CMS NOTES de la SMC

Volume 36 No. 2 March/mars 2004

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## MESSAGE DU VICE-PRÉSIDENT

*Steven Boyer*
*Vice-président, Québec*

English page 11

Une des grandes forces de la communauté mathématique canadienne est la capacité de ses membres à coopérer sur des projets bénéficiant à la communauté dans son ensemble. L'Institut des sciences mathématiques (ISM) en est une frappante illustration : un réseau liant les six universités québécoises offrant des programmes de doctorat en mathématiques (Concordia, Laval, McGill, Université de Montréal, Université de Sherbrooke, UQÀM). Son mandat est de promouvoir la culture mathématique au Québec, renforcer la formation en coordonnant les programmes d'études supérieures en sciences mathématiques de ses universités membres et faciliter l'échange des ressources.

Un des facteurs clefs ayant mené à la création de l'ISM en 1991 fut la prise de conscience que l'heureuse proximité des quatre universités montréalaises permettait de créer une école supérieure de mathématiques au niveau de la métropole. Il existait déjà un nombre appréciable d'interactions informelles entre les divers départements et les activités de recherche subventionnées par le Centre de recherches mathématiques (CRM) avaient généré un esprit de groupe au sein des mathématiciens locaux. Francis Clarke, alors directeur du CRM, prit l'initiative d'amener les départements à développer une proposition commune. En moins d'un an, les finances de l'Institut étaient fermement assises avec les contributions des quatre universités montréalaises et une subvention substantielle du Ministère de l'éducation du Québec. Ainsi armé, l'ISM commença à développer des programmes et à rechercher de nouveaux partenaires. Avec l'ajout des universités Laval et Sherbrooke en 1997-1998, l'ISM est devenu un réseau pan-québecois. Aujourd'hui il est impliqué dans un large éventail d'activités :

- Coordonner les cours de mathématiques de deuxième et troisième cycles des universités membres et faire en sorte que les étudiants puissent
  - s'inscrire dans n'importe quelle université membre
  - être supervisés par les professeurs de n'importe quelle université-membre
  - avoir accès aux bibliothèques de n'importe quelle université-membre

- Organiser en collaboration avec le CRM, les colloques hebdomadaires CRM-ISM de mathématiques et de statistique;

- Financer le séminaire ISM des étudiants de deuxième et troisième cycles. Organisé par et pour les étudiants des cycles supérieurs, il leur permet de se rencontrer chaque semaine afin de discuter de leurs travaux; Financer et fournir les infrastructures nécessaires pour le colloque annuel pan-québécois des étudiants des cycles supérieurs. Ce colloque amène des étudiants du Québec, du Canada et de l'étranger à échanger des idées, à présenter leur recherche et à assister aux conférences de prestigieux mathématiciens.

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**CMS NOTES**

**NOTES DE LA SMC**

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# EDITORIAL

*S. Swaminathan*

## Hard Work

"Century-old math problem may have been solved" is the title of a recent newspaper column which reports on the Russian mathematician Grigory Perelman's claim to have solved the famous Poincaré Conjecture. Perelman is said to have given up a promising career in order to work in seclusion in St. Petersburg, visiting centres like M.I.T. occasionally for lectures. After a decade of hard work he has posted his results online which are under intense scrutiny by specialists to check the accuracy of the results. This is yet another instance where hard work on a deep problem has paid off. Even if it is found that the work is flawed it is believed that the methods devised by Perelman would record significant progress towards a solution to the age-old problem. Hard and intensive work in seclusion is the key lesson that we learn from this exercise. Recall that Andrew Wiles almost-shut himself up in the attic of his home for seven long years working on Fermat's Last Theorem, and finally achieved his goal in 1993. The February issue of the Notices of the American Mathematical Society contains an article on *Geometrization of 3-Manifolds via the Ricci Flow* by Michael T. Anderson, which discusses the recent work of Perelman, and the work of Thurston and Hamilton on which it builds, towards the classification of 3-manifolds.

To work on problems in mathematics and achieve success needs strong determination not to give up when hurdles arise. We all know how some students tend to relinquish mathematics when it gets difficult. John A. Adam, author of the recent book *Mathematics in Nature* (Princeton & Oxford) [a review of this book will appear in the NOTES later], describes, in a Prologue to the book entitled "Why I might never have written this book", his youthful ambition to become an astronomer. His algebra teacher had asked him what he wanted to be when he grew up. When he replied that he wanted to be an astronomer, the teacher said, "But, Adam, astronomers need to know an awful lot of mathematics, and you are very near the bottom of the class in it."

He had either to give up or, as he put it, "take the opportunity to rise to the challenge and work [his] tail off to learn and understand mathematics" that he would need to become an astronomer. He chose the latter. After perseverance through six or seven years spending complete weekends on math homework, he says that another math teacher wrote in his report card "by dint of sheer hard work, Adam is sometimes able to achieve far more than his brighter peers". That was his secret: plod, plod and plod on his part with the blessing of having supporting parents. He finally got his Ph.D. in theoretical astrophysics from the University of London. This is not an isolated story; biographies of great mathematicians testify how they were successful because of perseverance and hard work.

There is, of course, another side to the coin. While the hard-work habit is a valuable one, it can be overdone. Anybody who has graded undergraduate assignments has seen how one student can give, in five clear lines, a correct answer to a question that takes another student five pages. Moreover, ninety-nine times out of a hundred, the brief answer is the more mathematically mature one of the two. As J. E. Littlewood in his *Miscellany* writes "It is possible for a mathematician to be 'too strong' for a given occasion. He [or she] forces through, where another might be driven to a different, and possibly more fruitful, approach."

There is an aphorism that sometimes takes the form "Genius is five percent inspiration and ninety-five percent perspiration". Here, as with the recipe for a Martini, opinions differ on the exact proportions; but (in contrast with the cocktail) nobody suggests that one ingredient should be omitted entirely. Nor (and here our analogy is back on track) is the idea to simply get through the greatest possible amount of hard work (or gin). Excellence in research is to put in as much hard work as the project may require – but waste none.

This process of clarification, cutting corners, and simplification continues to be part of the evolution of any major result beyond its initial publication. One generation's hundred-page research paper often becomes the next generation's ten-page article in a popular journal; and this keeps the volume of mathematics (almost) manageable. Should Grigory Perelman indeed have proved the Poincaré Conjecture, there is a good chance that what the experts are at pains to check today will be accessible to the graduate students of a future academic generation.

## Persévérance

« Un vieux problème mathématique pourrait être résolu », titrait récemment la chronique d'un journal annonçant que le mathématicien russe Grigory Perelman affirme avoir démontré la célèbre conjecture de Poincaré. On dit que Perelman aurait renoncé à une carrière prometteuse afin de travailler en retrait de la société à Saint-Pétersbourg, en donnant à l'occasion des conférences dans des centres comme le MIT. Après dix ans de travail acharné, il a publié ses résultats sur Internet, résultats que des spécialistes passent en ce moment au peigne fin pour en vérifier l'exactitude. Voilà un autre cas où la persévérance à résoudre un problème complexe aura porté ses fruits. Même si l'on juge en bout de ligne que les travaux de Perelman comportent des lacunes, on croit toutefois que les méthodes qu'il aura proposées marqueront un progrès considérable vers la résolution de ce problème centenaire. Quelle grande leçon pouvons-nous tirer de cet exercice? Que le travail acharné et intensif en isolement peut rapporter. Rappelons-nous qu'Andrew Wiles s'était lui aussi pour ainsi dire retiré du monde dans le grenier de sa maison pendant sept longues années, afin de travailler au dernier théorème de Fermat, et qu'il a finalement atteint son but en 1993. Le numéro de février des Notices of the American Mathematical Society présente un article de Michael T. Anderson intitulé « Geometrization of 3-Manifolds via the Ricci Flow », où l'auteur aborde les récents travaux de Perelman, ainsi que les travaux de Thurston et de Hamilton, à la base de ceux de Perelman, sur la classification des variétés à 3 dimensions.

Quiconque souhaite travailler à la résolution d'un problème mathématique et obtenir un certain succès doit avoir une détermination sans borne pour ne pas abandonner devant les obstacles. Nous savons tous que bon nombre d'étudiants abandonnent les mathématiques dès qu'ils connaissent quelques difficultés. John A. Adam, auteur d'un ouvrage récent intitulé *Mathematics in Nature* (Princeton & Oxford) [une critique de ce livre paraîtra plus tard dans les *Notes*], raconte en prologue pourquoi il aurait très bien pu ne jamais écrire ce livre, son rêve de jeunesse étant plutôt l'astronomie. Un jour que son professeur d'algèbre lui a demandé quel métier il voulait faire plus tard, il lui a répondu qu'il aimerait être astronome. Et son professeur de répliquer : « Mais, Monsieur Adam, les astronomes doivent avoir des connaissances mathématiques poussées, et vous êtes pratiquement dernier de classe dans cette matière. »

Il pouvait soit abandonner, soit, comme il l'écrit, profiter de l'occasion pour faire ses preuves et travailler d'arrache-pied afin d'apprendre et de comprendre les mathématiques qui lui permettraient de devenir astronome. Il a choisi la seconde option. Après six ou sept ans de persévérance, où il passait des week-ends entiers à peiner sur des devoir de mathématiques, un autre professeur de mathématiques a écrit sur son bulletin que, « par son acharné, J. Adam arrivait parfois à surpasser de loin ses confères les plus brillants ». Car c'était là son secret : trimer, trimer et trimer encore, avec l'appui de parents bienveillants. Il a fini par décrocher un doctorat en astrophysique théorique de l'Université de Londres. Ce n'est pas là un cas isolé. Des biographies de mathématiciens célèbres montrent le grand rôle de la persévérance et du travail acharné dans leur réussite.

Mais il y a aussi l'envers de la médaille. Si le dur labeur est une habitude tout à fait louable, il est aussi possible d'en faire trop. Si vous avez déjà corrigé des travaux d'étudiants de premier cycle, vous savez qu'un étudiant peut fournir une bonne réponse en cinq lignes claires, tandis qu'un autre le fera en cinq pages. Ainsi, dans 99 % des cas, la réponse la plus brève est la plus mûre (mathématiquement parlant) des deux. Comme l'écrit J. E. Littlewood dans son ouvrage Miscellany, « il est possible qu'un mathématicien soit "trop fort" dans certaines circonstances; celui-ci forcera la voie, tandis qu'un autre adoptera une approche différente, et possiblement plus souhaitable ».

