CMS NOTES de la SMC

June juin 2015

IN THIS ISSUE DANS CE NUMÉRO

Canadian Mathematical Society
Société mathématique du Canada

Vice-President's Notes /Notes du Vice-président

Mark Lewis, *University of Alberta, Vice-President -Western Provinces and Territories*

Calculus that delivers

With two calculus-aged students at home and a recent foray into teaching freshman students under my belt, I have been reflecting on the way we deliver calculus in bigger, research-intensive universities. I know many are professionally better qualified than I to opine on this. My only real qualifications, other than having had glimpses of the "teenage brain" and having taught first-year calculus, is being newly involved in an effort to develop an alternative calculus course at the University of Alberta.

We are challenged at the postsecondary level to provide freshman students with the best possible calculus education. Ideally it would be good to teach small classes, where instructors know the name of each student. While this is sometimes possible in smaller universities and colleges, it is typically beyond the reach of bigger research-intensive universities. Here, a mixture of large numbers of students, fiscal constraints, and a strong emphasis upon providing resources for research make it difficult if not impossible to make the small classes available at the first-year level.

Exceptions do exist. For example, my home university, the University of Alberta, has a successful Science 100 program, which specializes in teaching interdisciplinary, first-year science to a small class of highly motivated students. I know other large universities, such as UBC have similar programs. However, such programs are very expensive, difficult to mainstream, and can be the first to fall when cutbacks loom.

For some students, the first-year calculus class is a source of

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Des cours de calcul qui donnent des résultats

Ayant deux jeunes en âge d'apprendre le calcul différentiel et intégral à la maison et une expérience récente d'enseigner à des étudiants de première année d'université à mon actif, je réfléchis depuis un certain temps à la façon d'enseigner cette matière dans les grandes universités de recherche. Je reconnais que vous êtes nombreux à être plus qualifiés professionnellement que moi pour faire une réflexion à ce sujet. Ma seule vraie compétence, à part avoir un aperçu du « cerveau adolescent » et avoir enseigné le calcul à des étudiants de première année, c'est de faire partie depuis peu d'une initiative visant à élaborer un nouveau cours de calcul à l'Université de l'Alberta.

On nous demande, au postsecondaire, d'offrir aux nouveaux étudiants universitaires les meilleurs cours de calcul possible. L'idéal serait de pouvoir enseigner à de petits groupes, où les professeurs connaissent les étudiants par leur prénom. Bien que cela soit possible dans de petites universités et les collèges, ça ne l'est généralement pas dans les grands établissements axés sur la recherche. Ici, c'est à la fois en raison du grand nombre d'étudiants, de compressions budgétaires et d'un effort constant pour trouver les ressources nécessaires à la recherche qu'il est difficile, voire impossible, de former de petits groupes en première année.

Mais il y a des exceptions. Mon université, par exemple, l'Université de l'Alberta. Elle offre un programme exceptionnel de Science 100, dont l'objectif est d'enseigner les sciences de première année à un petit groupe d'étudiants de plusieurs disciplines très motivés. Je

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Opinions

Robert Dawson
Saint Mary's University, Halifax

In the last month I've heard that some CMS members are dissatisfied with the March-April cover article by Dr. Robert van den Hoogen, the Vice-President for the Atlantic region. Various people have disagreed with van den Hoogen's views on program prioritization and the sustainability of mathematics major and graduate programs. At least one person has expressed this dissatisfaction on a well-known blog.

It might be a good time for us all to remember that nobody writing in the Notes is writing as spokesperson of the CMS. When a vice president writes an article for us, he or she is expressing his/her own opinions. The same is true of the President - and very definitely also of the editors.

Mathematicians being what we are, no doubt a significant proportion of you are even now analyzing my last sentence, wondering whether your editor has stumbled into a new variant of Epimenides' Liar Paradox. Well, actually, that's a statement of fact, not an opinion, and as such hopefully trustworthy. In the same way, Dr. van den Hoogen was stating easily verifiable facts when he stated that Program Prioritization is a reality that we will have to learn to live with.

But what of the rest of the membership? Where do your opinions fit in? What do you do if your views on Program Prioritization differ? Let me remind you all of another fact, one that is by no means a secret but is often forgotten.

The Notes publishes letters to the Editors and contributed articles.

No, you don't see them very often. That's not because we're suppressing them - it's because we're very rarely getting them. Feel free to help us out on this.

We don't guarantee we'll publish everything we're sent. We will certainly not publish anything that seems to us to be actionable, unpleasant, or just plain quarrelsome. We won't publish your proof (correct or otherwise) of Fermat's Last Theorem or your used-car ad. And if we find ourselves short of space, we might have to pass on material we'd have liked to have published. But that's a problem we'll happily deal with when we come to it. If you have a view on something we've published –or something we haven't –let us know.

Please!

Opinions

Robert Dawson
Saint Mary's University, Halifax

Au cours du dernier mois, j'ai appris que quelques membres de la SMC étaient insatisfaits de l'article vedette de l'édition du mois de mars-avril, article qui a été rédigé par le Dr Robert van den Hoogen, vice-président de la Région de l'Atlantique. Diverses personnes ne partagent pas les mêmes opinions que M. van den Hoogen au sujet de la priorisation des programmes et de la pérennité des programmes de diplôme avec spécialisation en mathématiques et les programmes des cycles supérieurs dans le domaine. Au moins une personne a indiqué son mécontentement sur un blogue bien connu.

Le moment est venu, je pense, de se rappeler que toute personne qui écrit dans les Notes n'écrit pas au nom de la SMC. Lorsqu'un vice-président nous propose un article, il n'y exprime que ses opinions personnelles. Il en va de même pour le président… et tout autant pour les rédacteurs.

Notre nature de mathématicien étant ce qu'elle est, je n'ai nul doute que la grande majorité de vous qui me lisez analysez déjà ma dernière phrase, en vous demandant si votre rédacteur est tombé par pur hasard sur une nouvelle variante du paradoxe du menteur d'Épiménide. Et bien, à vrai dire, c'est un énoncé de faits et non pas une opinion. Par conséquent, j'espère qu'on peut s'y fier. Dans un même ordre d'idées, le Dr van den Hoogen relatait des faits facilement vérifiables lorsqu'il a dit que nous devrons tous nous habituer à ces exercices de priorisation.

Et qu'advient-il des autres membres? Où se situent vos opinions par rapport à tout cela? Que faites-vous si vous ne partagez pas les mêmes opinions sur cette question d'établissement des priorités? Permettez-moi de vous rappeler un autre fait, un qui n'est certes pas un secret, mais qu'on oublie trop souvent.

On retrouve dans les Notes des lettres aux rédacteurs et des articles proposés par des membres.

Non, vous n'en voyez pas souvent. Ce n'est pas que nous les supprimons, mais plutôt parce que nous n'en recevons pas fréquemment. Je vous invite à nous aider à cet égard.

Nous ne garantissons pas de publier tout ce que nous recevons. Certes, nous ne publierons aucun d'article qui, selon nous, pourrait donner matière à procès, est déplaisant ou incite à confrontation. Nous ne publierons pas vos preuves incontestables (qu'elles soient fondées ou non) du dernier théorème de Fermat ni l'annonce de vente de votre voiture d'occasion. Et faute d'espace, nous devrons peut-être parfois laisser tomber quelques articles, même si nous aurions bien aimé les publier. Il s'agit toutefois d'un problème que nous réglerons volontiers lorsqu'il se présentera. Si vous avez une opinion à formuler au sujet d'un article que nous avons publié –ou que nous n'avons pas publié –veuillez nous l'indiquer.

De grâce!

2015 CMS MEMBERSHIP RENEWALS

RENOUVELLEMENTS 2015 À LA SMC

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 cms.math.ca/forms/member

Les avis de renouvellements ont été envoyés électroniquement. Veuillez s-il-vous-plaît renouveler votre adhésion le plus tôt possible. Vous pouvez aussi renouveler au site Web cms.math.ca/forms/member?fr=1

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-letters@cms.math.ca**

Lettres aux Rédacteurs

Les rédacteurs des NOTES acceptent les lettres en français ou en anglais portant sur n'importe quel 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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Continued from cover

alienation from mathematics. From my own experience, I know that this certainly true in the life sciences, where the seeming lack of applicability to biology and medicine can leave the students wondering "why should I care about mathematics?" The somewhat impersonal large classroom environment can serve to compound this sense of alienation.

