



CMS Member Profile :
Tom Salisbury 9

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CMS NOTES de la SMC

June
2014

Vice-President's Notes

Mark Lewis, Vice-President, *Western Provinces & Territories*



The subject of discovery-based mathematics education has been recently very much front and centre in Canada. Here K through 12 students are encouraged to create their own techniques for solving problems. Conventional mathematical techniques are discouraged in favour of using objects like blocks to solve problems. Many see this as being at the detriment of more traditional structured mathematical learning, which includes memorization. I read about discovery-based learning frequently in the newspaper, I hear about it in discussions with colleagues, and even experience it as the parent of a school-aged child in Alberta. There is a concern about the lack of skills in high school graduates, and parents are protesting the shift away from traditional learning and the seeming loss of skills in students.

In response to a petition from 12,000 parents, Alberta's Education Minister, Jeff Johnson, recently announced that Alberta students will be taught to memorize times tables as of September 2014. You may wonder why this is not already required. According to Anna Stokke (University of Winnipeg), it is easy for anti-memorization advocates to set up false dichotomies between basic skills and understanding [1]. By saying that "basic understanding, not memorization is needed," anti-memorization advocates do not countenance that understanding and memorization can go hand-in-hand.

Mathematics is not simply memorization versus ideas. It is both, and, of course, is far more complex. When explaining mathematics to undergraduates I tell them that mathematics is like sports. To be successful, one needs to be in good shape,

needs to have mastered certain skills, and needs to understand how the game is played. The first and second come from repeated exercises, including memorization, which hone ability and acuity. The third comes from the kind of learning that happens in class. In terms of these three key elements, why should mathematics and sports be any different?

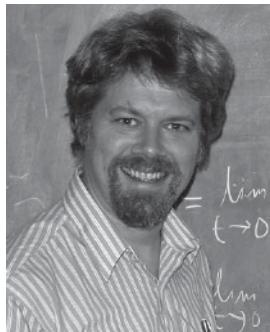
Rather than chasing sports medals, scientists are encouraged to measure their success other ways. It seems that the increasingly common use of metrics, such as paper counts, or impact factors, to evaluate scientific quality can paradoxically lead to an overall decline in the quality of science. This is because scientists are encouraged to chase metrics rather than good scientific ideas. For example, a risky but potentially significant research venture may be pushed aside in favour of "safe science," where results are virtually certain and more numerous, filling "much-needed gaps in the literature."

It is well known by evolutionary ecologists that, under certain dynamical constraints, populations where each individual evolves to maximize their individual fitness can eventually spiral downwards to the point of evolutionary suicide, resulting in the complete extinction of the population. We should try to be sure that the metrics we apply to science evaluation don't provide dynamical constraints of the evolutionary suicide type. We should be able to do better than that.

However, there is already evidence of changes to the ecology of science communication. A recent article by Tom Spears (Postmedia News) [2] bemoans the growth in predatory journals, where "online

Looking Back

Robert Dawson, Saint Mary's University



One more term, one set (or more) of grades entered. You think back to the beginning of the term: the new faces, the fresh start. Maybe you were teaching a new course, maybe it was one you'd taught many times before. Perhaps you were experimenting with a new course structure or textbook; perhaps the existing structure was tuned like a fine engine, and your only hope was

that you could repeat the success of your last time. Of course, it didn't all go according to plan. Somebody had registered for the course against all common sense and advice, and struggled bravely all term, before finally dropping the course a week before exams. One of the

students who appeared most talented, whose first five assignments could have served as models for the next edition of the textbook, suddenly vanished mid-term and was seen no more. After a while, you all lost a little momentum. Attendance dropped off, hopefully not too much. Maybe (you don't have to admit it) there were lectures you gave without enthusiasm,

only because the course outline had promised that you would speak on that topic. But you stepped up to the plate and none of the students noticed anything amiss. You hope, anyhow. Final exams are getting near. Suddenly, your office hours become popular. You look at the class list and realize that you don't need as many copies as you needed for the first midterm. You hold an extra-help session. Some of the students who attend will get A's without much effort; many of the others will be lucky to get a D. The ones in the middle are off studying on their own. You try to give them all some help and encouragement. Exam day. Neat rows of tables in the gymnasium, or a half-dozen seats in a familiar classroom. Three hours of desperate writing for them, three hours of lynx-eyed pacing for you. Rumor has it that students in some classes are using their cellphones to access an online symbolic algebra engine. You see no sign of it, but how certain can you be? Then you grade the papers, trying to be as objective and dispassionate as possible. The halls are strangely silent. A correct answer has no face, no personality; an error is an error, whoever made it. You check your sums, enter the data, check once more, and hit "Enter." One more term.

"Rumor has it that students in some classes are using their cellphones to access an online symbolic algebra engine."

Une autre session de terminée, une autre série (ou plusieurs autres séries) de notes d'enregistrées. Vous repensez au début de la session : les nouveaux visages, un nouveau départ. Peut-être donnez-vous un nouveau cours, ou encore un cours que vous avez donné à maintes reprises. Vous avez peut-être fait l'essai d'une nouvelle structure de cours ou d'un nouveau manuel, ou bien la structure de votre cours était si au point que vous souhaitiez seulement répéter le succès de la dernière fois. Évidemment, tout ne s'est pas déroulé comme prévu. Un étudiant s'était inscrit malgré les conseils et le gros bon sens, il a bravement combattu toute la session avant d'abandonner le cours une semaine avant les examens. Un autre qui semblait bourré de talent, dont les cinq premiers travaux auraient pu servir de modèle à la prochaine édition du manuel, est soudainement disparu à la mi-session sans laisser de trace. Après un certain temps, vous avez perdu un peu de votre ardeur initiale. La présence à vos cours a diminué, pas trop si possible. Peut-être aussi (mais vous n'avez pas à l'admettre) avez-vous livré certains cours sans enthousiasme, seulement parce que le plan de cours indiquait que vous deviez aborder ce sujet. Mais vous vous êtes montré à la hauteur, et aucun de vos étudiants n'a remarqué quoi que ce soit qui cloche. C'est du moins ce que vous espérez. Les examens de fin de sessions approchent. Soudain, les étudiants affluent à votre bureau à vos heures de permanence. Vous regardez votre liste d'étudiants et vous vous rendez compte que vous n'avez pas besoin d'autant de copies qu'à l'examen de mi-session. Vous organisez une séance de récupération. Certains de vos étudiants qui y participent obtiendront un A sans trop d'effort; bien d'autres seront chanceux s'ils finissent avec un D; ceux qui se trouvent entre ces deux extrêmes étudient seuls dans leur coin. Vous essayez de les aider et de les encourager. Arrive le jour de l'examen. Les tables bien alignées dans le gymnase, ou une demi-douzaine de bureaux dans votre classe habituelle. Trois heures à écrire désespérément pour eux, trois heures à épier leurs moindres gestes pour vous, car le bruit court que des étudiants utilisent leur téléphone cellulaire pour utiliser un « moteur » d'algèbre symbolique en ligne. Vous ne voyez rien, mais comment en être tout à fait certain? Ensuite vous essayez de corriger les examens en essayant d'être le plus objectif et neutre possible. Les

« ... car le bruit court que des étudiants utilisent leur téléphone cellulaire pour utiliser un « moteur » d'algèbre symbolique en ligne. »

corridors sont étrangement silencieux. Une bonne réponse n'a pas de visage, pas de personnalité. Une erreur est une erreur, peu importe qui l'a commise. Vous vérifiez vos totaux, vous entrez les données, vérifiez une dernière fois et hop!, vous tapez Entrée. Ça y est. Une autre session de terminée.

Mark Lewis, Vice-président, provinces et les territoires de l'Ouest



Dernièrement, le thème de l'enseignement des mathématiques par expérience a fait couler beaucoup d'encre au Canada. Ici, on incite les élèves de la maternelle à la 12^e année à inventer leurs propres techniques pour résoudre des problèmes. On les invite plutôt à mettre de côté les techniques mathématiques conventionnelles au profit de l'utilisation d'objets (comme des cubes) pour résoudre les problèmes. Pour certains, ces méthodes se font au détriment d'un apprentissage structuré plus traditionnel, qui comprend la mémorisation. Je lis tout ce qui passe sur l'apprentissage par découverte dans les journaux, j'écoute les discussions à ce sujet entre collègues et j'en fais même l'expérience en tant que parent d'un enfant d'âge scolaire en Alberta. On s'inquiète des lacunes mathématiques des diplômés du secondaire, et les parents s'élèvent contre le recours aux méthodes traditionnelles et l'apparente perte de compétences chez nos élèves.

En réaction à une pétition signée par 12 000 parents, le ministre de l'Éducation de l'Alberta, Jeff Johnson, a annoncé récemment que les élèves albertaines reviendraient à la mémorisation des tables de multiplication à compter de septembre 2014. Vous vous demandez peut-être pourquoi ce n'était plus obligatoire. Selon Anna Stokke (Université de Winnipeg), il est facile pour les opposants à la mémorisation d'établir de fausses dichotomies entre les compétences de base et la compréhension [1]. En affirmant que les élèves ont besoin de « comprendre les bases et non de mémoriser », ces personnes n'admettent pas que la compréhension et la mémorisation peuvent aller de pair.

Les mathématiques ne sont pas qu'une question de mémorisation ou d'idées. Les deux éléments sont importants et, bien sûr, la question est bien plus complexe que cela. Quand j'explique des notions mathématiques à mes étudiants de premier cycle, je compare les mathématiques aux sports. Pour réussir dans ces deux domaines, il faut être en bonne forme, avoir maîtrisé certaines compétences et comprendre les règles du jeu. Les deux premiers éléments s'acquièrent au moyen d'exercices répétés, dont la mémorisation est un élément clé, qui favorisent la compétence et l'acuité. Le troisième élément vient du type d'apprentissage qui se fait en classe. Si l'on considère ces trois éléments clés, pourquoi les mathématiques seraient-elles différentes des sports après tout?

Au lieu d'être en quête de médailles sportives, les scientifiques mesurent leurs réussites par d'autres moyens. Il semble que le recours de plus en plus fréquent à des instruments de mesure comme le nombre d'articles publiés ou le facteur d'impact pour évaluer la qualité scientifique pourrait entraîner, paradoxalement, un déclin de la qualité des travaux scientifiques. Cela tient au fait que les scientifiques sont incités à produire des éléments mesurables plutôt que de bonnes idées scientifiques. Par exemple, un projet de recherche risqué, mais ayant un potentiel considérable pourrait être mis de côté en faveur d'un projet « scientifiquement sûr », dont les

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Letters to the Editors

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

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

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hucksters cheapen science by publishing junk--for a price." To prove a point, the author invented a short paper comprised of randomly copied phrases from unrelated papers in soil science and haemotology, with footnotes from a paper on wine chemistry. When the paper was submitted to 18 journals, acceptances started rolling in within 24 hours, offering online publication for a fee. The market is driven, at least in part, by authors desperate to gain academic credentials for successful career advancement. Thus the answer lies partly in the way we evaluate colleagues, where weight is given to paper counts, rather than paper content. Of course this should really only be a problem for evaluating committees who prefer to count rather than to read.

One could argue that, with the publishing landscape changing so quickly, a historical perspective may be useful. Recently I had the opportunity to leaf through a first edition of Newton's *Philosophiae Naturalis Principia Mathematica*. It is at the Library of the University of Louisville, Kentucky, and I was giving a guest lecture there. The book was the gift of the late William Marshall Bullitt, a university benefactor who made a local fortune in actuarial law. This edition even had Newton's handwritten corrections, made in 1687 as the copy came off the press. Although stymied by my rudimentary nonexistent Latin, I was disappointed not to find any grand sweeping statements regarding principles of mathematics or physics. Rather, the book was full of detailed geometrical calculations involving the motion of bodies when perturbed by multiple attractive forces. This was a reminder to me that even the great mathematical and physical concepts that we associate with Newton, such as calculus and gravitation, had lowly roots in calculations for specific applied problems.

This was a reminder of connections between pure and applied mathematics in our world, our country and our departments, and how dependent we really are on the flow of ideas, not only from

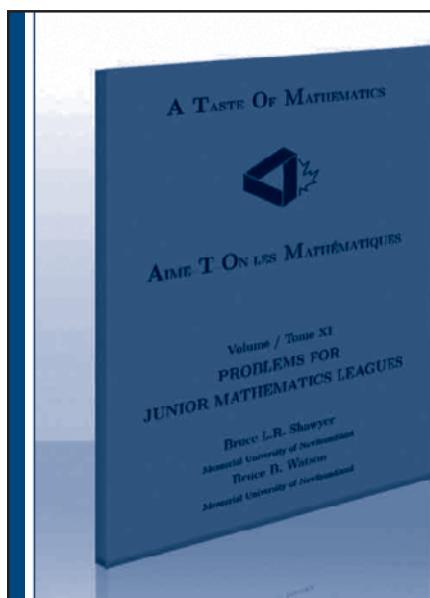
applied to pure, but also from pure to applied. Sometimes we forget this need, believing our particular area to be more or less self-sufficient. Inevitably, our discipline can become balkanized if we lose track of the rich cross-pollination of ideas.