Un aphorisme bien connu dit que « le génie, c'est 95 % de travail et 5 % d'inspiration ». Comme au sujet de la recette d'un Martini, les opinions diffèrent quant aux proportions exactes. Dans ce cas-ci, toutefois (contrairement au cocktail), personne ne dit qu'un des ingrédients devrait être omis, ni (et là l'analogie se confirme) qu'il suffit d'y mettre le plus d'efforts (ou de gin) possible. L'excellence en recherche consiste à mettre tous les efforts nécessaires à l'aboutissement d'un projet, sans toutefois en gaspiller.

Le processus de clarification, d'élagage et de simplification fait toujours partie de l'évolution normale d'une solution importante, au-delà de sa publication initiale. Un rapport de recherche de 100 pages produit par une génération devient souvent un article de 10 pages publié dans une revue populaire à la génération suivante. Et c'est ce qui maintient le « volume » de mathématiques à un niveau (presque) raisonnable. S'il devait s'avérer que Grigory Perelman ait effectivement démontré la conjecture de Poincaré, il y a fort à parier que ce que les spécialistes d'aujourd'hui vérifient si méticuleusement sera accessible aux étudiants diplômés d'une future génération.

## TRIVIA

1) The Polish mathematician Bruno Abdank-Abakanowicz invented a device so that when one curve is traced out by the device, the curve which is an antiderivative of the first curve is drawn simultaneously. What was this device called?

a) The Fluxionator
b) The Accumulator
c) The Integraph
d) The De-sloper

2) What was the title of famous treatise on pure mathematics by Professor Moriarty (Sherlock Holmes' arch-enemy)?

a) The dynamics of an asteroid
b) An ingenious solution to Fermat's equations
c) On the conundrum of parallels
d) A solution to the invariant subspace problem

3) Which of the following is not a song by Tom Lehrer?

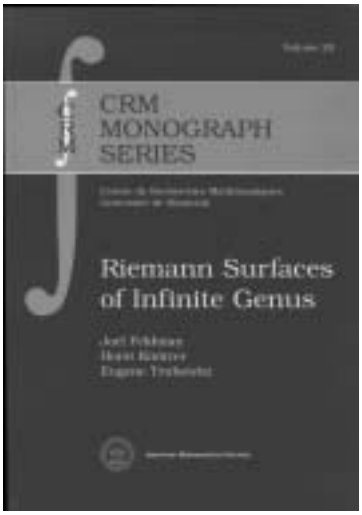
a) New math
b) Oh Calculus
c) There's a delta for every epsilon
d) The derivative song

Readers are invited to send their favorite mathematical trivia to Gordon MacDonald at *gmacdonald@upei.ca* for possible inclusion. ANSWERS ON PAGE 6

# RIEMANN SURFACES USED IN THE STUDY OF PDE

Book review by Morris Kalka, Tulane University

**RIEMANN SURFACES OF INFINITE GENUS**
*by Joel Feldman, Horst Knörrer and Eugene Trubowitz*
CRM Monograph Series Volume 20
American Mathematical Society, 2003
vii + 296 pages




I remember myself as a graduate student one day making a pronouncement to a lunch-time gathering of fellow students to the effect that all of twentieth century mathematics has its origin the theory of Riemann surfaces. Thinking back now, I cringe at the thought of myself making such sweeping statements about things I do not know (all of twentieth century mathematics!). I must admit, however, that the theory of Riemann surfaces, in addition to being one of the jewels of nineteenth century mathematics, has served an incubator of later work; the subject motivated and gave rise to so much mathematics which became important later on. It is striking to read Hermann Weyl's masterpiece [4], *The Idea of a Riemann Surface* and find in it the first modern definition of a manifold, the Dirichlet principle to solve elliptic partial differential equations and more.

It was during my graduate student years that I learned, from Henry McKean, to whom the book under review is dedicated, of the close connection between theta functions on infinite genus Riemann surfaces and the Korteweg-de Vries equation. The idea that one could use the machinery of Riemann surfaces to study a partial differential equation which modelled shallow water waves seemed, to me at the time, a confirmation of my belief. The use of the machinery of Riemann surfaces to study certain partial differential equations has seen quite a development in the last thirty years and forms the subject of the monograph by Feldman, Knörrer and Trubowitz.

To understand the book it would be good to begin with a review of certain parts of the theory of compact Riemann surfaces (a good source for this material is [1]). From a topological viewpoint a compact Riemann surface $X$ is a compact oriented two-dimensional manifold. These are just surfaces of genus $g$ and elementary topology tells us that the homology group, $H_1(X,Z)$, is a free abelian group with $2g$ generators $A_1,B_1,\dots A_g,B_g$, which can be chosen so that the self intersections $A_i\times A_j=B_i\times B_j=0$ and $A_i\times B_j=\delta_{ij}$. If one imposes the structure of a Riemann surface on $X$, i.e. a complex structure, for each homology basis $A_i,B_i$ as above there is a unique basis $\omega_1,\dots\omega_g$ of the complex vector space of holomorphic one-forms with the property that for all $1 \le i,k \le g$

$$\int_{A_i} \omega_k = \delta_{ik}.$$

Having normalized the integrals of the holomorphic one-forms over the $A_i$s, the matrix of integrals of the holomorphic one-forms over $B_j$,

$$R_{ij} = \int_{B_j} \omega_i \,,$$

is called the *period matrix* and is an object of great importance in the theory. One proves that it is symmetric with positive-definite imaginary part. The periods generate a lattice; forming the quotient of $C^g$ by this lattice one obtains the Jacobi variety. One of the deepest results in the theory of Riemann surfaces is the Torelli theorem, which says that the period lattice completely determines the Riemann surface. This is proved by a detailed study of the zero-locus of the theta function

$$\theta(z,R) = \sum_{n\in Z^g} e^{2\pi i(z,n)} e^{\pi i(n,Rn)}.$$

The book under review proceeds at a pace which is substantially more leisurely than a research paper, but it assumes a knowledge of the theory of Riemann surfaces, at least at the level of the material outlined in the previous paragraphs. Its purpose is to generalize these results to certain surfaces of infinite genus and to show that the class of surfaces considered is rich enough to yield interesting new results about the Kadomcev-Petviashvilli (KP) equations. The discussion is broken up into four parts, which we will attempt to summarize.

Chapter 1 is written in the most expository style and, compared to the rest of the book at least, proceeds at a leisurely pace. Here the authors generalize some of the theory of compact Riemann surfaces to a class of surfaces, which they call finite charge. These are surfaces which admit an exhaustion, $h$, with certain finiteness properties, namely it should be a non-negative, proper Morse function with finite integral

$$\int_X |d^*dh| < \infty$$

which is compatible with a given homolgy basis $A_i,B_j$. For such surfaces they construct an $L^2$ basis of holomorphic one-forms, just as in the compact case.

For surfaces of finite charge, one can form the theta series. The authors show that there are examples where this diverges.This series is crucial to the application to the KP equations which the authors have in mind. Thus Chapter 2 is devoted to a discussion of a class of infinite genus Riemann surfaces for which the theta series converges. These are formed by pasting together plane domains and handles in such a way that the surfaces formed in this manner are asymptotic to a finite number of complex lines joined by infinitely many handles. For these surfaces the authors show that the proof of the Torelli theorem goes through: namely they can analyze the zero locus of the theta function (which is shown to exist). I should emphasize that this is far from a transcription from the compact to the infinite genus case; it is an extremely delicate and difficult piece of analysis.

Chapters 3 and 4 are devoted to showing that the class of surfaces introduced in the second chapter is rich in interesting and natural examples and to developing the connection between these Riemann surfaces and the KP equation. To appreciate what is done here for the KP equation it is useful to summarize some of the theory for the Korteweg- deVries (KdV) equation. If $q$ is an $L^2$, $2\pi$-periodic function on the real line, one can define the spectral curve $S(q)$ as the set of points $(\chi,\lambda)$, $\chi \neq 0$ for which there is a non-trivial distribution solution, $\psi$, solution in $L^{\infty}_{loc}$ of the Schrödinger equation

$$\left(-\frac{d^2}{dx^2} + (q-\lambda)\right)\psi = 0$$

with $\psi(x+2\pi)=\chi\psi(x)$, for all $x$. For generic $g$ it is shown here that the curve $S(q)$ satisfies the geometric hypotheses of Chapter 2. If we use $q$ as initial value for the KdV equation then McKean [2],showed that the curve $S$ stays the same in the evolution. This fact was used to prove that spatially periodic solutions of the KdV-equation propagate almost periodically in time. McKean and Trubowitz [3],use the theta function on $S(q)$ to give an explicit solution of the initial value problem for KdV. The technique there relies on the explicit realization of $S(q)$ as a branched (under the $\lambda$ projection) double cover of $C$.

For applications to the KP-equation one looks instead at the heat equation

$$\left(\frac{\partial}{\partial x} - \frac{\partial^2}{\partial y^2}\right)\psi + q(x,y)\psi = 0,$$

where $q$ is $L^2$ and periodic with respect to the lattice generated by $\omega_1,\omega_2$, and $\psi$ satisfies

$$\psi(x+\omega_1,y)=\chi_1\psi(x,y), \qquad \psi(x,y+\omega_2)=\chi_2\psi(x,y).$$

The curve $H(q)$ is defined to be the the set of all pairs $(\chi_1,\chi_2)$, neither vanishing, for which a solution exists. It is shown in Chapter 3, that if $H(q)$ is smooth then it satisfies the geometric hypotheses of Chapter 2. Here, however, there is no realization of $H(q)$ as a branched cover of the complex line, necessitating the constructions and analysis in Chapter 2. The theory outlined for the KdV equation is proved for the KP equation in Chapter 4, using the theta functions for the curves $H$.

As I think I have indicated, this book is not for beginners. But for those who know the rudiments of the theory of Riemann surfaces and wish to see how this theory applied to classes of partial differential equation, this is a valuable resource.

**References**

[1] Phillip Griffiths, Joseph Harris, *Principles of Algebraic Geometry*, Wiley 1978.

[2] Henry McKean, *Integrable systems and algebraic curves*, Springer Lecture Notes in Math., vol 755, 1979, pp. 83-200.

[3] Henry McKean and Eugene Trubowitz, *Hill's operator and hyperelliptic function theory in the presence of infinitely many branch points*, Comm. Pure Appl. Math. 29 (1976), 143-226.

[4] Hermann Weyl, *Die Idee der Riemannschen Fläche*, Second edition, Leipzig:Teubner, 1923.