How are larger research-intensive universities to offer a better experience in this world of diminished resources and changing expectations? We need to find the best possible ways to re-engage students when we deliver our first-year calculus material. Nothing is a substitute for a good instructor. Some large universities make this a strategic focus, moving to the Teaching Professor model, where top teaching faculty are recruited, with expectations of leadership in the area of teaching and research in the area of post-secondary education. However, not all universities agree that this is the route to take if they are to simultaneously excel in both teaching and broader research goals.

Specialty courses are another possibility. With so many sections of first-year calculus, it is possible to create different courses for physicists, business students, life scientists and so forth. These courses can then demonstrate the real connections between calculus and applications areas, inspiring the students to internalize the calculus material by connecting it to their application area. Many universities have taken this approach. Sometimes these specialty courses have been designed to be "dead end," and cannot lead to further mathematics courses. I believe "dead end" course designations are a real mistake, implicitly discouraging students in certain disciplines to continue in mathematics.

Fortunately, textbook writers have realized that the educational future includes specialty calculus courses, and have written many new fine quality texts. In my area of mathematics and the life sciences, there is a burgeoning supply of very high quality texts that are easy to use.

There is growing a trend towards harnessing internet technology in our teaching. What of Massive Open Online Courses (MOOCs)? Once heralded as the new mode for developing course content, these are online courses aimed at unlimited participation and open access via the web. As well as videos, reading material, and problem sets, MOOCs can provide interactive user forums to support community interactions between students and teachers. MOOCs are relative newcomers, emerging as a popular mode of learning in 2012.

Would they work for first-year calculus students? Initial analysis of success rates for MOOCs has shown a high level of drop out, with about 10 percent actually completing the MOOC (Onah et al., 2014). Even with excellent teachers and content, MOOCs rely on students to take much of the control and responsibility for the learning, without the benefit of a live instructor in the classroom.

An alternative comes from staying with the live classroom environment but rethinking the way we deliver material in and out of class. The flipped classroom, pioneered by the Harvard physicist Eric Mazur (http://en.wikipedia.org/wiki/Flipped_classroom), is an instructional methodology that changes the traditional mix of lectures within the classroom and homework outside the classroom. It delivers some of the instructional content online, using methods such as YouTube videos. It moves other activities, such as homework problem solving, into the classroom where students get guidance and feedback. Other activities can include real-time electronic feedback from students during lecture, in-class group evaluation of tests, and collaborative online discussions. The idea is to re-engage the students, changing the classroom experience from passive in-class information absorption to active engagement. Not all students, and certainly not all instructors, favour this flipped classroom concept, although it holds the promise for improved performance as well as livelier in-class dynamics.

One reason that the flipped classroom could prevail is that, unlike many of us who teach the courses, student brains appear to be wired for the information age, just as much as their phones and laptops are. Already, YouTube is a favoured method for learning mathematics, with multiple videos available online. Short individual instructional videos of 5-10 minutes length make it easy to introduce the information. Electronic feedback and communication is totally natural for the students taking the classes.

I am sure that many, myself included, feel ambivalent about the flipped classroom model. I well remember hours of concentrated effort on my own, working through problem after problem in the textbook. I cannot help but think that it was that effort that helped me become a better mathematician. I do not want to dilute such formative experiences for the next generation of scientists. However, times have changed, and I hope that the flipped classroom can still deliver the needed content, but in a new and better format.

So what of my own efforts at the University of Alberta? A group of us are designing a new Calculus for the Life Sciences course, trying to strike the right balance between calculus content and biological applications. This course is meant to have the same rigour as the regular calculus course, but engage students in a new way, both with respect to biological content and by incorporating the best of what the flipped classroom has to offer. It is with some trepidation but considerable excitement that I view my fall teaching assignment. If you would like to know how well it works, ask me in six months.

References

[1] Onah, D. F., Sinclair, J., & Boyatt, R. (2014). Dropout rates of massive open online courses: behavioural patterns. EDULEARN14 Proceedings, 5825-5834.v

CALENDAR NOTES

Calendar Notes brings current and upcoming domestic and select international mathematical sciences and education events to the attention of the CMS readership. Comments, suggestions, and submissions are welcome.

Johan Rudnick, *Canadian Mathematical Society, (director@cms.math.ca)*

Le calendrier des activités announce aux lecteurs de la SMC les activités en cours et à venir, sur la scène pancanadienne et internationale, dans les domaines des mathématiques et de l'enseignement des mathématiques. Vos commentaires, suggestions et propositions sont le bienvenue.

Johan Rudnick, *Société mathématique du Canada (directeur@smc.math.ca)*

JUNE 2015

1-4 CanaDAM **5th biennial Canadian Discrete and Algorithmic Mathematics Conference**, University of Saskatchewan, Sask.

5-8 **CMS Summer Meeting**, University of Prince Edward Island, Charlottetown, P.E.I

5-9 CMESG **2015 Meeting**, University of Moncton, Moncton, N.B.

7-12 AMMCS- CAIMS **2015 AMMCS-CAIMS Congress**, Waterloo, Ont.

10 PIMS **Marsden Memorial Lecture: Yann Brenier**, École Polytechnique Fédérale de Lausanne, Switzerland

10-13 **2015 Joint International Meeting** with the AMS, the European Mathematical Society (EMS) and the Sociedade Portuguesa de Matemática (SPM) University of Porto, Porto, Portugal

12-14 FIELDS **Math and Coding Symposium**, Faculty of Education, Western University, Ont.

13-14 FIELDS/CANSSI Thematic Program on Statistical Inference, Learning and Models for Big Data, **Closing Conference**, Toronto, Ont.

14-17 SSC **2015 43rd Annual Meeting**, Dalhousie University, Halifax, N.S.

15-16 FIELDS/CRM **Séminaire de Mathématiques Supérieures - Geometric and Computational Spectral Theory**, Montreal, Que.

17-21 **Canadian Undergraduate Mathematics Conference**, University of Alberta, Alta.

29-J7 PIMS **Symposium on the Geometry and Topology of Manifolds**, University of British Columbia, B.C.

JULY 2015

6-8 AARMS **International Symposium in Statistics** 2015, Memorial University, St. John's, N.L.

6-10 IWOTA 2015 **Workshop on Operator Theory & Applications**, Tbilisi, Georgia

8-11 Canadian Undergraduate Computer Science Conference, University of British Columbia, Okanagan, B.C.

AUGUST 2015

3-8 AARMS **"Domain Decomposition Methods for PDEs" Short Course + Collaborative Workshop**, Halifax, N.S.

17-21 PIMS **Combinatorial Constructions on Topology,** University of Regina, Regina Sask.

17-21 **Sixth Montreal Industrial Problem Solving Workshop**, Centre de recherches mathématiques, Montreal, Que.

17-21 AARMS, **AHA 2015**, Dalhousie University, Halifax, N.S.

31-S4 CRM **Conference on Topology, Geometry & Dynamics in honor of François Lalonde**, Montreal, Que.

SEPTEMBER 2015

14-21 FIELDS **Workshop on Symbolic Combinatorics and Computational Differential Algebra,** The Fields Institute, Toronto, Ont.

OCTOBER 2015

26-31 FIELDS **Workshop on Linear Computer Algebra and Symbolic-Numeric Computation,** The Fields Institute, Toronto, Ont.

DECEMBER 2015

4-7 **2015 CMS Winter Meeting,** McGill University, Montreal, Que.

7-10 SIAM **Conference on Analysis of Partial Differential Equations,** Scottsville, Arizona

7-11 **39th Australian Conference on Combinatorial Math & Combinatorial Computing,** Brisbane, Australia.

7-16 FIELDS **Workshop on Algebra, Geometry and Proofs in Symbolic Conputation**, The Fields Institute, Toronto, Ont.

14-18 **Geometric & Categorical Representation Theory,** Mooloolaba, Queensland, Australia

Book Review Notes brings interesting mathematical sciences and education publications drawn from across the entire spectrum of mathematics to the attention of the CMS readership. Comments, suggestions, and submissions are welcome.

Karl Dilcher, *Dalhousie University (notes-reviews@cms.math.ca)*

Les critiques litéraires présent aux lecteurs de la SMC des ouvrages intéressants sur les mathématiques et l'enseignement des mathématiques dans un large éventail de domaines et sous-domaines. Vos commentaires, suggestions et propositions sont le bienvenue.