I am not thinking of applied mathematics simply as *the application of mathematics* to interesting problems. Rather, applied mathematics can be a wellspring of ideas, inspired by physical or scientific problems, whose abstractions can give rise to new mathematical concepts and methods. String theory, once the domain of particle physicists, has stimulated developments in algebraic and differential geometry, topology and representation theory. Problems from my own area of mathematical biology inspired the noted algebraic geometer, Bernd Sturmfels, to ask "Can Biology Lead to New Theorems?" This question is actually the title to a paper where Sturmfels' answer is given as a strong affirmative, replete with examples. In the words of my former colleague and mathematical physiologist, Jim Keener (Utah), "heart attacks can give you mathematics."

We can do better at building connections between pure and applied mathematics, and the Canadian Mathematical Society has the opportunity to do so. Joint ventures with the Canadian Applied and Industrial Mathematics Society would be one way to start. As far as I can tell, our last joint meeting was in 2004. Perhaps it is time to think about this again.

[1] Stokke, Anna "Let 3 sticks represent 30 and other Neanderthal math methods" *The Globe and Mail* April 1, 2014.

[2] Spears, Tom "Journals' clamour for nonsense" *Edmonton Journal* April 26, 2014.



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JUNE 2014

- 1-6** The Future of Trace Formulas <http://www.birs.ca/events/2014/5-day-workshops/14w5001>
- 2-27** 2014 Summer School in Probability (*University of British Columbia*) <http://www.pims.math.ca/scientific-event/140602-ssp>
- 6-9** CMS Summer Meeting (*Winnipeg*) cms.math.ca/events/summer14
- 8-13** Integrability in Holography (HALF) <http://www.birs.ca/events/2014/5-day-workshops/14w5070>
- 8-13** Programming with Chemical Reaction Networks: Mathematical Foundations (HALF) <http://www.birs.ca/events/2014/5-day-workshops/14w5167>
- 9-14** String Math Conference - 2014 (*University of Alberta*) <http://www.pims.math.ca/scientific-event/140609-smc>
- 15-20** Quantum curves and Quantum Knot invariants (*Banff, AB*) <http://www.birs.ca/events/2014/5-day-workshops/14w5073>
- 15-22** Dirichlet spaces and de Branges-Rovnyak spaces <http://www.birs.ca/events/2014/research-in-teams/14rit183>
- 16-20** 12th Workshop on interactions between Dynamical Systems and PDEs, (*Barcelona, Spain*) <http://www.mal.upc.edu/recerca/jisd/jisd2014>
- 20-21** Conference on Graph Theory, Matrix Theory and Interactions (*Queen's University*)
- 22-27** Emerging Statistical Challenges and Methods For Analysis of Massive Genomic Data in Complex Human Disease Studies <http://www.birs.ca/events/2014/5-day-workshops/14w5011>
- 22-28** 4th International School-Seminar on Nonlinear Analysis and Extremal Problems (*Irkutsk, Russia*) <http://www.idstu.irk.ru/en/nla-2014>
- 22-Jul 5** 2014 Summer IMO Training Camp <http://www.birs.ca/events/2014/summer-schools/14ss172>
- 29-Jul 4** Entropy Methods, PDEs, Functional Inequalities, and Applications <http://www.birs.ca/events/2014/5-day-workshops/14w5109>

JULY 2014

- 3-4** International Workshop on Boundary Value Problems: new Trends and Applications-2014 (*WBVP2014*) (*Evora, Portugal*)
- 6-10** CBMS conference on Higher Representation Theory (*Kac-Moody Algebras*) (*Raleigh, NC*) <http://www.math.ncsu.edu/~jing/conf/CBMS/cbms14.html>
- 6-11** New Directions in Financial Mathematics and Mathematical Economics <http://www.birs.ca/events/2014/5-day-workshops/14w5168>
- 13-18** Stochastic Network Models of Neocortex (a Festschrift for Jack Cowan) <http://www.birs.ca/events/2014/5-day-workshops/14w5138>
- 16-20** History and Pedagogy of Mathematics The HPM Satellite Meeting of ICME-12 (*Daejeon, Korea*)
- 20-25** Spin Glasses and Related Topics <http://www.birs.ca/events/2014/5-day-workshops/14w5082>
- 20-27** Spectrum Asymptotics of Operator Pencils <http://www.birs.ca/events/2014/research-in-teams/14rit182>

- 21-25** PIMS Summer School on The Economics and Mathematics of Systemic Risk and the Financial Networks (*University of British Columbia*) <http://www.pims.math.ca/scientific-event/140721-psstemsrafn>

- 27-Aug 1** Statistics and Non-linear Dynamics in Biology & Medicine (*Banff, AB*) <http://www.birs.ca/events/2014/5-day-workshops/14w5079>

AUGUST 2014

- 3-8** Approximation algorithms & hardness of algorithms (*Banff, AB*) <http://www.birs.ca/events/2014/5-day-workshops/14w5051>
- 6-10** International conference on K-theory & related Topics (*Beijing, China*) <http://www.ktheorybeijing.org/>
- 8-10** The Fourth International Workshop on the Perspectives on High-dimensional Data Analysis <http://www.birs.ca/events/2014/2-day-workshops/14w2178>
- 10-15** Recent progress in Dynamical Systems and related topics (*Banff, AB*) <http://www.birs.ca/events/2014/5-day-workshops/14w5058>
- 10-23** Two weeks at WATERLOO - A Summer School for Women in Math Organizers: B. Csima, S. A. Campbell, K. Hare, M. Frigon, I. Laba, M. Lalín, L. Pramanik, G. Wolkowicz (*University of Waterloo*) Contact Information: Barbara Csima
- 11-13** Canadian Conference on Computational Geometry Organizers: Norbert Zeh, Meng He (*Dalhousie University*) Contact Information: Norbert Zeh
- 17-22** "Recent Developments in Adaptive Methods for PDEs", AARMS-CRM Collaborative Workshop and Short Course, Memorial University of Newfoundland (*St. John's, NL*)
- 17-22** Mathematical Modelling of Particles in Fluid Flow <http://www.birs.ca/events/2014/5-day-workshops/14w5122>
- 17-22** Recent developments in the adaptive solution of PDEs Organizers: Ronald Haynes, Paul Muir, Hermann Brunner (*Memorial University, St. John's*) Contact Information: Ronald Haynes
- 24-29** Communication complexity and applications (*Banff, AB*) <http://www.birs.ca/events/2014/5-day-workshops/14w5164>

- 31-Sep 5** Front Propagation and Particle Systems <http://www.birs.ca/events/2014/5-day-workshops/14w5055>

SEPTEMBER 2014

- 7-12** Mathematics of the Cell: Integrating Genes, Biochemistry and Mechanics <http://www.birs.ca/events/2014/5-day-workshops/14w5075>
- 14-19** Probability on Trees and Planar Graphs <http://www.birs.ca/events/2014/5-day-workshops/14w5159>
- 21-26** Multiscale Models of Crystal Defects (HALF) <http://www.birs.ca/events/2014/5-day-workshops/14w5069>
- 21-26** Rigorously Verified Computing for Infinite Dimensional Nonlinear Dynamics (HALF) <http://www.birs.ca/events/2014/5-day-workshops/14w5098>
- 28-Oct 3** Vojta's Conjectures <http://www.birs.ca/events/2014/5-day-workshops/14w5129>

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résultats sont pratiquement certains et plus nombreux, et « comblent d'importantes lacunes dans la littérature mathématique ».

Les écologistes évolutionnistes savent très bien que des populations soumises à certaines contraintes dynamiques, où chaque individu évolue de façon à maximiser son potentiel individuel, peuvent finir par décliner jusqu'au « suicide évolutionniste », qui mène à l'extinction totale de la population. Nous devrions essayer de faire en sorte que les instruments de mesure que nous appliquons à l'évaluation scientifique ne posent pas de contraintes dynamiques risquant de mener à une forme de suicide évolutionniste. Nous devrions pouvoir faire mieux que cela.

Toutefois, on constate déjà des changements à l'écologie de la communication scientifique. Un article récent de Tom Spears (Postmedia News) [2] déplore le phénomène des « revues prédatrices » qui dévalorisent la science en publant n'importe quoi en faisant payer les auteurs. Pour prouver ses dires, M. Spears a créé de toutes pièces un court article constitué de phrases copiées aléatoirement d'articles sans liens les uns avec les autres en science des sols et en hématologie, avec des notes en bas de page d'un article sur la chimie du vin... Il a soumis son article bidon à 18 revues, et les offres ont afflué dans les 24 heures, certaines revues lui proposant de publier l'article en ligne s'il payait. Le marché est alimenté, du moins en partie, par des auteurs désespérés de cumuler les réalisations scientifiques pour leur avancement professionnel. La solution à ce problème est donc en partie liée à la façon dont nous évaluons nos collègues, à l'importance accordée au nombre d'articles publiés plutôt qu'à la qualité du contenu. Évidemment, ce problème ne devrait concerner que les comités d'évaluation qui préfèrent compter plutôt que lire.

On pourrait dire qu'en raison de la rapidité à laquelle se transforme le monde de l'édition, il serait utile d'apporter une perspective historique. Dernièrement, j'ai eu la chance de feuilleter une première édition des *Philosophiae Naturalis Principia Mathematica* de Newton à la bibliothèque de l'Université de Louisville, au Kentucky, où j'étais invité à prononcer une conférence. Le livre est un don de feu William Marshall Bullitt, donateur de l'université qui a fait fortune en actuariat dans cette région. Cette édition portait même des corrections manuscrites de Newton datant de 1687, année de parution de l'ouvrage. Malgré ma connaissance rudimentaire, voire inexistante du latin, j'ai été déçu de ne pas trouver dans cet ouvrage de grand énoncé à l'emporte-pièce sur des principes physiques ou mathématiques. Cet ouvrage contient plutôt toutes sortes de calculs géométriques détaillés concernant le mouvement des corps perturbés par de multiples forces d'attraction. Pour moi, ce fut un rappel que même les grands concepts mathématiques et physiques que nous associons à Newton, comme le calcul et la gravitation, tirent leurs origines de modestes calculs portant sur des problèmes appliqués spécifiques.

Ce fut également un rappel des liens entre les mathématiques pures et appliquées dans le monde actuel, dans notre pays et dans nos départements, et de notre dépendance envers la circulation des idées, non seulement des mathématiques appliquées aux mathématiques pures, mais aussi du contraire. Il nous arrive d'oublier ces liens nécessaires et de croire que notre domaine de

spécialisation est plus ou moins autonome. Inévitablement, notre discipline risque la balkanisation si nous perdons de vue la richesse du croisement des idées.

Pour moi, les mathématiques appliquées ne se résument pas simplement à l'application des mathématiques à des problèmes intéressants. Les mathématiques appliquées peuvent être tout un réservoir d'idées, inspirées de problèmes physiques ou scientifiques, dont les abstractions peuvent donner lieu à de nouveaux concepts et méthodes mathématiques. La théorie des cordes, d'abord du domaine de la physique des particules, a engendré des développements en géométrie algébrique et différentielle, en topologie et en théorie des représentations. Des problèmes de mon propre domaine, la biologie mathématique, ont amené le géomètre algébriste Bernd Sturmfels à se demander si la biologie pouvait donner naissance à de nouveaux théorèmes. Cette question (« Can Biology Lead to New Theorems ») est en fait le titre d'un article dans lequel Sturmfels répond par un oui convaincu assorti de nombreux exemples. Pour reprendre les paroles d'un ancien collègue physiologiste-mathématicien, Jim Keener (Utah), « une crise cardiaque peut donner naissance à des mathématiques ».

Nous pouvons certainement nous efforcer d'améliorer les liens entre les mathématiques pures et les mathématiques appliquées, et la Société mathématique du Canada a la possibilité de le faire. Organiser des activités en collaboration avec la Société canadienne de mathématiques appliquées et industrielles serait un bon départ. À ma connaissance, notre dernier congrès conjoint a eu lieu en 2004. Il est peut-être temps de reprendre la formule.

[1] Stokke, Anna. « Let 3 sticks represent 30 and other Neanderthal math methods », The Globe and Mail, 1^{er} avril 2014.

[2] Spears, Tom « 'Journals' clamour for nonsense », Edmonton Journal, 26 avril 2014.

2014 CMS MEMBERSHIP RENEWALS

RENOUVELLEMENTS 2014 À LA SMC



REMINDER : Your membership notices have been e-mailed. Please renew your membership as soon as possible. You may also renew on-line by visiting our website at www.cms.math.ca/forms/member

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OCTOBER 2014

- 3-5** Connecting Women in Mathematics Across Canada
<http://www.birs.ca/events/2014/2-day-workshops/14w2196>
- 18-19** AMS Regional Meeting (*Halifax, NS*) www.ams.org/amsmtgs/sectional.html
- 19-24** Dynamics and C*-Algebras: Amenability and Soficity
<http://www.birs.ca/events/2014/5-day-workshops/14w5161>
- 26-31** Biological and Bio-Inspired Information Theory
<http://www.birs.ca/events/2014/5-day-workshops/14w5170>

NOVEMBER 2014

- 1-5** 38th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing (*Wellington, New Zealand*)
msor.victoria.ac.nz/Events/38ACCMCC
- 2-7** Geometric Scattering Theory and Applications
<http://www.birs.ca/events/2014/5-day-workshops/14w5105>
- 9-14** Particle-Based Stochastic Reaction-Diffusion Models in Biology
<http://www.birs.ca/events/2014/5-day-workshops/14w5103>
- 16-21** Algorithms for Linear Groups
<http://www.birs.ca/events/2014/5-day-workshops/14w5031>
- 17-21** Categorical Structures in Harmonic Analysis Workshop (*Berkeley, CA*) <http://www.msri.org/web/msri/scientific/workshops/all-workshops/show/-/event/Wm9805>
- 23-28** Algebraic and Model Theoretical Methods in Constraint Satisfaction
<http://www.birs.ca/events/2014/5-day-workshops/14w5136>
- 30-Dec 5** Families of Automorphic Forms and the Trace Formula (HALF)
<http://www.birs.ca/events/2014/5-day-workshops/14w5120>

DECEMBER 2014

- 5-8** CMS Winter Meeting, (*Hamilton, ON*)
<http://www.cms.math.ca/events/summer14>

CMO Report

Seventy-six students, invited mainly on the basis of performance in the Sun Life Financial Canadian Open Mathematics Challenge, or the Sun Life Financial Repêchage, wrote the 2014 Canadian Mathematical Olympiad. A small number of additional invitations were made to winners of the Concours de l'Association mathématique du Québec and the Alberta High School Mathematics Competition.