## NEWS FROM DEPARTMENTS

### University of British Columbia, Vancouver, BC

**Appointments**:
Dan Coombs (Assistant Professor, Mathematical Biology, July 2003); Kalle Karu (Assistant Professor, Algebraic Geometry, July 2003); Dominik Schoetzau (Assistant Professor, Numerical Analysis,October 2003); Jimmy Feng, (Associate Professor, Fluid Dynamics, January 2004, joint Math/Chemical Engineering appointment); Neil Balmforth (Professor, Applied Mathematics, Astrophysics, October 2003, joint Math/Earth Sciences appointment); Eric Cytrynbaum (Associate Professor, Mathematical Biology, July 2003); Ivar Ekeland (Professor, Mathematical Finance, February 2003).

**Promotions**:
Ian Frigaard (Associate Professor, July 2003);
Nike Vatsal (Associate Professor, July 2003).

**Retirements**:
Lon Rosen (June 2003); John MacDonald, (December 2003);
John Walsh, (December 2003).

**Resignations**:
Sergeui Novelcelskii (Instructor, May 2003).

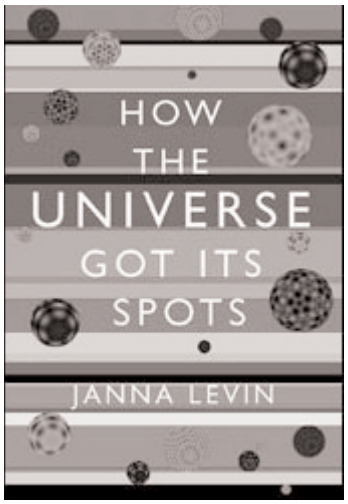
**Deaths**:
Charles Swanson (Professor Emeritus, March 2003).

**Awards/Distinctions**:
Jingyi Chen (2003 Coxeter-James Prize and Killam Research Fellowship); Joel Feldman (2004 Jeffrey-Williams Prize); Ed Perkins (2002-2003 CRM-Fields Prize); Nassif Ghoussoub (2003 UBC Distinguished University Scholar); Nike Vatsal (2003-2004 Aisenstadt Prize); Dominik Schoetzau (2003 Canada Research Chair Tier II); Ivar Ekeland (2003 Canada Research Chair Tier I).

# COSMOLOGIST'S PERSONAL AND PROFESSIONAL CHRONICLE

Book review by Andy Hone, University of Kent

**HOW THE UNIVERSE GOT ITS SPOTS**
**Diary of a Finite Space in Finite Time**
*By Janna Levin*
Weidenfeld & Nicholson 2003
paperback 224 pages




Popular science has become gradually more fashionable over the past fifteen years or so. This trend has partly been set by the bestsellers of Stephen Hawking, which have introduced modern cosmology into the public awareness. However, while there are now several good popular books on the subject, this new contribution from young cosmologist Janna Levin provides something unique: a rare insight into the personal and intellectual life of a scientist.

The book is a two-year diary of unsent letters to the author's mother, chronicling the peripatetic and insecure existence of a postdoctoral researcher. At the start she leaves behind her sun-drenched life in California, in order to strike out a new path in the chillier climes of England, with British boyfriend Warren in tow. Her unfortunate partner makes a great sacrifice, giving up his musical career to become a domestic drudge while she chases her scientific muse.

The main motivation behind the writing is the urge to explain what her work is about and what makes her tick. A history of the scientific view of the cosmos is presented, from Copernicus via Newton to Einstein and beyond. Being addressed to a non-scientist, everything is explained beautifully in an intuitive way, with many pictures. Even more unusual is the backdrop of her personal life, so that the most technical descriptions are interspersed with thoughts and reflections on where she is and who she's with.

The 'Finite Space' of the subtitle refers to Levin's original work concerning the possible extent of the universe. She has a gut feeling that nature abhors infinities, so the space we live in should be finite. However, just as we can travel on the curved surface of our planet without falling off, in a compact universe there is no edge of space. To explain this requires an appreciation of topology, in order to understand how space fits together, and the book gives a highly accessible introduction to these ideas. An important insight is that while Einstein's general theory of relativity describes the local geometry of the universe, in terms of the curvature of space-time, it does not address global topological questions.

The notion of a finite universe has received very recent media attention due to new measurements of the cosmic microwave background radiation by NASA's WMAP spacecraft, prompting the Guardian headline 'Universe is shaped like a football, says scientist'. The experts are still in disagreement about the correct interpretation of the WMAP results - apparently the football has already been ruled out! For a non-expert like me, Levin's book provides a fascinating introduction to the work of Thurston, Best and Weeks on compact three-manifolds with negative curvature. There is also a wonderful scientific analogy between patterns of radiation in the sky and Murray's work in mathematical biology on the leopard's spots, which gives the book its title.

Science is viewed here as a creative expression of our sense of wonder at the universe, and its human face is vividly evoked by the autobiographical passages. Levin is also brave enough to expose her raw nerves, not least the deterioration of her relationship with Warren. Yet she ends on a note of hope, suggesting that there may be a reconciliation of the differences between science and art, and between mind and heart.

*This article originally appeared in the Newsletter of the London Mathematical Society, No. 322 - January 2004*

## TRIVIA ANSWERS

1.C 2.A 3.B

# EDUCATION NOTES

Ed Barbeau

## OCUFA Teaching Award

Congratulations are due to David Poole of the Department of Mathematics at Trent University in Peterborough, ON, on his receiving a 2002 Teaching Award from *OCUFA* (the Ontario Confederation of University Faculty Associations). He was one of six from various disciplines to receive the award at a special meeting in Toronto on Friday, June 6.

## The general value of Olympiad problems

In the November, 2003 column of these Notes, I gave some websites for contest problems. This drew a response from Marcus Emmanuel Barnes, an undergraduate student at York University, who told me of other sites that I was unaware of. Here are some excerpts from this letter:

> "The first site is 20,000 Problems Under the Sea *(http://problems.math.umr.edu/index.htm)*. I think you will find this website quite interesting.
>
> "Another site which I would like to mention is a webpage with a collection of links to Web sites with information about mathematics competitions compiled by MathPro Press *(http://www.mathpropress.com/competitions.html)*.
>
> "MathPro Press also has compiled a list of Mathematics Problem Books *(http://www.mathpropress.com/mathBooks/)*."

I am grateful for his reminding me of MathPro Press. This was founded by Stanley Rabinowitz, a well-known problemist who in fact was recruited as one of the coordinators when Toronto hosted the International Mathematical Olympiad in 1995. Dr. Rabinowitz set himself the task of sorting according to topic and publishing problems that appeared in problem sections of journals (including the Canadian Mathematical Bulletin) over five-year periods. This is an exceedingly difficult undertaking, but he succeeded in producing two volumes covering the period 1975-1984. He has brought to light other longlost caches of problems, and his website has a compendium of 20000 problems.

New problems books are appearing all the time, and two have recently appeared from the MAA.

Marcin E. Kuczma, *International Mathematical Olympiads 1986-1999* Mathematical Association of America, 2003 ISBN 0-88385-811-8 x + 192 pp. List price: $34.95; Member price: $27.95 (paper) Catalogue Code: ITM/JR

Titu Andreescu, Zuming Feng & George Lee Jr. (editors), *Mathematical Olympiads: Problems and solutions from around the world, 2000-2001* Mathematical Association of America, 2003 ISBN 0-88385-810-X ix + 282 pp. List price: $29.95; Member price: $23.50 (paper) Catalogue Code: OP3/JR.

Both can be ordered from the MAA through their website *www.maa.org* or by telephone (1-800-331-1622). The second book contains problems from the Olympiads of over twenty countries (including Canada) as well as over a half dozen regional contests (including APMO).

One might think that such books are of interest only to the contest participants and problem buffs, but this is not so. These problems, created by mathematicians, often with considerable qualifications and experience, are frequently little gems, well-designed to highlight interesting ideas, approaches and results. While they cannot be directly imported into general classroom situations, they can often be reworded and adapted to become accessible to a wide range of students and to foster some interesting investigations.

A popular type of problem involves the repetition of an algorithm that can be carried out by a group of students and form the basis of conjectures. Here are a couple:

*To each vertex of a regular pentagon, an integer is assigned in such a way that the sum of all the five numbers is positive. If three consecutive vertices are assigned the numbers $x$, $y$, $z$ respectively and $y < 0$, then the following operation is allowed: the numbers $x$, $y$, $z$ are replaced by $x + y$, $-y$, $y + z$ respectively. Such an operation is performed repeatedly as long as at least one of the five numbers is negative. Determine whether this procedure necessarily comes to an end after a finite number of steps.* (IMO, 1986/3)

*In an equilateral triangle of $n(n+1)/2$ pennies, with n pennies along each side of a triangle, all but one penny shows heads. A move consists of choosing two adjacent pennies with centres $A$ and $B$ and flipping every penny on line $AB$. Determine all initial arrangements – the value of $n$ and the position of the coin initially showing tails – from which one can make all the coins show tails after finitely many moves.*

In the first problem (which can be used to tune up facility with negative numbers), it appears that not only does the procedure terminate, but regardless of the choice of negative number selected for the role of $y$ at any step, you wind up with the same configuration after the same number of steps.

Ordinary students might find it a bit of a challenge to make a table of the values of the function f defined on the positive integers by

$$f(1) = 1, \quad f(3) = 3, \quad f(2n) = f(n)$$
$$f(4n + 1) = 2f(2n + 1) - f(n)$$
$$f(4n + 3) = 3f(2n + 1) - 2f(n)$$

for all positive integers $n$ and try to get a handle on exactly when $f(n) = n$. (IMO, 1988/3)

Many International Mathematical Olympiad problems invite students to investigate divisibility of various numbers, and this would provide interesting numerical practice for even some quite young students: $a^2 + b^2$ divided by $ab + 1$ (1988/6), $2^n + 1$ divided by $n^2$ (1990/3), $n^3 + 1$ divided by $mn - 1$ (1994/4), or $abc - 1$ divided by $(a-1)(b-1)(c-1)$ (1992/1).

## Students taking mathematics at university

In October, 2002, this column took notice of a report published by APICS in the Atlantic Provinces on deficiencies of students coming to university. I was talking to a high school teacher from the region who received the report with a certain amount of dismay, having felt that she and her colleagues were indeed addressing some of the issues that concerned our tertiary colleagues. However, it is not clear how even the most assiduous teacher can plan to produce students that have not only facility but the capacity to deploy their knowledge strategically.