Karl Dilcher, *Dalhousie University (notes-critiques@smc.math.ca)*

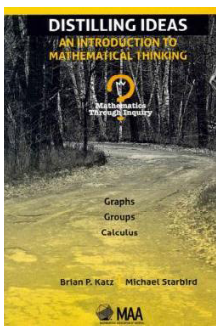
Distilling Ideas: An Introduction to Mathematical Thinking (Mathematics Through Inquiry)

by Brian P. Katz and Michael Starbird

Mathematical Association of America, 2013

ISBN: 978-1-93951-203-1

Reviewed by ***Richard Hoshino,*** *Quest University Canada*



The Merriam-Webster Dictionary defines distilling as "the process of taking the most important parts of something and putting them in a different and usually improved form." Alternative definitions of this word include "concentrating," "purifying," "refining" and "extracting the essential elements."

All of these definitions are encapsulated by the excellent book Distilling Ideas: An Introducing to Mathematical Thinking. Unlike a traditional textbook that seeks to impart content through the delivery of definitions, formulas, proofs, tools, skills and exercises, Katz and Starbird present a pedagogy for teaching graph theory, group theory and calculus via an alternative approach of having the students distill mathematical ideas through the six-fold approach of abstraction, exploration, conjecture, justification, application and extension.

In a typical undergraduate graph theory course, teachers begin the course with a formal definition of a graph (V, E), with vertex set $\{v_1, v_2, \ldots, v_n\}$ and edge set $\{e_1, e_2, \ldots, e_m\}$. On the other hand, Katz and Starbird begin their graph theory chapter by presenting three seemingly unrelated problems: the Bridges of Königsberg, the Five Station Quandary and the Gas-Electricity-Water Dilemma. The objective is for a student to discover, through the process of solving these three problems, that the essential ingredients in each problem are locations and connections, from which an abstract definition of $G = (V, E)$ makes sense to the student, both intuitively and contextually.

Once the process of abstraction is complete, the student can begin exploring the definitions, asking precise questions to formulate conjectures: if a graph is "traceable", i.e., if there is a way to walk along each edge of the graph exactly once, what properties must the graph hold? Once exploration leads to the asking of the right question, the student is able to formulate a conjecture, which is then rigorously justified, and applied to find a three-line solution to the Bridges of Königsberg problem. After applying the theories to solve problems, the student is naturally motivated to generalize: finding extensions, based on their ideas, definitions and theorems.

When we mathematicians create mathematics, we usually start with our own questions rather than begin with somebody else's answers. It is this process that Katz and Starbird try to replicate through their inquiry-based book, to challenge the definition-theorem-proof approach used in most undergraduate classrooms, where the mathematics is handed down as a finished product from an authority, pre-packaged, pure and polished.

This is why the Group Theory chapter begins with a section on rotating an equilateral triangle to motivate the four-part definition of a group, rather than with the definition of a group and the formal definitions of binary, well-defined, closed, and identity. This is why the Calculus chapter begins with Zeno's paradox to motivate the idea of convergence, emphasizing the "important role of starting with an appealing intuitive idea and then mercilessly refining and specifying the notion until we have finally formulated rigorous definitions that unequivocally capture our generative intuition." (p. 91).

"Distilling Ideas is a welcome resource for mathematics faculty interested in exploring non-traditional approaches of teaching graph theory, group theory and calculus."

Since joining the faculty of a small Canadian liberal arts university two years ago, I have taught every course using an inquiry-driven approach, and have found that my students, none of whom are "math majors," achieve a surprising depth of mastery and retention. Recently, I taught introductory Calculus, and applied the material in Distilling Ideas to help students carefully create rigorous definitions that captured their intuitive notions of limits, derivatives and integrals.

There are several minor shortcomings in this book: I would have liked to see more contextual graph theory problems, such as the "six people at a party" puzzle to motivate Ramsey Theory, or a scheduling problem that can be solved by transforming into an equivalent simpler problem in graph colouring. Also, I feel the section on clock arithmetic could have been placed before the formal definition of a group, rather than after.

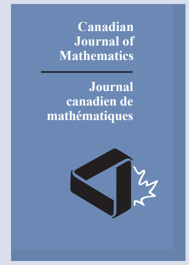
As the authors point out, "researchers in the field of human learning have found that the best learning occurs through a process of engaged struggle with the ideas" (Preface, p. x). The guided investigations in this book facilitate engaged struggle, and would particularly be of benefit to faculty teaching upper-year students in small seminars, using the six-fold approach advocated this book to drive student learning.

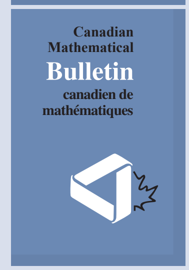
Despite the high price tag ($45 for MAA members and $54 for non-MAA members), Distilling Ideas is a welcome resource for mathematics faculty interested in exploring non-traditional approaches of teaching graph theory, group theory and calculus.

Richard Hoshino is author of the recently published novel The Math Olympian.

Call for Nominations — CJM/CMB Associate Editors

The Publications Committee of the CMS solicits nominations for five Associate Editors for the Canadian Journal of Mathematics (CJM) and the Canadian Mathematical Bulletin (CMB). The appointment will be for five years beginning January 1, 2016. The continuing members (with their end of term) are below.





For over fifty years, the Canadian Journal of Mathematics (CJM) and the Canadian Mathematical Bulletin (CMB) have been the flagship research journals of the Society, devoted to publishing original research works of high standard. The CJM publishes longer papers with six issues per year and the CMB publishes shorter papers with four issues per year. CJM and CMB are supported by respective Editors-in-Chief and share a common Editorial Board.

Expressions of interest should include your curriculum vitae, your cover letter and sent electronically to: cjmcmb-ednom-2015@cms.math.ca before **November 15th 2015**.

Current Members of CJM/CMB Editorial Board:

Henry Kim (Toronto)	12/2016	Editor-in-Chief CJM
Robert McCann (Toronto)	12/2016	Editor-in-Chief CJM
Jie Xiao (Memorial)	12/2019	Editor-in-Chief CMB
Xiaoqiang Zhao (Memorial)	12/2019	Editor-in-Chief CMB
Louigi Addario-Berry (McGill)	12/2018	Associate Editor
Florin Diacu (Victoria)	12/2016	Associate Editor
Ilijas Farah (York)	12/2015	Associate Editor
Skip Garibaldi (UCLA)	12/2016	Associate Editor
Dragos Ghioca (UBC Vancouver)	12/2018	Associate Editor
Eyal Goren (McGill)	12/2018	Associate Editor
Robert Leon Jerrard (Toronto)	12/2016	Associate Editor
Izabella Laba (UBC Vancouver)	12/2015	Associate Editor
Anthony To-Ming Lau (Alberta)	12/2016	Associate Editor
Alexander Litvak (Alberta)	12/2016	Associate Editor
Alexander Nabutovsky (Toronto)	12/2015	Associate Editor
Assaf Naor (Courant Institute)	12/2018	Associate Editor
Erhard Neher (Ottawa)	12/2016	Associate Editor
Frank Sottile (Texas A&M)	12/2015	Associate Editor
McKenzie Wang (McMaster)	12/2016	Associate Editor
Juncheng Wei (UBC Vancouver)	12/2018	Associate Editor
Daniel Wise (McGill)	12/2018	Associate Editor
Efim Zelmanov (UCSD)	12/2016	Associate Editor

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Volume 47 No. 3, June 2015

Coxeter-James Prize

Dong Li

University of British Columbia Professor Dong Li is one of the leading young mathematicians in Canada and the recipient of the 2015 CMS Coxeter-James prize. Dong is described as, "one of the top young researchers working the broad area of Analysis and Partial Differential Equations," by his colleagues. His main research field is mathematical fluid dynamics, nonlinear dispersive equations and mathematical physics. The Coxeter-James Prize was inaugurated in 1978 to recognize young mathematicians who have made outstanding contributions to mathematical research.

Prix Coxeter-James

Dong Li

Le professeur de l'Université de la Colombie-Britannique Dong Li est l'un des jeunes mathématiciens les plus illustres du Canada et lauréat du prix Coxeter-James 2015 de la SMC. Monsieur Li est décrit par ses collègues comme « l'un des meilleurs jeunes chercheurs s'intéressant au domaine général de l'analyse et des équations aux dérivées partielles ». Son domaine de recherche principal est la dynamique mathématique des fluides, des équations dispersives non linéaires et de la physique mathématique. Créé en 1978, le prix Coxeter-James rend hommage aux jeunes mathématiciens qui se sont distingués par l'excellence de leur contribution à la recherche mathématique.

