CMS NOTES de la SMC

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FROM THE TREASURER'S DESK

David Rodgers

On July 1, 2006, I assumed the role of Treasurer, succeeding Arthur Sherk. Arthur served the Society with dedication and distinction for thirteen years in the position. I greatly admire Arthur and the contributions he has made to the CMS over a very long period of time. Arthur leaves an enormous pair of shoes to fill and it is my intent to work diligently with members, committees, and directors to extend his legacy.

In early August, I spent four days in the Ottawa Office with Graham Wright and the Executive Office staff to begin preparations for the 2007 budget process. We designed a special report format that *directly* identifies the current level of self-sufficiency associated with each CMS activity. This data is important not only for the budgeting process but also for our fund-raising activities going forward. After several years of financial difficulty, the CMS situation appears to have stabilized. We need now to build on this foundation.

Our financial goal for 2007 is to raise, where feasible, the overall level of self-sufficiency for existing CMS activities through specific efforts by *Membership and Publications* to increase operating revenues; and work by the Development Coordinator on both an Annual Giving Program and on identifying corporate partners for specific (for example, Competitions, Math Camps, Research Support) CMS programs. Donations can be used to improve overall levels of self-sufficiency, to extend existing programs, or to seed new initiatives. Tom Salisbury and Eddy Campbell will take the lead on goals and strategy for fund-raising and Mark Bowman the lead on implementation. Liliane Sousa is the lead for Membership and Publications.

The CMS is indeed fortunate to have dedicated, hard-working, and loyal staff in the Ottawa, Winnipeg, and other offices. Nevertheless, without a cadre of truly outstanding volunteers who give freely of themselves and their time to lead and manage a very large portfolio of educational, research support, and service activities, it is simply not possible for the Society to serve both the long-term interests of Canada and the global mathematical community. By working together, however, I am confident we are up to any challenges and opportunities that lie ahead.

If you have thoughts or suggestions you would like to share, please feel free to contact me (`drodgers@umich.edu`).

David L. Rodgers
Treasurer

DU BUREAU DU TRÉSORIER

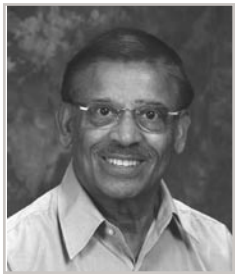
Depuis le 1er juillet dernier, je remplace Arthur Sherk au poste de trésorier de la SMC. Arthur a donné treize années de loyaux et éminents services à la Société à ce titre. Je lui voue une grande admiration pour son travail à la trésorerie et l'ensemble de sa contribution à la SMC, étalée sur de nombreuses années. Il ne sera pas facile de le remplacer, mais j'ai l'intention de travailler diligemment avec les membres, les comités et les administrateurs afin de poursuivre son travail.

Au début d'août, j'ai passé quatre jours au bureau administratif d'Ottawa avec Graham Wright et le personnel pour amorcer la préparation du budget 2007. Nous avons conçu un nouveau format de rapport qui établit *directement* le degré réel d'autosuffisance associé à chaque activitvé de la SMC. Ces données sont importantes non seulement

suite page 4

EDITORIAL

by S. Swaminathan
Dalhousie University



REFEREEING

As mathematicians we do many chores for the mathematical community. One of these is refereeing. Although we get to referee papers which pertain to topics of our expertise we are often requested to examine papers of a general nature. Many years ago J. L. Kelley told me how to referee a paper: "Do not read the paper in full first. Just read the introduction, the preliminary section containing definitions, etc, the statement of lemmas and the theorems. Put away the paper, think about it and try to prove the results yourself. Then read the paper in full. You will be in a very good position to judge the work of the author." This works very well with short papers. The same method can be used in stages for longer papers.

R. P. Boas, Jr. writes in a self-profile in [1] that when G. H. Hardy was an editor of the *Journal of the London Mathematical Society* he used to tell referees to ask three questions: Is it new? Is it true? Is it interesting? He comments that the third is the most important. He would add: Is it decently written? If Hardy got a paper that was interesting but badly written he would get a graduate student to rewrite it. R. P. Boas was sure of this since he had done a couple of rewrites for Hardy for authors, who subsequently became very well known.

Refereeing takes time. If a paper is in an area of our current interest then it is, indeed, enjoyable to read and write a report. Papers of peripheral interest tend to be put away for another time. What are the benefits of refereeing? A paper with good and interesting results certainly enhances our knowledge and enables us to keep abreast in research. It could also stimulate further work in the area. The referee is thanked anonymously when the paper gets published. D. E. Knuth has written the following addendum to *A Class of Projective Planes* in [2]: "When I first submitted this paper for publication, I had gone only as far as Theorem 6. I thank the referee for encouraging me strongly to try harder, because those remarks prompted me to discover Theorems 7, 8, 9 and 10. (And I hope the referee is still alive and able to read this note, because I foolishly failed to give any acknowledgement when this paper was originally published. Long live conscientious referees who cajole authors into extending their reach!)"

Getting the right referee for a paper is a hard problem for editors of journals. This is especially true of papers which involve more than one discipline. In 1918 the famous statistician R. A. Fisher published an important paper, 'On the correlation between relatives on the supposition of Mendelian inheritance,' in the *Transactions of the Royal Society of Edinburgh*. This paper was previously submitted to and rejected by the Royal Society of London after having been refereed by 'a mathematician who knew no biology' and 'a biologist who knew no mathematics.' Many issues concerning refereeing and the responsibilities of a referee are discussed with a case history by R. C. Thompson in [3].

Do you have an anecdote of personal experience about refereeing? If so, please tell us about it.

References:

1. *More Mathematical People*, edited by Donald J. Albers, *et al*, Academic Press, 1990, page 24.

2. *Selected Papers in Discrete Mathematics*, CSLI Publications, Stanford, CA.

3. R. C. Thompson, *Author vs. Referee: A case history for middle level mathematicians,* American Mathematical Monthly, 90, 1983, 661-668.

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L'ÉVALUATION D'ARTICLES

En tant que mathématiciens, nous accomplissons des tâches de toutes sortes pour la communauté mathématique. Bon nombre d'entre nous font notamment partie d'un comité de lecture. Même si nous évaluons des articles dans nos domaines de spécialité, on nous demande aussi d'évaluer des articles de nature plus générale. Il y a bien longtemps, J. L. Kelley m'a prodigué quelques conseils : « Ne lis pas l'article en entier. Lis seulement l'introduction, la section préliminaire contenant les définitions, etc., les lemmes et les théorèmes. Mets ensuite l'article de côté, réfléchis-y un peu et essaie de prouver les résultats toi-même. Lis ensuite l'article au complet. Tu seras alors très bien placé pour évaluer le travail de l'auteur. » C'est une méthode qui marche très bien pour les articles courts, mais qui s'utilise aussi pour les plus longs, à condition de procéder par étapes.

Dans son autobiographie [1], R. P. Boas Jr. raconte qu'à l'époque où G. H. Hardy était rédacteur au *Journal of the London Mathematical Society*, il demandait aux membres de ses comités de lecture de se poser trois questions : Est-ce nouveau? Est-ce vrai? Est-ce intéressant? À son avis, la troisième question était la plus importante. Il ajoutait ceci : L'article est-il bien écrit? Quand il recevait un article intéressant mais mal écrit, il demandait à un étudiant à la maîtrise ou au doctorat de le récrire. R. P. Boas pouvait affirmer cela avec certitude puisqu'il avait lui-même récrit quelques articles pour G. H. Hardy, dont les auteurs sont devenus célèbres plus tard.

L'évaluation d'articles prend du temps. Bien sûr, il est agréable de lire un article sur un sujet qui rejoint nos intérêts du moment, et même de produire le rapport d'évaluation. Les articles qui s'éloignent un peu de nos intérêts, par contre, sont souvent remis à plus tard. Il faut se demander quels sont les avantages de l'évaluation. Un article présentant des résultats intéressants et de qualité contribue assurément à l'enrichissement des connaissances de l'évaluateur et l'aide à se tenir au fait de la recherche. L'évaluateur « encaisse » ses remerciements (anonymes) lorsqu'un article est publié. Dans *A Class of Projective Planes* [2], D. E. Knuth ajoute la note suivante : « Lorsque j'ai présenté cet article pour publication la première fois, je me suis rendu au théorème 6. Je remercie l'évaluateur de m'avoir encouragé vivement à pousser plus à fond parce que ses remarques m'ont amené à découvrir les théorèmes 7, 8, 9 et 10. (Et j'espère que cette personne est toujours en vie et qu'elle lira cette note parce qu'en étourdi que j'étais, je ne l'ai aucunement remercié après la publication initiale de mon article. Longue vie aux évaluateurs consciencieux qui incitent les auteurs à approfondir leurs recherches! »).

Pour l'équipe de rédaction d'une revue, trouver l'évaluateur idéal n'est pas une mince affaire, surtout lorsqu'un article couvre plus d'une discipline. En 1918, le célèbre statisticien R. A. Fisher a publié un article important intitulé « On the correlation between relatives on the supposition of Mendelian inheritance », dans *Transactions of the Royal Society of Edinburgh.* Cet article avait d'abord été présenté à la Société royale de Londres, qui l'avait rejeté d'après le rapport d'un évaluateur décrit comme « un mathématicien qui ne connaissait rien à la biologie » et un « biologiste qui ne connaissait rien aux mathématiques ». Dans un de ses ouvrages [3], R. C. Thompson aborde un bon nombre de questions et de responsabilités associées au travail des évaluateurs.

Vous avez une anecdote personnelle à raconter à propos de votre travail d'évaluation? Écrivez-nous!

Références

1. *More Mathematical People,* sous la direction de Donald J. Albers, et al, Academic Press, 1990, page 24.

2. *Selected Papers in Discrete Mathematics*, CSLI Publications, Stanford, CA.

3. R. C. Thompson, *Author vs. Referee: A case history for middle level mathematicians,* American Mathematical Monthly, 90, 1983, 661-668.

COMPTES RENDUS MATHEMATIQUES

MATHEMATICAL REPORTS

Comptes rendus mathématiques -- Mathematical Reports, published by the Academy of Science of the Royal Society of Canada, is a refereed journal dedicated to fast publication in any area of mathematics.

We invite authors to submit short papers (not exceeding 6 TEX pages) announcing important new results. Summaries of Ph.D. theses are welcome. We also welcome review or expository articles (up to 32 TEX pages) that are written or presented by Fellows of the Royal Society.

Papers may be sent either to the Editors-in-Chief or to one of the Fellows of the Royal Society. More information on preparing and submitting manuscripts can be found inside the back cover of the journal.

Editors-in-Chief:

Edward Bierstone and Pierre Milman
(University of Toronto).

pour le processus budgétaire, mais aussi pour nos activités de financement. Après plusieurs années de difficultés financières, la SMC semble avoir retrouvé une certaine stabilité. Il sera important toutefois de poursuivre dans cette veine.

En 2007, nous chercherons à accroître, dans la mesure du possible, l'autosuffisance générale des activités actuelles de la SMC en trouvant des moyens d'augmenter les recettes générées par les ***adhésions et publications***. Le ***coordonnateur du développement*** se consacrera pour sa part à l'élaboration du programme de don annuel et à la recherche de partenaires privés pour financer des programmes particuliers de la SMC (concours mathématiques, camps mathématiques, appui à la recherche, etc.). Les dons serviront à rehausser l'autosuffisance générale des activités, à enrichir les programmes actuels ou au démarrage de nouveaux projets. Tom Salisbury et Eddy Campbell seront les maîtres d'œuvre des objectifs et de la stratégie de financement, et Mark Bowman, de la mise en œuvre de l'ensemble. Liliane Sousa s'occupera quant à elle des adhésions et des publications.