The successful running of the contest is due mainly to the work of the CMS Staff, including Sarah Watson and Jessica St. James. Thanks are also due to Matthew Brennan, and to the members of the CMO Committee, particularly David Arthur and (as always) Adrian Tang.

The first prize winner, with a perfect score of 35, was Alex Song, who attends the Exeter Academy, Exeter, NH.

Mr. Song has represented Canada three times in the International Mathematics Olympiad, getting a gold medal each time.

Question 1 was a relatively accessible telescoping series/inequality problem. It was fully solved, with the occasional small blemish, by 42 of the 76 students. Question 2 was a combinatorial configuration problem, essentially solved by 41 of the students. After that, the dropoff was steep. There were 8 full solutions of the number-theoretic/combinatorial Question 3, and 7 of the geometric Question 4. The difficult combinatorial Question 5 had only 1 full solution.

Andrew Adler

Chair, CMO Committee

Department of Mathematics, UBC

CMS Member Profile

Dr. Tom Salisbury, Professor

Home: York University, Department of Mathematics and Statistics

Research: Probability theory and Brownian motion, including applications to finance.

CMS Membership: Joined CMS in 1984 after completing a PhD at UBC.

Select Achievements: Fields Deputy Director; IMS fellow.

Hobbies: Music, books, hiking, canoeing.

Latest Books Read: "Where late the sweet birds sang" by Kate Wilhelm; "The Yiddish policemen's union" by Michael Chabon.

Latest Publication: "Conditioning super-Brownian motion on its boundary statistics, and fragmentation" (with Deniz Sezer)

Recent news: Selling our startup, the Quantitative Wealth Management Analytics group.

What I would Change: Have more Canadian mathematicians join the CMS than the AMS!

CMS Roles: President; Vice-President; CMB co-editor-in-chief; and chair of numerous committees over the years.



Why I belong to the CMS: Supporting the CMS gives Canadian mathematics a voice. Because of the CMS, there is a sense of community to mathematics in Canada, and a place for that community to work together to nurture our discipline. I want to be a part of that.

Interpolation and Sidon Sets for Compact Groups

by Colin C. Graham and Kathryn E. Hare

CMS Books in Mathematics Series

Springer Verlag, 2013

ISBN 978-1-4614-5391-8

Reviewed by **Hervé Queffélec**, Université de Lille 1, France



A Sidon set is a subset E of the integers such that every continuous function having its Fourier spectrum inside E has an absolutely convergent Fourier series. The seminal result is that of Sidon (1927) showing that the set of powers of 4 is a Sidon set. Later on, several equivalent definitions and other examples were given (Rudin 1960), and Drury proved that the union of two Sidon sets is again a Sidon set

(1970). The book of Lopez and Ross (1975) gave a fairly complete account of the progress made at that time. Later on, in the eighties and till 2010 about, mainly under the influence of Pisier and Bourgain, spectacular progress was made in the comprehension of Sidon sets and of their importance. The book of C.Graham and K.Hare appears as the modern continuation of the Lopez-Ross work. This new and well-written book has about 240 pages and consists of ten chapters and three appendices. Each chapter ends with a Section "Credits" where the main contributors are quoted with some detail, and then by quite a few exercises. I now describe the content of each chapter:

Chapter One:

This chapter presents the Hadamard sets E of positive integers, gives some nice and not so-well known properties of power series with spectrum in such sets (like the Fuchs theorem 1.3), and describes two important technical tools needed later: the Riesz products and the Iteration Procedure. The latter amounts in some sense to the open mapping theorem for Banach spaces (if $T : X \rightarrow Y$ verifies that, for each $y \in B_Y$, there is some $x \in CB_E$ such that $\|y - T(x)\| \leq \alpha$ where $C < \infty$ and $\alpha < 1$ are fixed, then T is onto with constant $C/(1 - \alpha)$), this could be mentioned. The authors then describe an important interpolation of those sets, the I_0 -property (Theorem 1.3.9) saying roughly that every bounded sequence indexed by E can be interpolated on E by the Fourier-Stieltjes transform of a discrete measure. I regretted that a precise definition of those I_0 -sets was not given at this early stage of the book. Finally, a topological (in the sense of the Bohr topology) property of Hadamard sets is given, under the form of a theorem of Kunen and Rudin.

Chapter Two:

The main notion here is that of ε -Kronecker set E , given in the general context of a pair of abelian groups G and Γ in duality, where

$E \subset \Gamma$. It is required that every unimodular function φ on E can be approximated by a character $x \in G$ with an error $< \varepsilon$. A main result is that being ε -Kronecker for some $\varepsilon < \sqrt{2}$ implies being I_0 (and hence Sidon) and that the bound $\sqrt{2}$ is sharp. Every infinite set E with not too many elements of order two is shown to contain a weak 1-Kronecker subset (Theorem 2.4.3). Then, arithmetical necessary conditions (mesh type conditions) for being ε -Kronecker are given (Theorem 2.6.2, in which N_τ should be read $N\tau$), as well as topological properties (no cluster points for E in the Bohr topology).

Chapter Three:

A precise definition of E being I_0 is given, namely $\ell^\infty(E) = B_d(E)$. Approximate interpolation of signs is shown to imply I_0 , a characterization by Kahane in terms of extension of almost periodic functions is given, and the Ramsey-Bourgain-Wells theorem quoted. A topological characterization (Hartman-Ryll-Nardzewski theorem 3.4.1) of I_0 -sets is given and proved, as well as a refinement due to Kahane.

Chapter Four:

This is a specialized chapter on some restrictive classes of I_0 -sets, and pseudo-Rademacher sets.

Chapter Five:

This is devoted to the notion of E being a $I_0(U)$ -set. It is required that the discrete interpolating measures have their support in some fixed open subset U of G , a notion which was already underlying in chapter 1 with Hadamard sets. It is shown that if E is $I_0(U)$ and F is $I_0(V)$, then $E \cup F$ is $I_0(W)$ for some W hardly bigger than $U \cup V$ and that if E is $I_0(U)$ with bounded constants (a more restrictive notion), so is the Minkowski sum $E + F$ if F is finite. An important decomposition property due to Méla (Theorem 5.3.1) is proved.

Chapter Six:

This chapter is devoted to Sidon sets $E \subset \Gamma$ (Sidon(U) or topological Sidon sets, and Déchamps-Gondim theorem, are mentioned) and some of their main properties, in particular the Fatou-Zygmund property (if $0 \notin E$, every hermitian bounded sequence on E can be interpolated by the Fourier transform of a positive measure) and the union theorem of Drury (too bad that those two theorems are not proved again). The basic examples of quasi-independent and Rider sets are given, as well as a decomposition theorem of Pisier (every Rider set is a finite union of quasi-independent sets), proved by a "selector" method, and the more classical result of Khintchine inequalities for Sidon sets (Zygmund-Rudin). Mesh necessary conditions are also given, as well as a striking theorem of Bourgain (fully proved) asserting that every Sidon set not containing 0 is for each integer k a finite union of k -independent sets (a weaker notion of independence).

Chapter Seven:

This chapter is essentially devoted to the proof of a complete arithmetic (among others) characterization by Pisier of Sidon sets E

(Theorem 7.2.1, the formulation 4. of which is I think rather due to Bourgain), namely the fact that every finite $F \subset E$ contains G quasi-independent with size proportional to that of F . The spectacular seminal result of Pisier (solution to Rudin's problem) according to which Khintchine inequalities with $O(\sqrt{p})$ -constants imply Sidonicity is proved as well. Finally, a beautiful theorem of Déchamps-Gondim and Bourgain (for a Sidon set, being Sidon(U) with bounded constants amounts to have step length tending to infinity) is stated and proved.

Chapter Eight:

This chapter revolves around a still open problem: are there Sidon sets which are Bohr-dense in the group \mathbf{Z} ?

A first observation is the Ramsey cluster theorem (if some Sidon set is not Bohr-closed, and another Sidon set will be Bohr-dense), fully proved. Then, the main result is a random-type one due to Kahane and Katznelson (2008): if you select at random (in a poissonian way) the integer $n \geq 1$ with probability p_n , independently, getting a random set $E(\omega) \subset \mathbf{Z}$, then:

1. if $\limsup np_n < \infty$, $E(\omega)$ is almost surely Sidon and Bohr-closed, and
2. If $\limsup np_n = \infty$, $E(\omega)$ is almost surely Bohr-dense, ... but not Sidon.

Here, the paper of D.Li, H.Queffélec, L.Rodriguez-Piazza, "Some new thin sets of integers in Harmonic Analysis, *Journ.Anal. Math.* 86 (2002), 105-138", which also uses random techniques and gives examples of Bohr-dense sets of integers which are p -Sidon for each $p > 1$ should be quoted, as well as several contributions of Lefevre and Rodriguez-Piazza (*Journ.Funct.Anal.* 2005) on the Bohr topology and Rosenthal sets.

Chapter Nine:

This chapter is devoted to the comparison between Sidon and I_0 sets, the latter notion being more restrictive as we know. The highlight here is the Ramsey-Wells-Bourgain theorem which characterizes I_0 -sets by the interpolation property $B(E) = B_d(E)$, namely: every Fourier-Stieltjes sequence on E is indeed a "discrete" Fourier-Stieltjes sequence on E . The proof is long and involved, and requires several preliminaries on sup-norm partitions, interesting in themselves, but is given in full detail.

Chapter Ten:

This chapter contains variations on two outstanding open problems (the second of which was already mentioned):

1. Is every Sidon set a finite union of I_0 -sets? and
2. Are there Bohr-dense Sidon sets?

Those questions are not unrelated since every finite union of I_0 -sets is Bohr closed, so that a positive answer to the first problem would imply a negative one to the second! They are approached here

through the notion of zero discrete harmonic density for E (zdh in short), namely: for every discrete measure μ and every open set U , there is a discrete measure σ supported by U with the same Fourier transform as μ on E . It is shown that the union of two I_0 -sets has zdh and that there are non-Sidon sets with zdh. Finally, an extension of Hadamard gap theorem is given: a Taylor series with spectrum in a zhd set cannot be analytically extended across any point of the circle of convergence.

Finally, three short and useful appendices (respectively on interpolation, combinatorics, harmonic analysis on groups) are given.

Conclusion

This book contains quite important work on the state of art in 2013 concerning Sidon and interpolation sets. Many *difficult proofs*, in particular, of Pisier and Bourgain, are *fully given* in this clearly written work on a topic that the authors obviously master quite well, as experts in harmonic analysis. And this book will undoubtedly be quite useful to researchers in this subject, even though it has already been deeply explored (but some important questions remain open).

As I already said, I suggest that a second edition contains a proof of the Fatou-Zygmund property of Sidon sets as well as the Drury union theorem, and that the references are completed. Except for this small restriction, I think that this book is excellent and should be present in every Math library of every University!

David Borwein Celebrates Benchmark Birthday

SFU held an April workshop to honour David Borwein who had just celebrated his 90th birthday. Having authored more than 130 publications in a span of 53 years, **David Borwein** is one of the most significant contributors to the development of Canadian mathematics in the second part of the 20th century. A direct descendant of G.H. Hardy, David is known for his research in the summability theory of series and integrals, measure theory and probability theory, and in number theory. He has also published on generalized subgradients and coderivatives, and on the remarkable properties of single- and many-variable sinc integrals. Even at the age of 90, David Borwein remains actively involved in research. David also served as president of the Canadian Mathematical Society (CMS) from 1985 - 1987. To the wider Canadian mathematical community David Borwein is known as the eponym of the CMS Distinguished Career Award. Congratulations and best wishes David!



Jennifer Hyndman, University of Northern British Columbia
John McLoughlin, University of New Brunswick

This issue of Education Notes features an array of mathematical activities from across the country. The editors thank the various contributors: Melania Alvarez, Tom Archibald, Jean-Marie De Koninck, David Langstroth, Kathleen Nolan, and Harley Weston. These activities range from national to regional, while drawing upon the support of various organizations including AARMS, Mitacs, and PIMS. As summer approaches, be reminded that Education Notes depends upon such contributions. Send along articles and/or ideas to Jennifer (hyndman@unbc.ca) or John (johngm@unb.ca).