Excellence in Teaching Award

Jamie Mulholland

Simon Fraser University (SFU) Senior Lecturer Jamie Mulholland is the 2015 recipient of the CMS Excellence in Teaching Award for his innovative teaching techniques. Jamie's colleagues describe him as a tremendously adaptable and flexible teacher –a master in the art of balancing the use of contemporary technology with face-to-face interactions. The Excellence in Teaching Award nationally recognizes sustained and distinguished contributions in mathematics education at the post-secondary undergraduate level at a Canadian institution.

Prix d'excellence en enseignement

Jamie Mulholland

Le professeur de l'Université Simon Fraser Jamie Mulholland est le lauréat 2015 du Prix d'excellence en enseignement de la SMC pour ses méthodes d'enseignement novatrices. Les collègues de Jamie le décrivent comme un enseignant des plus souples doté d'une capacité impressionnante de s'adapter – un maître de l'art de concilier technologie contemporaine et interactions individuelles. Le Prix d'excellence en enseignement souligne au niveau national une contribution soutenue et exceptionnelle à l'enseignement des mathématiques au premier cycle postsecondaire dans un établissement d'enseignement canadien.

Krieger-Nelson Prize

Jane Ye

University of Victoria Professor Jane J. Ye is the recipient of the 2015 Krieger-Nelson Prize for her outstanding research contributions. Jane's research includes optimization, optimal control theory and variational analysis, and its application in economics, engineering, management science, operations research and statistics. She has published over 70 articles and her work has been cited in almost 700 articles. The CMS Krieger-Nelson Prize was inaugurated to recognize outstanding research by a female mathematician.

Prix Krieger-Nelson

Jane Ye

Le professeure de l'Université de Victoria Jane J. Ye est lauréate du prix Krieger-Nelson 2015 de la SMC pour sa contribution exceptionnelle à la recherche. Ses travaux portent notamment sur l'optimisation, la théorie du contrôle optimal et l'analyse variationnelle et ses applications en sciences économiques, en génie, en science de la gestion, en recherche sur les opérations et en statistiques. Elle a publié plus de 70 articles, et son travail a été cité dans près de 700 articles. Le prix Krieger-Nelson de la SMC souligne la contribution exceptionnelle de mathématiciennes en recherche mathématique.

The Coxeter James Prize, Excellence in Teaching Award and the Krieger Nelson Prize will be presented at the June CMS Summer Meeting in Charlottetown, P.E.I.

Le prix Coxeter-James, le Prix d'excellence en enseignement et le prix Krieger-Nelson seront remis en juin à la Réunion d'été de la SMC qui se tiendra à Charlottetown (Î.-P.-É.).

Appel à candidatures — Rédacteur(trice) associé(e) pour le JCM et le BCM

Le Comité des publications de la SMC sollicite des mises en candidatures pour cinq postes de rédacteurs associés pour le Journal canadien de mathématiques (JCM) et pour le Bulletin Canadien de mathématiques (BCM). Le mandat sera de cinq ans qui commencera le 1er janvier 2016. Les membres qui continuent (avec la fin de leur terme) sont ci-dessous.

Revues phares de la Société depuis plus de 50 ans, le Journal canadien de mathématiques (JCM) et le Bulletin canadien de mathématiques (BCM) présentent des travaux de recherche originaux de haute qualité. Le JCM publie des articles longs dans ses six numéros annuels, et le BCM publie des articles plus courts quatre fois l'an. Le JCM et le BCM ont chacun leur rédacteur en chef et partagent un même conseil de rédaction.

Les propositions de candidature doivent inclure votre curriculum vitae, votre lettre de présentation et doivent être envoyé par courriel électronique à : jcmbcm-rednom-2015@smc.math.ca **au plus tard le 15 novembre 2015**.

Membres Actuels du Conseil de rédaction scientifique pour le JCM et le BCM:

Henry Kim (Toronto)	12/2016	Rédacteur en chef JCM
Robert McCann (Toronto)	12/2016	Rédacteur en chef JCM
Jie Xiao (Memorial)	12/2019	Rédacteur en chef BCM
Xiaoqiang Zhao (Memorial)	12/2019	Rédacteur en chef BCM
Louigi Addario-Berry (McGill)	12/2018	Rédacteur associé
Florin Diacu (Victoria)	12/2016	Rédacteur associé
Ilijas Farah (York)	12/2015	Rédacteur associé
Skip Garibaldi (UCLA)	12/2016	Rédacteur associé
Dragos Ghioca (UBC Vancouver)	12/2018	Rédacteur associé
Eyal Goren (McGill)	12/2018	Rédacteur associé
Robert Leon Jerrard (Toronto)	12/2016	Rédacteur associé
Izabella Laba (UBC Vancouver)	12/2015	Rédactrice associée
Anthony To-Ming Lau (Alberta)	12/2016	Rédacteur associé
Alexander Litvak (Alberta)	12/2016	Rédacteur associé
Alexander Nabutovsky (Toronto)	12/2015	Rédacteur associé
Assaf Naor (Courant Institute)	12/2018	Rédacteur associé
Erhard Neher (Ottawa)	12/2016	Rédacteur associé
Frank Sottile (Texas A&M)	12/2015	Rédacteur associé
McKenzie Wang (McMaster)	12/2016	Rédacteur associé
Juncheng Wei (UBC Vancouver)	12/2018	Rédacteur associé
Daniel Wise (McGill)	12/2018	Rédacteur associé
Efim Zelmanov (UCSD)	12/2016	Rédacteur associé

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CMS Notes
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Education Notes brings mathematical and educational ideas forth to the CMS readership in a manner that promotes discussion of relevant topics including research, activities, and noteworthy news items. Comments, suggestions, and submissions are welcome.

Jennifer Hyndman, *University of Northern British Columbia (hyndman@unbc.ca)*
John McLoughlin, *University of New Brunswick (johngm@unb.ca)*

Les articles sur l'éducation présente des sujets mathématiques et des articles sur l'éducation aux lecteurs de la SMC dans un format qui favorise les discussions sur différents thèmes, dont la recherche, les activités et des nouvelles d'intérêt. Vos commentaires, suggestions et propositions sont le bienvenue.

Jennifer Hyndman, *University of Northern British Columbia (hyndman@unbc.ca)*
John McLoughlin, *University of New Brunswick (johngm@unb.ca)*

The approach to mathematics education and the development of educators varies both within countries and across countries. John McLoughlin has had the opportunity to go to Ireland and witness first hand how mathematicians and educators can work together to create a joint program that creates teachers with a strong mathematical base. Here he reports on a resulting student research symposium and two conferences. Education Notes welcomes comments, suggestions or submissions on similar events in other countries.

Glimpses of Mathematics Education in Ireland

John McLoughlin
University of New Brunswick

This spring I have had the chance to be in Ireland learning a little about mathematics and education here. This article offers some insight into the perspectives gained in this experience. Specifically the focus of the article is on a symposium organized by the graduating class of students in a joint mathematics and education programme.

The National University of Ireland Galway (NUI Galway) offers a four year mathematics and education degree. The graduating (4th year) class of the BA in Mathematics and Education organizes a symposium following final teaching placements to conclude the Education component of the degree. These students, as I write in mid-April, are presently taking final exams in maths courses to conclude the degree requirements.

The Joint Programme Directors, Máire Ní Ríordáin and Aisling McCluskey, share these words in the booklet detailing the symposium:

"The BA in Mathematics and Education was established in 2008 and emerged from a vision to produce inspirational teachers of mathematics and applied mathematics, equipped with a strong honours mathematics degree. The programme has gone from strength to strength and this year's final year students have served as outstanding ambassadors for it in schools nationwide. Our students have shown unstinting commitment to the simultaneous and challenging pursuits of an honours mathematics degree and a post-primary teaching qualification. Their study of mathematics naturally and appropriately exceeds the minimal requirements for Teaching Council recognition, as befits such an aspirational programme. Their knowledge and skills in applied mathematics complete a solid mathematical education. Across the board, their undergraduate experience has emphasised depth of learning, breadth of knowledge, technological expertise, critical thinking and problem solving skills."