La SMC est chanceuse de pouvoir compter sur un personnel dévoué, travaillant et loyal dans ses bureaux d'Ottawa, de Winnipeg et d'ailleurs au pays. Néanmoins, si elle ne pouvait pas compter sur une base de bénévoles absolument exceptionnels qui se dévouent sans compter et consacrent de nombreuses heures à la bonne marche d'un très large éventail de services, d'activités éducatives et de services d'appui à la recherche, la Société n'arriverait tout simplement pas à répondre aux aspirations à long terme du Canada ni à celles de la communauté mathématique. En travaillant ensemble, toutefois, j'ai bon espoir que nous arriverons à surmonter tous les obstacles qui pourraient s'élever devant nous.

Si vous avez des idées ou des suggestions, n'hésitez surtout pas à m'en faire part (**drodgers@umich.edu**).

David L. Rodgers, trésorier

NEWS FROM INSTITUTES

Fields Institute
Postdoctoral Fellowships

Description: Applications are invited for postdoctoral fellowship positions at the Fields Institute in Toronto for the 2007-2008 academic year. The thematic program on Operator Algebras will take place at the Institute from August-December 2007, while the thematic program on New Trends in Harmonic Analysis will run from January-June 2008. The fellowships provide for a period of engagement in research and participation in the activities of the Institute. They may be offered in conjunction with partner universities, through which a further period of support may be possible. One recipient will be awarded the Institute's prestigious Jerrold E. Marsden Postdoctoral Fellowship. Applicants seeking postdoctoral fellowships funded by other agencies (such as NSERC or intdernational fellowships) are encouraged to request the Fields Institute as their proposed location of tenure, and should apply to the Institute for a letter of invitation. Funding is being sought from NSF to support junior U.S. participants in these programs.

Eligibility: Qualified candidates who will have recently completed a PhD in a related area of the mathematical sciences are encouraged to apply.

Deadline: December 7, 2006, although late applications may be considered.

Application Information: Please consult **www.fields.utoronto.ca/proposals/postdoc.html** The Fields Institute is strongly committed to diversity within its community and especially welcomes applications from women, visible minority group members, Aboriginal persons, persons with disabilities, members of sexual minority groups, and others who may contribute to the further diversification of ideas.

PROBLEM OF THE MONTH

The following problem was submitted by Dr Stan Wagon of Macalester University.

Plane Divided by Eight

A "figure eight" is a curve in the plane obtained from the basic "8" shape by any combination of translation, rotation, expansion, or shrinking; the lines forming the 8s are assumed to have no thickness. True or False: One can place uncountably many disjoint figure 8s in the plane?
Answers will be provided in the next month's Notes.

Send your own favorite problems to: notes-editors@cms.math.ca
Solution for September's problem: page 7.

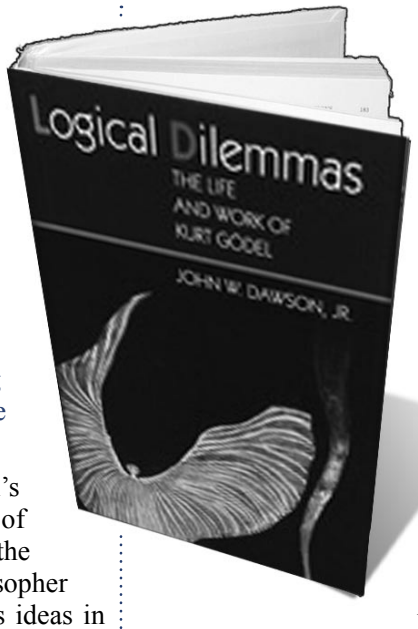
REMARKABLE BIOGRAPHY

J. Lambek
McGill University

Logical dilemmas: the life and work of Kurt Gödel

by John W. Dawson, Jr.
A.K. Peters, Ltd New paperback edition.

I HAVE HAD contact with Gödel only twice. In 1950, at the International Conference of Mathematicians, I attended his lecture, in which he showed that Einstein's field equations allowed a periodic solution in which the future repeats the past. The second time was in Princeton in 1960, when he phoned my wife to give his excuses for not appearing at our party for logicians, fearing that there might be too many germs.



Over the years, I have given much thought to Gödel's revolutionary contributions to the foundations of mathematics, some thoughts in discussion with the mathematician Phil Scott and some with the philosopher Jocelyne Couture. However, I never studied Gödel's ideas in their historical context and am grateful to find an integrated account of his life and work in this remarkable biography. The author manages to present Gödel's pioneering work in logic and philosophy in a technically accurate way, yet understandable by mathematicians untrained in logic and even by general readers untrained in mathematics. I don't wish to deprive the reader of this review of the pleasure of perusing the book under review, where she will learn much about Gödel's life, embellished by fascinating anecdotes. I will therefore concentrate here on Gödel's main contributions, as described by Dawson, with some elaborations of my own, which do not always agree with conventional opinion.

Gödel proved his *completeness theorem* in his doctoral dissertation of 1929. Originally, it dealt with first order classical logic and was later extended to higher order logic by Leon Henkin. It implies, in particular, that a statement in formal arithmetic is provable if and only if it is true in all models, which he originally called "realizations".

Gödel's famous *incompleteness theorem* does not contradict this. What its proof shows is that it is not enough to look only at models with the so-called ω-property (where S denotes the successor function): if $\phi(S^n0)$ holds for each natural number n, then so does $\forall_{x\in N}\ \phi(x)$.

The crucial role of this property was first pointed out by Hilbert, when trying to react positively to Gödel's challenge. Most people who cite the incompleteness theorem put it more strongly: there are true statements of arithmetic which are not provable. But this formulation presumes truth in a Platonic universe, which is here seen as a distinguished model with the ω-property.

There is a classically, though not intuitionistically, equivalent ω*-property:
if $\exists x\in N\ \phi(x)$ holds, then so does $\phi(S^n0)$ for some natural number n.

Although Gödel first announced his incompleteness theorem for classical arithmetic, it also holds for intuitionistic arithmetic (as I first learned from Dirk van Dalen). We now know that this does have a distinguished model with the ω*-property, in which all true statements are provable. We will return to this in the Postscript below.

The incompleteness theorem was to be submitted for Gödel's so-called habilitation (a prerequisite for permission to lecture at a university); but he first announced it at a conference in Königsberg (now Kaliningrad). There Rudolf Carnap, Arend Heyting and John von Neumann were to defend the three prevailing mathematical philosophies: logicism, intuitionism and formalism respectively, when Gödel threw his bombshell.

Of course, logicism may be attacked on the grounds that arithmetic requires one extra-logical axiom, the so-called axiom of infinity; but intuitionistic arithmetic was shown to be formalizable by Heyting. Gödel's Platonism, at first sight, seems to contradict Hilbert's formalist program, at least as long as one confines attention to classical arithmetic and as long as one does not possess a model of the latter with the ω-property. While intuitionists have no problem with the ω*-property, they may have difficulty with the ω-property. They might argue that we can accept the truth of $\forall_{x\in N}\ \phi(x)$ only if there is a uniform way of getting to know the truth of each $\phi(S^n0)$. After all, the proofs of the formulas $\varphi(S^n0)$ might get more complicated as n increases. Perhaps this helps to explain Gödel's lifelong interest in intuitionism.

To carry out his proof, Gödel had to re-invent the theory of *primitive* recursive functions, which may already have been known to Dedekind and Peano. Prompted by Herbrand, he later lectured on *general* recursive functions in Princeton, to fit in with the Church-Turing thesis. Today, these may be more easily described as recursively enumerable relations which happen to be one-to-one and universally defined, although the latter property need not always be provable.

Gödel barely beat von Neumann to the second incompleteness theorem, which asserts that the consistency of arithmetic, suitably codified, cannot be proved within arithmetic. Many people, including Gödel himself, saw this as destroying Hilbert's program. I am not so impressed with this result; for, if a formal language is inconsistent, then anything can be proved, including its consistency.

In his 1938 Princeton lectures, published in 1940, Gödel proved the consistency of the continuum hypothesis, in what came to be known as Gödel-Bernays set theory. He used the constructible hierarchy of sets as his model. This model depends

on the axiom of choice and is not really constructible, in spite of its name. Gödel tried very hard to prove the independence of the continuum hypothesis, but did not succeed. This was proved about twenty years later by Paul Cohen, whom Gödel generously encouraged to publish his proof immediately. Unlike some famous mathematicians in similar circumstances, he did not claim priority.

In a letter to von Neumann in 1955, we find the first known statement of what is now called the $P = NP$ problem, although Gödel professed no interest in the emerging Computer Science.

His last important contribution was the 1958 Dialectica Interpretation. In this paper he outlined the notion of a computable function of finite type and stressed how it can be applied to provide a constructive proof of the consistency of classical arithmetic. The paper also enunciated a number of constructivist principles, most of which are now known to be provable in higher order intuitionistic arithmetic.

Although raised as a freethinker, Gödel later declared: "in religion there is much more that is rational than is generally believed". He thought he had found a proof of the existence of God, an updated version of the famous argument by Anselm of Canterbury, which essentially asserted that God is defined to be a perfect being and that perfection implies existence. Gödel hesitated to publish his proof for fear that a belief in God might be ascribed to him, whereas he only wanted to show that such a proof could be carried out on the basis of accepted principles of formal logic. Still, it turned up in his Nachlass and has given rise to some recent discussion.

The Italian algebraist Magari had found a flaw in the argument, but the Czech logician Hajek claimed to have fixed this. One wonders whether the existence of elephants can be proved by the same method.

Gödel's life ended sadly by self-induced starvation, like that of Eratosthenes, famous for his sieve and for being the first to measure the circumference of the earth. Yet their reasons were different: Eratosthenes was losing his eyesight and did not wish to live as a blind man; Gödel believed that his food had been poisoned.

An appendix to Dawson's book contains some interesting biographical vignettes of other logicians, from Paul Bernays to Ernst Zermelo. One is struck by how many of them also suffered from nervous breakdowns, depression or even paranoia: Cantor, Post and Zermelo. Dawson speculates that there is "a deep connection between rationalism and permanent unshakable delusional system."

POSTSCRIPT: Some categorical afterthoughts may be appropriate. It is now evident that many of Gödel's ideas can be illuminated by contributions from category theory. Bill Lawvere, searching for a characterization of the category of sets, was led to the notion of an elementary topos. This first saw the light of day in the Proceedings of the 1971 Halifax conference, in a joint article with Myles Tierney, offering a categorical proof of Paul Cohen's independence theorem. Candidates for the classical category of sets are now recognized as elementary toposes (with natural numbers object) in which the terminal object is a generator. They may be viewed as Henkin models of classical higher order arithmetic. Gödel and other Platonists would wish to single out one such model with the ω-property as *the* category of sets. It is not clear whether a distinguished such model can be constructed, and classical mathematicians may have to live with a whole sheaf of such models. The situation is different when it comes to models of intuitionistic higher order arithmetic.

These are elementary toposes in which the terminal object is a non-trivial indecomposable projective, as was first pointed out by Peter Freyd. The Platonist Gödel might have been pleased that a distinguished such model exists, the so-called *free* topos, the initial object in the (large) category of all (small) toposes. Being opposed to nominalism, Gödel might have been less pleased that the free topos can be constructed linguistically as what might be called the Tarski-Lindenbaum category of higher order intuitionistic arithmetic. Phil Scott and I wrote our book "Introduction to higher order categorical logic" with the explicit aim of showing that the free topos is a constructible model with the ω*-property in which all true statements are provable. Hilbert might have been pleased with this result if he could have overcome his antagonism to Brouwer's intuitionism. Phil and I were motivated by Gödel's Dialectica Interpretation, inasmuch as we attempted to show that the principles of constructive mathematics outlined there do indeed hold in the free topos. Unfortunately, we never completed this project.