The opening piece prepared by Jean-Marie De Koninck describes an example of mathematical outreach stemming from l'Université Laval in conjunction with Mitacs. The author has agreed to elaborate on the range of outreach activities in a full length Education Notes later in the year. That article will be prepared in both English and French. The piece here is presented in French, with an abstract in English.

Le plaisir de partager sa passion pour les mathématiques

Jean-Marie De Koninck

(Jean-Marie.DeKoninck@mat.ulaval.ca)

In this note, I describe various math outreach activities pioneered by SMAC (Science and Mathematics in Action), a program initiated by Université Laval and Mitacs. We built a number of activities primarily intended to excite kids about math and science. One of these is *Show Math*, a multimedia show involving professional comedians where math and humour are at the forefront. While *Show Math* is offered in high schools, *Petit Show Math* was built for primary school students. Our latest creation is '*The case for Pluto*', a play in which the former planet Pluto makes a plea to the Sun to be reinstated. For more information, visit www.smac.ulaval.ca.

Avez-vous déjà pensé que certains adolescents curieux et déjà en réflexion sur leur avenir pourraient être intéressés à vous entendre? À vous entendre leur parler de votre passion pour les mathématiques? C'est effectivement à cet appel que j'ai personnellement répondu il y a une dizaine d'années, soit après avoir animé pendant deux ans la série télévisée *C'est mathématique!*. En effet, fort du feed-back reçu des téléspectateurs dont plusieurs étaient des étudiants et des enseignants des niveaux secondaire et collégial, j'ai constaté que peu de gens

savaient que les maths sont partout et qu'elles sont même essentielles au fonctionnement de notre société moderne. Pensons simplement aux outils technologiques ipod, ipad, iPhone, etc. qui ont littéralement changé nos façons de communiquer et d'interagir.



C'est donc dans ce contexte qu'en 2005, fort de l'appui de l'Université Laval et de Mitacs, j'ai créé le programme SMAC (Sciences et mathématiques en action) dont les principaux acteurs sont des étudiants universitaires et des enseignants de tous les niveaux. Notre mission est d'éveiller et renforcer chez les jeunes un intérêt pour les mathématiques et les sciences, et de démythifier les

mathématiques auprès de la population en général. La voie que nous avons choisie est celle d'offrir des activités ludiques et amusantes, tels des jeux et des spectacles. C'est dans cette philosophie qu'est né le spectacle multimédia *Show Math*, offert dans les écoles secondaires et faisant intervenir des comédiens sur scène. L'objectif de cette activité est de faire rire les jeunes dans un environnement mathématique, en leur expliquant par exemple que les meilleures méthodes utilisées en cryptographie sont basées sur les propriétés des nombres premiers. Pour aller rejoindre les élèves de 4^e, 5^e et 6^e années du niveau primaire, nous avons ensuite créé *Petit Show Math*, un spectacle mathématique plus accessible et qui porte sur l'histoire des nombres, le phénomène du son et l'astronomie.

Tout récemment, nous avons créé un nouveau spectacle totalement différent: *Pluton va en appel!* Voici de quoi il s'agit. Dans les livres d'astronomie publiés avant 2006, on pouvait lire que notre système solaire comprenait 9 planètes : Mercure, Venus, la Terre et Mars (dites rocheuses), Jupiter, Saturne, Uranus et Neptune (dites gazeuses) et Pluton (faite de roche et de glace). Or, en 2006, l'Union astronomique internationale a décidé, suite à un vote serré, de retirer à Pluton son titre de planète. Triste, Pluton va donc en appel de cette décision auprès du Soleil. Elle peut compter sur l'appui des 4 planètes rocheuses mais doit contrer les arguments incisifs des 4 planètes gazeuses qui craignent de voir les planètes rocheuses devenir majoritaires. Un nouveau prétexte pour parler sur un ton humoristique de géométrie, des points de Lagrange, etc.

Notre équipe a créé une foule d'autres activités : un jeu en ligne (*Math en jeu*), une conférence destinée aux parents du primaire intitulée *Les enfants comptent... et leurs parents aussi!*, des livres destinés aux jeunes du secondaire (*En chair et en maths*, *En chair et en maths 2*) et au grand public (*Cette science qui ne cesse de*





nous étonner) et des ateliers de mathématiques pour les jeunes du primaire. Nous tentons sans cesse d'innover, de sortir des sentiers battus et dans tous les cas d'offrir des activités complémentaires à celles déjà offertes par les écoles primaires et secondaires.

Certains pourraient se demander si le fait de s'engager dans de telles

activités auprès des jeunes sera en bout de ligne beaucoup trop exigeant en termes de temps et d'énergie. Certes, il faut s'investir un peu. Cependant, l'enthousiasme manifesté par les enseignants qui nous accueillent dans leurs institutions est si tangible que l'on constate rapidement que l'investissement en vaut la peine. Par ailleurs, l'étincelle que l'on peut voir dans les yeux des enfants qui comprennent enfin que les mathématiques sont utiles et qu'on peut même avoir beaucoup de plaisir à faire des maths est déjà en soi une source de motivation sans pareille pour celui ou celle qui la provoque!

Canadian Society for History and Philosophy of Mathematics

Tom Archibald, *Simon Fraser University*
(tarchi@sfu.ca)

Both the history and the philosophy of mathematics have a devoted following in Canada. Courses in both are taught at many universities and colleges, and graduate degrees in one or the other are available at several institutions. It's probably fair to say that the history of mathematics courses tend to be based in mathematics departments (an exception is Toronto, where the historian of mathematics is affiliated with the Institute for the History and Philosophy of Science and Technology), and attract students many of whom are interested in teaching mathematics at the elementary or secondary levels. The Canadian Society for History and Philosophy of Mathematics (CSHPM) brings together an international group of scholars with varying levels of interest in one or both of these fields. Membership gets you a Bulletin, an annual get-together for the presentation of papers – the spring meeting is at Brock May 25-27 – and the possibility of reduced personal subscription rates to *Historia Mathematica* or *Philosophia Mathematica*. There is also a Proceedings volume containing papers given at the annual meetings, a certain number of which have a specifically educational focus. We also schedule invited paper sessions regularly with the CMS Winter meeting (the next being in Hamilton, December 5-8). The Society would be particularly interested in welcoming as members people who teach such courses regularly or occasionally and wish to make better contact with scholarship in the field. If you are interested, have a look at <http://www.cshpm.org>, or feel free to contact me, Tom Archibald.

AARMS Summer School

David Langstroth, *Dalhousie University*
(dll@cs.dal.ca)

During a four-week period every summer AARMS (Atlantic Association for Research in the Mathematical Sciences) invites highly regarded faculty from around the world to deliver graduate courses in the mathematical sciences and their applications. Our goals are to broaden the education of graduate students and to encourage promising undergraduates to continue their studies. While, in a given year, a good number of students come from Canada and more specifically Atlantic Canada, our School continues to bring international students to this region. Indeed, the multicultural, international flavour of our School and the possibility of forming lifelong friendships and collaborations amongst people of different backgrounds and cultures is one of our School's strengths.

Given that our students have diverse backgrounds, courses are taught at the entry level of a typical Canadian graduate programme. Our courses cover a broad spectrum of mathematics. Each student must register for two courses, but in order to increase the value of the programme and the overall educational experience, just one of these should be in a familiar subject. Students must apply to attend, and are selected based on their background and academic excellence. Room and board is free for admitted students. The admission rate in the last few years has been about 50%.

The themes are selected to represent areas of research strength in Atlantic Canada. Topics are chosen to represent particularly active research areas. Thus, the material goes beyond any course that is part of a regular graduate curriculum in mathematics. Lecturers are recognized experts in the chosen topics, invited by local academics. Apart from teaching the courses, the lecturers also interact informally with the students, and with the faculty at the host institution. Students routinely express their appreciation of the chance to interact with these experts. Collaborations between visiting lecturers and local faculty and students during the summer school has more than once resulted in research papers.

This year the AARMS Summer School at Dalhousie University (July 21 – August 15, 2014) features course offerings in the themes of Commutative Algebra and Statistics:

- Gröbner Bases in Commutative Algebra
Instructor: Dr. Giulio Caviglia, Purdue University
- Homological Conjectures in Commutative Algebra
Instructor: Dr. Hailong Dao, University of Kansas
- Statistical Learning with Big Data
Instructors: Drs. Hugh Chipman, Acadia and Xu (Sunny) Wang, St. Francis Xavier University
- Spatial Statistics
Instructor: Dr. Julie Horrocks, University of Guelph

For more information: www.aarms.math.ca/summer

Math on the Move

Kathleen Nolan (kathy.nolan@uregina.ca) and
J. Harley Weston (weston@uregina.ca)
 University of Regina

Math on the Move (MOTM) is an initiative at the University of Regina to deliver inquiry-based mathematics activities at the grade 9/10 levels to schools outside the major urban centres in Saskatchewan. This initiative began in 2005 as an extension of the University of Regina math camp and operated for two years. Due to lack of funding, MOTM was forced into a hiatus until 2010 when support was received from the Pacific Institute for the Mathematical Sciences to continue the project.

MOTM facilitators Kathleen Nolan (Faculty of Education) and Harley Weston (Department of Mathematics and Statistics) hire four mathematics education students each year to develop and deliver the activities; a fifth student is also hired as the organizer, to contact schools, make travel arrangements and keep everyone on schedule during school visits. During a typical school visit, the grade 9/10 students are divided into two groups and each group takes part in a 40-minute activity. The groups then switch to participate in the second activity for a further 40 minutes. In addition to being inquiry-based, the two 40-minute activities are explicitly connected to learning outcomes drawn directly from Saskatchewan curriculum documents. Following these two activities, the school visit closes with a 20-minute mathematics Olympics activity which involves dividing the students into four smaller groups to compete in solving mathematics challenge problems. A winning team is determined and each student receives a prize.

In our *Math on the Move* initiative, the intent is to engage high school students in rewarding, hands-on mathematics activities, give the university students an opportunity to practice designing and delivering inquiry-based lessons, and demonstrate to teachers the use of inquiry-based lessons with learning outcomes drawn directly from the curriculum. *Math on the Move* has established a strong reputation in Saskatchewan and has visited 30 communities across the province since 2005. A map of these locations, along with photos from a number of school visits, can be seen at MathOnTheMove.uregina.ca.



Math Mania

Melania Alvarez (melania@pims.math.ca)

In the early nineties, the first *Math in the Mall* (later renamed Math Mania) was organized by Małgorzata Dubiel and Katherine Heinrich from the Mathematics Department at Simon Fraser University (SFU). The first *Math in the Mall* took place at Lougheed Mall - a large mall in Burnaby, BC, close to SFU and several elementary schools, but soon this event was being replicated at several locations all around the country. Teachers and principals began requesting similar events at their schools and *Math Mania* was born.

Organized by The Pacific Institute for the Mathematical Sciences (PIMS), *Math Mania* is a popular alternative math education event which has run between 15 and 20 times a year in elementary and secondary schools all around British Columbia since 1997. As of 2013, *Math Mania* is also being offered in Saskatchewan, with plans to move into Alberta as well. *Math Mania* is delivered by mathematicians and educators at the University of British Columbia, University of Victoria and University of Saskatchewan sites, Douglas College (BC), and the University of the Fraser Valley.

Math Mania welcomes all age levels, but is particularly suited to students in grades 2 to 5 and presents a variety of interactive demonstrations, puzzles, games and art including kaleidocycles, hexaflexagons, platonic forms, nets, geometrical models made of flexible plastic drinking straws, Möbius bands, the penny game, the Set Game, the 'Game of 24', Nim, Tower of Hanoi, the amazing sorting network and other mathematical puzzles and paradoxes (as seen in the photos of this issue).

These activities are designed to demonstrate fun ways of learning both math and computer science concepts, and to provide teachers, students and their parents with an opportunity to see in mathematics its beauty, as well as the amazement and excitement of discovering something unexpected. This spirit is reflected in the comments of a host school principal:

Students, parents and teachers were thrilled with the opportunity to work with your team of volunteers in exploring mathematics through the use of games. Your volunteers were pleasant and knowledgeable as well as fun-loving. The fact that your team consisted of a variety of people from different cultures and different ages and stages of life truly demonstrated that math can be fun for everyone!

Math Mania is usually presented in a school gymnasium in the early evening, for a period of ninety minutes. *Math Mania* is free and open to the public. All students, parents and teachers in the host school, as well as those involved in home schooling, are encouraged to attend. Events usually attract more than two hundred participants. Each event requires about twenty volunteers and hence, considerable advance planning. New activities are added each time. More information can be found at: www.pims.math.ca/educational/math-mania

President's Report 2013

Keith Taylor

The Canadian Mathematical Society continues to thrive through the hard work of a vast number of members of our community and our professional staff in the Ottawa office. In my brief report, I can only highlight some aspects of the range of operations of the CMS. You will find a more complete picture from our full annual report.

We had considerable turn-over in the Executive of the society as the four Vice-Presidents - Karl Dilcher (Atlantic), Olivier Collin (Quebec), Stephen Kudla (Ontario), and Elena Braverman (Western) – completed their terms and were replaced by Robert van den Hoogen, Louigi Addario-Berry, Gregory Smith and Mark Lewis, respectively. I extend my sincere thanks to the previous Vice-Presidents for the contributions they all made. Lia Bronsard joined the Executive as President-Elect and David Oaken took over as Treasurer. Our Executive Director Johan Rudnick is also a key member of the Executive Committee. The new members have enthusiastically engaged with all the interesting issues that are current.