During my whole career, it has been customary for university folk to grump about the lack of proficiency on the part of high school graduates. This is a complex issue where progress seems often desultory and fragile. I would like to discuss a small example that seems to illustrate some of the dimensions of the situation, the computation of the integral

$$\int_0^{\pi/2} \sin^2 x \, dx \ .$$

There is a good chance that a high percentage of a typical first year calculus class will simply not be able to make any progress at all with this one. If anyone thinks to use the substitution $\sin^2 x = 1/2\ (1 - \cos 2x)$, then she will quickly get the answer. But is it just a matter of knowing the formula? Many students, especially from abroad, will be familiar with the formula, but will still fail to see that it is appropriate in this exercise. For the utility of the formula turns on its replacing a power of a trigonometric function, not readily integrable, by a function of a multiple angle, which is easily handled. In other words, the formula must not only be known but its meaning understood. Having got to the point of integrating $\int_0^{\pi/2} \cos 2x \, dx$, how many students will recognize from the graph of $\cos 2x$ that the value of the integral is $0$ without having to grind it out?

Students are taught that, to find an area, compute an integral. But the reverse is also possible: to compute an integral, find an area. This strategy is available here for the student who recognizes the significance of the two identities:

$$\cos^2 x = 1 - \sin^2 x$$

and

$$\cos^2 x = \sin^2 \left( \frac{\pi}{2} - x \right).$$

The first tells us that the graph of $\cos^2 x$ is obtained from that of $\sin^2 x$ by a reflection in the line $y = 1/2$; the second that the graph of $\cos^2 x$ is obtained from that of $\sin^2 x$ by a reflection in the line $x = \pi/4$. The product of these two reflections is a 180° rotation about the point $(\pi/4, 1/2)$; this rotation carries the graph of $\sin^2 x$ onto itself and interchanges the lines $y = 0$ and $y = 1$. Accordingly, the graph of $\sin^2 x$ partitions the rectangle bounded by $x = 0$, $x = \pi/2$, $y = 0$, $y = 1$ into two portions of equal area and so $\int_0^{\pi/2} \sin^2 x \, dx = \pi/4$.

The student who just takes account of the first of the foregoing identities can still deduce that $\int_0^{\pi/2} \sin^2 x \, dx = \int_0^{\pi/2} \cos^2 x \, dx$ and that each of these is half the value of $\int_0^{\pi/2} (\sin^2 x + \cos^2 x) \, dx = \pi/2$. Readers of this column will recognize how helpful is the sort of insight demonstrated by these approaches for students. It is unreasonable to expect them to automatically approach exercises with such a sensitivity to structure, but one can at least hope that through exposure to this type of thing, they develop an appreciation for the power of a flexible approach and begin to look for possibilities on their own.

Not merely do students lack technical skills, but they lack a suitable attitude of mind that allows them to exploit their skills effectively. Indeed, there is a type of student who has memorized all the formulae, but is very much at sea in tackling any but the most mundane exercise. One can imagine what might happen to an unfortunate student besotted with formulae who recognizes the integrand as a rational function of $\sin^2 x$ and tries the substitution $w = \tan x$.

Technical proficiency *is* important, as the student needs to find the insights from somewhere, but the student needs other qualities if the mathematics she learns is to be of conceivable use. Readers who are teaching a second undergraduate analysis course may wish to experiment with the following exercise: determine the Fourier expansion of $\sin^2 x$ on the interval $[0, 2\pi]$. I did this once. Only one out of a class of about one hundred immediately recognized the formula $\sin^2 x = 1/2 - 1/2 \cos 2x$ as a finite trigonometric sum which must be the Fourier series. About a quarter of the class used the substitution to blithely find the Fourier coefficients from the formula, and the remainder got bogged down.

## Stepping up to the plate

Data management has become an important part of the modern curriculum. Even at the elementary level, children are taught methods of presenting and interpreting numerical information, basic probability, and the determination of means, modes and medians. In Ontario at least, one of the Grade 12 high school courses is devoted to a project in the area. At the tertiary level, many students have to study it as a technical requirement.

The quintessential generator of statistics is baseball, and the MAA has just produced in its Classroom Resources series a book on the subject by Jim Albert, a statistics professor at Bowling Green State University.

Jim Albert, *Teaching statistics using baseball,* Mathematical Association of America, 2003 ISBN 0-88385-727-8 xi + 289 pp. List price: $45.00 (paper) Catalogue code: TSB/JR

The author is evidently a baseball buff; his book, *Curve ball*, coauthored with Jay Bennett, won the 2001 *The Sporting News - SABR Baseball Research Award.*

Although the book is too specialized in content to serve as a text, except possibly for sports majors, a teacher of data management or statistics will find a great deal to illustrate any of the standard topics. Each chapter

consists of case studies, along with copious data and suggested exercises; these highlight specific techniques.

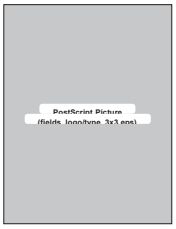
The first three chapters following an introductory chapter expore what comparisons and inferences can be drawn from raw data. The introductory paragraph is Case Study 4-4 illustrates the approach:

**Topics covered**: Multiple linear regression, root means square error, least squares criterion. In the earlier case studies, we introduced a number of batting measures, some old and some new, for evaluating the value of a hitter. We use the 2000 American League team data to evaluate the different measures ... We found that many of the modern batting measures ... did substantially better compared to the traditional measures ... for predicting run production. There is actually a straightforward way of finding a "best" measure of hitting performance using the tool of multiple linear regression.

Probability is introduced in chapter 5 in a discussion of simulation by table-top games. Chapter 6 treats the use of probability distributions in modelling baseball events, for example, predicting the number of hits a given batter will achieve in a year. Then follows a chapter on statistical inference (for example, assessing the opinion given in print that Olerud is "a fairly streaky hitter prone to torrid hot streaks and horrible slumps several times a year") and the use of Markov chains to model the sport. For the uninitiated, the rules of the game and a sample box score are described in an appendix, and internet data sources are noted.

## Retiring AMS presidential address

The Joint AMS-MAA Mathematics Meetings in Phoenix, AZ, held in January, 2004, featured many sessions that had to do with edcuation, particularly with the formation of teachers and with courses for non-mathematical students. But one of the highlights of the meeting was the retiring AMS presidential address by Hyman Bass, who spoke on education and the role of the research mathematician. He began, using the examples of Felix Klein and Hans Freudenthal, by making the points that many research mathematicians have made a significant contribution to school education at the peaks of their careers, and pointed out that his colleagues have an essential role in uncovering and analyzing mathematical issues that arise in class. He urged his audience to become familiar with classroom issues and get to know some teachers. He concluded his lecture with a tape of young children grappling with the notion of even and odd that came out his work with Deborah Ball in Michigan. (A brief account of the work of Bass and Ball was given in the September, 2003 issue of these *Notes* in the report on the Montreal National Forum last May.)



# THE COXETER LEGACY - REFLECTIONS AND PROJECTIONS

## INVITATION FOR CONTRIBUTED TALKS

### A conference at the University of Toronto, May 12-16, 2004

The symposium is centred around H.S.M. Coxeter's achievement and his influence on mathematics. We invite contributions on any topic connected with Coxeter's research and vision. If you are planning to attend the symposium and want to propose a 20-minute talk, please submit your title and abstract to: *www.fields.utoronto.ca/programs/scientific/03-04/coxeterlegacy/*

**Confirmed Speakers include**

Alexandre Borovik (UMIST)
Michel Broué (Paris VII)
John Conway (Princeton)
Branko Grünbaum,(Washington)
James Humphreys (Massachusetts)
Mikhail Kapranov (Toronto)
Ruth Kellerhals (Fribourg)
Askold Khovanskii (Toronto)
Bertram Kostant (MIT)
Peter McMullen (UC London)
Robert Moody (Alberta)
Bernhard Mühlherr, (Bruxelles)
Doris Schattschneider (Moravian College)
Egon Schulte (Northeastern)
Marjorie Senechal (Smith College)
Neil Sloane (AT&T Shannon Lab)
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# BRIEF BOOK REVIEWS

Srinivasa Swaminathan

## INTRODUCTION TO DYNAMICAL SYSTEMS

*by Michael Bain and Garrett Stuck*

Cambridge University Press

2002, xii + 240 pp.

Dynamical Systems is the study of long-term behavior of evolving systems. This book provides a broad introduction to the subject of dynamical systems, suitable for a one- or two- semester graduate course. The book begins with over a dozen examples in the first chapter. These examples are used to motivate the topics in the subsequent chapters. Topics include topological dynamics, symbolic dynamics, ergodic theory, hyperbolic dynamics, complex dynamics and measure-theoretic entropy. Interesting applications of dynamical systems theory are presented. These cover such areas as number theory, data storage and Internet search engines. Every section ends with exercises. The book can be read profitably by anyone with a good knowledge of functional analysis.

## AN ELEMENTARY INTRODUCTION TO MATHEMATICAL FINANCE

*by Sheldon Ross*

Second edition, Cambridge University Press, 2003, xv + 253 pp.

The subtitle is: Options and other topics. An option gives on the right, but not the obligation, to buy (call option) or sell (put option) a security under specified terms. An American style call option allows the buyer to exercise the option at any time up to the expiration time, whereas a European style call option can only be exercised at the expiration time. A prerequisite for a strong market in options is a computationally efficient way of evaluating, at least approximately, their worth; this is accomplished for call options of either style by the famous Black-Scholes formula, which assumes that prices of the underlying security follow a geometric Brownian motion. Black and Schloes showed that there will be no certain profit (i.e., no arbitrage) if and only if the price of the option is as given by their formula.

Without assuming any prior knowledge of probability the book of Sheldon Ross presents the Black-Scholes theory of options as well as such general topics in finance as the time value of money, rate of return of an investment cash flow sequence, utility functions and expected utility maximization, mean variance analysis, value at risk, optmal portfolio selection, optimization models, and the capital assets pricing model.

Many examples and exercises are given. The book will appeal to professional traders as well as undergraduates studying the basics of finance.

## OVAL TRACK AND OTHER PERMUTATION PUZZLES AND JUST ENOUGH GROUP THEORY TO SOLVE THEM

*by John O. Kiltinen*

Mathematical Association of America, Washington, DC, 2003,

xv + 305 pp.

In the early 1980's Rubik's Cube and the spate of permutation puzzles which followed it turned out to be good examples to show how group theory provides exactly the right mathematical structure for understanding and solving these puzzles. One of the puzzles of this type which came out later was called "Top Spin". It has twenty numbered disks that rotate freely on an oval-shaped track. In addition, there is a circular turntable at the top of the track that has room for four disks. By rotating this turntable through 180 degrees with the four disks on it, one can reverse the order of the disks. Scrambling the disks is possible and one can try to solve the problem. This puzzle is a concrete realization of the subgroup of the symmetric group $S_{20}$ by the twenty-cycle $(1, 2, \ldots, 20)$ and the product $(1,4)(2,3)$ of two disjoint transpositions.

