and their solutions marked major breakthroughs in their respective fields. We considered the question: "Why were each of these two solutions received so differently? Is a many-case computer study a proof?"

The Concept of Infinity

The second concept whose evolution we traced in class was that of infinity. First we studied Zeno's Paradoxes and Aristotle's refutations of these paradoxes in which an infinite number of repetitions is understood as an arbitrary number of repetitions rather than a non-finite number [12].

Second, we examined the concept of infinity as presented in *Vijaganita*, a book by the Indian Mathematician Bhaskara (1114-1185 A.D.) where he states:

"Quotient the fraction $\frac{3}{0}$. This fraction, of which the denominator is cipher [zero], is termed an infinite quantity. In this quantity, consisting of that which has cipher for its divisor, there is no alteration, though many be inserted or extracted." [1] page 116

One could interpret this quote to mean infinity is an actual number with which one could perform arithmetic. Thus, $\infty + 3 = \infty$, and $\infty - 5 = \infty$. There are obvious problems with this. Subtracting the previous two equations, one might conclude that $8 = 0$. Performing arithmetic with infinity is a common error among first year calculus students who misconstrue arithmetic operations on limits involving infinity as arithmetic operations on a symbolic infinity. As for Bhaskara's statement, since limits were not rigorously defined until the 19th century, it is difficult to identify the intended meaning.

As a third example of infinity, I explained the definition of cardinality and provided several examples of countable sets, countably infinite sets, and uncountable sets including a proof using Cantor diagonalization that the real numbers are uncountable. My class was surprised to discover that there are different levels of infinity.

Infinity is a perplexing concept to which the history of mathematics provides a natural contextual introduction. When students can consider different varieties of the infinite - an arbitrary number of repetitions, a symbolic quantity, a limiting value, and cardinality - the concept will more easily crystallise in their minds.

The Approximation of π

In [4], the authors give an excellent account of the history of the computation of this mathematical constant, part of which I presented to my class. After reviewing geometrical approximations for π based on inscribing and circumscribing regular polygons about a circle and the development of series approximations with the advent of calculus, we discussed the impact of computer technology on approximation techniques and accuracy. In particular, we examined the David and Gregory Chudnovsky formula, described in [4]:

$$\frac{1}{\pi} = 12 \sum_{k=0}^{\infty} \frac{(-1)^k (6k)!(13{,}591{,}409 + 545{,}140{,}134k)}{(3k)!(k!)^3 \, 640{,}320^{3k+\frac{3}{2}}}$$

Remarkably, each successive term of the series produces another 14 correct digits of π. The Chudnovsky's used this series to attain an approximation to over 4 billion decimal places.

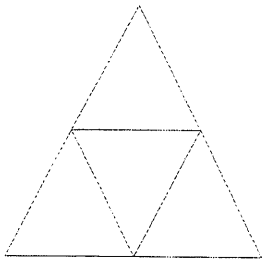
I then asked my class: "Why would one want to approximate π?" and, moreover, "Why would one want to approximate it to 4 billion decimal places?" Initially, students felt that a 1,000-decimal-place approximation for π would more than suffice for all practical problems, but then conceded that the numerical techniques discovered for more accurate approximations may be of use in other numeric problems. In addition, such techniques may be employed to disprove or lend credence to theoretical conjectures. We then discussed whether a problem need have immediate practical application to be worthy of study and the relevance of basic research to society. As with previous in-class discussions, the students' understanding grew as their assertions were challenged either by their peers or by me.

The Interconnection of Ideas

Part of the joy of the study of mathematics derives from observing the surprising interconnections obtaining among seemingly unrelated ideas. One example is the relationship among Pascal's triangle, Fibonacci sequences, the golden ratio, and Sierpinski's gasket. Since the relationship among the first three is well known [8] [10], I will describe here only the lesser known relationship between Sierpinski's gasket and Pascal's triangle.

Waclaw Sierpinski (1882-1969), a Polish mathematician, was the first to construct this fractal gasket [17]. Take an equilateral triangle and join the midpoints of the sides. This results in four sub-contained equilateral triangles.

First step to Sierpinski's gasket



Repeat the procedure on each sub-triangle except the centre one and then repeat the procedure on each upward pointing sub-sub-triangle. After an infinite[1] number of steps, the final product is Sierpinski's gasket[2].