After many years of service to the Society, David Rogers stepped down from the position of Treasurer. We sorely missed him at our last Executive meeting. Through his good-natured professionalism and detailed knowledge of our operation, David provided a solid overview of the finances of the Society over a difficult period as investment markets waned and waxed and income levels struggled to match expenses.

A first Mathematical Congress of the Americas took place in Mexico in August, 2013. Jacques Hurtubise was kind enough to represent the CMS at the meeting of society presidents which took place in conjunction with the Congress. Possibly as a result of the impression he made, the CMS was invited to submit a bid to host the next Mathematical Congress of the Americas. Endorsed by the Executive, Jacques and the CMS office prepared a compelling national proposal with the support of the institutes and other organizations. While there was also a strong bid from Argentina, Canada was awarded the 2017 event to take place in Montreal. The MCA has the potential to be an outstanding conference and an opportunity to establish or enhance scientific relations with like-minded researchers and educators throughout the Americas. I encourage all mathematicians to consider ways to be involved, especially through the proposal of scientific sessions.

Lee Lorch 1915-2014

Lee Lorch was born in New York City on September 20, 1915 and died in Toronto on February 28, 2014. He graduated from Cornell University in 1935 and obtained a PhD from the University of Cincinnati, under the supervision of Otto Szász, in 1941. His mathematical work, spanning more than 65 years, was in various areas of classical analysis, including Fourier series, summability, ordinary differential equations and special functions. *Continued on page 15.*

The two scientific meetings of the CMS were highly successful. The Summer Meeting took place in Halifax and the Winter Meeting was in Ottawa.

A number of outstanding members of our community were recognized by awards from the Society in 2013:

- Eddy Campbell, University of New Brunswick, received the Graham Wright Award for Distinguished Service.
- Kenneth Davidson, University of Waterloo, and Alex Wright won G. de B. Robinson Award, for their paper titled “Operator algebras with unique preduals” which appeared in the Canadian Mathematical Bulletin.
- John McLoughlin, University of New Brunswick won the Adrien Pouliot Award.
- Marc Ryser was the recipient of the 2013 Doctoral Prize for his thesis research at McGill University.
- Balázs Szegedy, University of Toronto, delivered the Coxeter-James Prize Lecture.
- Chantal David, Concordia University, delivered the Krieger-Nelson Prize Lecture.
- Zinovy Reichstein, University of British Columbia, gave the Jeffery-Williams Prize Lecture.
- Jan Minac, Western University, received the CMS Excellence in Teaching Award.

Perhaps the most noteworthy public activity related to mathematics last year was MPE2013. It developed into a world-wide movement and continues on as Mathematics of Planet Earth (<http://mpe.dimacs.rutgers.edu/>). Former CMS President Christiane Rousseau was the creator and driving force in making MPE2013 the success it became. The CMS launched the initiative in Canada and in collaborations with PIMS, Fields, CRM, AARMS, and a number of universities, sponsored a well-received series of public lectures across the country.

The Executive Committee and the Board have been working on new bylaws for the Society in response to new Federal legislation on governance of not-for-profit organizations. These bylaws are expected to be put into final form at the upcoming Summer Meeting AGM in Winnipeg. This will be the last meeting at which I will serve as President. At the end of June, I will pass the role into the capable hands of Professor Lia Bronsard of McMaster University.



The Dynamical Mordell-Lang Conjecture

Dragos Ghioca, Department of Mathematics,
University of British Columbia

A linear recurrence sequence $\{x_n\}_{n \geq 1}$ of complex numbers has the property that there exist a positive integer N and constants $c_1, \dots, c_N \in \mathbb{C}$ such that, for all $n \geq 1$, $x_{n+N} = c_1 x_{n+N-1} + c_2 x_{n+N-2} + \dots + c_N x_n$. It is natural to ask “what is the structure of the set $S := \{n \in \mathbb{N}: x_n = 0\}\text{?}^*$. Skolem (in the case each $x_i \in \mathbb{Z}$), later Mahler (in the case each $x_i \in \mathbb{Q}$), and finally Lech (in the general case) answered this question by showing that S is a union of at most finitely many (infinite) arithmetic progressions along with a finite set. It is indeed possible that S contains an arithmetic progression, for example, if $N = 3$, $c_1 = c_2 = 0$ and $c_3 = 1$, while $x_2 = 0$, then $\{2 + 3n: n \geq 0\} \subseteq S$. We sketch briefly the method of Skolem-Mahler-Lech. There exist complex numbers r_1, \dots, r_m and polynomials $f_1, \dots, f_m \in \mathbb{C}[z]$ such that, for all $n \geq 1$,

$$x_n = f_1(n)r_1^n + \dots + f_m(n)r_m^n.$$

The numbers r_i are the distinct, nonzero roots of the characteristic equation for the linear recurrence sequence: $x^N - c_1 x^{N-1} - \dots - c_{N-1} x - c_N = 0$, while each polynomial f_i is not constant only if the corresponding r_i is a multiple root of the above equation. We let K be the finitely generated extension of \mathbb{Q} containing each r_i and each coefficient of each f_i . Then one can show that there exists a prime number p and a suitable embedding $K \hookrightarrow \mathbb{Q}_p$ such that each r_i is mapped into a p -adic unit, [1]. Furthermore, there exists $k \in \mathbb{N}$ such that $|r_i^k - 1|_p < 1$ and so, for each $i = 1, \dots, m$, the function $z \mapsto (r_i^k)^z$ is analytic on \mathbb{Z}_p . Hence, for each $\ell = 0, \dots, k-1$, we let G_ℓ be the p -adic analytic function given by

$$G_\ell(z) := \sum_{i=1}^m r_i^\ell f_i(kz + \ell) \cdot (r_i^k)^z,$$

for each $z \in \mathbb{Z}_p$, and obtain that, for all $n \in \mathbb{N}$, $x_{nk+\ell} = G_\ell(n)$. Therefore $x_{nk+\ell} = 0$ if and only if $G_\ell(n) = 0$. But, similarly to a nonzero complex analytic function, a nonzero p -adic analytic function does not have infinitely many zeros in a compact set, such as \mathbb{Z}_p . So, for each $\ell = 0, \dots, k-1$, either $G_\ell(z) = 0$ has finitely many solutions in \mathbb{Z}_p , and therefore in \mathbb{N} , or G_ℓ is identically equal to 0, and thus $G_\ell(n) = 0$ for all $n \in \mathbb{N}$. This yields that the set $S = \{n \in \mathbb{N}: x_n = 0\}$ is a union of at most finitely many arithmetic progressions (of ratio k) along with a finite set.

The above argument can be formulated also in a geometric setting. Indeed, for any linear map $\Phi: \mathbb{C}^N \rightarrow \mathbb{C}^N$ (i.e., a N -by- N matrix A with complex entries) and any point $\alpha \in \mathbb{C}^N$, again one can find a prime number p (together with a suitable embedding into \mathbb{Q}_p of α and of all entries of A), a positive integer k , and p -adic analytic maps $G_\ell: \mathbb{Z}_p \rightarrow \mathbb{Z}_p^N$, $\ell = 0, \dots, k-1$, such that

$\Phi^{nk+\ell}(\alpha) = G_\ell(n)$ for all $n \in \mathbb{N}$ (note that $\Phi^n := \Phi \circ \dots \circ \Phi$, where Φ is composed with itself n times).

Hence the same reasoning as above regarding the discreteness of zeros for nontrivial p -adic analytic functions yields that for any (linear) subvariety $V \subset \mathbb{C}^N$, the set $S := \{n \in \mathbb{N}: \Phi^n(\alpha) \in V\}$ is a union of at most finitely many arithmetic progressions along with a finite set. An argument identical with this one yields the same conclusion for automorphisms Φ of \mathbb{P}^N defined over \mathbb{C} .

The above extension of the original Skolem-Mahler-Lech method to the geometric setting works since one has explicit formulas for the n -th iterate of a point under an automorphism of \mathbb{P}^N . Quite surprisingly, one can extend this p -adic method to any automorphism of an affine variety [1], and even further to any étale endomorphism Φ of any quasiprojective variety X [2], even though in these cases there are *no* explicit formulas for the n -th iterate of a point $\alpha \in X(\mathbb{C})$. Nevertheless, one can show that there exist finitely many p -adic analytic functions G_ℓ that parametrize the orbit of α under Φ . Then again we obtain that for any subvariety $V \subseteq X$, the set $S := \{n \in \mathbb{N}: \Phi^n(\alpha) \in V(\mathbb{C})\}$ is a union of at most finitely many arithmetic progressions along with a finite set. It is natural to ask whether the above conclusion holds for any endomorphism of any variety.

The Dynamical Mordell-Lang Conjecture. Let X be a quasiprojective variety defined over \mathbb{C} , let $V \subseteq X$ be a subvariety, let $\alpha \in X(\mathbb{C})$ be a point, and let $\Phi: X \rightarrow X$ be an endomorphism. Then the set $S = \{n \in \mathbb{N}: \Phi^n(\alpha) \in V(\mathbb{C})\}$ is a union of at most finitely many arithmetic progressions along with a finite set.

An alternative formulation of this statement is to say that whenever $V \subseteq X$ contains no positive dimensional periodic subvariety periodic under Φ , then the above set S must be finite. The name of this conjecture comes from its connection with the Mordell-Lang Conjecture of arithmetic geometry (now a theorem due to Faltings), which states that the intersection of a subvariety of a semiabelian variety G with a finitely generated subgroup Γ of $G(\mathbb{C})$ is a union of at most finitely many cosets of subgroups of Γ . If Γ is a cyclic group generated by a point $\gamma \in G(\mathbb{C})$, the Mordell-Lang Conjecture reduces to the one stated above applied to the translation-by- γ map $\Phi: G \rightarrow G$. Also, there are counterexamples to the Dynamical Mordell-Lang conjecture if X is defined over a field of positive characteristic [3].

There are only a few partial results known for the above conjecture besides the case of étale endomorphisms [2]; we list some of the cases below:

1. If $X = (\mathbb{P}^1)^N$ and $\Phi(x_1, \dots, x_N) = (\varphi_1(x_1), \dots, \varphi_N(x_N))$ for some classes of rational maps $\varphi_i \in \mathbb{C}(z)$ and some classes of subvarieties $V \subseteq X$, [4], [5]. For each such result, if the conditions on V are milder, then the conditions on the φ_i are stricter. For example, the Dynamical Mordell-Lang Conjecture holds for any subvariety $V \subseteq X$ defined over $\bar{\mathbb{Q}}$ if $\varphi_i(z) = z^2 + c_i$ for some $c_i \in \mathbb{Z}$, for each $i = 1, \dots, N$, [4]. In the opposite direction, the Dynamical Mordell-Lang

Conjecture holds for complex curves $V \subseteq X$ if $\varphi_1 = \varphi_2 = \dots = \varphi_N \in \mathbb{C}[z]$ is a polynomial with no periodic ramified points, except for the point at infinity;

2. If $X = \mathbb{A}^N$, V is a complex line, and $\Phi(x_1, \dots, x_N) = (f_1(x_1), \dots, f_N(x_N))$, where each $f_i \in \mathbb{C}[z]$, [7]; and
3. If Φ is a generic endomorphism of $X = \mathbb{P}^N$ defined over \mathbb{C} , [6]; and
4. If Φ is a birational polynomial morphism of the complex plane, [8].

Only for the results in (1) one relies heavily on the use of the Skolem-Mahler-Lech method to find suitable p -adic parametrizations of the orbit of α under Φ . In general, it is very difficult to find such parametrizations since one needs to find a prime p such that the orbit of α does not meet the ramification locus of Φ modulo p . Heuristically it is even expected that this method might never work for endomorphisms of \mathbb{P}^N if $N \geq 5$ [4]. Also, for (2)–(4), the methods of proof do not seem to allow generalizations. So, one would need a new approach to prove the Dynamical Mordell-Lang Conjecture in its full generality. Finally, in [3] it is shown that in the Dynamical Mordell-Lang Conjecture the set S is always a union of at most finitely many arithmetic progressions along with a set T of Banach density 0. However, proving that T is actually finite seems currently beyond the reach.

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Lee Lorch 1915–2014, Continued from page 13.

After service with the US Army in India and the Pacific, Lee held a series of positions in US colleges and universities until 1959. This period was marked by his struggle against racial discrimination in housing and education in which he was joined by his wife Grace and daughter Alice. This led to pressure on several institutions leading to his termination or non-renewal. Despite the disruption caused by these events, he managed to continue his research activity and to mentor several African-American students who were to go on to successful completion of graduate programs. But eventually, Lee found it impossible to get a regular position in the United States.

His first position in Canada was at the University of Alberta. Alvin Baragar (“The Department of Mathematics (1908–1982)”, *Folio*, University of Alberta, 25 November 1982, pages 5–9) writes of how Lee built up the mathematical library and of his major role in inviting international visitors to Alberta: “During the nine years he spent here ... this courageous man was a major factor in opening the department to the international mathematical community.” Lee joined York University in 1968, and continued with an active program of research and travel including international contacts, especially in Eastern Europe. Although he had to retire in 1985, he always insisted that it was “just his salary” that had been retired. As recently as 2011, he was heard to mention his regret at missing a departmental meeting!