WANTED:
Books for Review

Have you written a book lately? Would you like to see it reviewed in the CMS Notes? If so, please arrange to have a review copy sent to our Book Review Editor.

RECHERCHÉS :
Livres pour critiques littéraires

Vous avez récemment écrit un livre? Vous aimeriez une critiques littéraires de celui-ci dans les Notes de la SMC? Si oui, veuillez faire parvenir une copie au rédacteur des critiques littéraires

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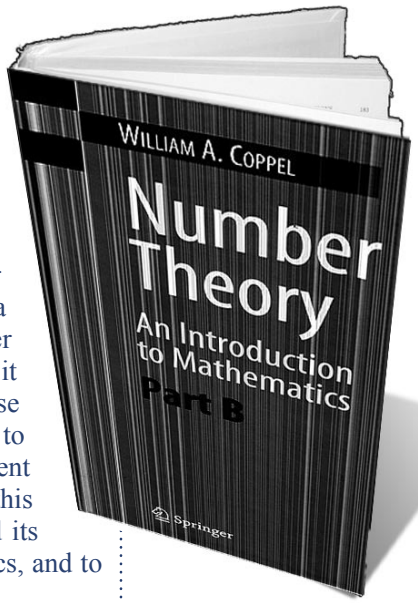
MATHEMATICS VIA NUMBER THEORY

Dixon
McGill University

Number Theory: an introduction to mathematics (vols. A and B)

William A. Coppel

Springer, New York, 2006



ALTHOUGH THESE TWO volumes were published earlier (2002) by a small press (Phalanger), readers of the *CMS Notes* who are not specialists in number theory might have missed them. That would be a pity, since they should be of interest to a much wider constituency. As the author writes in his preface, it is useful for students of mathematics, including those who will not become professional mathematicians to have a clear understanding of the nature and extent of mathematics. The author attempts to provide this through the connecting theme of number theory and its many connections with other branches of mathematics, and to a large extent he succeeds.

The book is in some sense a collection of extended essays on interesting and significant topics, providing a thorough background of the basic material and then leading into related topics of current interest. Complete proofs are provided where possible, and an extensive list of annotated references to the literature given at the end of each chapter. For example, the first chapter (The expanding universe of numbers, 95 pages) begins with the natural numbers and Peano axioms, through ring properties of the integers, construction of the rationals and reals, an introduction to metric spaces, the fundamental theorem of algebra and the complex numbers, quaternions and octonions, groups, rings, fields, vector spaces and algebras. This is done in a deceptively leisurely style with full details in most of the proofs. Similarly the fourth chapter (Continued fractions and their uses, 50 pages) gives a complete introduction to continued fractions and their approximating properties, and applications to Pell type equations. It then moves seamlessly into the modular group, and finishes with a section on non-Euclidean geometry. The final two chapters of volume B (Elliptic functions, 40 pages and Connections with number theory, 50 pages) begin with an excellent introduction to the classical theory of elliptic integrals, the AGM algorithm, elliptic functions, theta functions and the modular function. This is followed with applications to sums of square and partition identities before considering cubic curves and an almost complete proof of Mordell's theorem. The book ends with a brief discussion of the solution of Fermat's conjecture.

A list of chapter headings gives only some idea of the scope of the books: The expanding universe of numbers; Divisibility; More on divisibility; Continued fractions and their uses; Hadamard's determinant problem; Hensel's p-adic numbers; The arithmetic of quadratic forms; The geometry of numbers; The number of prime numbers; A character study; Uniform distribution and ergodic theory; Elliptic functions; Connections with number theory. You will not find much on algebraic number theory outside of quadratic extensions of the rationals, but almost everyone will find some gem with which they are not familiar such as a simple ergodic proof of van der Waerden's theorem on arithmetic progressions, the Bruck-Ryser-Chowla theorem on 2-designs, or a discussion of the Weil conjectures on zeta functions.

This is a book which many mathematicians could enjoy browsing, and one which a good undergraduate could be encouraged to read to learn something of the interconnections, which exist between apparently disparate part of mathematics.

SOLUTION FOR SEPTEMBER'S PROBLEM

Four points of R^3 are missing.

Suppose the elements of X to be O = (0,0,0), A = (0,1,1), B = (1,0,1) and C = (1,1,0). It may be verified that no line through any of the other four vertices of the unit cube meets two extended edges of the tetrahedron $OABC$ at distinct points. For instance, a line through (1,1,1) that intersects $\overleftrightarrow{BC}$ must lie in the plane x=1 and thus cannot meet $\overleftrightarrow{OA}$ and it could only meet the other four edges at B or C.

$L(L(X))$ thus fails to contain (1,0,0), (0,1,0), (0,0,1) or (1,1,1); it may be shown that it does contain every other point.

BRIEF BOOK REVIEWS

By Peter Fillmore
Dalhousie University

Fundamentals of Actuarial Mathematics

by S. David Promislow
Wiley 2006 xix + 372 pages $45 US

Acturial science uses mathematics and statistics to analyze problems in life insurance, pensions and investments. The present volume, which deals mainly with the mathematical aspects of the subject, is directed to upper-level students, as well as actuarial professionals. It covers all material on the current modeling examinations of the Canadian and US actuarial societies. Part I introduces the subject in its simplest setting, the deterministic model, beginning with the discrete case, for which the only mathematical requirements are elementary linear algebra and probability theory, and progressing to continuous models, requiring some basic calculus. These topics occupy the first half of the volume. In Part II the full stochastic model is developed. The more advanced probability theory needed for this is summarized in a twenty-page appendix. Part III treats the collective risk model and includes two chapters on the basics of stochastic processes on which it depends.

There are numerous exercises, both computational and theoretical, as well as a number which make use of spreadsheets, supporting the author's goal of giving "full recognition to modern computing methods and techniques."

Nonlinear Dynamics and Evolution Equations

Hermann Brunner et al, Editors
Fields Institute Communications 48
AMS 2006 vii + 311 pages

The thirteen papers in this volume, all invited and refereed, are based on lectures given during the International Conference on Nonlinear Dynamics and Evolution Equations held at Memorial University, St. John's, Newfoundland, in July of 2004. They cover a broad spectrum of current research activities, both theoretical and applied, in the field. Nine of them are survey articles, dealing with various aspects of the theory of partial differential equations and dynamical systems, as well as applications in biological sciences and materials science. These papers are complemented by four research papers that examine particular problems in the theory of dynamical systems. The goal of the editors was to create a proceedings volume that would serve as an important resource, both for new researchers and experts in the field, for many years to come.

Interpolation and Approximation by Polynomials

by George M. Phillips
CMS Books in Mathematics 14
Springer 2003 xiv + 312 pages

This is the second book by George Phillips to be published in the CMS/Springer series. The first, *Two Millenia of Mathematics*, was enthusiastically reviewed by Karl Dilcher in the *CMS Notes* (Sept 2001), who said that it "was written by someone who loves doing, writing about, and teaching mathematics." In the present volume the same attributes are once again evident, but whereas the first was directed to the general mathematical reader, this is "intended as a course in numerical analysis and approximation theory for advanced undergraduates or graduate students, and as a reference work for those who lecture or research in this area." As Phillips explains, its title "pays homage" to Philip Davis's classic *Interpolation and Approximation*, though pitched at a less advanced level.

Besides the preface, four pages of references and an index, the book consists of eight chapters, each divided into three to six sections, each of which includes a good selection of examples and problems. The chapter titles are: univariate approximation, best approximation, numerical integration, Peano's Theorem and applications, multivariate interpolation, splines, Bernstein polynomials, and properties of the "q"-integers.

Global Analysis on Foliated Spaces, second edition

by Calvin C. Moore and Claude L. Schochet
MSRI Publications 9
Cambridge 2006 xiii + 293 pages $39.99 US pb

As the preface to this edition states, "a lot has happened in the realm of foliated spaces and their operator algebras since 1988, when this book first appeared." Besides adding updates at the end of each chapter, the authors have correspondingly enlarged the bibliography, made improvements to the exposition, and added an index. In writing the book, they were motivated by "the desire to make the general subject and the work of Alain Connes in particular more readily accessible to the mathematical public." The original formulation (1979) of the Connes Index Theorem was for foliated manifolds. The version presented here is for the larger category of foliated spaces, generality which is essential for some recent applications of the Index Theorem. An appendix discusses an example of this, the Gap Labeling Theorem, which describes the gaps in the spectrum of the Schrödinger operator of a particle moving in a solid which is almost periodic but not periodic.

Galileo Galilei: When the Earth Stood Still

by Atle Naess

Springer 2005 viii + 221 pages $29.95 US

Googling Galileo produces some 50 million hits, about one-third the number for Newton, but twice as many as Aristotle. This gives an idea of the stature of Galileo in intellectual history, and may cause one to wonder about the purpose of another biography. The author does not tell us. There is no preface, but a brief prologue brilliantly evokes the 68 year old Galileo and the contemporary situation, as he prepares to travel to Rome to answer the summons of the Inquisition. Anyone who gets this far will want to read on, and that is perhaps sufficient justification.

Though well-written and interesting, the book does not always keep to this high level. But the tale to be told is complicated and nuanced. Galileo himself was a complicated man, capable of astonishing errors along with the brilliant insights. He was proud, determined to get the credit due him for his discoveries, and more if possible. Science in the seventeenth century was not the cooperative government-supported activity it is now; the battle for priority—and the princely patronage that followed--was intense. And the politics of the period were complicated, with many competing mini-states and principalities, not least the Vatican and its struggle with the reformation. The church itself was divided in its attitude to the new science of Copernicus, Brahe, Kepler, and Galileo. All this, and the effect it had on Galileo's life and work, is very well described.

The book itself is beautifully designed and produced, and includes two eight-page sections of well-chosen and nicely reproduced illustrations. The Norwegian original was published in 2001. The translation is excellent, though on page 59 we learn that "...Brahe himself was a passed master of observation."

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Ed Barbeau
University of Toronto

CHALLENGES IN THE MATHEMATICS CLASSROOM

Early in the summer, I was cochair of a conference in Trondheim, Norway, on Mathematical Challenges In and Beyond the Classroom, the fruits of which will ultimately be a Study Volume published by ICMI. Even though I have never studied Norwegian, I was able to guess at their meaning of street signs through their apparent context. My knowledge of English, French and German helped as many Norwegian words are either borrowed from or related to words in these languages. Sometimes the equivalences were a little stretched: "heis" referred to an elevator, but recalled the English word "hoist", while "stol" described a chair rather than a stool. But my apprehension of the language was fragmentary and prone to uncertainty and error.

It struck me that many pupils in schools must be in a similar position as they negotiate mathematics. They struggle for meaning, making use of whatever clues might be available from context and other things that seem similar or related. The fragility of their knowledge makes it easy for them to get the wrong end of the stick. Traditionally, one has tried to cure this by imposing a heirarchical structure on what is to be learned and drilling various facts and techniques.

When I learned French at school, this was the approach. There were vocabulary lists, conjugation of verbs (and the learning of the "irregular verbs") and various grammatical rules. While I can read French quite readily, my attempts to write or speak it are stymied by the lurking fear that the French really do not express themselves in the way that I attempt.

In mathematics, a well organized excursion through a syllabus may culminate in a knowledge of main results and a small range of skills. Those who are well-prepared can read a book or follow an argument, but can they do mathematics? Many of the readers of this article can probably remember when they first became able to do mathematics rather than just learn it, and it is possible that very little of what went on in the classroom contributed to this transformation.