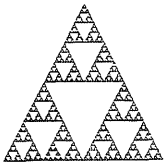
Where is the connection with Pascal's triangle? If Pascal's triangle is plotted modulo 2, that is, if for each odd number in the triangle a point is plotted and for each even number, a blank space, after rescaling and taking a limit, the resultant figure is

1 Infinite, not in the Aristotelean sense of an arbitrary number, but rather in the sense of a limiting process.
See section 4.2.

2 Sierpinski not only had a gasket, but also had a cheese (not to mention the carpet) [17].

Sierpinski's gasket[3] [17].

Sierpinski's gasket



First 512 rows of Pascal's triangle modulo 2

I did not present the topics of Pascal's triangle, Fibonacci sequences, the golden ratio, and Sierpinski's gasket all at once to my class. Rather, without mention of any greater connection, each topic was addressed separately in the appropriate context — Pascal's triangle with the problem of the points [8] and the advent of probability, Fibonacci sequences with the discussion of 13th century algebra, the golden ratio with the constructibility of the regular pentagon in Greek mathematics, and Sierpinski's gasket with modern mathematics and fractals. In a culminating lecture, which began unassumingly with a review of each of these constructions, I revealed their interplay to dramatic effect.

Contributions of Cultures and Thinkers Outside Western Mathematics

A history of mathematics course affords an opportunity to discuss the development of mathematics in cultures outside Western Europe. In my course, Chinese, Indian, and Arabic mathematics were featured in more than a month of lectures. Among the topics addressed were the Chinese Remainder Theorem, Brahmagupta's solution to Pell's equation, and Omar Khayyam's geometric solution for finding a root of a cubic equation. Some students selected Mayan, Incan, and traditional African mathematics for their projects [3], [5], [12], [19].

Exposure to the diversity of mathematics across cultures is exciting and informative for students. For example, in [3], Ascher describes the kinship relations of the Warlpiri, an aboriginal people from the Northern Territory of Australia. In their kin system, each person belongs to one of eight sections, membership in which is determined by a set of rules. When their kin system is modelled with group theory, it corresponds to the dihedral group of order 8, or the group of symmetries on the square (for information on dihedral groups see [9]). Although symmetries of the polygon are geometrical, they are still abstract; this kin system, however, provides a real-world representation of the dihedral group.

Conclusion

The content of a history of mathematics course can far surpass historical detail. Such a course provides a vehicle for discussing mathematical concepts in a historical context with a global non-sexist perspective. It is important to have mathematical role models of both sexes from the past and the present. Before teaching this course, I could not name a female mathematician who lived before the 19th century. One of my students researched the history of women in mathematics, and she reported on three of note: Hypatia, Maria Gaetana Agnesi, and Sophie Germain. It is important that students have mathematical role models of both sexes from the past and the present. It is important that students not only know how to perform mathematics but also how it is developed. Mathematics is not recorded or communicated the way it is discovered. The structure of mathematical teaching tends to be a lemma-theorem-corollary style as opposed to a research style of intuitive questing with rigorous

3 I generated Sierpinski's gasket several ways in class using a computer.

conditions imposed later. In a history of mathematics course, students can study the historical progress of an idea, observe the notational and conceptual improvements, and glean understanding into the intuitive development of the idea. This works particularly well if they are required to employ historical techniques to solve problems. For example, the proof that $\sqrt{2}$ is irrational can be approached from the Greek geometrical perspective [12], from Fermat's method of infinite descent [6], or by contradiction of the assumption $\sqrt{2}$ that is a rational number in its lowest terms. The more different formulations in which students can experience a problem or pursue solutions, the better their understanding of the fundamental concept behind the problem. In the teaching of history, the present is as important as the distant past. Modern mathematics can be synthesised with more ancient mathematics to impress upon students the evolution of ideas.

I am now convinced of the pedagogical benefits of a history of mathematics course and the learning advantages of the historical perspective. For me, this course was an invaluable experience begun with reservation but ended with appreciation. A course I thought I would be glad to have taught became — and will be — a course I was glad to teach.

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[18] L. Osen, *Women in Mathematics*, Cambridge: The M.I.T. Press, 1974.

[19] C. Zaslavsky, *Africa Counts: Number and Pattern in African Culture*, Westport, Connecticut: Laurence Hill & Co.