By having a computer to take over the memory functions, the author develops a computerized version of this and similar puzzles and incorporates applications of permutation groups to solving them. The Oval Track Puzzles package includes software in a CD ROM. The book introduces the necessary permutation group theory. The book and the puzzle software can be a source of individual research projects for students in abstract algebra and related courses.

## MARKOV PROCESSES FROM K. ITÔ'S PERSPECTIVE

*by Daniel W. Stroock*

Annals of Mathematics Studies, No.155

Princeton University Press, 2003, xvi + 267 pp.

The book presents Itô's theory of stochastic integration and its application to Brownian motion. The author concludes the Preface as follows: "…. Because the book is really an introduction to continuous time stochastic processes, the reader who is looking for the most efficient way to learn how to do stochastic integration (or price an option) is going to be annoyed by Chapters 1 and 2. In fact, a reader who is already comfortable with Brownian motion and is seeking a no frills introduction to the most frequently used aspects of Itô's theory should probably start with Chapter 5 and dip into earlier parts of the book only as needed for notation. On the other hand, for someone who already knows the nuts and bolts of stochastic integration theory and is looking for a little "culture" a reasonable selection of material would be the contents of Chapter 1, the first half of Chapter 2, and Chapter 3. In addition, all readers will find some topics of interest in the later chapters."

**MATHEMATICAL CIRCLES**

*by Howard Eves*

published as a three-volume set, [Volume I. In Mathematical Circles, Quadrants I, II, III and IV, 368 pp.; Volume II. Mathematical Circles Revisited & Mathematical Circles Squared, 412 pp. ; Volume III. Mathematical Circles Adieu & Return to Mathematical Circles, 404 pp.] The Mathematical Association of America, 2003.

"For many years Howard Eves, famed historian of mathematics and master teacher, collected stories and anecdotes about mathematics and mathematicians. He gathered them together in six Mathematical Circles books. Thousands of teachers of mathematics have read these stories and anecdotes for their own enjoyment and used them in classroom – to add spice and entertainment, to introduce a human element, to inspire the student, and to forge some links in cultural history. Through a special arrangement with Professor Eves, the MAA is proud to reissue all six of the Mathematical Circles books in this three-volume edition."

**PRIME OBSESSION**

*by John Derbyshire*

Joseph Henry Press, Washington, DC, 2003, xv + 422 pp.

Subtitle: Bernhard Riemann and the Greatest Unsolved Problem in Mathematicsi

When, at the age of 32 in 1859, Riemann had the great honor of being made a corresponding member of the Berlin Academy, he presented a paper to the Academy with the title "On the Number of Prime Numbers Less than a Given Quantity," in which he introduced the zeta function and made a conjecture that all non-trivial zeros of the zeta function have real part one-half. This conjecture is known the Riemann Hypothesis'(RH). It has attracted the attention of brilliant mathematicians ever since.

The author of Prime Obsession, who is a mathematically trained banker and a novelist, writes in the Prologue: "Unlike the Four-color Theorem, or Fermat's Last Theorem, RH is not easy to state in terms a non-mathematician can easily grasp. It lies deep in the heart of some quite abstruse mathematical theory. To the ordinary reader, even a well-educated one, who has had no advanced mathematical training, the statement of RH is quite incomprehensible. In this book, as well as describing the history of the Hypothesis, and some of the personalities who have been involved with it, I have attempted to bring this deep and mysterious result within the understanding of a general readership, giving just as much mathematics as is needed to understand it." The odd-numbered chapters are devoted to mathematical exposition of all the concepts necessary for an understanding of the hypothesis. The even-numbered ones deal with the relevant history and biographical background matter.

**ON NUMBERS AND GAMES**

*by John Conway*

Second edition, A. K. Peters, Natick, Massachusetts, 2001, xi + 242 pp.

ONAG, as this book is popularly known, is one of those rare publications that sprang to life in a moment of creative energy over a quarter of century ago. It has given rise to research activities in a number of fields. Originally written to clarify the relation between the theories of transfinite numbers and mathematical games, it turned out to be a mathematically sophisticated, yet eminently enjoyable, guide to game theory. By defining numbers as strengths of positions in certain games, Conway creates a new class, called the surreal numbers by David Knuth, that includes both real numbers and ordinal numbers. Applications to mathematical analysis of game strategies form the second part of the book. The additions to the second edition present recent developments in mathematical game theory, with a concentration on surreal numbers and the additive theory of partizan games. Donald Knuth writes, "ONAG is a unique and wonderful book, certainly one of the top mathematical creations of the twentieth century. Warning: it is essentially as addictive as the Internet, because you will think of fascinating new things to explore as you examine every page." In his Prologue to this edition Conway describes how the first edition came to be written "in a week". The book ends with "Theorem 100. This is the last theorem in this book. (The proof is obvious.)" In his Epilogue, Conway records his reflections on the "surreal progress" of the first edition.

## MESSAGE DU VICE-PRÉSIDENT *(Suite)*

Organiser le programme liaison Cégep-Université. Ce programme vise à organiser des conférences données par des chercheurs universitaires dans le réseau des Cégeps de la province. Les exposés ont pour but d'offrir un aperçu du champ d'activité du chercheur et mettent en évidence ses aspects théoriques, ses applications pratiques et les opportunités de carrières.

**L'ISM subventionne diverses bourses :**

- Le programme de bourses d'été qui met en relation les étudiants de premier cycle et les stagiaires postdoctoraux. Son but est double : il initie les étudiants à la recherche en mathématiques et il permet aux stagiaires postdoctoraux d'acquérir une expérience en supervision de recherche;
- Le programme de bourse pour étudiants de deuxième et troisième cycles administré conjointement avec les départements des universités membres;
- Le programme de bourses postdoctorales CRM-ISM administré conjointement avec le CRM;
- La bourse Carl Herz décernée chaque année à un étudiant de deuxième ou troisième année de doctorat particulièrement prometteur;
- Des bourses de voyage pour des étudiants des cycles supérieurs assistant à des conférences dans leur domaine de recherche.

L'ISM a créé la fondation Carl Herz en 1997 en l'honneur de Carl Herz, mathématicien montréalais éminent et président de la SMC (1987-89). Carl Herz fut étroitement impliqué dans la création de l'ISM dont il fut le second directeur. La fondation est une organisation à but non lucratif mis sur pied pour soutenir les étudiants des cycles supérieurs et les stagiaires postdoctoraux des six universités membres. Elle finance la bourse Carl Herz.

Le directeur actuel de l'ISM est S. Twareque Ali de l'Université Concordia. Il travail en collaboration avec un comité de gestion composé des directeurs des départements et des directeurs des programmes avancés, et les dix groupes scientifiques de l'ISM qui représentent les domaines mathématiques les plus actifs au Québec (e.g. analyse, mathématiques appliquées et calcul scientifique, géométrie et topologie). Chaque groupe est composé de professeurs, stagiaires postdoctoraux et étudiants des cycles supérieurs du Québec travaillant dans le domaine. Ils jouent un rôle essentiel dans les activités de l'Institut en proposant des cours des cycles supérieurs et des candidats pour les bourses postdoctorales CRM-ISM.

Après douze années d'existence, l'ISM est en période de consolidation. Son action coordonnée a été le fer de lance d'une meilleure gestion des ressources. Mais ce qui m'apparaît le plus important, c'est que par le biais de l'ISM, le Québec est devenu un lieu bien plus attrayant pour faire des mathématiques. Nos étudiants et stagiaires postdoctoraux disposent d'une grande richesse en terme d'expertise. Étant donné la nature inter-universitaire de nos programmes et les particularités linguistiques des universités membres, ils développent en même temps d'excellentes habiletés en français et en anglais. Pour les professeurs, les programmes de l'Institut ont développé un niveau de collégialité et de coopération tout à fait unique se répercutant sur d'autres aspects de leurs vies professionnelles. Par exemple, le CRM s'est re-structuré en 2002-03 autour des laboratoires qui sont, en effet, les contreparties recherche des groupes scientifiques de l'ISM. Bien que la structure de l'ISM ne soit pas nécessairement viable pour d'autres juridictions, les bénéfices d'une coopération pro-active planifiée le sont. La communauté québécoise en tirera profit pour les années à venir.

Ceux qui souhaitent obtenir plus d'information au sujet de l'ISM peuvent écrire à :

Institut des sciences mathématiques
Université du Québec à Montréal
P.O. Box 888, Succursale Centre-Ville
Montréal (Québec) H3C 3P8
Tél (514) 987-3000 ext 1811
Fax : (514) 987-8935
*ism@math.uqam.ca*

Ou consulter son site internet au *www.math.uqam/ISM*

## AARMS SUMMER SCHOOL 2004

The third annual Summer School of the Atlantic Association for Research in the Mathematical Sciences (AARMS) will take place at Memorial University, St. John's, Newfoundland, from July 12 through August 6, 2004. The School is intended for graduate students and undergraduate students contemplating graduate school from all parts of the world.

Each participant will be expected to register for two of four courses, each consisting of four 50-minute lectures and two ninety-minute problem sessions per week. As these are Memorial University graduate courses, grades will be given and transfer credits facilitated wherever possible.

**The following courses will be offered this year:**

- Mathematical Biology, by Professor Brian Sleeman, Leeds University
- Number Theoretic Cryptology, by Professor Renate Scheidler, University of Calgary
- Number Theory, by Professor Michael Bennett, University of British Columbia
- Probability and Statistics, by Professor Priscilla Greenwood, University of British Columbia and Arizona State University

This year's School immediately follows an international conference on Nonlinear Dynamics and Evolution Equations which Summer School participants are encouraged to attend as well.

Students are responsible for travel costs to and from St. John's, but AARMS will meet all local expenses, including accommodation, meals and text books. There are no registration fees. For more information and to express interest in attending, visit the School's web site at *www.math.mun.ca/~aarms/summerschools/SS2004* or email Edgar Goodaire (*edgar@math.mun.ca*) directly.

# MESSAGE FROM THE VICE-PRESIDENT

Steven Boyer, Vice-President - Quebec

One of the great strengths of the Canadian mathematical community is the ability of its members to cooperate on projects beneficial to the community as a whole. A striking example of this is the Institut des Sciences Mathématiques (ISM), a network of the six Quebec universities that offer doctoral programs in mathematics (Concordia, Laval, McGill, the Université de Montréal, UQAM, and the Université de Sherbrooke). Its mandate is to promote mathematical culture within Quebec, to strengthen training by coordinating the graduate programs in the mathematical sciences of its member institutions, and to facilitate the exchange of resources.