Mathematics and Education 4th Annual Research Symposium

The symposium on March 31, 2015 focused attention on the action research projects of the students. All students completed research projects connected to their final teaching placements. Many students presented research in the form of typical conference presentations, whereas, several others offered findings through poster presentations.

The day was symmetrical in form with opening (closing) remarks preceding (following) keynote talks. The heart of the program featured the student presentations with an allotment of time for the poster presentations in the morning. In fact, the poster presentations took place alongside a showcase of materials that were drawn out of the teaching experiences. "The materials and activities chosen represent the key aspects of our programme: Mathematics, Mathematics Education and Teaching Practice."

Nevil Hopley, a secondary school teacher from Glasgow, presented the opening keynote: *The use of computer algebra systems (CAS) to develop understanding*. My closing keynote was entitled *The Importance of Problem Selection*. My description of the event is offered through the lens as a keynote speaker and participant in the day. Any quotes come directly from the programme booklet.

Attendees at the symposium included the cohort of 3rd year students, in addition to representation from the mathematics and education departments, along with various teachers and other personnel involved in mathematics within the Irish school system.

The poster presentations offered insights into a diversity of topics ranging from pedagogical issues around math and dyslexia to the place of competition in learning. The conversations with students concerning the posters were informative. In particular, two conversations were noteworthy: the first, with Patricia Ní Mheachair, concerned dyslexia. The second, with Robert Higgins, was about problem solving. The practicality of this conversation was almost immediate as I was then able to bring another perspective to one of his focus problems in my talk that afternoon. Specifically, it was the idea of solving the problem without algebra that was brought into play in my talk. The day preceding the symposium I enjoyed leading a two-hour session on mathematical problem solving with 2nd year students. One of the themes of that workshop became the challenge of solving problems without reverting to algebra as a primary means. We discussed some questions that became interesting problems when we excluded familiar algebraic forms of solution. We examined the questions as if working with students who may not yet have algebraic tools available to them.

The lasting impressions of the day came from watching students present research projects to peers, teachers, and professors. Understandably the presenters were nervous, and I commend each of them for their fine efforts. As a credit, I list the names and titles here:

Genna O'Callaghan: *The Integration of GeoGebra into the Teaching and Learning of Mathematics*

Sarah Faughey: *Exploring the Effect of 3-2-1 cards on Student Engagement in the Classroom*

Tomás Crosbie & Shane Keane: *Establishing Positive Student-Teacher Relationships*

Fiona McGonigle: *The Effect of Socratic Questioning on Students' Problem Solving Skills*

Aoife O'Leary: *The Impact of ICT in Teaching on the Affective Domain in the Classroom*

Aidan Walsh: *A Gambling Awareness Programme*

Here I make particular mention of the presentation by Aidan Walsh. His topic was unusual and his past experience as a black jack dealer led him to develop a unit for secondary math that went well beyond the probability into social issues. I appreciated the insights and efforts shared by Aidan. The abstract of his presentation follows.

"The gambling industry has become a greater threat to the youth in our society than ever before. Smartphones, tablets and other such devices allow youths to gamble anonymously from the comforts of their home. My action research project examined the need for a programme to be introduced into the secondary schools in Ireland, breaking down the mathematics, psychology of addiction and marketing that are the foundation of the gambling industry. The results of my study show that there is a need and desire for such an educational programme to be introduced in second level education."

The Symposium Model and other Meetings Both the symposium and the nature of the joint offering suggest a model that may be helpful to others interested in bridging mathematics and education. It was clear from the participation of faculty members that these efforts are strongly supported by both areas at NUI Galway. I am confident that the co-directors would welcome queries via email: maire.niriordain@nuigalway.ie (education) and aisling.mccluskey@nuigalway.ie (mathematics). Indeed, I wish all of the graduating students well as they embark on paths as mathematics teachers.

Since participating in the symposium, I have also attended the meeting of the Educational Studies Association of Ireland (ESAI) in Maynooth, and the Project Maths Conference in Dublin. The ESAI meeting featured educational research. I was particularly interested in two sessions (each consisting of several papers or presentations) on mathematics education. Curiously, Canada arose in various references and contexts including an evaluation of the Jump Math Program. The latter conference in Dublin was geared to second level school mathematics teachers (Years 1 to 6 corresponding to Grades 7 to 12). Those interested in secondary math issues and curriculum will find a range of resources at the Project Maths website (www.projectmaths.ie). The core of the program featured teachers presenting sessions related to Project Maths experiences, particularly with respect to lesson study.

One benefit of participation in the symposium has been the manner in which it connected me with people who I would meet again in other settings, including Genna and Sarah, the first two presenters among the graduating class, as well as teachers or Project Maths personnel who took up the NUI Galway invitation to attend the event. I learned much about the mathematics education community through the past few weeks. It is evident

that there is considerable ongoing effort dedicated to research and discussion of teaching practices, policies, and priorities concerning mathematics education in Ireland. The practicality of bringing together people from across the country with relative ease has its merits.

Closing Comments

The Canadian Mathematics Education Study Group's model of meeting with working groups and select plenary talks remains a personal preference over delivery of papers or presentations with minimal time for discussion. However, much context was provided to me in a short time by way of the wide range of presentations. These extended to reports by education officials at the Project Maths event. For instance, strengths and weaknesses identified by examiners of Leaving Certificate papers were outlined. In addition, an Examination Division representative discussed changes to the styles of questions.

If you are interested in learning more about any of the ideas mentioned here, feel free to contact me (*johngm@unb.ca*). I will do my best to answer or direct you to someone who can be of assistance. In the interest of disclosure, I am looking to spend more time as a visitor at NUI Galway in my forthcoming sabbatical. I will understand the setup more fully this time next year and will be happy to answer more questions then.

suite de la couverture

sais que d'autres grandes universités, comme l'Université de la Colombie-Britannique, ont des programmes semblables. Toutefois, de tels programmes coûtent très cher, ils sont difficiles à offrir à l'ensemble des étudiants et ils sont souvent les premiers à écoper quand il faut sabrer les dépenses.

Pour certains étudiants, le cours de calcul de première année crée un sentiment d'aliénation face aux mathématiques. D'après mon expérience, je sais que c'est le cas en sciences de la vie, où l'absence, à première vue, de liens avec la biologie et la médecine amène certains étudiants à se demander à quoi peuvent bien leur servir les mathématiques. Un grand groupe impersonnel contribue sans doute à amplifier ce sentiment d'aliénation.

Comment les grandes universités de recherche peuvent-elles bien offrir une meilleure expérience à leurs étudiants en cette époque de ressources précaires et d'attentes toujours changeantes? Nous devons trouver les meilleures façons possible de réintéresser les étudiants à la matière du cours de calcul de première année. Or, rien ne remplace un bon enseignant. Certaines grandes universités en font un objectif stratégique et se tournent vers le modèle du professeur enseignant : elles recrutent les meilleurs enseignants et leur demandent de donner l'exemple en matière d'enseignement et de recherche en enseignement postsecondaire. Ce ne sont toutefois pas toutes les universités qui s'entendent sur cette façon de faire, surtout si elles veulent en même temps atteindre des objectifs en enseignement et des objectifs plus larges en recherche.

Les cours spécialisés sont une autre possibilité. Comme le cours de calcul de première année compte tellement de sections, il est possible de créer des cours différents pour les physiciens, les étudiants en administration, les étudiants en sciences de la vie, etc. On peut alors montrer, dans ces cours, les liens réels entre le calcul intégral et les domaines d'application, ce qui incitera les étudiants à absorber la matière en établissant des liens avec leur domaine. De nombreuses universités ont adopté cette voie. Par contre, ces cours spécialisés sont parfois conçus comme étant une fin en soi, de sorte qu'ils n'offrent pas la possibilité de suivre un cours de mathématiques plus avancé. À mon avis, c'est une grave erreur de concevoir des cours de la sorte, car ils découragent les étudiants de certaines disciplines de poursuivre l'étude des mathématiques.

Heureusement, les rédacteurs de manuels ont compris que l'avenir de l'éducation comprend des cours de calcul spécialisés, car ils proposent en ce moment un grand nombre de nouveaux manuels d'excellente qualité. Dans mon domaine des mathématiques et en sciences de la vie, il y a en ce moment une prolifération de manuels de très grande qualité qui sont aussi faciles à utiliser.