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President (Continued from page 4)

Finally, I would like to report that Hardy Grant has graciously accepted appointment as CSHPM's representative to the HSSFC annual meeting. Jacques Lefebvre or Robert Thomas will represent the CSHPM Canadian National on the Committee of the International Union of History and Philosophy of Science. Congratulations to Alexander Jones of the University of Toronto Classics Department and IHPST, who has joined the list of CSHPM members invited to the Dibner Institute at Massachusetts Institute of Technology as Resident Fellows. Welcome to Rebecca Adams, who has been elected to the CSHPM Executive Council. I am happy to report that Glen Van Brummelen is back at King's College after a hiatus at Simon Fraser University and the Institute for Advanced Study at Princeton.

Academic Journals on the Web: Fact or Fiction?

Glen Van Brummelen

The past three years have revolutionized our expectations of what computers can do for our professional activities, primarily through the promise of increased access to information through the Internet. We have been tempted by the prospects of working day-to-day as a global community, using the resources of libraries around the world without needing to leave our offices, and even sharing teaching resources using virtual classrooms not limited by mere geography.

However, we have a long way to go before these promises are realized. The Internet does give greatly improved access to information, but it is becoming harder to find among the millions of commercial sites, banner advertisements, and other more dubious products. Technology must improve considerably before video conferencing becomes truly available to all, and costs must decrease if the services are to be accessible to those who cannot afford it now. Finally, human habits change more slowly than technology; simply because we *can* do something new does not mean that we *will*.

One aspect of academia where the technology has surpassed the requirements is the electronic publication of scholarly journals. In mathematics alone, the AMS lists 18 journals that exist solely in electronic form [1], and a number of print journals are also available on the Internet. The advantages are clear: by avoiding paper, journals are able to reduce production costs drastically, provide browsing and searching facilities, and reduce the lag time between paper submission and appearance in "print" [1].

Several mathematics journals have been available for free on the Internet for some time. Curious readers may check **www.ams.org/publications/** to view both the *AMS Bulletin* and the *AMS Notices*, and sample the search and browse facilities at no charge. (Various other journals require a fee.) Issues are online only for the last two or three years. At the same site, MathSciNet is an electronic version of *Mathematical Reviews*, and a concerted effort has been made to archive old material, back to the early 1970's. For readers whose institution does not have a license, a 30-day trial is available. Surfers may view and search past issues of the *Canadian Journal of Mathematics* at **camel.math.ca/CMS/CJM**.

For most historical journals, working independently and on small budgets, online presence is still years away. However, *Historia Mathematica*, as part of the Academic Press (AP) publishing empire, is one of 174 AP journals accessible online at IDEAL, AP's centralized journals Web site (**www.idealibrary.com**). If you are at one of the large number of universities that have purchased a site license, you can peruse the complete contents of *Historia Mathematica* from 1996 to the present, and the other 173 journals, at your library. (The table of contents of all previous issues, from 1974, may be found at the *Historia Mathematica* editors' Web site, **www.math.ruu.nl/hm/**.) If you're not so lucky, IDEAL still allows you to read the abstracts of the articles. AP is currently offering a free online issue to interested surfers. Apparently AP is working on a site licensing arrangement for individual members. I have been looking into a site license for CSHPM members, but the administrative difficulties involved in such a license may not be resolvable.

Some of you may not be aware that the CSHPM provides online access to two newsletters at its Web site: the *CSHPM Bulletin*, and the *History and Pedagogy of Mathematics Newsletter*. Current and past issues may be downloaded in WordPerfect format. I am working on versions that will be directly readable within your Web browser (in Adobe Acrobat format).

Virtually all of the journals now available online are not much more than paper made virtual; the promises of expanded presentation possibilities are as yet unfulfilled. Few people have the tech-

nical knowledge, creativity, and scholarly skills to take advantage of the new medium; reading online journals often feels a bit like watching still pictures on a TV set. Some mathematicians with the vision and capacity, including Tom Banchoff of Brown University, have posted a prototype of a new online journal, *Communications in Visual Mathematics* (CVM), that actually attempts to combine scholarly articles with interactive technology. CVM (**www.geom.umn.edu/~dpvc/CVM/**), which sells itself as the world's "first totally electronic journal", caters to research that cannot be portrayed well on paper. The papers contain animations illustrating concepts and mathematical arguments. I was disappointed that most of the interactivity consists in controlling the speed at which the animations are displayed, but this is a prototype. Future editions may allow for mathematical experimentation and exploration, perhaps at first similarly to David Joyce's excellent *Euclid's Elements Online* (**aleph0.clarku.edu/~djoyce/java/elements/elements.html**).