In the conference, we examined challenges as a means of making students more fluent and capable in mathematics. If challenges are to be successfully employed in the classroom, then a number of changes must occur. Our present emphasis on covering material within a certain time frame and testing it afterwards forces a regimentation that leaves little room for exploration. To be sure, there is a syllabus that must be taught so that pupils have the background to tackle challenges that are significant and productive. This poses a dilemma to the teacher who must at the same time keep her classes on track while providing them with experiences that are mathematically rich. Probably, the first task of the mathematical community is to create a larger corps of teachers who themselves are conversant with mathematics, have a zest for solving problems and are able to meet this dilemma. The second is to develop material that is not banal and is designed to foster the emergence of important mathematical ideas and techniques in a way that the student can internalize.

A confounding feature of current secondary mathematics education is that the same courses are taught to classes that exhibit a wide range of ability, background, interest, ambition and motivation. The weaker students struggle while the stronger are dissatisfied and bored. It is hard to introduce challenges into such a situation and keep all students on board. Despite the rhetoric of problem solving, much that takes place in this regard is either banal or too programmed to promote either challenge or fluency. The syllabus focusses on algebra and geometry, but is insufficient to give a coherent introduction to these areas and skews the views of the students on the nature of mathematics. They may see in it a collection of meaningless rituals, rather than as a language and a way of thinking and analyzing. Opportunities are lost in adopting meaningful topics for those who will not go on in the subject and in providing those who want to take up mathematics, science or engineering at the tertiary level with the background that they need. Where different types of courses exist, students are often misplaced, partly because of a prejudice that some courses are "superior" and others "inferior".

If we can find a way of separating at the secondary level those students who need a strong technical preparation from those who do not require this, but can profit from a proper understanding of our discipline, then we will be free to devise courses, each with its own integrity and respectibility, that provide challenges to both populations and well serve society. For the future scientists and engineers, we can provide a solid background in algebra and geometry that takes them far enough to appreciate the power of these areas and tackle some really challenging problems, rather than the pablum that the current regime has to offer. For the rest, we can look to areas of mathematics that are less technical, but have the ability to convey important mathematical concepts of structure and reasoning, often in a way that the usual topics never did. We can look to mathematical history, societal applications of arithmetic, graph theory, informal geometry, dynamical systems, puzzles and recreational mathematics, to leave students with an understanding of our discipline that will provide a foundation should they later desire or need to study it further.

Students who need mathematics for tertiary study require a sequence of courses that are well-orchestrated and for which prerequisites are clear and enforced. They should be required to pass an examination for entry at the grade 9 level to ensure that they have a solid arithmetical base to continue. The challenges introduced into these courses can be reasonably sophisticated and technical. For example, they should be able to perform difficult factorings of polynomials that require them to exploit such attributes as symmetry and degree and make use of such results as the factor theorem. Such courses should be offered to no more than about 25% of the secondary population.

For the rest, there is a great deal of flexibility in designing the courses, according to the backgrounds, abilities and predilections of the students. Some of the time can be devoted to remediation and application of mathematics to everyday situations, but we can draw on situations that require analysis, judicious use of notation, reasoning, without being sidetracked

by technicalities. The goal is to produce citizens who at some level can enjoy mathematics (in a way that most of the population enjoy music or literature), perhaps with a penchant for puzzles and brain-teasers, and who can negotiate with insight the occurrence of mathematics in their daily lives. A second goal would be to provide an ideological foundation for the success of those who, for whatever reason, find later that they have to need more background in mathematics.

For a secondary curriculum to flourish, it is important that the stage be set at the elementary level, particularly in the seventh and eighth grades. In these grades, students should have been exposed to everything they need to know about arithmetic, and at this level, their skills in this area need to be consolidated. Additionally, time should be spent on mathematical issues of the everyday world. But in addition, there should be time for recreations, projects and challenges that will both entice the students and prepare them, conceptually and attitudinally, for an authentic approach to secondary mathematics.

The modern high school has the mandate to serve virtually the entire adolescent population. Its students are old enough to take stock of their own interests, ambitions and abilities, with the help of their teachers and parents along with courses that accurately reflect the various disciplines. The choices they make have consequences, and it is no longer efficient or wise to artifically shield them from these. This is particularly true in mathematics, where one of the tasks of the secondary panel is to prepare students for advanced study in science and engineering. Our colleges and universities have a heavy enough load as it is dealing with ill-prepared students, and we need to look at ways of curing this without overloading the school years. Since complaints about first year students often focus on their mathematical fluency, perhaps the use of challenges in school is a way to foster a productive attitude and enable students to learn more efficiently and enjoyably.

Letters to the Editors
Lettres aux Rédacteurs

The Editors of the *Notes* welcome letters in English or French on any subject of mathematical interest but reserve the right to condense them. Those accepted for publication will appear in the language of submission. Readers may reach us at notes-letters@cms.math.ca or at the Executive Office.

Les rédacteurs des *Notes* acceptent les lettres en français ou anglais portant sur un sujet d.intérêt mathématique, mais ils se réservent le droit de les comprimer. Les lettres acceptées paraîtront dans la langue soumise. Les lecteurs peuvent nous joindre au bureau administratif de la SMC ou a l'addresse suivante: notes-lettres@smc.math.ca.

NEWS FROM DEPARTMENTS

University of Alberta, Edmonton, AB

Appointments: A. Rosenschon (Assistant Professor, Algebraic Geometry); J. Kuttler (Assistant Professor, Algebraic Groups); P. Zhang (Assistant Professor, Statistics).

Awards: B. Sutherland (McCalla Professorship 2006); M.A. Lewis (Killam Annual Professorship Award 2006); A.T.M. Lau (3M Teaching Fellowship Award 2006); N. Tomczak-Jaegermann (PIMS-CRM-FIELDS Research Prize); G. deVries (Rutherford Award for Excellence in Undergraduate Teaching).

University of Regina, Regina, SK

Promotion: Andrei Volodin (Associate Professor, July 2006).

Appointment: Remus Floricel (Assistant Professor, Operator Algebras, August 2006).

Retirements: Denis Hanson (Professor June 30, 2006); Jim Tomkins (Professor, June 30, 2006).

Visitors: Andrew Douglas (Post-Doctoral Fellow, Algebra, July-December 2006); Pedro Massey (Argentina, Post-Doctoral Fellow, Operator Algebras, September-August 2007).

Memorial University, St. John's, NL

Promotions: S. Kocabiyik (Professor, September 2005); J. Xiao (Associate Professor, September 2005); Y. Yuan (Associate Professor, September 2006); X. Zhao (Professor, September 2005).

Appointments: D. Dyer Assistant (Professor, Mathematics, September 2005); Z. Fan (Assistant Professor, Statistics, September 2005); J. C. Loredo-Osti (Assistant Professor, Statistics, September 2005); C. Ou (Assistant Professor, Mathematics, September 1, 2005); M. Kotcheto (Assistant Professor, Mathematics, July 1, 2006); M. Merkli (Assistant Professor, Mathematics, August 14, 2006).

Retirements: P. Booth (Professor, August 2006); H. Brunner (Professor, August 2006); D. Bass (Professor, August 2006); D. Rideout (Associate Professor, August 2006).

Resignation: X. Zou (December 2005).

Vistors: Vandna Jowaheer (Mauritius, Statistics, June 7-August 7, 2006); Jongjin Kim (Korea, Mathematics, July 2005-December 2006); Ling Liang (P.R. China, Mathematics, July 1-August 31, 2006); Yi Wang (P.R. China, Mathematics July 1-August 31, 2006); Shinya Fujita (Japan, Mathematics July 26-August 16, 2006); Lubomir Dechevsky (Norway, Mathematics, April 9-24, 2006); Ed Keppelmann (U.S., Mathematics, March 18-27, 2006); Lizhong Peng (P.R. China, Mathematics, August-September, 2006); Yuanlin Li (Brock, Mathematics, March 6-17, 2006); Vasily Babich (Russia, Mathematics, February 28-April 27, 2006); Barry Gardner (Tasmania, Mathematics January 22-February 13, 2006); Weihua Jiang (P.R. China, Mathematics February-April, 2006); Andrey Trifonov (Russia, Mathematics, September15-30, 2005); Mikhail Zaitsev (Russia, Mathematics, November 2005); Kathy Baker (Canada, Mathematics, July 18-22, 2006).

Distinctions/Awards: Marina Tvalavadze, a student of Yuri Bahturin, became the first woman to obtain a PhD in Mathematics at Memorial University. Marina's brother, Teymuraz, also a student of Yuri Bahturin, successfully defended his PhD Thesis and has won a competition for a PDF position at Carleton University. Two graduate students won NSERC graduate scholarships, Colin Reid, PGSD, McMaster University and Neil McKay, PGSM, Dalhousie University.

Other News: May 2006 witnessed the creation of the Atlantic Algebra Centre, the second AARMS institute in the region.

SESSIONS

By invitation of the Meeting Committee, there will be sessions in the following areas. The list of speakers is preliminary, and participants interested in delivering a talk in one of the sessions should contact one of the organizers of that session.

À l'invitation du comité de coordination, des sesions sont prévues dans les domaines ci-dessous. La liste de conférenciers est préliminaire, et l'on demande à toute personne intéressée à présenter une communication dans l'une des sessions de contacter l'un des organisateurs de la session en question.

Algebraic Combinatorics
Combinatoires algébriques

Org: Nantel Bergeron (York), Christophe Hohlweg (Fields Institute) and Michael Zabrocki (York)

Marcelo Aguiar (Texas A&M), François Bergeron (UQAM), Philippe Choquette (York), Sergey Fomin (Michigan-Ann Arbor), David Jackson (Waterloo), Aaron Lauve (UQAM), Rosa Orellana (Dartmouth), Muge Taskin (York), Hugh Thomas (UNB), Stephanie Van Willigenburg (UBC).

Calabi-Yau Varieties and Mirror Symmetry
Les variétés de Calabi-Yau et symétrie miroir

Org: James Lewis (Alberta) and Noriko Yui (Queen's)

Marie José Bertin (Paris VI), Patrick Brosnan (UBC), Xi Chen (Alberta), Adrian Clingher (Stanford), Igor Dolgachev (Michigan), Chuck Doran (Washington), Yasuhiro Goto (Hokkaido University of Education), Matt Kerr (Chicago), Nam-Hoon Lee (KIAS;Queen's), James Lewis (Alberta), Bong H. Lian (Brandeis), Ling Long (Iowa State), Steven Lu (UQAM), Gregory Pearlstein (Alberta), Andreas Rosenschon (Alberta), Matthias Schuett (Harvard), Abdullah Sebber (Ottawa), Andrey Todorov (UC- Santa Cruz), Johannes Walcher (IAS, Princeton), Shing-Tung Yau (Harvard), Jeng-Daw Yu (Queen's), Noriko Yui (Queen's).

Commutative Algebra and Algebraic Geometry
Algèbre commutative et géométrie algébrique

Org: Ragnar-Olaf Buchweitz (Toronto), Graham Leuschke (Syracuse) and Greg Smith (Queen's)

Luchezar L. Avramov (Nebraska-Lincoln), Neil Epstein (Michigan), Anthony V. Geramita (Queen's; Genoa), Colin Ingalls (UNB-Fredericton), Srikanth B. Iyengar (Nebraska-Lincoln), David A. Jorgensen (Texas-Arlington), Alexander Nenashev (York-Glendon College), Ravi Vakil (Stanford), Adam Van Tuyl (Lakehead), Alexander Yong (Fields Institute; Minnesota).

Complexity and Computability in Analysis, Geometry, and Dynamics
Complexité et calculabilité en analyse, géométrie et dynamique

Org: Alex Nabutovsky and Michael Yampolsky (Toronto)

www.math.utoronto.ca/yampol/complexity.html.