On constate en outre une tendance lourde à vouloir intégrer les technologies Internet à notre enseignement. Qu'en est-il des cours en ligne ouverts à tous (CLOT)? Déjà annoncés comme le nouveau mode de développement de contenu pédagogique, ces cours en ligne visaient une participation illimitée et le libre accès à tous par le web. Tout comme les vidéos, les lectures obligatoires et les ensembles de problèmes, les CLOT sont des lieux d'échange interactifs qui favorisent les interactions entre étudiants et enseignants. Les CLOT sont assez nouveaux; leur popularité date environ de 2012.

Mais les CLOT conviennent-ils aux étudiants de première année en calcul différentiel et intégral? Une analyse initiale du taux de succès des CLOT a révélé un taux élevé d'abandon, et un taux d'environ 10 % d'étudiants qui terminaient ces cours (Onah et coll., 2014). Même avec des enseignants et du contenu exceptionnels, les CLOT demandent aux étudiants de prendre le contrôle et la responsabilité de l'apprentissage, sans pouvoir compter sur la présence d'un enseignant en chair et en os dans la classe.

Une autre option consiste à conserver le modèle de la classe conventionnel, mais en repensant notre façon de donner la matière en classe et hors classe. L'approche dite de la « classe inversée », instaurée par le physicien de Harvard Eric Mazur (http://en.wikipedia.org/wiki/Flipped_classroom), est une méthode d'enseignement qui transforme le modèle traditionnel de cours en classe et de devoirs à l'extérieur de la classe. Une partie de la matière est présentée en ligne, à l'aide de vidéos sur YouTube par exemple. Les autres activités – devoirs, résolutions de problèmes, etc. – se font en classe, où les étudiants reçoivent l'aide et les commentaires personnalisés dont ils ont besoin. Entre autres activités possibles, mentionnons les commentaires électroniques d'étudiants en temps réel pendant les cours, l'évaluation de tests en groupe en classe et les discussions collaboratives en ligne. L'idée consiste à remotiver les étudiants en transformant leur expérience en salle de classe pour qu'ils passent de l'absorption passive d'information à la participation active. Ce ne sont pas tous les étudiants – et certainement pas tous les enseignants – qui adhèrent au modèle de la classe inversée, même si ce modèle permet d'espérer une amélioration du rendement des étudiants et une dynamique de classe plus vivante.

L'une des raisons pour lesquelles le modèle de la classe inversée pourrait prévaloir, c'est que, contrairement à la plupart d'entre nous qui enseignons, les étudiants ont le cerveau adapté à l'âge de l'information, tout comme le sont leurs téléphones et leurs ordinateurs portatifs. Déjà, les vidéos sur YouTube sont une méthode de prédilection pour l'apprentissage des mathématiques, comme en font foi les nombreuses vidéos publiées. De courtes vidéos individuelles de 5 à 10 minutes permettent de présenter facilement l'information. Et les commentaires et communications électroniques sont tout à fait naturels pour les étudiants qui suivent ces cours.

Je suis certain que bon nombre d'entre vous – moi y compris – sont ambivalents par rapport au modèle de la classe inversée. Je me souviens très bien des heures d'efforts et de concentration qu'il me fallait consacrer tout seul, à tenter de résoudre un problème après l'autre dans mon manuel… Je ne peux pas m'empêcher de penser que cet effort a fait de moi un meilleur mathématicien. Je

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Research Notes brings mathematical research ideas forth to the CMS readership in a generally accessible manner that promotes discussion of relevant topics including research (both pure and applied), activities, and noteworthy news items. Comments, suggestions, and submissions are welcome.

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Les articles de recherche présente des sujets mathématiques aux lecteurs de la SMC dans un format généralement accessible qui favorise les discussions sur divers sujets pertinents, dont la recherche (pure et appliquée), les activités et des nouvelles dignes de mention. Vos commentaires, suggestions et propositions sont le bienvenue.

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Anti-De Sitter Space: From Physics to Geometry

Jean-Marc Schlenker, *Mathematics Department, University of Luxembourg*

Many geometers have been fascinated with hyperbolic geometry, which can be defined as the geometry of Riemannian spaces of constant curvature -1. But for most physicists, Riemannian geometry is not as natural as Lorentzian metrics, which assigns negative square length to tangent vectors in some directions, corresponding to "time evolution," and positive square length to others, corresponding to "space direction."

This concept leads us to define the anti-de Sitter (AdS) n-dimensional space as the Lorentzian analog of hyperbolic space, the quadric

$$AdS_n = \{x \in \mathbb{R}^{n-1,2} \mid \langle x, x \rangle = -1\}$$

in $R^{n-1,2}$, which is just $\mathbb{R}^{n+1}$ endowed with a bilinear symmetric form of signature $(2, n-1)$, just as n-dimensional hyperbolic space is defined as

$$H^n = \{x \in \mathbb{R}^{n,1} \mid \langle x,x \rangle = -1\}$$

in the Minkowski space of dimension $n + 1$. AdS_n is a geodesically complete n-dimensional Lorentzian manifold of constant curvature -1.

In physical terms, it is a solution of Einstein's equation without matter but with negative cosmological constant. This AdS_n space, as well as its positive curvature cousin, the de Sitter space dS_n, is named after Willem de Sitter (1872-1934), who introduced dS_n as a cosmological model in the 1920s.

There are fundamental relations between 3-dimensional hyperbolic geometry and Teichmüller theory that we will recall briefly before considering the more recent relations between AdS geometry and surfaces. We call S a closed surface of genus at least 2, and T_S the Teichmüller space of S, that is, the space of complex structures on S (considered up to deformation). This finite-dimensional space is ubiquitous in mathematics, from number theory to differential geometry and mathematical physics, and it carries a rich geometric structure — including a Kähler metric of negative sectional curvature, the Weil-Petersson metric — as well as an action of a large, interesting and still somewhat mysterious entity, the mapping-class group of S.

A hyperbolic manifold is a manifold that looks locally like the hyperbolic space. Quasifuchsian hyperbolic manifolds provide the simplest non-trivial examples. They are the complete hyperbolic manifolds homeomorphic to $S \times R$ that "behave well" at infinity. Let QF_S be the space of quasifuchsian structures on $S \times R$. A quasifuchsian manifold is the quotient of H^3 by a discrete subgroup Γ of the isometry group of H^3 isomorphic to $\pi_1 S$. The *limit set* Λ_Γ of Γ is then defined as the intersection with the sphere at infinity of H^3 of the closure of the orbit $\Gamma.x$ of any point $x \in H^3$. If Γ is quasifuchsian, then Λ_Γ is a Jordan curve.

A quasifuchsian manifold M homeomorphic to $S \times R$ has a boundary at infinity $\partial_\infty H^3$, which can be identified with $(\partial_\infty H^3 \setminus \Lambda_\Gamma)/\Gamma$. As such, it is endowed with a complex structure (because the action of Γ on H^3 extends as a complex action on $\partial_\infty H^3$). Since $\partial_\infty H$ is the disjoint union of two copies of S, we can associate to M two points in T_S. According to well-known theorem of Bers [1] this correspondence between QF and $T_S \times T_S$ is one-to-one : any couple of complex structures on S can be obtained from exactly one quasifuchsian structure on $S \times R$.

This Bers double uniformization theorem is a key tool for Teichmüller theory. The following is one example (among many others) of this relation. The volume of quasifuchsian manifolds is infinite, but one can use ideas originating in mathematical physics [?, 4, 10] to define a finite,

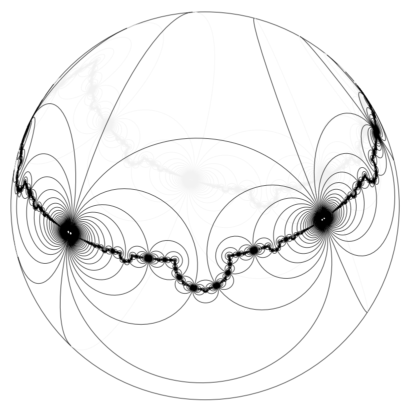

FIGURE 1. The limit set of a quasifuchsian group (picture made by C. McMullen).

"renormalized" volume. By fixing the complex structure on one boundary component of M and varying the other, one obtains a function $V_R : T_S \to \mathbb{R}$, which turns out to be a Kähler potential for the Weil-Petersson metric on T_S, and therefore a good tool to describe and understand this metric.