The easiest step, converting to electronic form what we are already doing on paper, is already being taken. (One "wish list" item I would like to see soon is a centralized preprint server for the history of mathematics. Any offers?) The harder part is to adapt ourselves to what we can do with the Web, and I believe it will be years before most of us understand what that is.

Reference

[1] "Backlog of mathematics research journals", *American Mathematical Society Notices* **45** (1998), 999-1002.

CONSTITUTIONAL CHANGES

The following changes to the Society's constitution are hereby recommended to the membership by the Executive. They will be voted on at the next Annual General Meeting, next July in Toronto. The proposed changes are additions *to the existing bylaws, and appear in square brackets below.*

Article IV, Section 2: The Executive Council shall consist of the Officers of the Society, the immediate past President, [the Editor of the *Proceedings*, the *Bulletin* Editor(s), and four other members of the Society.]

Article IV, Section 2: Le Conseil exécutif est composé des officiers de la Société, du président sortant, [du responsable de la publication des *Actes*, du ou des rédacteur(s) du *Bulletin*, et de quatre autres membres de la Société.]

Article IV, Section 6: A vacancy in the office of the President shall be filled by the Vice-President. [A vacancy in any of the offices of Vice-President, Secretary, or Treasurer shall be filled by appointment by the Executive Council, such appointments expiring at the close of the next meeting of the Society, at which meeting any office so temporarily filled and any vacancy among the four elected members of the Council shall be filled by election using the procedure outlined in Article IV, Section 3 and Section 4 if time permits. The membership shall be notified of vacancies.]

Article IV, Section 6: Lorsqu'il y a vacance au poste de président, le vice-président devient président. [Une vacance au poste de vice-président, de secrétaire ou de trésorier est comblée par une désignation faite par le Conseil exécutif, laquelle désignation prend fin à l'ajournement de la réunion suivante de la Société, lors de laquelle tout poste ainsi comblé temporairement et toute vacance parmi les quatre membres élus au Conseil exécutif sont comblés par une élection selon la procédure décrite aux sections 3 et 4 de l'article IV si le temps le permet. Toute vacance doit être communiquée aux membres.]

Minutes of the Executive Council

The Executive Council held two meetings at the annual meeting held at the University of Ottawa in May.

Executive Meeting -- May 29, 1998

1. The agenda was approved as distributed.

2. The minutes of the previous executive meeting, distributed in the May *Bulletin*, were approved.

3. Annual General Meeting Agenda:
* It was decided to recommend that the affiliate membership arrangement with the CSHPS be made permanent.
* The theme for next year's annual meeting, the joint meeting with the BSHM, will be Applied Mathematics. This should be announced at the AGM.

4. Other Business:
* The procedures involved in the distribution of ballots for election to the Council by e-mail and the possibility of needing to change the Constitution to permit the practice was discussed. Since the matter is constitutional, sufficient notice of the membership is required, and no action can be taken at the AGM.
* A Constitutional change permitting the editors of Society publications (currently the *Bulletin* and the *Proceedings*) to be made ex-officio members of Council was discussed. Again, no official action can be taken at this year's AGM.
* The need for a by-election to replace Fred Rickey's Council spot was discussed. Rebecca Adams was recommended as a candidate.
* It was decided to make a proposal to handle procedures for the replacement of a Council member who cannot serve his/her term, due to resignation, illness, death, or lapse of membership.
* No report on the refereeing of abstracts is forthcoming from Tom Drucker.
* There was some discussion on the CSHPM's representative to the HSSFC meetings. There was agreement that a CSHPM member who lives in or near Ottawa could serve as the representative, rather than the President, to save on travel costs.

5. The meeting was adjourned.

Glen Van Brummelen, Secretary-Treasurer

Executive Meeting -- May 31, 1998

1. 1999 Annual Meeting:
* The Society agreed to supply $1000 in support of the annual meeting to help pay for keynote speakers. This is roughly the level of support that has been given to support keynote speakers at past CSHPM meetings.
* The question of whether SSHRC's travel subsidy funds are explicitly connected to the Congress of Social Sciences and Humanities (with which our 1999 meeting will not be held) was raised. Glen Van Brummelen will look into this.
* Glen Van Brummelen agreed to poll the membership on the number of people who are likely to attend the meeting.
* It was decided that conference registration and accommodation will be separate items on the registration form.