The key factor which led to the foundation of the ISM in 1991 was the realization that the fortuitous proximity of the four Montreal universities made it possible to create a city-wide graduate school in mathematics. There was already a fair amount of informal interaction between the various departments and the many research activities sponsored by the Centre de Recherches Mathématiques (CRM) had fostered a sense of common purpose amongst the local mathematicians. Francis Clarke, then director of the CRM, took the initiative and got the departments to put together a proposal. Within a year, the finances of the institute were put on a firm basis with contributions from the four Montreal universities and a significant grant from the Ministère de l'Education du Québec. So armed, the ISM began to develop programs and seek out new partners. With the additions of the Universté Laval and the Universté de Sherbrooke in 1997-98, the ISM became a Quebec-wide network. Today it is involved in a full range of activities:

- coordinating the mathematics graduate courses of the participating universities and ensuring that students can
  - cross-register for courses at any of the participating universities;
  - be supervised by professors at any of the participating universities;
  - have access to the library facilities of all participating universities;
- organizing, in conjunction with the CRM, the CRM-ISM mathematics and statistics colloquia, each of which meets weekly during the academic year;
- funding the ISM graduate student seminar, organized by and intended for graduate students. It allows the students to meet on a weekly basis to discuss their work;
- funding and providing the necessary infrastructure for the annual student organized Quebec graduate conference, which brings together students from Quebec, Canada and abroad to exchange ideas, present their research, and listen to talks by exceptional mathematicians;
- organizing the CÉGEP-University Liaison Project. This program arranges talks in the province's network of CÉGEP's (junior colleges) by university researchers. The talks are intended to provide insight into the researcher's field, touching on theoretical aspects, applications, and career opportunities.

**The ISM offers funding in the form of:**

- a summer scholarships program which pairs undergraduates and post-doctoral fellows. The goal is twofold: to introduce students to research level mathematics and to give the post-doctoral fellows experience as research supervisors;
- a scholarship program for graduate students administered in collaboration with the participating departments;
- the CRM-ISM postdoctoral fellowship program;
- the Carl Herz scholarship, awarded each year to a second or third year doctoral student who shows great promise;
- travel grants for graduate students attending conferences in their research area.

The ISM established the Carl Herz Foundation in 1997 in honour of Carl Herz, a distinguished Montreal mathematician and former president of the CMS. He was actively involved in the creation of the ISM and served as its second director. The foundation is a non-profit organization established to support graduate students and postdoctoral fellows from the six member universities.

The current director of the ISM is S. Twareque Ali of Concordia University. He works in collaboration with the ISM steering committee, composed of the department heads and graduate program directors, and the ten program groups representing mathematical fields that are particularly active in Quebec (e.g. applied and computational mathematics, analysis, geometry and topology). Each program group is made up of those professors, postdoctoral fellows, and graduate students in Quebec who work in the field. They play an essential role in the institute's activities, such as the selection of graduate courses and candidates for the CRM-ISM post-doctoral fellowships.

Twelve years on, the ISM is in a period of consolidation. A more efficient use of resources has been achieved through the coordinated action it has spearheaded, and this is important. But to my mind, an even more important consequence is that through the ISM, Quebec has become a much more attractive place to do mathematics. Our students and post-doctoral fellows have a wealth of expertise at their disposal, and given the inter-university nature of our programs and the linguistic make-up of the participating universities, they develop excellent skills in French and English as a matter of course. For professors, the institute's programs have led to a level of collegiality and cooperation that is quite unique and has found outlets in other areas of our professional lives. For instance, the CRM re-organized itself during the 2002-03 academic year around what are essentially the research wings of the ISM's program groups. Though the ISM's structure is not necessarily suitable in other jurisdictions, the benefits of pro-active cooperative planning are. We in Quebec will profit from it for years to come.

Those who would like to know more about the ISM can write to
Institut des sciences mathématiques
tel.: (514) 987-3000, ext 1811
Université du Québec à Montréal
fax: (514) 987-8935
P.O. Box 8888, Station Centre-Ville
Montréal, Qc, Canada H3C 3P8

*ism@math.uqam.ca*

or visit its website at *www.math.uqam.ca/ISM*

# FAREWELL TO A MATHEMATICIAN

by James Brooke and Jacek Szmigielski, University of Saskatchewan

*Mahmood Khoshkam (1951-2003)*

On October 13, 2003 the Department of Mathematics and Statistics and the University of Saskatchewan, Saskatoon, lost one of its most dedicated teachers and scholars in Professor Soltan Mahmood Khoshkam.

Mahmood was born in the port of Bandar Lengeh in the Persian Gulf on the ancient caravan route to Shiraz, a city of great cultural significance for Iranian culture, and the place of burial of its two most beloved poets Hafez and Saadi. It was in Shiraz where Mahmood spent his formative years, which left an indelible mark on him. Mahmood was educated in Iran and Canada receiving both his BSc and MSc in Mathematics from Shiraz University and his PhD from Dalhousie University under the supervision of Professor John Phillips. While studying mathematics at Shiraz University he also developed, in the very rich cultural environment of that ancient city, his passion for political ideas and poetry. After finishing his PhD Mahmood received first a postdoctoral fellowship at Queen's University (1982-83), followed by another postdoctoral position at the University of Waterloo (1983-84). These were two very productive years for Mahmood - years in which he established life-long professional associations. Perhaps the best illustration of the enlivening collaborative spirit of those years is found in the following excerpt from the letter from his friend and collaborator Georges Skandalis (Centre de Mathématiques de Jussieu, Université Paris 7 Denis Diderot): " We spent a year together in Kingston - at Queens - with Thierry Giordano (who is now at the University of Ottawa). The three of us spent a great year, working a lot: we were talking mathematics from early in the morning until late at night, each of us telling the others the mathematics he knew. Mahmood taught us perturbation theory of operator algebras (he was writing a couple of papers from his thesis), Thierry Giordano explained to us the flow of weights and I talked about Kasparov's KK-theory. But most of all, we had lots of fun. We were so young and having fun with everything."

Mahmood became a member of the Department of Mathematics and Statistics at the University of Saskatchewan in 1984. He went through all the steps of an academic career, starting with the assistant, then associate and finally full professorial positions. Mahmood's greatest contribution to the administrative side of the department was undoubtedly through his six years as Chair of the Graduate Committee. What singled out Mahmood's efforts was his selfless and generous promotion of the graduate program for the benefit of all members of the Department. Mahmood took it as his duty to direct students to whichever member of the graduate department best-suited the student's interests, often excluding himself from the potential supervisors. By doing this he demonstrated, through his unselfish nature, the deepest respect for his discipline, and for this he will be fondly remembered. Mahmood also chaired the Budget and Planning Committee for 2 years, in addition to being a member of numerous committees of the College of Arts and Science.

Mahmood's work was in the subject of operator algebras, which is one of the core branches of Mathematics, most often associated with the name of John von Neumann, one of the undisputed leaders of 20th century mathematics, and a mathematician and physicist of astonishing breadth. It was von Neumann's interest in the then new Quantum Mechanics and the need for clear mathematical foundations for this challenging physical theory that gave rise to the study of operator algebras. Mahmood was keenly aware of the history of his subject of specialization and was always very receptive to the mathematical challenges posed by developing physical theories. To talk with him about mathematics – and many of us in the department did this endlessly, at the office, at each other's homes, on the tennis court – would be to discover his great passion. Mahmood was living proof of the fact that mathematics is not only the language of Science – as Galileo made us realize – but that it is also an art – as the Greeks taught us. Its true value, as Mahmood saw it, is found in its ever-so-elusive beauty of expression; you would not expect anything less from a lover of poetry. Mahmood's pursuit of Mathematics as an artistic ideal found its true realization in his later work; the work that brought him international recognition after a discouraging hiatus in his research activities in the early 1990s.

He was particularly proud of his joint works with Georges Skandalis, of his almost twenty year long collaboration with Bahman Mashood, as well as with Javad Tavakoli and of his future plans of collaborative work with Dave Cowan. We, his colleagues, shared in this pride and we feel deeply privileged to have known him as our friend and colleague. Before he was stricken by his final illness, Mahmood expressed to us on many occasions in the summer of 2002 his sense of fulfilment in his private life and in his professional life. It looked as if everything was right on track, with prospects of so many new and exciting research projects, seminars, courses to teach and, above all, papers to write. It is perhaps ironic that Mahmood, having overcome the adversity of a lull in his research output for a few years, bounced back with an energy and success (as indicated by the recent glut of acceptances of his papers) that was truly inspiring. In his last months he continued to make plans for the next line of attack on his research problems and for the write-up of the next paper. He was fully engaged until the end. What is even more astonishing is that he appeared never to have been happier with his work. Truly, he seemed fulfilled in his life's work.

Mahmood was a kind and gentle man, unique in his positive attitude towards people, and a great social companion. Perhaps these few verses from Hafez will give a hint of how profound our loss is, but, at the same time, how near to us Mahmood remains. If Mahmood could speak to us perhaps he would say:

> "Sit near my tomb, and bring wine and music – Feeling thy presence, I shall come out of my sepulchre – Rise, softly moving creature, and let me contemplate thy beauty".

## CALL FOR MANUSCRIPTS - ATOM

### A Taste Of Mathematics

The booklets in the series, ATOM, are designed as enrichment materials for high school students with an interest in and aptitude for mathematics. Some booklets in the series will also cover the materials useful for mathematical competitions.

So far, four volumes have been published – volume I, Problems from the Olympiad Correspondence Program; Volume II, Algebra – Intermediate Methodes; Volume III Inequalities; and Volume IV, Problems for Mathematics Leagues. There are two manuscripts under active consideration on Number Theory and Trigonometry.

The Editorial Board is interested in receiving proposals for future volumes, either as a specific proposal or as a manuscript. Proposers should note that the booklets are relatively short, not exceeding 64 pages in length. So far we have published only in English because of perceived sales demand.

All proposals and manuscripts should be sent to the Editor-in-Chief, Bruce Shawyer, Department of Mathematics, Memorial University of Newfoundland, St. John's NF, Canada A1C 5S7, or email *atom@math.mun.ca*.

## DEMANDE DE MANUSCRITS - ATOM

### Aime-T-On les Mathématiques

Les livrets de la collection ATOM sont destinés au perfectionnement des étudiants du secondaire qui manifestent un intérêt et des aptitudes pour les mathématiques. Certains livrets de la collection ATOM servent également de matériel de préparation aux concours de mathématiques sur l'échiquier national et international.