Lee served the CMC (or its successor the CMS) as a member of Council, of the Research Committee and of The Women in Mathematics Committee. He was a member and Chair of the Mathematics Grant Selection Committee, then under the auspices of NRC. He regarded his fellowship in the Royal Society of Canada as not merely an honour, but as conferring a duty and an opportunity to influence decision-making. Though he had increasingly severe difficulty in walking, Lee attended the entire CMS Winter 2009 meeting at Windsor and most of the Winter 2011 meeting in Toronto. Lee was a longstanding member of the CMS from 1960–2013.

At the same time, he remained close to the American mathematical community, serving on the AMS Council and being a strong supporter of the associations for women and minority mathematicians. Internationally, he was active in supporting mathematicians and others who were the victims of discrimination, military occupation or blockade. A feature of his approach was to work within “the system”, persuading the organizations of which he was a member to take principled stands. His campaigns would include a clear statement of the issue, he would anticipate some counterarguments, and make concrete suggestions for action.

The photo on page 13 shows Lee (right) with fellow activists Chandler Davis, Jon Thompson and Nancy Olivieri during a 2005 CAUT-sponsored conference on Academic Freedom held in Toronto. This led the book *Free Speech in Fearful Times: After 9/11 in Canada, the U.S., Australia and Europe*, ed. by J. L. Turk and A. Manson, Lorimer, Toronto, 2007.

For an excellent set of links to information on, and tributes to Lee, see John Dupuis’ blog posting, which is most easily reached via scienceblogs.com and search for “Lee Lorch”.

Martin Muldoon

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The interplay between mathematical and biological insight

Frithjof Lutscher, Department of Mathematics and Statistics, University of Ottawa

One aspect that always fascinates me about the application of mathematics in the sciences is the interplay of mathematical insight and proof with scientific intuition and knowledge.

I present here a recent case from biology, in which a completely reasonable mathematical model led to partially unreasonable biological results. A deeper understanding of the mathematical basis then gave new insights into biological mechanisms, removed at the same time the unreasonable results, and generated novel mathematical challenges.

The study of the spread of a biological population or gene began with Fisher in the 1930s in genetics, continued with Skellam and others in ecology in the 1950s, and has been a focal point of research for the past decades as non-native invasive species are a cause for great concern worldwide. Fisher studied the reaction-diffusion equation

$$\frac{\partial u}{\partial t} = D \frac{\partial^2 u}{\partial x^2} + f(u), \quad (1)$$

with $f(u) = u(1 - u)$ for the relative density $u(t, x)$ of an advantageous gene in one-dimensional space ($x \in \mathbb{R}$) and time ($t \geq 0$). Skellam used the same equation with linear function $f(u) = ru$, where $u(t, x)$ is the density of a population. A straightforward way to derive the diffusion equation is to assume that an individual performs a random walk on the grid $\delta\mathbb{Z}$ with probability $1/2$ of going left or right per time step τ . In the parabolic limit $\delta, \tau \rightarrow 0$, with $\delta^2/(2\tau) = D$, the diffusion equation arises. The additional assumption that growth (represented by f) and movement (diffusion) occur on the same time scale leads to the above equation. The famous formula for the speed, c , at which a population (or gene) described by equation (1) advances in space is, $c = 2\sqrt{Df'(0)}$. I will not discuss the various ways of defining a measure of speed, since they all coincide for this equation. The interested reader may look into the works by Fisher (1937), Kolmogorov-Petrovskii-Piscunov (1937), or Weinberger (1982).

Since diffusion and growth in (1) are independent of spatial location, the equation is valid only for a spatially homogeneous landscape, but naturally occurring and human-altered landscapes tend to show strong heterogeneity. A great step towards a more realistic model for spatial spread was made by Shigesada et al. (1986). They presumed that a one-dimensional landscape consists of two types of patches of different quality: favorable and unfavorable. On each patch, an equation of the form (1) holds, with parameter values possibly varying between patch types. At the interface between two patches, the flux, $D \frac{\partial u}{\partial x}$, and the density, u , are assumed continuous. It is this latter inconspicuous and mathematically perfectly reasonable assumption that should prove essential for the qualitative properties

of solutions. It also turns out to be biologically questionable. Shigesada and coworkers found an implicit relation between the speed of spread and model parameters (i.e. diffusion and growth rates, patch sizes) and illustrated this relationship with various scenarios. When I read their paper in 2003, all results seemed sensible, except those related to movement in unfavorable habitat. One such result said that a species could slow down and ultimately fail to spread when its movement rate in unfavorable patches becomes large. Why should an invasion slow down if individuals move faster? Nobody could give me a satisfactory explanation of this result – and nobody seemed particularly disturbed by it either. To be clear, there is no analytical mistake in the work by Shigesada; the result is correct, just not so easy to justify biologically.

Eight years later, Gabriel Maciel, a very bright PhD student from Brazil, came to work with me on models for population persistence in a fragmented landscape such as the Amazon rain forest. We realized that, in order to describe population dynamics and movement, we needed to include individual movement behavior at an interface between habitat types into a reaction-diffusion equation. He found a paper by Ovaskainen and Cornell (2003), who had derived such conditions from a random walk on a linear grid. And it turns out that while the population flux needs to be continuous at an interface (to conserve the number of individuals), their density is typically *not* continuous, *even* if individuals choose either habitat type with equal probability. In fact, the ratio of the population densities on either side of the interface is related to the ratio of the diffusion coefficients and also on the probability of choosing one patch type over the other. I remembered the result by Shigesada and coworkers, and I asked Gabriel to re-analyze their model with these new, discontinuous interface conditions. I was elated when he came back to report that the biologically unreasonable results had disappeared.

Eventually, he generalized the approach by Ovaskainen and Cornell and derived also the continuous interface conditions from certain mechanistic assumptions about how an individual behaves at an interface. Namely, if the probability of entering a patch equals the probability of moving left and right inside that patch, then continuous interface conditions arise. With this interpretation, we could explain the earlier paradoxical result: if the movement rate inside an unfavorable patch is large, then the probability of an individual moving into that unfavorable patch is also large, and therefore the death rate is large (since the patch is unfavorable). Hence the population may collapse rather than spread quickly. Ecological theory, however, suggests otherwise: individuals should move quickly within an unfavorable patch and move out of it with high probability. With the new, discontinuous interface conditions, increasing the movement rate in unfavorable patches does increase the rate of spread of the population.

In summary, a perfectly fine mathematical model gave a hard-to-interpret biological result. To resolve the situation, a more detailed movement model uncovered that biologically reasonable behavior should be incorporated as discontinuous interface conditions; the previous unreasonable results could be explained by the mechanisms

that the continuous interface conditions actually represented. Ecologists now have the challenge to measure individual movement behavior at the interface between two patch types. Mathematically, the discontinuous interface conditions pose challenges in the qualitative analysis of reaction-diffusion equations. Beginning with questions of existence and regularity of solutions, we are led to rework and extend the theory of spreading speeds and traveling waves to include certain types of discontinuities, namely those that come out of careful model derivations.

The modeling and analysis of the dispersion relation, together with its ecological interpretation and implications are published as Maciel and Lutscher (2013) *How individual movement response to habitat edges affects population persistence and spatial spread*, *The American Naturalist* 182: 42–52. All references mentioned here can be found in this paper.



CMS Research Prizes

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. The recipient shall be a member of the Canadian mathematical community. Nominations may be made up to ten years from the candidate's Ph.D: researchers having their PhD degrees conferred in 2004 or later will be eligible for nomination in 2014 for the 2015 prize. 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 prize lecture will be given at the 2015 CMS Summer Meeting.

The Jeffery-Williams Prize Lectureship recognizes mathematicians who have made outstanding contributions to mathematical research. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for three years. The prize lecture will be given at the 2015 CMS Summer Meeting.

The Krieger-Nelson Prize Lectureship recognizes outstanding research by a female mathematician. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for two years. The prize lecture will be given at the 2015 CMS Summer Meeting.

The deadline for nominations is **June 30, 2014**.

Nominators should ask at least three referees to submit letters directly to the CMS by September 30, 2014. Some arms-length referees are strongly encouraged. Nomination letters should list the chosen referees, and should include a recent curriculum vitae for the nominee, if available. Nominations and reference letters should be submitted electronically, preferably in PDF format, by the appropriate deadline to the corresponding email address:

Coxeter-James: cjprize@cms.math.ca

Jeffery-Williams: jwprize@cms.math.ca

Krieger-Nelson: knprize@cms.math.ca



Prix de recherche

Le Comité de recherche de la SMC lance un appel de mises en 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 aux jeunes mathématiciens qui se sont distingués par l'excellence de leur contribution à la recherche mathématique. Cette personne doit être membre de la communauté mathématique canadienne. Les candidats sont admissibles jusqu'à dix ans après l'obtention de leur doctorat : ceux qui ont obtenu leur doctorat en 2004 ou après seront admissibles en 2014 pour le prix 2015. Toute mise en candidature est modifiable et demeurera active l'année suivante, à moins que la mise en candidature originale ait été faite la 10^e année suivant l'obtention du doctorat. La personne choisie prononcera sa conférence à la Réunion d'été SMC 2015.

Le prix Jeffery-Williams rend hommage aux mathématiciens ayant fait une contribution exceptionnelle à la recherche mathématique. Cette personne doit être membre de la communauté mathématique canadienne. Toute mise en candidature est modifiable et demeurera active pendant trois ans. La personne choisie prononcera sa conférence à la Réunion d'été SMC 2015.

Le prix Krieger-Nelson rend hommage aux mathématiciennes qui se sont distinguées par l'excellence de leur contribution à la recherche mathématique. La lauréate doit être membre de la communauté mathématique canadienne. Toute mise en candidature est modifiable et demeurera active pendant deux ans. La lauréate prononcera sa conférence à la Réunion d'été SMC 2015.

La date limite de mises en candidature est le **30 juin 2014**.

Les proposants doivent faire parvenir trois lettres de référence à la SMC au plus tard le 30 septembre 2014. Nous vous incitons fortement à fournir des références indépendantes. Le dossier de candidature doit comprendre le nom des personnes données à titre de référence ainsi qu'un curriculum vitae récent du candidat ou de la candidate, dans la mesure du possible. Veuillez faire parvenir les mises en candidature et lettres de référence par voie électronique, de préférence en format PDF, avant la date limite, à l'adresse électronique correspondante:

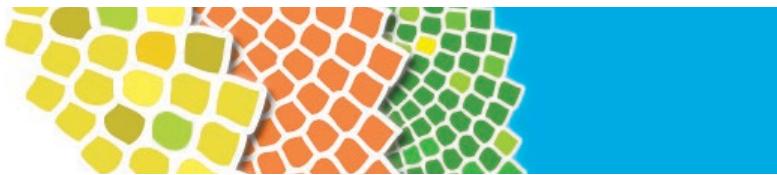
Coxeter-James: prixcj@smc.math.ca

Jeffery-Williams: prixjw@smc.math.ca

Krieger-Nelson: prixkn@smc.math.ca



2014 CMS Summer Meeting Winnipeg - June 6-9



June 6 - 9, 2014

Delta Winnipeg, Winnipeg (Manitoba)

Host: University of Manitoba

cms.math.ca

Prizes | Prix

Coxeter-James Prize | Prix Coxeter-James

Marco Gualtieri (Toronto)

Excellence in Teaching Award

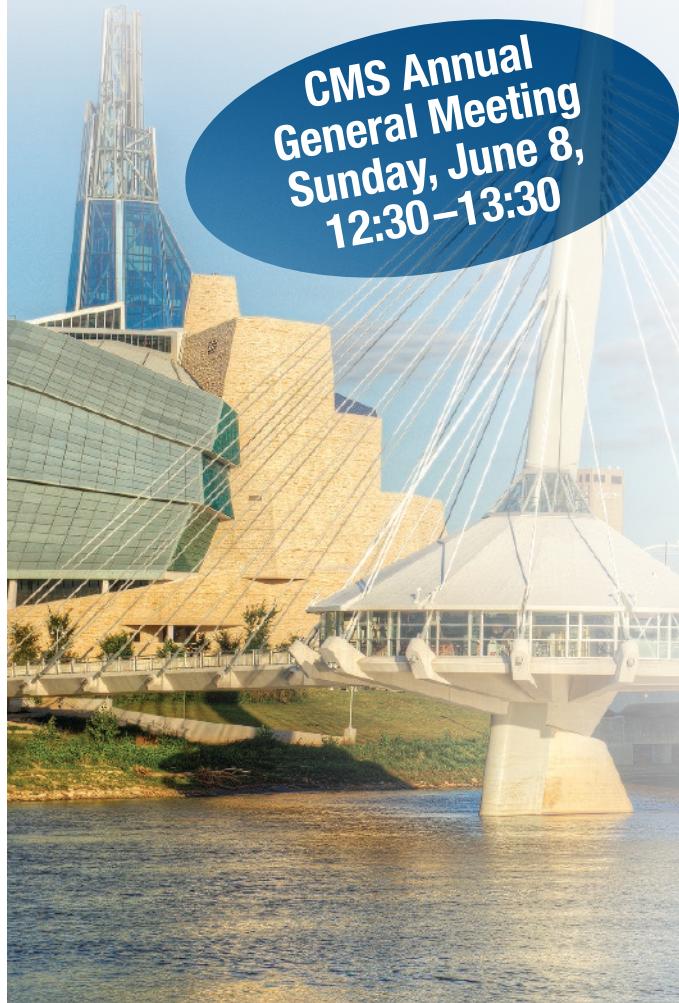
Prix d'excellence en enseignement

Gerda De Vries (Alberta)

Krieger-Nelson Prize Lecture

Conférence - Prix Krieger-Nelson

Gail Wolkowicz (McMaster)



6-9 juin 2014

Delta Winnipeg, Winnipeg (Manitoba)

Hôte : Université du Manitoba

cms.smc.ca

Public Lectures | Conférences publiques

Barbara Keyfitz (Ohio State)

John Mighton (Fields)

Plenary Speakers | Conférences plénierées

Bela Bollobas (Cambridge, Memphis)

Mark Lewis (Alberta)

James Maynard (Montreal)

Thomas Ransford (Laval)

Scientific Director | Directeur scientifique

Nina Zorboska (University of Manitoba)

Stephen Kirkland (University of Manitoba)

Related Events | Événements liés

The CMS Executive is inviting all CMS members and meeting participants to join them at an informal luncheon at the CMS Annual General Meeting to focus on what was achieved in 2013.