Let's now turn to AdS, the Lorentzian cousin of hyperbolic space. Closed Lorentzian spacetimes are not too relevant from a physical point of view because they always contain closed causal curves (curves on which the metric is negative), meaning that an observer could evolve and come back to the same point in spacetime — resulting in paradoxes often used in the science-fiction literature. It is more natural to consider globally hyperbolic spacetimes, containing a Cauchy surface, that is, a space-like surface that any causal curves intersects exactly once.

In 1990, G. Mess [8] discovered that, in spite of superficial differences, globally hyperbolic AdS 3-manifolds have many points in common with quasifuchsian hyperbolic manifolds. There is for instance an AdS analog of the Bers double uniformization theorem: the space GH_S of globally hyperbolic AdS structures on $S \times R$ is parameterized by $T_S \times T_S$. The mechanism behind this AdS version of Bers' theorem differs from the hyperbolic setting : the isometry group of AdS_3 is $O(2,2)$, which splits (up to finite index) as $O(2,1) \times O(2,1)$. So the holonomy representation of a globally hyperbolic AdS manifolds splits as two representations in the isometry group of the hyperbolic plane. Mess proved that each is the holonomy representation of a hyperbolic structures on S.

He also gave a simple and beautiful proof of Thurston's Earthquake Theorem based on globally hyperbolic AdS 3-manifolds. Thurston defined an earthquake to be a map sending a hyperbolic metric m and a measured lamination l (for instance, a closed curve with a positive number as "weight") to another hyperbolic metric m'. If l is a closed curve, than m' is defined by realizing l as a geodesic in (S,m), cutting S open along this geodesic, rotating the right-hand side by the weight, and then gluing back. Thurston's Earthquake Theorem asserts that given any two hyperbolic metrics m and m' on S, there is a unique measured lamination l such that an earthquake along l on m yields m'. This provides a convenient parameterization of the Teichmüller space T_S by the space of measured laminations, once a fixed point m has been chosen.

Thurston suggested a proof of this statement. An analytic proof was found by Kerckhoff [7]. However, the proof proposed by Mess is particularly simple. It is based on the geometric properties of the smallest non-empty subsets in globally hyperbolic AdS 3-manifolds. The boundary of this "convex core" has a hyperbolic induced metric and is "pleated" along a measured lamination. The relations between the induced metric and measured bending lamination, on one hand, and the two components of the holonomy representation, on the other hand, lead directly to the proof of Thurston's theorem.

Other valuable connections have appeared recently between closed AdS 3-manifolds and hyperbolic surfaces. In her thesis [6], Fanny Kassel gave a precise description of the holonomy representations of those closed AdS manifolds in terms of one hyperbolic surface S and a representation $\varrho : \pi_1(S) \to O(2,1)$ that "shortens every curve." This led Danciger, Guéritaud and Kassel [3] to new ways of describing all length-shortening deformations of a hyperbolic surfaces, opening new developments on hyperbolic surfaces.

Recently, AdS geometry has also proved useful in a understanding basic questions on the possible combinatorics of polyhedra inscribed in quadrics. Steinitz [9] discovered that any 3-connected graph embedded in the sphere can be realized as the 1-skeleton of a polyhedron in $\mathbb{R}^3$. He also found that not all such graphs can be realized as the 1-skeleton of a polyhedron inscribed in a sphere, answering a question asked by Steiner in 1832.

Understanding the combinatorics of polyhedra inscribed in a sphere then became an fashionable question, until Hodgson, Rivin and Smith [5] gave a simple but non-explicit answer: a graph can be realized in this manner if and only if a certain system of linear equalities and inequalities has a solution.

What about realizing a polyhedron inscribed in another quadric: the one-sheeted hyperboloid or the cylinder? In some recent work with Danciger and Maloni [5], we prove that the answer is remarkably simple: a graph embedded in the sphere can be realized as the 1-skeleton of a polyhedron inscribed in a one-sheeted hyperboloid (resp. a cylinder) if and only if it can be realized as the 1-skeleton of a polyhedron inscribed in a sphere and it admits a Hamiltonian cycle.

Perhaps surprisingly, the proof of this statement rests on AdS geometry and more specifically on the geometry of ideal polyhedra in AdS_3 — polyhedra with all vertices on the boundary at infinity. Hodgson, Rivin and Smith describe the geometry of ideal polyhedra in hyperbolic 3-space, and the statement follows from confronting and comparing the descriptions of dihedral angles of ideal polyhedra in H^3 and AdS_3.

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Nonlinear Dynamics and DNA transcription

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I will briefly describe an aspect of the study of the *nonlinear dynamics of DNA* by means of *mesoscopic models*. This is a very vast subject, and DNA an incredibly complex macromolecule; studying it in full generality is hopeless. It seems appropriate to focus one's attention on specific processes undergone by DNA. I will focus on the study of the nonlinear dynamics of *DNA transcription.*

In this process, a dedicated enzyme (RNA-polymerase) binds to DNA and runs through a part of it, reading the genetic information and producing a copy of this (RNA-Messenger) which will later be used to express information. To read the base sequence, which contains the genetic information, the double helix is open locally (in a *transcription bubble*), and then closed again; this process must take place orderly, or there could be a damage of genetic information. The energy required for opening the bases is given by ATP depletion, but the problem is to understand how this process is conducted in an orderly manner.

In a famous article published in 1980 [1] it was proposed that (despite the inhomogeneities of the molecule due to the base sequence) *solitons* could be present in the DNA chain, and that the motion of RNAP along DNA would exploit the presence of these solitons: in this way, after the creation of the soliton, the opening and closing of the double helix would take place in an ordered way and with a practically zero energy cost.

The idea was later extended to the study of DNA *denaturation*, in particular by the groups of M.Peyrard (France) and of A.Bishop (USA); in this area the approach has produced results in remarkable agreement with experiment [2]. It should be emphasized that in the denaturation process the only actors are the DNA (and the solution in which it lives) and the temperature, while in transcription there appear moreover the RNAP and RNA-M.

One usually considers excitations with wavelength much larger than the distance between adjacent bases (the transcription bubble involves about 20 base pairs), and passes to a continuum description. This process is modelled in terms of PDEs.

The models considered by Peyrard and Bishop (and subsequent refinements), describe the separation of the two strands of DNA and are based on the NLS equation, the relevant nonlinear excitations here are *breathers* (which do not travel, hence are less sensitive to inhomogeneities of the DNA molecule due to the base sequence). Instead, the models aimed to describe transcription consider the torsional degrees of freedom of DNA and are based on equations of sine-Gordon (SG) type. These lead one to consider *topological solitons*.

The classical models for torsional dynamics of DNA, as Yakushevich's Y model, [3], consider one degree of freedom per nucleotide (a nitrogen base and the associated segment on the DNA backbone), with pairing and stacking interactions. The analytical study of such models is only possible with several radical approximations, among which neglecting the differences between the different bases. Models closer to reality can only be studied numerically.

Unfortunately even just making a difference between purines and pyrimidines produces a physically unrealistic dynamics for the Y model.

A "composite Y model" taking into better account the peculiar geometry and structure of DNA has been formulated in 2007 [4]. This model considers separately the bases and the backbone; while the nitrogen bases are different from each other, the backbone is made of exactly identical segments. Remarkably, and at difference with standard SG models, the speed of traveling waves in the equal-bases version of this model is *not* a free parameter (subject to an upper bound), but is instead determined by the physical parameters (and roughly compatible with experimental data).

It is mathematically interesting that this model contains a field which is "topological" (an angle of torsion $\vartheta \in S^1$) and another which is "non-topological" (an angle φ associated to the bases, whose motion is subject to steric hindrances and hence limited). It supports very robust solitons, basically because the field associated with the bases is "slaved" to that of the backbone. (This model also applies to other macromolecules with a hierarchy of degrees of freedom, such as polyethylene - much simpler than DNA.)

Detailed numerical studies of a realistic version of the model, taking inhomogeneities into account (with the sequence of a real genome, an Adenovirus), shows that the solitons in the composite model do propagate over very long distances (on the scale of DNA). Even the presence of noise does not affect the possibility of solitons propagating over distances relevant to the process of transcription.