2. 2000 Annual Meeting:
* The meeting is to take place in Edmonton. HSSFC requests that we identify a theme for the conference prior to the 1999 Congress of Social Sciences and Humanities.
* In addition, the Executive will need to determine a program chair and local organizer at the same time.

3. Constitutional Amendments:
* Glen Van Brummelen will produce an updated constitution that takes into account the changes accepted at this year's Annual General Meeting.
* Jim Tattersall will develop a proposal for a constitutional amendment to permit editors of Society publications (currently the *Bulletin* and *Proceedings*) to be ex-officio members of the Executive Council.
* It was considered that no constitutional change

was necessary to permit ballots for elections of Council members to be distributed by e-mail. The term "mail" in the current Constitution may be reasonably said to include "electronic mail".

* Jim Tattersall will develop a proposal for a constitutional amendment to permit the Executive Council to appoint members to fill Council spots vacated in mid-term for reasons such as illness, incapacitation, or lapse of membership. This will not apply to the position of President.

* It was decided that no constitutional changes are required to make the proposed changes to the elections process, since those changes are already mandated by the Constitution.

* On the matter of finding a means of controlling access to Society membership now that the "two signatures" requirement has been struck down, Rebecca Adams will survey other academic societies to determine their practices.

"Diderot gives back to the Enlightenment ... an angrier note, which echoes down the whole romantic movement. Mathematics is worse than inhumane. It is arrogant. ... His indictment is curious and interesting and not mere petulance. Mathematics is the science by which a finite intelligence purports to plumb the infinite". — **C.C. Gillispie**, *The Edge of Objectivity*

"One day William Rowan Hamilton ... was crossing Phoenix Park in Dublin, when the foreknowledge came to him of an order of mathematics, which he called `quaternions', so far in advance of contemporary mathematic [sic] development that the gap has only recently been bridged by a long succession of intervening mathematicians. All outstanding mathematicians have this power of making a prodigious mental leap into the dark and landing firmly on both feet." — **Robert Graves**, *The White Goddess*

4. HSSFC representatives: Hardy Grant was appointed the CSHPM's representative to the HSSFC.

5. CNC/IUHPS: Either Jacques Lefebvre or Robert Thomas will be appointed as the CSHPM's representative to the Canadian National Committee of the International Union of History and Philosophy of Science. Council will decide this matter at a later date.

6. Refereeing of abstracts for the Annual Meeting and Proceedings: Since a report is not forthcoming from the current committee, the Council decided to pursue this matter by other means, to be decided shortly.

7. The meeting was adjourned.

Glen Van Brummelen, Secretary-Treasurer

New Members

The following have recently joined the Society. A warm welcome to all!

Karen Benbury, 613 Overhill Drive, Edgewater, MD, USA, 21037

Bruce Cload, Department of Mathematics, Brock University, St. Catharines, ON L2S 3A1, Canada

Robert Forsythe, Department of Matematical Sciences, Tabor College, 400 S. Jefferson, Hillsboro, KS 67063, USA

Arde Guran, Institute for Structronics, 275 Slater St. (9th floor), Ottawa, ON M5S 1K7, Canada

Miriam Lipschutz-Yevick, 22 Pelham St., Princeton, NJ 08540, USA

Amy Shell, 2656 W. Iowa, Chicago, IL, USA, 60622

Annual General Meeting -- May 30, 1998

Minutes

1. The agenda was approved as distributed.

2. The ballots for the Executive Council elections were collected.

3. The minutes of the previous Annual General Meeting, published in the November 1997 issue of the *Bulletin*, were approved.