The Canadian Mathematical Society invites you to their awards banquet to highlight exceptional performance in the area of mathematical research and education. Prizes will be awarded during the event.

Winnipeg will feature an art exhibit including art projects from Students in the Math in Art course from the University of Winnipeg by teacher Derek Brueckner.

STUDC will be holding an Intermediate LaTeX tutorial on Friday June 6th. This workshop is designed to help participants improve the quality and readability of their LaTeX documents.

Madeleine Bastien, Team Leader for the Research Grants at NSERC will provide an overview of the program news and results of the 2014 NSERC Discovery Grants Competition.

Pearson will be holding a luncheon to discuss innovative learning resources to support mathematics education luncheon and Nelson will be holding a session on digital culture and education.



Confirmed Regular Sessions | Sessions générales

Algebraic Tools and Design Theory

Outils algébriques et design combinatoire

Robert Craigen (Manitoba)

Analytic methods in Diophantine equations

Méthodes analytiques pour les équations Diophantiennes

Michael Coons (University of Newcastle), Patrick Ingram (Colorado State)

Communicating your Research: a Reflection on Mathematical Presentations | Communiquer sa recherche: une réflexion sur les présentations en mathématique

STUDC

Complex Analysis and Function Spaces

Analyse complexe et espaces de fonctions

Eric Schippers, Nina Zorboska (Manitoba)

Gröbner bases and Computer Algebra

Bases de Gröbner et Algèbre Informatique

Murray Bremner, Sara Madariaga (Saskatchewan), Yang Zhang, Jaydeep Chipalkatti, R. Padmanabhan (Manitoba)

Graphs and Hypergraphs | Graphes et Hypergraphes

David Gunderson, Bill Kocay (Manitoba), Ortrud Oellermann (Winnipeg)

Innovation and outreach in mathematics education

Innovation et promotion en enseignement des mathématiques

Darja Kalajdzievska (Manitoba), Anna Stokke (Winnipeg)

Low dimensional topology and geometric group theory

Topologie en basse dimension et théorie géométrique des groupes

Adam Clay (Manitoba), Eduardo Martinez-Pedroza (Memorial) Dale Rolfsen (UBC)

Mathematical Biology | Biologie mathématique

Abba Gumel (Manitoba)

Mathematics: Tools of investigation in cellular and molecular biology | Mathématiques: Outils pour l'étude de la biologie cellulaire et moléculaire

Eric Cytrynbaum (UBC), Stephanie Portet (Manitoba)

Numerical Analysis and Engineering Mathematics

Analyse numérique et Mathématiques de l'ingénieur

A.Bass Bagayogo (Université de Saint-Boniface)

Preserver problems | Problèmes de préservation

CK Li (College of William an Mary), SH Lui (Manitoba), YT Poon (Iowa State)

Symplectic geometry and equivariant topology

Géométrie symplectique et topologie équivariante

Thomas Baird (Memorial), Derek Krepski (Manitoba)

Topics in Approximation Theory

Sujets variés en théorie de l'approximation

Kirill Kopotun (Manitoba), Andriy Prymak (Manitoba)

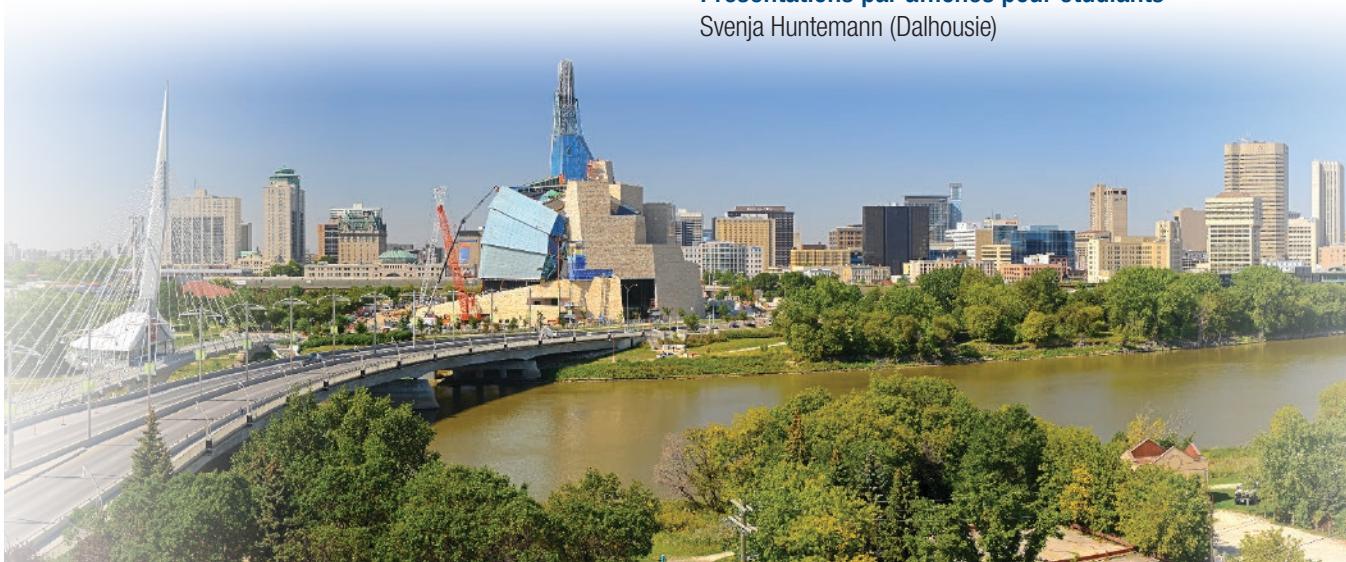
Contributed Papers | Communications libres

A.Bass Bagayogo (Université de Saint-Boniface)

AARMS-CMS Student Poster Session

Présentations par affiches pour étudiants

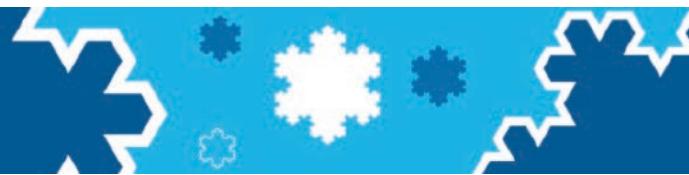
Svenja Huntemann (Dalhousie)





2014 CMS Winter Meeting

December 5 - 8, 2014 • Hamilton, Ontario



2014 CMS Winter Meeting

December 5 - 8, 2014, Hamilton (Ontario)

Hamilton Sheraton

Host: McMaster University

cms.math.ca

Prizes | Prix

Jeffery-Williams Prize | Prix Jeffery-Williams

Askold Khovanskii (University of Toronto)

Doctoral Prize | Prix de doctorat

recipient to be announced | lauréat à confirmer

Graham Wright Award for Distinguished Service

Prix Graham Wright pour service méritoire

recipient to be announced | lauréat à confirmer

Adrien Pouliot Award | Prix Adrien-Pouliot

recipient to be announced | lauréat à confirmer

David Borwein Distinguished Career Award and Lecture

Prix David-Borwein de mathématicien émérite pour

l'ensemble d'une carrière et conference in French

Kenneth R. Davidson (University of Waterloo)

G. de B. Robinson Award | Prix G. de B. Robinson

recipient to be announced | lauréat à confirmer

Réunion d'hiver 2014 de la SMC

5-8 décembre 2014, Hamilton (Ontario)

Hamilton Sheraton

Hôte : Université McMaster

cms.math.ca

Scientific Director | Directeur scientifique

Nicholas Kevlahan : kevlahan@mcmaster.ca

Deirdre Haskell : haskell@math.mcmaster.ca

Related Events | Événements liés

CMS Townhall Meeting and NSERC will be present to address any questions from CMS members

The Canadian Mathematical Society invites you to their awards banquet to highlight exceptional performance in the area of mathematical research and education. Prizes will be awarded during the event.





Regular Sessions | Sessions générales

Arithmetic Algebraic Geometry

Géométrie algébrique arithmétique

Manfred Kolster (McMaster)

Automorphic Forms and Representation Theory

Formes automorphiques et théorie des représentations

Chung Pang Mok (McMaster)

Computability Theory | Théorie de la calculabilité

Barbara Csima (Waterloo), Peter Cholak (Notre Dame)

Commutative Algebra: Interactions with Algebraic Combinatorics, Algebraic Geometry, and Representation Theory | Algèbre commutative : interactions avec la combinatoire algébrique, la géométrie algébrique et la théorie des représentations

Adam van Tuyl (Lakehead), Tony Geramita (Queens)

Differential Geometry | Géométrie différentielle

Spiro Karigiannis, Benoit Charbonneau (Waterloo), McKenzie Wang(McMaster)

Dynamics of Biological Systems | Dynamique des systèmes biologiques

Ben Bolker, David Earn (McMaster)

Dynamical Systems with Applications in Mathematical Biology | Systèmes dynamiques et applications en biologie mathématique

Gail Wolkowicz (McMaster), Hermann Eberl (Guelph)

Financial Mathematics | Mathématiques financières

Traian Pirvu (McMaster)

Frames, Fractals, Tiling, and Wavelets, in Connection with the Fuglede's Conjecture | Cadres, fractales, pavages et ondelettes, par rapport à la conjecture de Fuglede

Chun-Kit Lai, Jean-Pierre Gabardo (McMaster)

Game theory: Recent Advances and Applications

Théorie des jeux : dernières percées et applications

Monica Cojocaru (Guelph), Bill Farmer(McMaster)

Geometric, Combinatorial and Computational Aspects of Linear Optimization | Aspects géométriques, combinatoires et computationnels de l'optimisation linéaire

Antoine Deza (McMaster), Henry Wolkowicz (Waterloo)

Geometric Discretization Methods and Adaptivity

Méthodes de discréétisation géométrique et adaptativité

Gantumur Tsogtgerel (McGill)

Geometry and Topology of Manifolds in Low-Dimensions

Géometrie et topologie de variétés en basse dimension

Hans Boden (McMaster), Liam Watson (UCLA)

Environmental and Geophysical Fluid Dynamics

La dynamique des fluides géophysiques et environnementales

Francis Poulin (Waterloo)

History and Philosophy of Mathematics

Histoire et philosophie des mathématiques

Tom Archibald (SFU)

Model Theory | Théorie des modèles

Patrick Speissegger, Omar Sanchez (McMaster)

Non-linear PDE of mathematical physics | Les EDP nonlinéaires venant de la physique mathématique

Lia Bronsard (McMaster)

Origin and Evolution of Bacterial Genomes

Origine et évolution des génomes bactériens

Paul Higgs, Ralph Pudritz (McMaster)

Stochastic Models and Applications

Modèles stochastiques et applications

Shui Feng(McMaster), Bruno Remillard (HEC Montreal)

Teaching Introduction to Proofs Courses

Enseigner l'introduction aux preuves

Shay Fuchs (Toronto)

Toric and Combinatorial Algebraic Geometry

Géométrie algébrique torique et combinatoire

Jessie Yang(McMaster), Eric Katz(Waterloo)

Contributed Papers | Communications libres

AARMS-CMS Student Poster Session | Présentations par affiches pour étudiants

AARMS-CMS Student Poster Session

Présentations par affiches pour étudiants

Looking Forward to Doing Much More

Johan Rudnick, CMS, Executive Director

As the national association promoting the advancement, discovery, learning, and application of mathematics, the CMS engages and serves a broad mathematics community across Canada and internationally. The time has long since past when the primary CMS focus was meetings and publications – today's CMS is involved in a myriad of additional other activities and probably more so in the years to come.

In 2012, CMS was busy on the national as well as the international stage. The CMS promoted and helped celebrate Mathematics of Planet Earth (MPE2013) through a series of public lectures that were staged with university and institute partners across Canada. The CMS solidified a national partnership network of universities across Canada to engage students in national mathematics competitions. The CMS began preparations in earnest for the introduction on a contemporary set of by-laws in 2014. And the CMS promoted Canadian mathematics at the inaugural Mathematical Congress of the Americas 2013 in Guanajuato, Mexico. At the same time, the CMS continued to develop its core membership, research, and learning program initiatives.