Differentiable Dynamics and Smooth Ergodic Theory
Systèmes dynamiques différentiables et théorie érgodique lisse

Org: Giovanni Forni and Konstantin Khanin (Toronto)

Jayadev Athreya (Yale), Pavel Batchourine (Toronto), Vadim Kaloshin (Maryland), Hee Oh (CalTech), Federico Rodriguez-Hertz (IMERL, Uruguay), Amie Wilkinson (Northwestern).

Functional Analysis
Analyse fonctionnelle

Org: Robb Fry (Thompson Rivers) and S. Swaminathan (Dalhousie)

Razvan Anisca (Lakehead), Daniel Azagra (Universidad Complutense, Madrid), Manuel Cepedello-Boiso (Seville), Chandler Davis (Toronto), Joe Diestel (Kent State University, Kent), Alexander Litvak (Edmonton), Keith Taylor (Dalhousie), Jon Borwein (Dalhousie).

Harmonic Analysis
Analyse harmonique

Org: Izabella Laba (UBC) and Malabika Pramanik (Caltech; UBC)

Jim Colliander (Toronto), Galia Dafni (Concordia), Burak Erdogan (UIUC), Raluca Felea (Rochester Institute of Technology), Michael Greenblatt (SUNY - Buffalo), Allan Greenleaf (Rochester), Kathryn Hare (Waterloo), Alex Iosevich (Missouri-Columbia), Alexander Kiselev (Wisconsin - Madison), Michael Lacey (Georgia Tech), Neil Lyall (Georgia), Adrian Nachman (Toronto), Alexander Nagel (Wisconsin - Madison), Jill Pipher (Brown), Andreas Seeger (Wisconsin-Madison), Gigliola Stafillani (MIT), Paul Taylor (Shippensburg).

History of Mathematics
Histoire des mathématiques

Org: Tom Archibald (SFU)

Knot Homologies
Homologie de noeuds

Org: Dror Bar-Natan (Toronto)

Oliver Collin (UQAM), Mikhail Khovanov (Columbia), Ciprian Manolescu (Columbia), Jake Rasmussen (Princeton), Lev Rozansky (North Carolina), Paul Seidel (Chicago), Adam Sikora (New York State).

Mathematical Aspects of Continuum Physics: Analysis, Computation, and Modeling
Aspects mathématiques de la physique du continu: analyse, analyse computationnelle et modélisation

Org: Rustum Choksi (SFU) and Mary Pugh (Toronto)

Stan Alama (McMaster), Irene Fonseca (Carnegie Mellon), Carlos Garcia-Cervera (California - Santa Barbara), Joy Ko (Brown), Robert McCann (Toronto), Govind Menon (Brown), Bob Pego (Carnegie Mellon), Silvia Serfaty (NYU), Eric vanden Eijnden (NYU), Thomas Wanner (George Mason).

Mathematical Biology
Biologie mathématique

Org: Gail Wolkowicz (McMaster)

Julien Arino (Manitoba), Chris Bauch (Guelph), Sue Ann Campbell (Waterloo), Yuming Chen (Wilfrid Laurier), Troy Day (Queen's), Herb Freedman (Alberta), Abba Gumel (Manitoba), Michael Li (Alberta), Xinzhi Liu (Waterloo), Connell McCluskey (Wilfrid Laurier), Stephanie Portet (Manitoba), Robert Smith (Ottawa), James Watmough (UNB), Jianhong Wu (York), Huaiping Zhu (York), Xingfu Zou (Western).

Mathematics Education
L'éducation mathématique

Org: Walter Whiteley (York)

Nonlinear Schrodinger Equations
Équations de Schrödinger non linéaires

Org: James Colliander and Robert Jerrard (Toronto)

Poisson Geometry and Mathematical Physics
Géométrie de Poisson et physique mathématique

Org: Eckhard Meinrenken (Toronto)

Henrique Bursztyn (IMPA, Rio De Janeiro), Sam Evens (Notre Dame), Marco Gualtieri (MIT), Megumi Harada (McMaster), Tara Holm (Connnecticut;Cornell), Lisa Jeffrey (Toronto), Yael Karshon (Toronto), Boris Khesin (Toronto), Greg Landweber (Oregon), Eugene Lerman (Illinois - Urbana-Champaign), Yi Lin (Toronto), Johan Martens (MPI Bonn;Toronto), Markus Pflaum (Frankfurt), Reyer Sjamaar (Cornell), Xiang Tang (UC Davis), Aissa Wade (Penn State), Jonathan Weitsman (Santa Cruz), Graeme Wilkin (Brown).

Probabilistic Methods in Analysis and Algebra
Méthodes probabilistiques en analyse et algèbre

Org: Matthias Neufang (Carleton) and Balint Virag (Toronto)

Representations of Algebras
Représentations des algèbres

Org: Ibrahim Assem, Thomas Brustle and Shiping Liu (Sherbrooke)

Raymundo Bautista (UNAM-Morelia), Frauke Bleher (Iowa), Walter Burgess (Ottawa), Flavio Ulhoa Coelho (USP, Sao Paulo), José Antonio de la Peña (UNAM), Edward Green (Virginia Tech), Mark Kleiner (Syracuse), Alex Martsinkovsky (Northeastern), Ralf Schiffler (Massachusetts-Amherst), Markus Schmidmeier (Florida Atlantic), Xueqing Chen Shiping (Wisconsin-Whitewater), Hugh Thomas (UNB-Fredericton), Gordana Todorov (Northeastern), Sonia Trepode (UNMDP, Argentina).

Contributed Papers Session
Communications libres

Org: Bill Weiss (Toronto)

Contributed papers of 20 minutes duration are invited. For an abstract to be eligible, the abstract must be submitted online (https://cms.math.ca/forms/abs-w06) before October 15, 2006. The abstract must be accompanied by its contributor's registration form and payment of the appropriate fees. To better assist the organizers, please include the Primary (2000) AMS Classification (www.ams.org/msc/).

Nous lançons un appel de communications libres de 20 minutes chacune. Les résumés devront respecter nous parvenir au plus tard le 15 octobre (Veuillez utiliser le formulaire électronique à www.cms.math.ca/Reunions/hiver06/abs/). Nous demandons à chacun de joindre au résumé le formulaire d'inscription et le règlement des frais pertinents. Pour faciliter la tâche des organisateurs, veuillez préciser la classification de sujets AMS 2000 (www.ams.org/msc/).

Call for Sessions – CMS-Winter 2007 Meeting
Appel de sessions – Réunion d'hiver 2007 de la SMC

ADDITIONAL SELF-SUPPORTED SESSIONS play an important role in the success of our meetings. We welcome and invite proposals for self-supported sessions for this meeting (December 8-10, 2007) at the Hilton Hotel in London, Ontario. Proposals should include a brief description of the focus and purpose of the session, the expected number of the talks, as well as the organizer's name, complete address, telephone number, e-mail address, etc. These additional sessions will be incorporated with the other sessions in time blocks allocated by the Meeting Director. All sessions will be advertised in the CMS Notes, on the web sites and, if possible, in the Notices of the AMS and in publications of other societies. Speakers in these additional sessions will be requested to submit abstracts which will be published on the web site and in the meeting programme. Those wishing to organize a session should send a proposal to the Meeting Director by the deadline below.

LES SESSIONS COMPLÉMENTAIRES autonomes jouent un rôle important dans le succès de nos réunions. Nous vous invitons à proposer des sessions autonomes pour ce congrès qui se tiendra à l'hôtel Hilton de London, Ontario, du 8 au 10 décembre 2007. Votre proposition doit inclure une brève description de l'orientation et des objectifs de la session, le nombre de communications prévues et leur durée, ainsi que le nom, l'adresse complète, le numéro de téléphone, l'adresse courriel et les autres coordonnées de l'organisateur. Ces sessions complémentaires seront intégrées aux autres sessions du programme, dans des cases horaires prévues à cet effet par le directeur de la Réunion. Toutes les sessions seront annoncées dans les *Notes de la SMC*, sur le site Web et, si possible, dans le *Bulletin de l'AMS* et les publications d'autres sociétés. Les conférenciers de ces sessions complémentaires devront présenter un résumé qui sera publié sur le site Web et dans le programme de la Réunion. Toute personne qui souhaiterait organiser une session est priée de faire parvenir une proposition au directeur de la Réunion avant la date limite indiquée ci-dessous.

Meeting Director
Directeur de la réunion

J. F. Jardine
Department of Mathematics
University of Western Ontario
Middlesex College
London, ON N6A 5B7
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The following invited (partially funded) sessions have been confirmed for this conference:

Les sessions suivantes (partiellement subventionnées) ont été confirmées :

Algebraic Stacks
Piles algébriques
Org: Ajneet Dhillon (UWO)

Combinatorics and its Applications to Mathematical Physics
Combinatoires et ses applications en physique mathématique
Org: Michael Gekhtman (Notre Dame), Michael Shapiro (Michigan State)

Complex Analytic Geometry
Géométrie analytique complexe
Org: Tatyana Foth, Finnur Larusson, Rasul Shafikov (UWO)

Computer Algebra: «Algorithmic Challenges in Polynomial and Linear Algebra»
L'algèbre informatique: «Défis algorithmiques dans l'algèbre polynomiale et l'algèbre linéaire»
Org: Stephen Watt (UWO)

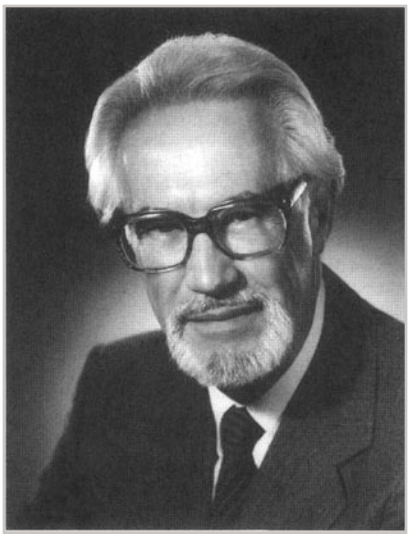
Iwasawa Theory
Théorie d' Iwasawa
Org: Manfred Kolster, Reza Sharifi (McMaster)

Mathematics Education
Éducation mathématique
Org: George Gadanidis (UWO)

Non-Commutative Geometry
Géométrie non commutative
Organizer: Masoud Khalkhali (UWO)

DEADLINE: DECEMBER 22, 2006
DATE LIMITE : 22 DÉCEMBRE, 2006

**Décès de Maurice L'Abbé,
un pionnier et un ancien président**



Maurice L'Abbé, président de la SMC de 1967 à 1969, est décédé le 21 juillet 2006 à l'âge de 86 ans. C'était un homme de grande culture et un pionnier qui a laissé sa marque tant au Québec qu'au Canada.

Il obtent son doctorat en mathématiques de Princeton en 1951, six ans après la création du *Canadian Mathematical Congress* qui allait devenir la Société Mathématique du Canada. Premier francophone du Québec à recevoir un doctorat en mathématiques[1], il assuma la direction du Département de mathématiques de l'Université de Montréal de 1957 à 1968[2]. Pendant cette période, il fit évoluer le département vers un département moderne avec une forte composante recherche : il fonde en 1962 le *Séminaire de mathématiques supérieures* (SMS) qui deviendra vite une institution d'une très grande visibilité dans le monde. En 1968 il est l'un des acteurs principaux dans l'élaboration du projet de création du *Centre de recherches mathématiques* (CRM) dont il assurera la direction pendant les six premiers mois avant de passer le flambeau à Jacques Saint-Pierre, un autre pionnier des sciences mathématiques au Québec. Initialement consacré à la recherche fondamentale dans un certain nombre de secteurs des mathématiques, avec un accent prioritaire sur les mathématiques appliquées et les mathématiques qui conduisent plus directement à des applications sur le modèle américain du *Mathematical Research Center* de l'Université du Wisconsin à Madison, le CRM élargit ses activités à tout le spectre des mathématiques contemporaines dans les années quatre-vingt avec sa reconnaissance comme *institut mathématique d'intérêt national* par le CRSNG.