4. Secretary - Treasurer's Report (Glen Van Brummelen): The report was printed in the May 1998 issue of the *Bulletin*. Key points are as follows:
* The Society ran an operating surplus of $1075.65 in 1997. Therefore, the phasing-out of the SSHRC Societies Operating Grant will not require a raise in dues.
* Membership grew from 154 to 188, primarily due to cross-membership arrangement with the CSHPS and the BSHM

5. President's Report (Robert Thomas):
The Society thanks the following people and organizations for their help and/or services:
* Fran Abeles for arranging the special session on Sunday and for chairing it;
* Len Berggren as Nominating Committee;
* Ed Cohen as Local Arranger under difficult personal circumstances;
* Hardy Grant and Sharon Kunoff for their work on the *Bulletin*;
* Hardy for acting as session chair and Sharon for acting as scrutineer;
* Israel Kleiner for accepting, in Toronto last December, the Phoenix Award won by *Philosophia Mathematica* for "significant editorial achievement" (see May *Bulletin*);
* Members of the Executive for their work on the constitutional revisions that we are about to consider;
* Volker Peckhaus for coming to Ottawa to be our featured speaker;
* Jim Tattersall for editing the 1997 *Proceedings*, making preliminary arrangements for 1999, for accepting nomination for president and for acting as session chair;
* Glen Van Brummelen for work as Secretary/ Treasurer under variable circumstances and for serving as Programme Committee for this meeting and for acting as session chair;
* Those standing for executive positions (Jacques Lefebvre as Vice-President, Rebecca Adams, Craig Fraser, John Fauvel, and Alexander Jones) for the next two years for their willingness to serve the Society;
* Alexander Jones for acting as session chair;
* Craig Fraser for accepting the task of local arranger and Programme Committee for the 1999 meeting;
* Providence College for sending out copies of the *Proceedings*;
* The University of Ottawa for hosting this meeting;
* HSSFC for organizing the Congress;
* The King's University College for hosting our Web site.

The Society works because so many of us are willing to make it work. It is a far healthier organization than many such societies.

The need for a by-election to fill a vacancy in the Executive Council was announced, and the nomination by Council of Rebecca Adams for this position. The membership will be polled for further nominations before the election is held. [See article on page 2 above.]

6. *Proceedings*: The editor, Jim Tattersall, reported that the *Proceedings* of the 1997 annual meeting had been completed and were in the mail.
* Jim, as incoming President and on behalf of the Society, officially thanked Robert Thomas for his dedicated and effective service as President of the Society over the past two years.

7. 1999 Annual Meeting: Craig Fraser, the organizer of the joint meeting with the British Society for History of Mathematics, announced that it will occur at Victoria College, University of Toronto on July 15-17, 1999. This meeting will also serve as the annual meeting of the CSHPM.

The theme of the meeting is Applications of Mathematics.

8. HSSFC Visit (Ronald Bond, Jacqueline Wright):
* The HSSFC representatives discussed their activities, including the Aid to Scholarly Publications program, the Congress of Social Sciences and Humanities, and a variety of other programs.
* HSSFC was thanked for its role in permitting communications between the CSHPM and SSHRC.
* The motives for the change of name of the congress (from the Learned Societies Congress) were discussed.
* The HSSFC requested that three or four profiles of the research of members of the Society be made available for the purpose of press releases.

9. Constitutional Changes:
* Motion: To separate consideration of the change of Article III, Section 2 from the other constitutional changes. 12 in favour, 8 opposed. Carried.
* Motion: To adopt the constitutional changes other than Article III, Section 2: Carried unanimously.
* Motion: To adopt the change of Article III, Section 2: Carried unanimously with one abstention.

10. Proposed Constitutional Changes:
Several changes are recommended by Council to be considered for next year. The membership is requested to provide feedback on the following:

* The inclusion of editors of Society publications (currently the *Bulletin* and *Proceedings*) as ex-officio members of Council.
* Explicitly permitting Council election ballots to be distributed by e-mail, and procedures for its implementation. Executive Council will make a recommendation to change the Constitution as required on these two items.
* The need to follow Constitution-mandated practices in elections (three members on the Nominating Committee, multiple candidates for posts) and mandating a 30-day period where members are given the opportunity to nominate council members was discussed.

11. CSHPS Cross-membership: Motion: To extend the affiliate membership arrangements with the CSHPS indefinitely. Carried unanimously.

12. Council election results:

President: James Tattersall; 39 yes
Vice-President: Jacques Lefebvre; 37 yes, 1 no, 1 abstention
Secretary-Treasurer: Glen Van Brummelen; 39 yes
Councilor: John Fauvel; 38 yes, 1 no
Councilor: Craig Fraser; 37 yes, 2 no
Councilor: Alexander Jones; 38 yes, 1 abstention.