À ce jour, quatre tomes ont été publiés – tome I, Problems from the Olympiad Correspondence Program; tome II, Algebra – Intermediate Methods; tome III, Inequalities; tome IV, Problems for Mathematics Leagues. Deux manuscrits sont en outre à l'étude, l'un sur la théorie des nombres, l'autres sur la trigonométrie.

Le Conseil de rédaction sollicite vos propositions pour des livrets à venir, sous la forme d'une proposition détaillée ou d'un manuscrit. Mentionnons que les livrets sont des publications courtes (64 pages max.). Nous ne les avons publiés qu'en anglais jusqu'à présent en raison de la demande estimée.

Faites parvenir vos propositions ou manuscrits au rédacteur en chef, Bruce Shawyer, Department of Mathematics, Memorial University of Newfoundland, St. John's NF, Canada A1C 5S7, ou par courriel à *atom@math.mun.ca*.

## THE FIFTH ANNUAL COLLOQUIUMFEST
### April 5 and 6, 2004
### Institut Henri Poincaré, Paris, France

This year's Colloquiumfest is organized by Zoé Chatzidakis (Equipe de Logique Mathématique, Université Paris 7), and Franz-Viktor Kuhlmann (Research Unit "Algebra and Logic", Mathematical Sciences Group, University of Saskatchewan, currently visiting the Equipe de Géométrie et Dynamique, Institut de Mathématiques de Jussieu).

The Fifth Annual Colloquiumfest is generously supported by the Institut Henri Poincaré, the Equipe de Géométrie et Dynamique, and the Equipe de Logique Mathématique.

The emphasis of this colloquiumfest will be on valuation theory in algebraic geometry and model theory.

**The list of invited speakers includes**
Peter Roquette (Heidelberg)
Alexander Prestel (Konstanz)
Bernard Teissier (Institut math. de Jussieu)
Mark Spivakovsky (Toulouse)
Vincent Cossart (Versailles-Saint Quentin)
Olivier Piltant (Versailles-Saint Quentin)
Jochen Koenigsmann (Basel/Freiburg)
Hagen Knaf (Kaiserslautern)
Raf Cluckers (ENS Ulm, Paris)

For further information, please see
*http://math.usask.ca/fvk/Mb5.htm*

## POLYNOMIAL-BASED CRYPTOGRAPHY
### July 7-12, 2004
### Melbourne, Australia

**Topic**: The topic of this symposium is the study of cryptographic schemes based on polynomial algebras.

**Organizers**: Lynn Batten, Deakin; Kathy Horadam, RMIT; Igor Shparlinski, Macquarie; Andreas Stein, Illinois; Hugh Williams, Calgary.

**Invited speakers** (partial list): John Cannon (Australia), Gary Carter (Australia), Kwangjo Kim (Korea), Bill Millan (Australia), Josef Pieprzyk (Australia), Alf van der Poorten (Australia), Andreas Stein (USA), Hugh Williams (Canada).

**Format**: The symposium will be Oberwolfach-style - casual, with talks of various lengths from invited participants. However, there will be some space for contributed talks, abstracts for which should be submitted by June 4. There will be a student day on June 11 and an industry workshop on June 12.

**Information**: Additional information is available from, Lynn Batten, *lmbatten@deakin.edu.au* or Hugh Williams, *williams@math.ucalgary.ca* and from *www.it.deakin.edu.au/cryptography2004*

## CALLS FOR NOMINATIONS / APPEL DE CANDIDATURES
### Coxeter-James, Jeffery-Williams, Krieger-Nelson Prize Lectureships

The CMS Research Committee is inviting nominations for three prize lectureships. These prize lectureships are intended to recognize members of the Canadian mathematical community.

The **Coxeter-James Prize Lectureship** recognizes young mathematicians who have made outstanding contributions to mathematical research. Nominations may be made up to ten years from the candidate's Ph.D. A nomination can be updated and will remain active for a second year unless the original nomination is made in the tenth year from the candidate's Ph.D. The selected candidate will deliver the prize lecture at the Winter **2004 Meeting in Montreal**. Nomination letters should include at least three names of suggested referees. The recipient shall be a member of the Canadian mathematical comminity.

The **Jeffery-Williams Prize Lectureship** recognizes mathematicians who have made outstanding contributions to mathematical research. A nomination can be updated and will remain active for three years. The prize lecture will be delivered at the **Summer 2005 Meeting**. Nomination letters should include three names of suggested referees. The recipient shall be a member of the Canadian mathematical comminity.

The **Krieger-Nelson Prize Lectureship** recognizes outstanding research by a female mathematician. A nomination can be updated and will remain active for two years. The prize lecture will be delivered at the Summer 2004 Meeting. Nomination letters should include three names of suggested referees. The recipient shall be a member of the Canadian mathematical comminity.

The deadline for nominations is **September 1, 2004**. Letters of nomination should be sent to the address below.

Le Comité de recherche de la SMC lance un appel à candidatures pour trois de ses prix de conférence. Ces prix ont tous pour objectif de souligner l'excellence de membres de la communauté mathématique canadienne.

Le **prix Coxeter-James** rend hommage à l'apport exceptionnel à la recherche de jeunes mathématiciens. Il est possible de proposer la candidature d'une personne qui a obtenu son doctorat il y a au plus dix ans. Les propositions pourront être mises à jour et demeureront actives pendant un an, à moins que la mise en candidature originale ne corresponde à la dixième année d'obtention du doctorat. La personne choisie présentera sa conférence à la Réunion d'hiver **2004**, **qui aura lieu à Montréal**. Les lettres de mise en candidature devraient inclure les noms d'au moins trois répondants possibles. Le récipiendaire soit être membre de la communauté mathématique canadienne.

Le **prix Jeffery-Williams** rend hommage à l'apport exceptionnel à la recherche de mathématiciens d'expérience. Les propositions pourront être mises à jour et demeureront actives pendant trois ans. La conférence sera présentée à la **Réunion d'été 2005**. Les lettres de mise en candidature devraient inclure les noms d'au moins trois répondants possibles. Le récipiendaire soit être membre de la communauté mathématique canadienne.

Le **prix Krieger-Nelson** rend hommage à l'apport exceptionnel à la recherche de mathématiciennes. Les propositions pourront être mises à jour et demeureront actives pendant deux ans. La conférence sera présentée à la **Réunion d'été 2004**. Les lettres de mise en candidature devraient inclure les noms d'au moins trois répondants possibles. Le récipiendaire soit être membre de la communauté mathématique canadienne.

La date limite pour les mises en candidature est **le 1er septembre 2004.** Faire parvenir vos lettres à l'adresse suivante:

**Ragnar-Olaf Buchweitz**
CMS Research Committee / Comité de recherche de la SMC
Department of Mathematics, University of Toronto
Toronto, Ontario, Canada M5S 1A1

## BOURSES CRSNG-SMC MATH À MOSCOU

Le **Conseil de Recherches en Sciences Naturelles et en Génie du Canada** (CRSNG) et la **Société mathématique du Canada** (SMC) sont fiers d'annoncer que trois bourses de 10,000 $ chacune seront attribuées. Les étudiantes ou étudiants du Canada inscrit(e)s à un programme de mathématiques ou d'informatique sont éligibles. Les bourses servent à financer un trimestre d'études à la petite université d'élite Moscow Independent University.

Programme Math à Moscou *www.mccme.ru/mathinmoscow/*
Détails de soumission *www.cms.math.ca/bulletins/Moscou_web/*

Pour plus de renseignements veuillez communiquer avec votre département ou la SMC au 613-562-5702.

**Deux bourses** seront attribuées au concours du printemps
Date limite
15 avril 2004 pour le trimestre d'automne 2004

**Une bourse** sera attribuée au concours d'automne
Date limite
30 septembre 2004 pour le trimestre d'hiver 2005

## NSERC-CMS MATH IN MOSCOW SCHOLARSHIPS

The **Natural Sciences and Engineering Research Council** (NSERC) and the **Canadian Mathematical Society (**CMS) are pleased to announce three scholarships of $10,000 each. Canadian students registered in a mathematics or computer science program are eligible. The three scholarships are to attend a semester at the small elite Moscow Independent University.

Math in Moscow Program *www.mccme.ru/mathinmoscow/*
Application details *www.cms.math.ca/bulletins/Moscow_web/*

For additional information please see your department or call the CMS at 613-562-5702.

**Two scholarships** will be awarded in the spring competition
Deadline
April 15, 2004 to attend the Fall 2004 semester

**One scholarship** will be awarded in the fall competition
Deadline
September 30, 2004 to attend the Winter 2005 semester

# CALL FOR NOMINATIONS / APPEL DE CANDIDATURES

**Associate Editors - CJM and CMB / Rédacteurs associés - JCM et BCM**

The Publications Committee of the CMS solicits nominations **for three Associate Editors** for the Canadian Journal of Mathematics (CJM) and the Canadian Mathematical Bulletin (CMB). The appointment will be for five years beginning January 1, 2005. The continuing members (with their end of term) are below.

The deadline for the submission of nominations is **April 15, 2004**. Nominations, containing a curriculum vitae and the candidate's agreement to serve should be sent to the address below.

**CJM Editors-in-Chief / Rédacteurs-en-chef du JCM**
Henri Darmon and/et Niky Kamran, McGill (2006)

**CMB Editors-in-Chief / Rédacteurs-en-chef du BCM**
James Lewis, Arturo Pianzola; Alberta and/et Noriko Yui; Queen's (2005)

Le comité des publications de la SMC sollicite des mises en candidatures **pour trois postes de rédacteurs associés** du Journal canadien de mathématiques (JCM) et Bulletin canadien de mathématiques (BCM). Le mandat sera de cinq ans et débutera le 1 janvier 2005. Les membres qui continuent suivent.

L'échéance pour proposer des candidats est le **15 avril 2004**. Les mises en candidature, accompagnées d'un curriculum vitae ainsi que du consentement du candidat(e), devrait être envoyées à l'adresse ci-dessous.