Si Maurice L'Abbé quitta la direction du CRM presque tout de suite après sa création, ce fut pour devenir le premier vice-recteur à la recherche dans une université québécoise. De 1968 à 1978, il dota l'Université de Montréal d'importantes structures de recherche. On lui doit par exemple la création du *Centre de recherche sur les transports* (CRT) et celle de *l'Observatoire du mont Mégantic*.

Il a été président de l'Association canadienne-française pour l'avancement des sciences (ACFAS) en 1964, président de la Société mathématique du Canada de 1967 à 1969, directeur général du *Conseil des sciences du Canada* de 1980 à 1983, et enfin premier président du *Conseil de la science et de la technologie du Québec* où il a travaillé à l'élaboration des politiques scientifiques et technologiques au Québec. Jusqu'en 2000 il assumait la présidence de nombreux comités d'évaluation scientifique de centres de recherche.

Son apport au développement des sciences au Canada et au Québec a été récompensé par de nombreuses distinctions : prix Armand-Frappier, prix Walter-Hitschfeld, Ordre national du Québec, et membre de l'Académie des Grands Montréalais. La Société mathématique du Canada lui décernait la distinction pour service méritoire en 1995.

L'action de Maurice L'Abbé s'est aussi étendue à la formation pré-universitaire (enseignement secondaire et collégial) par sa participation à la création de l'*Association mathématique du Québec* (AMQ), du *Concours mathématique du Québec* et du *Camp mathématique d'été* de l'AMQ. Ces organismes stimulent toujours aujourd'hui l'intérêt des jeunes pour les mathématiques.

Michel Delfour et Christiane Rousseau,
Université de Montréal

[1] L'émergence de la recherche en mathématiques au Québec est décrite dans l'article : « Émergence et évolution de la recherche en mathématiques au Québec, 1945-1984 », paru dans le volume I de « Mathematics in Canada/Les mathématiques au Canada » publié en 1995 par la Société mathématique du Canada dans le cadre de son 50è anniversaire.

[2] Dès l'automne 1948, M. L'Abbé s'était joint au département de mathématiques de l'Université de Montréal où il fut nommé professeur titulaire en 1956.

CALL FOR NOMINATIONS - 2007 DOCTORAL PRIZE
APPEL DE MISES EN CANDIDATURE - PRIX DE DOCTORAT 2007

La SMC a créé ce Prix de doctorat pour récompenser le travail exceptionnel d'un étudiant au doctorat. Le prix sera décerné à une personne qui aura reçu son dipôme de troisième cycle d'une université canadienne l'année précédente (entre le 1er janvier et le 31 décembre) et dont les résultats pour l'ensemble des études supérieures seront jugés les meilleurs. La dissertation constituera le principal critère de sélection (impact des résultats, créativité, qualité de l'exposition, etc.), mais ne sera pas le seul aspect évalué. On tiendra également compte des publications de l'étudiant, de son engagement dans la vie étudiante et de ses autres réalisations.

Les mises en candidature qui ne seront pas choisies dans leur première compétition seront considérées pour une année additionelle (sans possibilité de mise à jour du dossier), et seront révisées par le comité de sélection du Prix de doctorat l'an prochain.

Le lauréat du Prix de doctorat de la SMC aura droit à une bourse de 500 $. De plus, la SMC lui offrira l'adhésion gratuite à la Société pendant deux ans et lui remettra un certificat encadré et une subvention pour frais de déplacements lui permettant d'assister à la réunion de la SMC où il recevra son prix et présentera une conférence.

Candidatures

Les candidats doivent être nommés par leur université; la personne qui propose un candidat doit se charger de regrouper les documents décrits aux paragraphes suivants et de faire parvenir la candidature à l'adresse ci-dessous. Aucune université ne peut nommer plus d'un candidat. Les candidatures doivent parvenir à la SMC au plus tard le **31 janvier 2007**.

Le dossier sera constitué des documents suivants :

- Un curriculum vitae rédigé par l'étudiant.
- Un résumé du travail du candidat d'au plus dix pages, rédigé par l'étudiant, où celui-ci décrira brièvement sa thèse et en expliquera l'importance, et énumérera toutes ses autres réalisations pendant ses études de doctorat.
- Trois lettres de recommandation, dont une du directeur de thèse et une d'un examinateur de l'extérieur (une copie de son rapport serait aussi acceptable). Le comité n'acceptera pas plus de trois lettres de recommandation.

The CMS Doctoral Prize recognizes outstanding performance by a doctoral student. The prize is awarded to the person who received a Ph.D. from a Canadian university in the preceding year (January 1st to December 31st) and whose overall performance in graduate school is judged to be the most outstanding. Although the dissertation will be the most important criterion (the impact of the results, the creativity of the work, the quality of exposition, etc.) it will not be the only one. Other publications, activities in support of students and other accomplishments will also be considered.

Nominations that were not successful in the first competition, will be kept active for a further year (with no possibility of updating the file) and will be considered by the Doctoral Prize Selection Committee in the following year's competition.

The CMS Doctoral Prize will consist of an award of $500, a two-year complimentary membership in the CMS, a framed Doctoral Prize certificate and a stipend for travel expenses to attend the CMS meeting to receive the award and present a plenary lecture.

Nominations

Candidates must be nominated by their university and the nominator is responsible for preparing the documentation described below, and submitting the nomination to the address below. No university may nominate more than one candidate and the deadline for the receipt of nominations is **January 31, 2007**.

The documentation shall consist of:

- A curriculum vitae prepared by the student.
- A resumé of the student's work written by the student and which must not exceed ten pages. The resumé should include a brief description of the thesis and why it is important, as well as of any other contributions made by the student while a doctoral student.
- Three letters of recommendation of which one should be from the thesis advisor and one from an external reviewer. A copy of the external examiner's report may be substituted for the latter. More than three letters of recommendation are not accepted.

Président du Comité de sélection du Prix de doctorat
Chair, Doctoral Prize Selection Committee
Société mathématique du Canada / Canadian Mathematical Society
577 King Edward
Ottawa, Ontario Canada K1N 6N5

Robert Morewood
2006 Canadian IMO Team Leader

Problems, problems, problems... Is that a circle? Where is the centre? OK, a nice angle chase. Triangle inequality!... Too many triangles! How can this be reduced? Try a small piece and then use induction?... This one has a lot of symmetry. What about the equality case? Oops, ZERO. Of course, that's ANTI-symmetry. Hey! Zeros give factors. What to do with that? Maybe a change of variables? Now AM-GM might be useful...

It has been 24 hours struggling with 30 tough but interesting problems making up this year's IMO short list. The problem committee has certainly done a good job putting together a collection of challenging problems with a range of themes and difficulties. And what a setting to work in: we are in Portoroˇz, on the Adriatic Sea. Just steps from the beach, but 38^{O}C in the sunshine. It's a good thing the convention center is air-conditioned. Aside from a brief welcoming reception and a short jury meeting, the 90 leaders and numerous observers have been poring over the problems: Which are easy or hard? Interesting or plain? Have they been seen before? (One has been used in training the Brazilians and another appeared on the Iranian Olympiad.) All the problems have been read and I've started to form opinions, but I've solved far less than half of them. Right after the coffee break we will receive the solutions book, then over the next two days we'll select the actual six problems for this year's competition.

Setting the Stage

The next day, the selection process gets underway. After eliminating problems which may have been seen before, discussions lead into the "beauty contest." Each remaining problem is rated for both diffculty (easy/medium/hard) and beauty (plain/average/outstanding). This is just a straw poll, but it shows which way the wind is blowing. Problem "G10," a geometry problem with some combinatorial flavouring, is a clear front runner in both difficulty and beauty and eventually becomes #6, the final problem of the second day. Actually, this is a VERY hard problem. Only about half the leaders studied it sufficiently to comment on the beauty. We know there are some VERY strong students in the competition.

However, G10 cannot win the spot on its own, it needs a complementary companion to be the other "hard problem" for day one, problem #3. Many pairs are suggested, debated, and voted on. Eventually my own favorite, an unusual inequality/optimization problem which seems immune to standard mechanical approaches, takes the honour. These make a tough pair, but the Canadians are a strong team and I feel confident someone will crack at least one of them.

Attention shifts to the easy problems, #1 and #4. There is a strong feeling in the jury that these should give all the students an opportunity to make progress. Unfortunately for the Canadian team, the front leader in this race is also a geometry problem. Euclidean geometry is one of our strengths, so a very easy geometry problem will not be to our advantage — especially since there is already an "impossible" geometry problem (#6). This means the middle problems will not be geometry. The final winners are the two easiest problems — according to the beauty contest. Of course easy is a relative term: even these problems call for knowledge or techniques which go beyond the high school curriculum in British Columbia.

We still have to fill in the medium problems, #2 and #5. There is no combinatorial problem yet and only one problem from each of algebra and number theory. Although I'd like to see one of the more interesting combinatorics problems, which lost out in the race for the #3/#6 spots, they are just too difficult. It doesn't take long to identify the obvious candidate, which has the added benefit of involving the number 2006. It will have to go in spot #2 due to a superficial similarity to #6. They both involve triangles inscribed in a 2006-gon.

With that combinatorial geometry problem in #6, we now have one number theory, one algebra, one and half combinatorics and one and a half geometry problems. While several problems are considered, there is an interesting number theory problem with an algebraic flavour. That would make a very balanced contest — one and a half problems from each category. But, is it too difficult? Or is it too easy? It has some good algebra in it and wins out over an easier number theory problem and a harder combinatorial problem.

The problems are set, just in time for us to watch the World Cup final. But the work is not finished. The following morning we start on translations. The working language is English and I'm not particularly fluent in any of the other 50 languages required. However, it turns out that I'm not done. First the English language committee goes over the problems and notation carefully, trying to predict and remove anything that could be misinterpreted. We want the students to spend their time solving the problems, not trying to figure out what the problem is! The second problem is particularly contentious, especially when trying to translate it into other languages. The original proposer wanted to use the word "odd" for diagonals which cut an odd number of sides off the polygon. Unfortunately, in translation, "odd" means "oblique" in many languages. Then there was the problem of "non-intersecting diagonals." On another problem, it seemed wise to avoid using a for a general side since *a* is a word in the English language. We choose *c* for "côte." Unfortunately, *c* is a word in several other languages. After compromising on *b*, the rest of the translations can proceed.

The computer facilities are outstanding. In addition to a wireless network (internet access is disabled while we are working with problem files to avoid any unfortunate accidents), there are two labs in which every language known to microsoft has been installed. (Don't try this at home — it increases the boot time tremendously.) There are templates with all the formulas in all the official languages (English, French, German, Russian, and Spanish) for both LaTeX and Word, along with plans to scan hand-written translations for languages which the computers cannot accommodate. However, the organizers get their ingenuity and well-laid plans tested when they discover that some languages come in multiple versions. Apparently, the "Serbian" spoken in

Bosnia is not the same as that from Serbia and will require a different translation. There are three variations needed for Arabic. Of course it is vital that each student get the right version!

Finally, the marking guides. These are prepared by the chief coordinators, but have to be approved by the jury. The first drafts tend to be all or nothing, but jury members want to see where marks might be awarded for partial progress and limit the penalties for students who essentially had the right idea but whose proofs contain minor, or even fatal, flaws. The guides are approved just in time for the leaders to head off to the Opening Ceremony. We are ready for the students.