13. The meeting was adjourned.

Glen Van Brummelen, Secretary-Treasurer

RECOMMENDED READING

Martin Gardner, in "The New Math", *New York Review of Books*, September 24, 1998, pp. 9-12, reviews (1) *Multicultural and Gender Equity in the Mathematics Classroom: The Gift of Diversity*, edited by Janet Trentacosta and Margaret J. Kenney; (2) *Focus on Algebra: An Integrated Approach*, by Randall I. Charles, Alba Gonzalez Thompson, et al.; and (3) *Life by Numbers: Math as You've Never Seen it Before*, by Danny Glover, seven boxed video tapes from WQED, Pittsburgh. Martin Gardner also has an article on recreational mathematics in the September *Scientific American*.

— Contributed by **Judy Wubnig**

JOINT MEETING WITH BSHM, JULY 1999

Planning is well advanced for the second joint meeting of the Society with its transatlantic counterpart the British Society for the History of Mathematics (BSHM). The highly successful first venture in this line was hosted by the British side at Oxford in July 1997. The sequel is scheduled for July '99 at the University of Toronto. Craig Fraser of the U of T's Institute for the History and Philosophy of Science and Technology has kindly agreed to look after local arrangements. Craig writes:

"A difference between this meeting and previous meetings, including the Oxford joint meeting, is that there will be a special topic with several plenary speakers. The latter will take up only a fraction of the meeting, so there will be ample scope for contributed papers, the annual business meeting and some special evening events. The plenary addresses will provide an overview of the history of applied mathematics at different historical periods. The papers of the plenary speakers will be published in the proceedings of the annual meeting."

Craig has also agreed to act as one of the program organizers, and it is to him, at <cfraser@chass.utoronto.ca>, that members whose primary affiliation is with CSHPM should send titles and abstracts, **by February 28, 1999**.

The tentative schedule for the meeting is: July 14, evening, reception; July 15, morning: special session, part one; afternoon: contributed papers; July 16, morning: special session part two; lunch: annual meeting of the Society; afternoon: contributed papers; evening: banquet and bassoon recital; July 17, contributed papers; evening: closing reception.

There are several possibilities in terms of special events for the meeting, including a visit to the Stillman Drake Collection of Rare Scientific and Mathematical Books, the Royal Ontario Museum or the Ontario Science Centre, the Bata Shoe Museum, an excursion to Niagara Falls, a Toronto Blue Jays baseball game, ...

If you plan to attend this meeting and have not yet so advised the organizers, a note to that effect would be appreciated; please contact Craig Fraser (address above).

Members are reminded that this meeting *replaces* the one usually held in late May or early June in conjunction with the annual congress of Canadian "Learned Societies". Our Society will not participate in that congress in 1999.

Judy Grabiner Wins Award

Judy Grabiner has won a Lester R. Ford award for her article "Was Newton's Calculus a Dead End? The Continental Influence of Maclaurin's Treatise of Fluxions", which appeared in the May issue of the *American Mathematical Monthly*. Society veterans may recall that a very preliminary version of this research was first presented at the annual meeting in Victoria in 1990. The Lester Ford awards honour the best papers published in the *Monthly* in a given year. Congratulations, Judy!

Personal Items

Fran Abeles gave the keynote address, "Charles L. Dodgson's Theory of Infinitesimals", at the Midwest Conference on the History of Mathematics, Iowa State University, Oct. 2-4. Dodgson's work on this subject appeared in 1888, in his *Curiosa Mathematica, Part I. A New Theory of Parallels*, apparently the first publication linking the necessity of a non-Archimedean number system containing infinite and infinitesimal numbers with a geometry that includes infinitely large and infinitely small quantities. Fran's talk included a survey of the main lines of thought about infinitesimals in analysis and geometry in the 19th century.

Pat Allaire presented a paper, "Artemas Martin: An Amateur Mathematician of the Nineteenth Century" (researched with Antonella Cupillari) at the Midwest Conference on the History of Mathematics, Iowa State University, Oct. 2. She then presented an expanded version of the paper as the kickoff of the Frederick V. Pohle Colloquium Series on the History of Mathematics and the Exact Sciences at Adelphi University, Oct. 14.

Katherine Hill
* is starting a New position as a lecturer at the Unit for History and Philosophy of Science at the University of Sydney, Australia, in January
* will publish "The Rhetoric of Utility: Avoiding Occult Associations for Mathematics Through Profitability and Pleasure", in *History of Science*, and "'Juglers or Schollers'? Negotiating Roles for Mathematical Practitioners" in *British Journal for the History of Science*.