Operationally, the CMS has historically relied heavily on journal publication revenues to sustain overall operations. Today the viability of academic publications is being challenge by a shift from controlled research distribution to subscribed research services coupled with the evolution of Open Access. As a result CMS is being challenged to transform and recast its publishing activities while at the same time diversifying its revenue stream. The requisite transformation of CMS operations necessitates a certain level of investment and some considerable time to complete.

The 2013 preparatory work on new CMS by-laws provided a unique opportunity to begin assessing the current state of CMS governance, management, and operations. In addition, the new by-laws are expected to result in a smaller more efficient and representative Board. The renewed CMS Board in 2014 is expected to have an early opportunity to assess what CMS should be doing and how best to do it.

Financially CMS incurred an operating deficit in 2013 and is expected to continue to do so over the next few years until additional revenues develop. Fortunately, the CMS has a mature investment fund to sustain operations. As a result of the general 2013 investment market recovery, notwithstanding the operating deficit, the net value of the CMS increased in 2012.

As the multi-year cycle of quiet CMS renewal and development continues to unfold, so will the vision of a Canada where mathematics is robustly supported, developed and applied to fuel individual, sectorial, and national prosperity. In that future state, the CMS will definitely be doing much more than meetings and publications.

En attendant d'en faire encore plus

En tant que porte-parole national ayant pour mission de promouvoir l'avancement, la découverte et l'apprentissage des mathématiques, ainsi que les applications qui en découlent, la SMC est au service de la grande communauté mathématique du Canada et d'ailleurs. Il s'en est écoulé du temps depuis que le principal rôle de la SMC était l'organisation de ses Réunions et ses publications. La SMC d'aujourd'hui prend part à toutes sortes d'autres activités, et en rajoutera probablement encore de nouvelles dans les années à venir.

En 2012, la SMC a été occupée tant au pays que sur la scène internationale. La Société a fait la promotion et participé à la célébration de Mathématiques de la planète Terre (MPT2013) par l'entremise d'une série de conférences publiques organisées avec des universités et instituts partenaires d'un peu partout au Canada. Elle a consolidé un réseau national de partenariat entre les universités du pays pour stimuler la participation d'étudiants à des concours nationaux de mathématiques. Elle se prépare à adopter un nouveau règlement administratif actualisé en 2014. Et elle a fait la promotion des mathématiques canadiennes au premier Congrès mathématique des Amériques 2013 à Guanajuato, au Mexique. Tout cela en poursuivant le développement de ses activités pour les membres et de ses programmes de recherche et d'éducation.

Du côté des opérations, la SMC mise depuis longtemps sur les recettes tirées de la publication de ses revues pour financer son fonctionnement général. Aujourd'hui, la viabilité des publications scientifiques est remise en question en raison de la disparition des services de recherche contrôlés au profit des services de recherche par abonnement, ainsi que de la popularité croissante d'Open Access. Résultat : la SMC est appelée à transformer et à recentrer ses activités de publication, tout en diversifiant ses sources de revenus. Ces transformations obligées des opérations de la SMC nécessitent un certain niveau d'investissement et prennent un certain temps.

Les travaux préparatoires réalisés en 2013 en vue de l'adoption du nouveau règlement administratif de la SMC nous ont donné une occasion unique d'entreprendre un examen de l'état actuel de la gouvernance, de la gestion et des opérations de la Société. Le nouveau règlement administratif prévoira également un conseil d'administration réduit, plus efficace et plus représentatif. On s'attend en outre à ce que le conseil renouvelé de 2014 ait la chance d'évaluer ce que la SMC devrait faire et comment elle devrait le faire.

Sur le plan financier, la SMC a enregistré un déficit en 2013, et l'on s'attend à ce que la même situation se reproduise dans les prochaines années, jusqu'à ce que la Société trouve de nouvelles sources de revenus. Heureusement, la SMC dispose d'un bon fonds d'investissement pour soutenir ses opérations. Grâce à la remontée générale du marché des investissements en 2013, et malgré le déficit enregistré, la valeur nette de la SMC a augmenté en 2012.

Alors que la SMC suit son cycle pluriannuel habituel de renouvellements et de développements, elle continue d'alimenter la vision d'un Canada où les mathématiques sont soutenues, développées et appliquées de façon énergique pour stimuler la prospérité individuelle, sectorielle et nationale. Dans ces nouvelles conditions, la SMC ne se limitera certainement pas à s'occuper de ses Réunions et de ses publications.

Rapport du président 2013

Keith Taylor, CMS President

La Société mathématique du Canada poursuit son élan grâce au travail acharné d'un grand nombre de membres de notre communauté et de notre professionnel du bureau d'Ottawa. Dans mon bref rapport, je ne peux que souligner quelques-uns des volets du large éventail d'activités de la SMC. On brosse un tableau beaucoup plus complet dans le rapport annuel intégral.

Le roulement a été important au sein de l'Exécutif de l'organisation puisque les quatre vice-présidents, à savoir Karl Dilcher (Atlantique), Olivier Collin (Québec), Stephen Kudla (Ontario) et Elena Braverman (Ouest), ont terminé leur mandat et ont été remplacés par Robert van den Hoogen, Louigi Addario-Berry, Gregory Smith et Mark Lewis respectivement. Je souhaite remercier sincèrement les anciens vice-présidents de leur contribution à l'organisation. Lia Bronsard s'est jointe à l'Exécutif au poste de présidente élue et David Oaken a accepté le poste de trésorier. Notre directeur exécutif, Johan Rudnick, est également un des membres principaux du Comité exécutif. Les nouveaux membres se sont mis au fait des dossiers intéressants d'actualité avec grand enthousiasme.

Après de nombreuses années de service à la SMC, David Rogers a quitté le poste de trésorier. Il nous a beaucoup manqué à la dernière réunion de l'Exécutif. Grâce à son professionnalisme empreint d'une grande amabilité et à ses connaissances approfondies du fonctionnement de la SMC, David a donné un excellent survol des finances de l'organisation pendant une période difficile marquée par un marché de placement à la baisse et où les niveaux de revenus suivaient difficilement les dépenses.

On a organisé un premier Congrès mathématique des Amériques (CMA) au Mexique au mois d'août 2013. Jacques Hurtubise a eu l'amabilité de représenter la SMC à la réunion des présidents de société, qui a eu lieu en parallèle au Congrès. Grâce peut-être à l'impression qu'a laissée Jacques, les organisateurs ont invité la SMC à présenter une soumission pour être l'hôte du prochain Congrès mathématique des Amériques. Ayant eu l'approbation de l'Exécutif, Jacques et le bureau de la SMC ont préparé une proposition nationale convaincante qui avait l'appui des instituts et d'autres organisations. Bien que l'Argentine ait également présenté une excellente proposition, le Canada s'est vu conférer l'honneur d'organiser la rencontre en 2017, à Montréal. Le CMA pourrait s'avérer une conférence exceptionnelle et une occasion de nouer ou d'améliorer des relations scientifiques avec des chercheurs et des enseignants aux valeurs semblables à l'échelle des Amériques. J'incite tous les mathématiciens à songer à des moyens de participer, surtout en proposant des séances scientifiques.

Les deux rencontres scientifiques de la SMC ont été très réussies. La réunion d'été a eu lieu à Halifax et celle de l'hiver à Ottawa.

La SMC a souligné la contribution d'un certain de membres exceptionnels de notre communauté en leur décernant des prix en 2013. Les voici :

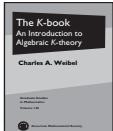
- Eddy Campbell, de l'Université du Nouveau-Brunswick, a été lauréat du prix Graham-Wright pour service méritoire.
- Kenneth Davidson, de la University of Waterloo et Alex Wright ont remporté le prix G. de B. Robinson pour leur article intitulé « Operator algebras with unique preduals », qui a paru dans le *Bulletin canadien de mathématiques*.
- John McLoughlin, de l'Université du Nouveau-Brunswick, a remporté le prix Adrien-Pouliot.
- Marc Ryser a été lauréat du Prix de doctorat 2013 pour sa thèse de recherche à l'Université McGill.
- Balázs Szegedy, de la University of Toronto, a présenté l'allocution plénière pour le prix Coxeter-James.
- Chantal David, de l'Université Concordia, a présenté l'allocution plénière pour le prix Krieger-Nelson.
- Zinovy Reichstein, de la University of British Columbia, a présenté l'allocution plénière pour le prix Jeffery-Williams.
- Jan Minac, de la Western University, a été lauréate du Prix d'excellence en enseignement de la SMC.

L'activité publique liée aux mathématiques principale qu'il convient de noter l'an dernier est sans doute MPT2013. L'activité s'est transformée en un mouvement mondial et se poursuit sous la désignation Mathématiques pour la planète Terre (<http://mpe.dimacs.rutgers.edu/>). L'ancienne présidente de la SMC, Christiane Rousseau, en est l'auteure, et c'est à ses efforts qu'on impute la grande réussite de MPT2013 aujourd'hui. La SMC a lancé l'initiative au Canada et, en collaboration avec le PIMS, l'institut Fields, le CRM, la AARMS et un certain nombre d'universités, a parrainé une série bien appréciée de conférences publiques à l'échelle nationale.

Le Comité exécutif et le Conseil d'administration s'affairent à rédiger les nouveaux règlements administratifs de la SMC à la suite de l'adoption d'une nouvelle loi fédérale sur la gouvernance des organisations sans but lucratif. On s'attend à fixer la version finale de ces règlements administratifs au cours de l'AGA à venir cet été, à Winnipeg. Ce sera pour moi ma dernière réunion en ma qualité de président. À la fin du mois de juin, je passerai les rênes à la très compétente professeure Lia Bronsard, de la McMaster University.

On Display *at the* CMS Summer Meeting

Titles from the
American Mathematical Society



The K-book

An Introduction to Algebraic K-theory

Charles A. Weibel, Rutgers University, New Brunswick, NJ

A comprehensive introduction to the subject of algebraic K-theory that takes the reader from the basics of the subject to the state of the art.

Graduate Studies in Mathematics, Volume 145; 2013; 618 pages; Hardcover; ISBN: 978-0-8218-9132-2; List US\$89; AMS members US\$71.20; Order code GSM/145



Pearls from a Lost City

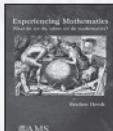
The Lvov School of Mathematics

Roman Duda, University of Wrocław, Poland

Translated by Daniel Davies

This chronicle of the Lvov school—its legacy and the tumultuous historical events which defined its life-span—will appeal equally to mathematicians, historians, or general readers seeking a cultural and institutional overview of key aspects of twentieth-century Polish mathematics not described anywhere else in the extant English-language literature.

History of Mathematics, Volume 40; 2014; approximately 216 pages; Hardcover; ISBN: 978-1-4704-1076-6; List US\$39; AMS members US\$31.20; Order code HMATH/40



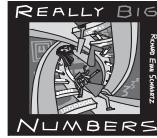
Experiencing Mathematics

What do we do, when we do mathematics?

Reuben Hersh, University of New Mexico, Albuquerque, NM

This book of selected articles and essays provides an honest, coherent, and clearly understandable account of mathematicians' proof as it really is, and of the existence and reality of mathematical entities.

2014; approximately 282 pages; Softcover; ISBN: 978-0-8218-9420-0; List US\$39; AMS members US\$31.20; Order code MBK/83

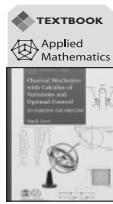


Really Big Numbers

Richard Evan Schwartz, Brown University, Providence, RI

This book guides readers on an accelerated tour through the number system, starting with small numbers and building up to ones too huge for names. Travel part of the way to infinity!

2014; 192 pages; Softcover; ISBN: 978-1-4704-1425-2; List US\$25; AMS members US\$20; Order code MBK/84

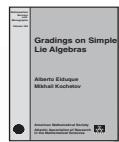


Classical Mechanics with Calculus of Variations and Optimal Control

Mark Levi, Pennsylvania State University, University Park, PA

An intuitively motivated, original, and insightful presentation of many topics in classical mechanics and related areas of control theory and calculus of variations.

Student Mathematical Library, Volume 69; 2014; 299 pages; Softcover; ISBN: 978-0-8218-9138-4; List US\$42; AMS members US\$33.60; Order code STML/69



Gradings on Simple Lie Algebras

Alberto Elduque, Universidad de Zaragoza, Spain, and Mikhail Kochetov, Memorial University of Newfoundland, St. John's, NL, Canada

This monograph is a self-contained exposition of the classification of gradings by arbitrary groups on classical simple Lie algebras over algebraically closed fields of characteristic not equal to 2 as well as on some nonclassical simple Lie algebras in positive characteristic.

Mathematical Surveys and Monographs, Volume 189; 2013; 336 pages; Hardcover; ISBN: 978-0-8218-9846-8; List US\$98; AMS members US\$78.40; Order code SURV/189



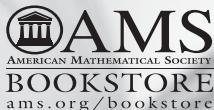
Random Matrices and the Six-Vertex Model

Pavel Bleher, Indiana University-Purdue University Indianapolis, IN, and Karl Liechty, University of Michigan, Ann Arbor, MI

A detailed description of the Riemann-Hilbert approach (RH approach) to the asymptotic analysis of both continuous and discrete orthogonal polynomials.

Titles in this series are co-published with the Centre de Recherches Mathématiques.

CRM Monograph Series, Volume 32; 2014; 224 pages; Hardcover; ISBN: 978-1-4704-0961-6; List US\$98; AMS members US\$78.40; Order code CRMIM/32



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