**Associate Editors / Rédacteurs associés**

W. Craig McMaster (2007)
A. Geramita, Queen's (2006)
S. Boyer, UQAM (2008
F. Shahidi, Purdue (2005)
S. Kudla (2008)
G. Elliott, Toronto (2005)
V. Kac, MIT (2006)
R. Murty, Queen's (2006)
P. Guan, McMaster (2008)
M. Zworski, California (2006)

**Dana Schlomiuk Chair / Présidente**
CMS Publications Committee
Comité des publications de la SMC
Département de mathématiques et de statistique
Université de Montréal, CP-6128 Centre-ville
Montréal, Québec H3C 3J7 *chair-pubc@cms.math.ca*

# CALLS FOR NOMINATIONS / APPEL DE CANDIDATURES

## Adrien-Pouliot 2004

Nominations of individuals or teams of individuals who have made significant and sustained contributions to mathematics education in Canada are solicited. Such contributions are to be interpreted in the broadest possible sense and might include: community outreach programmes, the development of a new program in either an academic or industrial setting, publicizing mathematics so as to make mathematics accessible to the general public, developing mathematics displays, establishing and supporting mathematics conferences and competitions for students, etc.

Nominations must be submitted on the "Nomination Form" available from the CMS Office. To assure uniformity in the selection process, please follow the instructions precisely. Documentation exceeding the prescribed limits will not be considered by the Selection Committee.

Individuals who made a nomination in 2003 can renew this nomination by simply indicating their wish to do so by the deadline date. Only materials updating the 2003 Nomination need be provided as the original has been retained. Nominations must be received by the CMS Office no later **April 30, 2004**. Please send six copies of each nomination to the address given below.

Nous sollicitons la candidature de personnes ou de groupe de personnes ayant contribué de fa\c con importante et soutenue à des activités mathématiques éducatives au Canada. Le terme "contributions" s'emploie ici au sens large; les candidats pourront être associés à une activité de sensibilisation, un nouveau programme adapté au milieu scolaire ou à l'industrie, des activités promotionnelles de vulgarisation des mathématiques, des initiatives, spéciales, des conférences ou des concours à l'intention des étudiants, etc.

Les candidatures doivent nous être transmises via le "Formulaire de mise en candidature" disponible du bureau de la direction de la SMC. Pour garantir l'uniformité du processus de sélection, veuillez suivre les instructions à la lettre. Toute documentation excédant les limites prescrites ne sera pas considérée par le comité de sélection.

Il est possible de renouveler une mise en candidature présentée l'an dernier, pourvu que l'on en manifeste le désir avant la date limite. Dans ce cas, le présentateur n'a qu'à soumettre des documents de mise à jour puisque le dossier original a été conservé. Les mises en candidature doivent parvenir au bureau de la SMC avant **le 30 avril 2004**. Veuillez faire parvenir vos mises en candidature en six exemplaires à l'adresse suivante:

**The Adrien Pouliot Award / Le Prix Adrien-Pouliot**
Canadian Mathematical Society / Société mathématique du Canada
577 King Edward, Suite 109, P.O. Box 450, Station A / C.P. 450, Succ. A
Ottawa, Ontario K1N 6N5

# CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

## MARCH 2004 MARS

**4-6** Workshop on Spectral Geometry
(CRM, U. de Montreal, Montreal, QC) *crm@ere.umontreal.ca*

**15-19** Workshop on Nonlinear Wave Equations (The Fields Institute, Toronto, ON) *www.fields.utoronto.ca/programs/scientific/03-04/kinetic_theory/index.htm*

**29- Apr 2** Workshop on Kinetic Theory (The Fields Institute, Toronto, ON) *www.fields.utoronto.ca/programs/scientific/03-04/kinetic_theory/index.htm*

## APRIL 2004 AVRIL

**1-4** Midwest Several Complex Variables Meeting, in conjunction with Distinguished Lectures given by Y.-T. Siu
(University of Western Ontario, London, Ontario)
*www.math.uwo.ca/~larusson/scv.html*

**4 -7** Fractal 2004, Complexity and Fractals in Nature, 8th International Multidisciplinary Conference
(Vancouver, BC) *www.kingston.ac.uk/fractal/*

**5-6** The Fifth Annual Colloquiumfest (Institut Henri Poincaré, Paris, France) *http://math.usask.ca/fvk/Mb5.htm*

**22-24** SIAM International Conference on Data Mining
(Hyatt Orlando, Orlando, FL) *ross@siam.org*

## MAY 2004 MAI

**3-8** AARMS-CRM Workshop on Singular Integrals and Analysis on CR Manifolds (Dalhousie University, Halifax, NS)
*http://math.mun.ca/aarms*

**4-7** Workshop on Spectral Theory and Automorphic Forms
(CRM, U. de Montreal, Montreal, QC) *crm@ere.umontreal.ca*

**12-16 THE COXETER LEGACY - Reflections and Projections**
(University of Toronto,Toronto,ON)
*www.fields.utoronto.ca/programs/scientific/03-04/coxeterlegacy/*

**13-15** Sixth International Joint Meeting of AMS and Soc.Mat.Mexicana
(Houston, TX) *www.ams.org/meetings/*

**17-18** Canadian Symposium on Abstract Harmonic Analysis
(Univ. of Western Ontario, London, Ont.)
*www.math.uwo.ca/~milnes/HA04.htm*

**24-28** Workshop on Hamiltonian Dynamical Systems (jointly with the Fields Institute) (CRM, U. de Montreal, Montreal, QC)
*crm@ere.umontreal.ca*

**28-31** International Conference on Mathematics and its Applications
(Hong Kong) *www.cityu.edu.hk/rcms/icma2004*

## JUNE 2004 JUIN

**1-11** Workshop on Semi-classical Theory of Eigenfunctions and PDEs
(CRM, U. de Montreal, Montreal, QC) *crm@ere.umontreal.ca*

## JUNE 2004 JUIN

**7-10** 6th International Conference on Monte Carlo Methods in Scientific Computing and 2nd International Conference on Monte Carlo and Probabilistic Methods for PDE (Juan-les-Pins, France) *www.sop.inria.fr/omega/MC2QMC2004*

**8-12** Projective Varieties with Unexpected Properties
The conference is in honour of the 150th anniversary of the birth of Giuseppe Veronese, Siena, Italy.
*www2.dsmi.unisi.it/newsito/PVWUP/index.html*

**10-14** CCWEST 2004, National Conference for the Advancement of Women in Engineering, Science and Technology (Brock University, St. Catharines, ON) *www.brocku.ca/fms/ccwest2004*

**13-15 CMS Summer Meeting / Réunion d'été de la SMC**
(Dalhousie University, Halifax, Nova Scotia)
*meetings@cms.math.ca*

**18-23** Mathematical Foundations of Learning Theory
(Barcelona, Spain)
Gábor Lugosi: *www.crm.es/MathematicalFoundations*

**20-25** Canadian Number Theory Association VIII Meeting (University of Toronto, Toronto, ON)
*www.fields.utoronto.ca/programs/scientific/03-04/CNTAB/*

**20-27** 42nd International Symposium on Functional Equations
Opava, Czech Republic
*isfe42@math.slu.cz — www.math.slu.cz/ISFE42/*

**21-25** Conference on Surface Water Waves (The Fields Institute, Toronto,ON) *www.fields.utoronto.ca/programs/*

**21-July 2** SMS-NATO Advanced Summer Institute : Morse Theoretic Methods in Non-linear Analysis and Symplectic Topology
Université de Montréal, Canada. *www.dms.umontreal.ca/sms*
*sms2004@dms.umontreal.ca*

**27-July 2** European Congress of Mathematics
(Stockholm, Sweden) Ari Laptev: *laptev@math.kth.se*

**28-July 2** 16th Annual Conference in Formal Power Series and Algebraic Combinatorics (UBC, Vancouver, BC)
*www.pims.math.ca/fpsac/ – fpsac@pims.math.ca*

**28-July 2** Workshop on Non-linear Differential Galois Theory
CRM, Bellaterra. Co-ordinator: Marcel Nicolau

**30-July 7** Fourth World Congress of Nonlinear Analysis(WCNA 2004)
(Hyatt Orlando, Florida)
*http://kermani.math.fit.edu/ — wcna2004@yahoo.com*

## JULY 2004 JUILLET

**4-11** The 10th International Congress on Mathematical Education
(Copenhagen, Denmark) *www.ICME-10.dk*

**5-9** 19th "Summer" Conference on Topology and its Applications
(University of Cape Town, South Africa)
*www.mth.uct.ac.za/Conferences/Topology*

**JULY 2004 JUILLET**

**5-9** 2nd Annual Conference on Permutation Patterns (Malaspina University-College, Nanaimo, BC) *www.mala.ca/math/PP/ westj@mala.bc.ca*

**5-16** Advanced Course on Automata Groups (Bellaterra, Barcelona, Spain) Warren Dicks: *www.crm.es/AutomataGroups*

**7-12** Polynomial-Based Cryptography Melbourne, Australia *www.it.deakin.edu.au/cryptography2004*

**6-11** The 17h International Conference on Multiple Criteria Decision Analysis (Whistler,BC) *www.mywhistler.com/about/2010_olympics.asp*

**12-15 First Joint Canada-France meeting of the mathematical sciences / Premier congrès Canada-France des sciences mathématiques**, (Toulouse, France) *www.cms.math.ca/Events/Toulouse2004/*

**12-August 6** Third Annual AARMS Summer School (Memorial University, St. John's), *edgar@math.mun.ca*

**16-20** Algebraic Topological Methods in ComputerScience, II University of Western Ontario, London, ON) *www.math.uwo.ca/~jardine/at-csII.html*

**18-24** International Conference on General Relativity and Gravitation (Dublin, Ireland) *m.a.h.maccallum@qmul.ac.uk*

**JULY 2004 JUILLET**

**26-30** Workshop on Spectral Theory of Schrödinger Operators (CRM, Université de Montreal, Montreal, QC) *crm@ere.umontreal.ca.*

**AUGUST 2004 AOÛT**

**2-6** Workshop on Dynamics in Statistical Mechanics(CRM, U. de Montreal, Montreal, QC) *crm@ere.umontreal.ca*

**6-7** New Directions in Probability Theory (Fields Institute, Toronto,ON) *www.imstat.org/meetings/NDPT/default.htm*

**OCTOBER 2004 OCTOBRE**

**6-9** HYKE Conference on Complex Flows: Analytical and Numerical Methods for Kinetic and Hydrodynamic Equations *www.crm.ex/AutomataGroups*

**DECEMBER 2004 DÉCEMBRE**

**11-13 CMS Winter Meeting / Réunion d'hiver de la SMC** (McGill University, Montréal, Québec) *meetings@cms.math.ca*

**JANUARY 2005 JANVIER**

**5-8** Annual Meeting of American Mathematical Society (Atlanta,GA) *www.ams.org/meetings/*

## RATES AND DEADLINES 2004 / TARIFS ET ÉCHÉANCES 2004

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