Mac Priestley has published *Calculus: A Liberal Art*, a second edition, "slimmed down" for use in a one-semester course, of his *Calculus: An Historical Approach.* The publisher is Springer.

Abe Shenitzer is completing a translation of Detlef Laugwitz's intellectual biography of Riemann.

Sylvia Svitak was awarded a grant by the New York City Alliance for Minority Participation in Science, Mathematics, and Engineering to develop a project, Functional Models for the Conceptual Understanding of Factor Analysis. Major components of the project are the mentoring of students as research assistants and the publication of a resource manual based on the models.

Robert Thomas is enjoying a sabbatical at Wolfson College, Oxford, where (he writes) "I'm simply studying philosophy of math as though I had to write a thesis, though I'm terribly glad I don't have to do so".

Glen Van Brummelen recently chaired a committee charged with putting together a proposal for a four-year Computer Science program at his home institution, The King's University College in Edmonton. He reports that "we had two weeks to do what usually takes months". The outcome is pending.

"The qualities embedded in the mind of the mathematician by the discipline of mathematics fail to extend beyond the boundaries of mathematics. It appears to be mathematics itself, rather than any inner constraint, that anchors the mathematician to caution and rational thought in his professional work — a measure of the astonishing power of the discipline. For example, departmental and mathematics-society meetings are occupied mainly with talk — aimless and pedantic talk, billowing with Latinisms. Little of substance is ever accomplished, or even intended." — **Alfred Adler**

Davies (continued from page 6)

167-89; and G. Ricci & T. Levi-Civita, "Méthodes du calcul différentiel absolu et leurs applications", *Mathematische Annalen* 54 (1900), 125-201.

[6] See Kip S. Thorne's account of Einstein's work in *Black Holes and Time Warps — Einstein's Outrageous Legacy*, Norton, 1994, chapter 2.

[7] *Science*, 5 January 1996, 37-38. The article, entitled "Relativity and Experiment", is a review of the book *Gravitation and Inertia* by Ignazio Ciufolini and John Archibald Wheeler, Princeton University Press, 1995.

[8] See Thorne (note [6]), page 124.

[9] My main mathematical sources for the Swarzschild solution are *Tensor Analysis — Theory and Applications to Geometry and Mechanics of Continua* by I. S. Sokolnikoff, 2nd edition, Wiley, 1964, sections 103-4; and *The Classical Theory of Fields*, by L. D. Landau and E. M. Lifshitz, 4th revised English edition, Pergamon, 1975, pages 299-303.

[10] Dover: "This Dover edition, first published in 1977, is an unabridged and unaltered republication of the English translation by Marjorie Long, first published by Blackie & Son Limited, London and Glasgow, in 1926. The Dover edition is published by special arrangement with Blackie & Son Limited, Bishop-briggs, Glasgow G64 2NZ, Scotland." Pages 86-208.

[11] T. Levi-Civita, "Nozione di parallelismo in una varietà qualunque", in *Rendiconte del Circolo matematico di Palermo*, 42 (1917) 173.

[12] See note [10], page 104: "[...] the directions of a geodesic at its various points are all parallel (along the geodesic itself); more shortly, the geodesics are auto-parallel curves. It follows from these arguments that auto-parallelism is a characteristic property of geodesics [straight lines] and can be used to define them. [footnote:] This statement will be recognized as an obvious extension to surfaces of any kind whatever of the primary intuition of the nature of the straight line, expressed by Euclid in the words [...] (a straight line is that which lies equally with respect to all its points).

[13] For pure analysis, my primary source will be *Introduction to Analysis*, by Maxwell Rosenlicht, Dover 1986, originally published by Scott, Foresman and Company, Glenview, Illinois, in 1968. For numerical analysis, one of my main sources will be *Introduction to Numerical Analysis*, by F. B. Hildebrand, Dover 1987, unabridged, slightly corrected republication of the second edition (1974) of the work first published by McGraw-Hill, Inc., in 1956.

Barry Davies (barry.davies@softlogic.com) is employed at SoftLogic Solutions, Ridgefield CT USA (but the work described here is — for now — nothing more nor less than a personal passion).

ABOUT THE BULLETIN

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