Day One

1. Let ABC be a triangle with incenter I. A point P in the interior of the triangle satisfies:
$\angle PBA + \angle PCA = \angle PBC + \angle PCB$.

   Show that $AP \geq AI$, and that equality hold if and only if $P = I$.

2. Let P be a regular 2006-gon. A diagonal of P is called good if its endpoints divide the boundary of P into two parts, each composed of an odd number of sides of P. The sides of P are also called good.

Suppose P has been dissected into triangles by 2003 diagonals, no two of which have a common point in the interior of P. Find the maximum number of isosceles triangles having two good sides that could appear in such a configuration.

3. Determine the least real number M such that the inequality
$|ab(a^2 - b^2) + bc(b^2 - c^2) + ca(c^2 - a^2)| \leq M(a^2 + b^2 + c^2)^2$

   holds for all real numbers a, b and c.

Day Two

4. Determine all pairs (x, y) of integers such that
$$1 + 2^x + 2^{2x+1} = y^2$$

5. Let $P(x)$ be a polynomial of degree $n > 1$ with integer coefficients and let k be a positive integer. Consider the polynomial
$Q(x) = P(P(...P(P(x))...))$,
where P occurs k times. Prove that there are at most n integers t such that $Q(t) = t$.

6. Assign to each side b of a convex polygon P the maximum area of a triangle that has b as a side and is contained in P. Show that the sum of the areas assigned to the sides of P is at least twice the area of P.

The rest of the short-listed problems, including a Canadian contribution by J.P. Grossman, will be kept confidential until next year so that they can be used for team training.

Six to get ready

At the opening ceremonies, we see our teams for the first time since the jury convened, albeit from a distance. Leaders are confined to the balcony while the students, deputy leaders and honoured guests fill out the main floor of the ballroom in the Grand Union Hotel of Ljubljana, two hours drive from our seaside retreat.

'Photogenic' Farzin Barekat, from Sutherland Secondary School in North Vancouver, is an IMO novice, but revels in the attention as he leads the Canadian Team in a moonwalk across the stage. 'Pithy' Peng Shi, from Sir John A. MacDonald Collegiate Institute in Toronto, is an experienced IMO medalist with a talent for producing intriguing commentaries, and Farzin's partner in fashion crimes. Peng ('Reckoning' Richard) Yang, from Vaughan Road Academy in Toronto, is another experienced medalist and our computing expert — he also has medals from the International Olympiad in Informatics and sometimes writes his mathematical proofs in the form of a computer program — as well as our top goal keeper for soccer. 'Virtuoso' Viktoriya Krakovna, from Vaughan Road Academy in Toronto, is Richard's protégé with a talent for languages, mixing up her Russian and Ukrainian into a usable facsimile of Slovenian. She likes to hand in only her perfect solutions. Dong Uk ('Distinctly' David) Rhee, from McNally High School in Edmonton, is yet another former medalist, the winner of this year's Canadian Mathematical Olympiad and an aficionado of the card game "set." He'll hand in ALL his rough work, annotated to make interesting reading. 'Master' Yufei Zhao, from Don Mills Collegiate Institute in Toronto, has previously earned an IMO gold medal and has led the team through this year's training. They are joined on stage by the team mascot 'CanMoo.' (Short for Canned Moose?) Not on stage but proudly watching from the floor is Naoki Sato, deputy leader and head trainer, himself a former IMO medalist and currently a member of the Art of Problem Solving.

This group first gathered as a team for the IMO Summer Training Seminar (June 24 -July 2) in Halifax on the campus of Dalhousie University. We all knew each other from the Winter Training Seminar at York University, but that was before the three Olympiads (Canadian, USA, and Asian Pacific) in which these six earned their places on this year's team. Also in Halifax were Shannon

Back Row: Robert Morewood, Slovenian Guide, Naoki Sato
Front Row: Richard Peng, Peng Shi, Viktoriya Krakovna, David Rhee, Farzin Barekat, Yufei Zhao

Fitzpatrick and J.P. Grossman, who helped with the training there, along with five junior students from around the Maritimes, and especially Dorette Pronk and Roman Smirnov, from Dalhousie University, whose efforts and help for the training seminar made everything run smoothly. The students appreciated that Keith Taylor, Dean of Science (Dalhousie University), dropped by to offer a mathematical paradox.

That camp got off to a slow start, foreshadowed by a two hour delay in the flight from western Canada. However, we soon got over the interruptions for uniform fittings and media events and got into a rhythm: morning lectures, afternoon mock exams and evening presentations with breaks for soccer or frisbee and late-night internet sessions. Even the weather cooperated, with heavy rain or fog obscuring the magnificent view of east Halifax from the Mulligan room during many of the lectures, while the sun warmed our outings to Pleasant Park, the Citadel, and the harbour.

Farzin cannon surfing, with Peng and Yufei.

The team mascot turns one year old.

But after one short week, and a Canada Day celebration including CanMoo's first birthday, we were travelling again. Departing Dalhousie at mid-afternoon on Sunday, we arrived at Bohinj (pronounced Bock-in) lake in the mountains of Slovenia late on Monday afternoon. There we were joined by the teams from Sweden and Luxemburg for the final week of training.

Typical Slovenia: Mountains, forests, and a hay drying rack.

Bohinj was beautiful, but isolated and rural — some of the students start to suffer from internet withdrawal. The staff didn't speak english so we were pretty much on our own. On the other hand, the children were enthusiastic soccer players. There was a little village about a half hour's walk down the road where the lady at the tourism office did speak english AND even did photocopies for us. We also got phone cards there, but they are very expensive for over-seas calls: Watch the numbers count down: 50-49-48-... as you say "Hello, how are things back in Canada..." Internet turns out to be much cheaper, but there is that half hour walk to the village — and I have to get my wife to read her email...

Training got back into swing again, with lots of lectures while we have a triple set of leaders and deputies. But it was only a few days before the leaders were taken into seclusion to join the jury, leaving the students with the deputy leaders to finish their training.

Competition

The actual competition takes place on the two mornings following the opening ceremony. While the leaders are sent back into seclusion at Portoroˇz, the students finally get to see the problems and show what they can do with them in just four and a half hours (for each set of three). An interesting innovation at the IMO is "question period." For the first half hour, the students may send questions to the jury. Mostly these are checking definitions ("Is zero an integer?" — Yes.) or conditions ("Can the diagonals have a common endpoint?" — Yes.), but other questions arise ("Where is the clock?" — The invigilator will show you.). Many times the jury's answer is just "Read the question." The efforts spent trying to phrase the problems clearly seems to be paying off as there are not very many questions — none from the Canadians.

After question period, the leaders are sent off on an excursion to the famous Postojna caves and other local sites. It keeps us occupied while the scripts are transported to Portorǒz and copied. We get the originals while the coordinators get a copy. The leaders are responsible for marking their team's papers, while the coordinators are responsible for assuring that the marks assigned by different leaders are comparable. (With the contest being written in more than fifty languages, this is a daunting task.) In fact, the marking process becomes a negotiation between leaders and coordinators. The coordinators can read English, so the Canadian team requires no translation, but there is no possibility of glossing over any omissions or subtle errors. Also, the Canadians seem to be developing a reputation — we are assigned to the same coordination table as top teams in the world.

Team Canada on a break above the training camp
Yufei, Viktoriya, Peng, Farzin, David, and Richard

After the second day Naoki joins me for the marking. We have a good team so there is lots of marking to be done! However, I don't get to talk to the students until the next day when they pass through on an excursion. (While the leaders work, the students can play!) It is helpful to find out what the students were thinking on incomplete problems and get some hints about what to search for in the rough work. Part marks are only awarded for work that actually leads toward a correct solution.

The first day's work looks very promising for the Canadians. All of them have nailed the first question. It is interesting to see 6 different angle chases (one student has gone all the way around the triangle) and four students finish with the triangle inequality while the other two use tangency arguments. The coordinators prove that they have scrutinized the work carefully by pointing out a typo we hadn't noticed, they also point out where the correct equality appears in the rough work — no deduction. So everyone has a perfect score on at least one problem — no one will go home empty handed.

The second question proves to be quite challenging. It is not so hard to find the answer — and all the Canadians have — but great care is required in proving that this is indeed the best possible. It is easy to overlook necessary conditions and claim false results. If the fatal error comes early on, the remainder is all built on false premises and earns no points. In the coordinators' report, there was an impression that this marking scheme was overly rigid and harsh. Many good ideas earned no credit. However, only one of the Canadians got caught by the early fatal flaw. Others just ran out of time to check all the details. One script had a note on the front asking readers to start on pages 13 and 14 then go to page 9 and finish on page 16! Peng managed to avoid the traps in the geometry by converting the problem into a graph theory question which could be done by a double induction, but ran out of time to show all the details. Viktoriya stayed true to form by handing in only complete proofs — no scratch work at all. She produced an induction based on reducing the polygon by carefully deforming the triangles. After much discussion — first between Viktoriya and Naoki, Naoki and myself, and finally between us and the coordinators — we all came to the conclusion that everything was correct and adequately described, earning a perfect score on this question. Yufei lived up to his reputation by producing the only other perfect score for Canada, with no discussion needed.

The third question was probably harder than the jury expected. Definitely a gold medal question, solved by less than 10 percent of all the students here and with only another 20 percent making any progress. Canada was one of the few teams to find a solution for this problem. Farzin noticed that the expression on the left could be factored and used the factors for a change of variables. Applying inequalities of means (both arithmetic-geometric and power means), he reduced the number of variables from three to two. Fixing one of the remaining variables, Farzin used standard one-variable calculus to find the value of M . (This problem can be finished without calculus, but almost all the solvers completed it this way.) Yufei and Peng also found the key factoring, but got distracted checking other possibilities. This was certainly a problem with a lot of potential.

By this time it is clear that Canada is doing well, and we are not the only ones. The Swedish team is doing much better than usual and their leader is giving some of the credit to the Canadians who helped train them. It is also remarkable how balanced the team has become since Christmas, with the novices keeping right up with the more experienced members who helped train them.

The second day proves to be even more challenging. The first problem is still easy, but not quite so straightforward. All the Canadians rearranged the equation until one side could be factored as a difference of squares. It is then a matter of matching up factors and considering cases. Lots of work, but no problem for these students. The students have found different factorings, some of which lead to quadratic inequalities while others can be reduced to parity or sign contradictions. However, in all cases, small values of 'x' must be handled separately. Only one student overlooks the possibility of negative exponents (x) giving an integral value for the left side, so Canada scores a near-perfect 41 out of 42.

For the fixed point problem, number 5, the Canadians as a team have found the necessary pieces, but no individual student has put it all together. Peng has proven that the polynomial, P, permutes the fixed points of Q. Yufei and Richard have the fact that, if x and y are integers, $x - y$ divides $P(x) - P(y)$. Putting these two ideas together and applying them to an ordered list $t^1 < t^2 < ... < tm$ of fixed points of Q would have led these students to the two possibilities: either all the fixed points of Q are fixed points of P, or all the fixed points of Q satisfy $P(t) + t$ =constant. An equation of degree n in either case. In fact, David's rough work featured a graph of fixed points of Q which looked suspiciously like $P(t) + t$ =constant, and Viktoriya, straying from her habit of handing in only complete proofs, earned a point for her discussion of divisibility.

The final question is a killer for which I'm not expecting much, but everyone hands in work handling various special cases. Peng made a particularly interesting observation looking at the largest triangle that can be inscribed in the polygon. However, in general, it only gets him 1.4 times the area, not twice the area. Not good enough for a point. In the end, Canada earns just one point for David's handling of the equality case: a centrally symmetric polygon. Still, that single point puts Canada ahead of most other teams for this question.

Average Scores for each IMO question.

	1	2	3	4	5	6
2006 Canadian Average	7.0	4.5	1.2	6.8	0.8	0.2
2006 World Average	5.6	1.8	0.7	5.0	1.2	0.2
World Average 2000-2006	3.7	2.7	0.8	3.8	2.2	0.9

Even when the scores are known for our team, we have to wait for the other teams to finish coordination in order to see how we compare. From the 498 participants,

about half will be awarded medals, with the numbers of bronze, silver, and gold as close as possible to 3:2:1. The grapevine gives an early idea what is happening. The first two questions (#1 & #4) were much easier than usual and the last two (#3 & #6) were very challenging, all as expected, but the middle problems (#2 & #5) were unexpectedly difficult. So the bronze cut-off is quite high, while the silver cut-off is relatively low. In the end, only three points separate the bronze and silver cut-offs! The gold cut-off is also fairly low, at 28 points; a student could earn gold without solving either of the two hardest problems. If #6 was the "China-killer," keeping most of China out of the perfect scores, then #5 was the "Canada-killer," keeping us out of the gold. However, aside from #5, Canada has done very well, with every team member winning a medal for only the second time in history — and this time the medals are mostly silver.

UNOFFICIAL top team scores and medals (G=Gold, S=Silver, B=Bronze, H=Honourable Mention)

Rank	Country	Score	Medals		Rank	Country	Score	Medals
1	China	214	6G		11	Poland	133	1G & 2S & 3B
2	Russia	174	3G & 3S		12	Italy	132	2G & 2S & 1H
3	South Korea	170	4G & 2S		13	Vietnam	131	2G & 2S & 2B
4	Germany	157	4G & 2B		14	Hong Kong	129	1G & 3S & 2B
5	USA	154	2G & 4S		15	Thailand	123	1G & 3S & 2B
6	Romania	152	3G & 1S & 2B		15	Canada	123	5S & 1B
7	Japan	146	2G & 3S & 1B		17	Hungary	122	5S & 1B
8	Iran	145	3G & 3S		18	Slovakia	118	1G & 2S & 3B
9	Moldova	140	2G & 1S & 3B		19	Turkey	117	4S & 1B & 1H
10	Taiwan	136	1G & 5S		19	Britain	117	4S & 1B & 1H

Aftermath

There are a few details for the jury aside from the actual competition. This year we need to elect a new chair and two new members to the IMO Advisory Board for four year terms. J´an, the Hungarian leader, is the incumbent ozsef Pelik´chair and stands for continuing tradition while Nazar Agakhanov, the Russian Leader, stands for change. J´ozsef wins the vote comfortably. There are eight strong candidates for the two board positions. After they have all had a chance to speak to the jury, Myung-Hwan Kim, from Korea, and Patricia Fauring, from Argentina, are elected.

In other business, there is a proposal from a private company, Art of Problem Solving Incorporated, to create and maintain a website for the IMO, to be supported by advertising. They already maintain websites which are heavily used by IMO students and two of their seven staff are former IMO medalists. The IMOAB agrees that it is time the IMO had its own offcial website, but is nervous about giving it over to a private company. They have a counterproposal. The Slovenian organizers have volunteered to create a permanent website for the IMO, with responsibility for year-by-year maintenance passing to the host country for each year. The Slovenians have proven their technical expertise with the most comprehensive annual IMO website ever and the annual upkeep ought to be simple. I still worry about future hosts. However, the Advisory Board proposal passes overwhelmingly, and Canada is thanked for having maintained the defacto IMO website (www.IMO.math.ca) up to this point.

After a final flurry of tours, and the rescuing of CanMoo from the American team, the medals are awarded at the closing ceremony, the IMO flag is passed from Slovenia to Vietnam, host to IMO 2007, and the students retire to the banquet hall to feast and dance the night away. Since the first teams (including us) leave for the airport just after 5am, many students keep the party going all night—and sleep away the long journey home.

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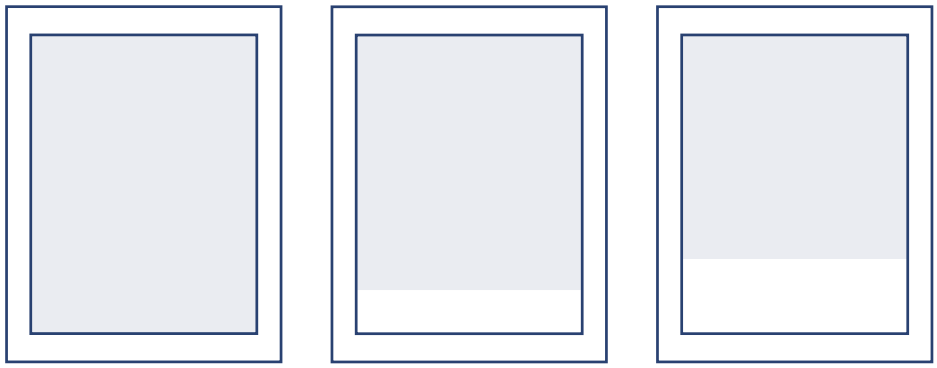

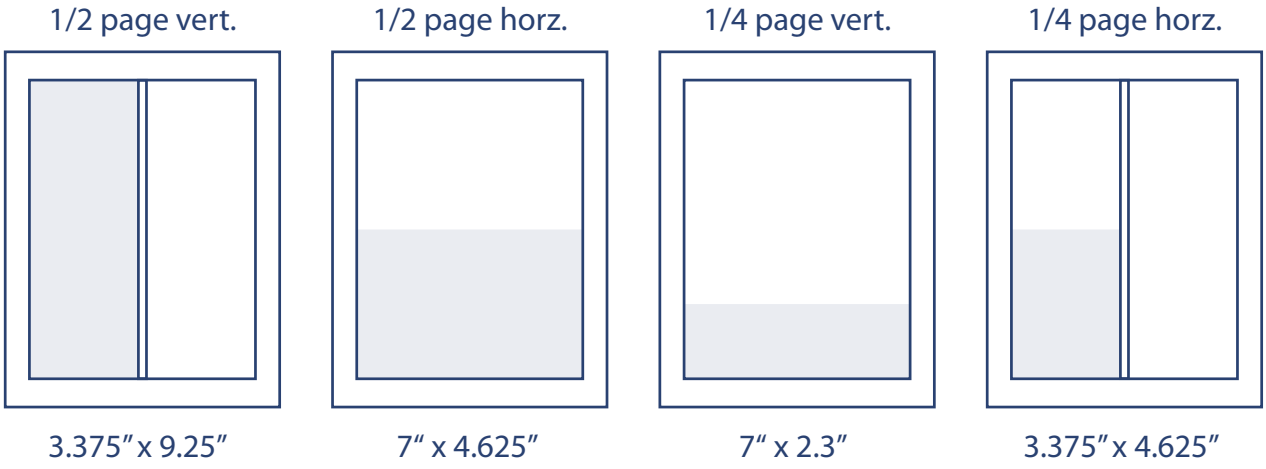

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January 2006 — v.1

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14-17 Conference On Routing And Location 2006 (CORAL 2006), Satellite to ICM 2006 (Puerto de la Cruz, Tenerife) www.icm2006.org

15-17 Asymptotic Analysis in Stochastic Processes, Nonparametric Estimation and Related Problems (Wayne State University, Detroit, MI) www.math.wayne.edu/~conf/

18-20 The 10th Workshop on Elliptic Curve Cryptography(ECC 2006), (Fields Institute, Toronto, ON) www.cacr.math.uwaterloo.ca/conferences/2006/ecc2006/

19-23 New Techniques in Hopf Algebras and Graded Ring Theory (Vrije Universiteit Brussel, Belgium) http://homepages.vub.ac.be/~scaenepe

21-23 **First Joint CMS/SMM Meeting** www.cms.math.ca

2-6 Quantum Cryptography And Computing Workshop (The Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/06-07/crypto/quantum

OCTOBER 2006 OCTOBER

10-13 Data Mining and Mathematical Programming (Centre de Recherches Mathématiques, Montreal, PQ) paradis@crm.umontreal.ca

17-20 Polyhedral Computation (Centre de Recherches Mathématiques, Montreal, PQ) paradis@crm.umontreal.ca

30-Nov.3 Computational challenges arising in algorithmic number theory and cryptography (Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/06-07/crypto/number_theory/

NOVEMBER 2006 NOVEMBRE

27-Dec.1 Workshop on Cryptography: Underlying Mathematics, Provability and Foundations (Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/06-07/crypto/crypto_foundations/

1-5 CCA 2006 Third International Conference on Computability and Complexity in Analysis (University of Florida, Gainesville, FL) http://ccanet.de/cca2006/

DECEMBER 2006 DÉCEMBRE

9-11 **CMS Winter 2006 Meeting / Réunion d'hiver 2006 de la SMC Toronto, ON** www.cms.math.ca/events, meetings@cms.math.ca

4-8 Finding and Keeping Graduate Students in the Mathematical Sciences (AIM Research Conference Center, Palo Alto, CA) http://aimath.org/ARCC/workshops/keepingrads.html

13-15 Workshop on "Geometry of vector distributions, differential equations, and variational problems" (International School for Advanced Studies (SISSA), Trieste, Italy) www.sissa.it/~zelenko/CEIHomepage.html

16-18 The 5th International Conference on Differential Equations and Dynamical Systems (University of Texas-Pan American, Edinburg,TX) xzliu@uwaterloo.ca, www.watam.org/deda06.html

JANUARY 2007 JANVIER

4-7 Joint Mathematics Meetings: AMS, MAA, AWM,etc. www.ams.math.org

JANUARY 2007 JANVIER

10-11 International Symposium on Mathematical Programming for Decision Making: Theory and Applications (Indian Statistical Institute, Delhi Centre) http://www.isid.ac.in/~ismpdm07/

MARCH 2007 MARS

4-8 Twelfth International Conference on Approximation Theory (Menger Hotel, San Antonio, TX) www.math.vanderbilt.edu/~at07/at07.html

19-23 Representation of Surface Groups (AIM Research Conference Center, Palo Alto, CA) www.aimath.org/ARCC/workshops/surfacegroups.html

MAY 2007 MAY

18-20 The 2007 Midwest Geometry Conference (MGC 2007) (University of Iowa, Iowa City, IA) www.emis.de/journals/SIGMA/

20-24 The CAIMS Annual Meeting (Banff Conference Centre)

22-26 Extremal problems in complex and real analysis (Peoples Friendship University of Russia, Moscow,Russia) www.albany.edu/~pb6916/, stessin@math.albany.edu

30-Jun.2 CMS/MITACS Summer 2007 Meeting Host: University of Manitoba Delta Hotel, Winnipeg, Manitoba www.cms.math.ca/events meetings@cms.math.ca

JUNE 2007 JUIN

18-23 Combinatorics and Optimization 40th Anniversary Conference (University of Waterloo, Waterloo, ON) www.math.uwaterloo.ca/Cand_Dept/Conference/40thConference.shtml

24 - Jul.1 45th International Symposium on Functional Equations (Bielsko-Biala, Poland) romanger@us.edu.pl, knikodem@ath.bielsko.pl

JULY 2007 JUILLET

2-6 Design Theory of Alex Rosa, a meeting in celebration of Alex Rosa's 70th birthday (Bratislava, Slovakia) www.dumn.edu/~dfroncek/alex/index.htm

16-20 6th International Congress on Industrial and Applied Mathematics (Zurich, Switzerland) www.iciam07.ch

16-22 The 8th International Conference on Fixed Point Theory and its Applications (Ching Mai Univesity, Thailand) www.math.science.cmu.ac.th/ICFPTA2007/

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