All models mentioned so far consider the macromolecule of DNA *per se* (interaction with the cellular environment can be considered through phenomenological parameters), but the transcription process sees the presence and the action of the RNAP. This problem has been recently addressed [5], formulating a modification of the composite Y model, which describes both the torsional dynamics of DNA and the motion of RNAP along the DNA chain, and the interaction between the two. In this model there exist solitons travelling along the DNA double helix and synchronized with the advancement of RNAP. Moreover, these solutions are stable. This is, maybe, the first full embodiment of the idea advanced by Englander [1] more than thirty years ago.

Much remains to be done in this field, also in view of comparison with the detailed single-molecule experiments nowadays possible. Maybe some readers of the present short note will provide the needed progress to understand this or other aspects of DNA nonlinear dynamics.

References

[1] W. Englander *et al.*, "Nature of the open state in long polynucleotide double helices: possibility of soliton excitations", PNAS USA **77** (1980) 7222-7226

[2] M. Peyrard, Th. Dauxois, *Physics of Solitons*, Cambridge U.P., 2006

[3] L.V. Yakushevich, *Nonlinear Physics of DNA*, Wiley, 1998, 2004

[4] M. Cadoni, R. De Leo, G. Gaeta, "A composite model for DNA torsion dynamics", *Phys. Rev. E* **75** (2007), 021919

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Suite à la page 17

ne voudrais donc pas priver la prochaine génération de scientifiques d'expériences aussi formatrices. Mais les temps ont changé, et j'espère que le modèle de la classe inversée pourra tout de même présenter le contenu obligatoire, mais dans un format repensé et amélioré.

Alors qu'en est-il de mes propres efforts à l'Université de l'Alberta? Nous avons formé un groupe pour préparer un nouveau cours de calcul intégral destiné aux étudiants en sciences de la vie, en essayant de viser le juste équilibre entre le contenu de calcul et les applications en biologie. Nous voulons que ce cours soit aussi rigoureux qu'un cours normal de calcul différentiel et intégral, mais qu'il suscite davantage l'intérêt des étudiants par l'ajout à la fois de liens avec la biologie et des meilleurs éléments du modèle de la classe inversée. C'est avec une certaine fébrilité, mais un grand enthousiasme que j'entrevois ma session d'automne. Si vous voulez savoir si ça fonctionne bien, posez-moi la question dans six mois.

Références

[1] Onah, D. F., Sinclair, J. et Boyatt, R. (2014). Dropout rates of massive open online courses: behavioural patterns. EDULEARN14 Proceedings, 5825-5834.

CMS Member Profile

Bill Sands

HOME: Retired to Qualicum Beach, BC from the University of Calgary.

CMS MEMBER SINCE: 1982.

RESEARCH: Combinatorics, mostly partial orders and lattices, some graph theory.

SELECTED ACHIEVEMENTS: The PIMS Education Prize in 2004, and the CMS's Graham Wright Award for Distinguished Service in 2008. I am very proud of both. But perhaps I am proudest of my stints as Crux Editor and as IMOC Chair, in my opinion the two most interesting (albeit time-consuming) jobs in the CMS.

HOBBIES: Walking, bicycling, reading, movies, music and of course math.

LATEST BOOK READ: *How I Almost Married a Russian* and *The Case for Barbara*, both written by John Ginsburg, a friend and research collaborator from Winnipeg who took up novel writing after he retired from the University of Winnipeg a few years ago.

LATEST PUBLICATION: Not counting proposed problems in Crux, it would be *Chop vectors and the lattice of integer partitions*, a paper written with my graduate student Thao Do and published in 2012, and one of five papers that resulted from my last extensive sabbatical before I retired in 2013. I hope it isn't my last research paper!

WHAT I WOULD CHANGE (ABOUT THE CMS): I would wish they had more money! Especially for worthwhile programs like math contests, like the IMO, and for Crux Mathematicorum, both of course dear to my heart.

CMS ROLES: Editor of Crux Mathematicorum, 1986-1995; International Mathematical Olympiad Committee Chair, 1997-2008; Math Competitions Committee Chair, 2010-present. I also was a Problem Captain at the 1995 IMO in Canada, Leader Observer on our IMO Team in 2002, and Leader of the Team in 2007.

WHY I BELONG TO THE CMS: If you are Canadian and an aficionado of mathematics, be it recreation, teaching, or research, you ought to be involved in the CMS. There's nowhere else to be.

CSHPM Notes brings scholarly work on the history and philosophy of mathematics to the broader mathematics community. Authors are members of the Canadian Society for History and Philosophy of Mathematics (CSHPM). Comments and suggestions are welcome; they may be directed to either of the column's co-editors,

Amy Ackerberg-Hastings, *University of Maryland University College (aackerbe@verizon.net)*

Hardy Grant, *York University [retired] (hardygrant@yahoo.com)*

Les articles de la SCHPM présente des travaux de recherche en histoire et en philosophie des mathématiques à la communauté mathématique élargie. Les auteurs sont membres de la Société canadienne d'histoire et de philosophie des mathématiques (SCHPM). Vos commentaires et suggestions sont le bienvenue; ils peuvent être adressées à l'une des co-rédacteurs,

Amy Ackerberg-Hastings, *University of Maryland University College (aackerbe@verizon.net)*

Hardy Grant, *York University [retraité] (hardygrant@yahoo.com)*

The New History of Ancient Mathematics

J.L. Berggren, *Simon Fraser University [retired]*

I began working in the history of mathematics in 1971 when SFU's Mathematics Department asked me to develop a course that might attract students from the liberal arts. It was a time when Kenneth May, then at the U of T's Mathematics Department, was promoting the history of mathematics as part of the mathematical community, work that eventually led to his founding the journal *Historia Mathematica*.

I wrote to Ken and asked his advice about what part of the history of mathematics might be a good area to work in. Because my Ph.D. was in group theory that was one of the areas I suggested, but (because of my interest in languages) I also mentioned the history of Greek mathematics. Ken thought that history of group theory might be a good idea, but next to "history of Greek mathematics" he penciled 'Overworked.' However, anyone who has ever given advice to someone will not be surprised to learn that my choice was history of Greek mathematics.

But, in Ken's defense, it should be said that at that time one might well have seen the area as having been worked over pretty thoroughly. There were two main lines of work in history of Greek mathematics at that time. One was the reconstruction of theories that were believed to exist on the basis of more-or-less indirect evidence in existing Greek texts. (An example of this was the supposed development of continued fractions as a means of approximating rational numbers, for which see *The Mathematics of Plato's Academy* by the late David Fowler.) Much, but certainly not all, of this approach, depended on inferring the mathematics of the classical period from texts written some centuries later.

The other was the close study of the mathematics of ancient texts, represented in North America by the group around Otto Neugebauer in the Department of the History of Mathematics at Brown University.

My own training in how to do research in the history of mathematics was as a visitor for two years in the History of Science and Medicine Department at Yale University, two of whose faculty of five were products of the Brown school, and two more who were very much part of that approach.

Both of these approaches had been intensively developed in Europe since the nineteenth century and no one was producing more ancient Greek texts, so it might well have seemed that there was little chance of doing new work that would make any real difference in the area.

However, within the past twenty-five years, a number of new approaches to the history of mathematics have arrived on the scene, approaches closely aligned with contemporary approaches in the history of science in general. [1]

Near the end of the past century, Ken Saito at Osaka University noted a shift in the historiography of Greek mathematics that had involved a move from rational reconstruction of lost ancient achievements to an analysis of existing texts to try to understand why the Greek authors wrote in a way which, to a modern point of view, seems so strange. Stanford's Reviel Netz, one of the representatives of the shift Saito referred to, wrote in 2002 of "a new wave of studies of Greek mathematics, where emphasis shifts from the Classical antecedents to the Hellenistic extant sources themselves." He continued, "As this shift gets us from speculation into facts, it is of obvious methodological value." [2]

In 2012, Karine Chemla articulated another aspect of this shift in her *History of Mathematical Proof in Ancient Traditions*, which very title speaks of the change in approach in the last few decades. In the early 1970s, the history of mathematical proof in the ancient world would have been part of the history of Greek mathematics, which was considered the 'native habitat' of proofs. The research program that Chemla outlines in her introduction, as well as the individual contributions to the book, very much reflects the change that has taken place since then, with its argument for broadening the definition of "proof" to include, for example, demonstrations of algorithms in Chinese, Babylonian, and Indian mathematical texts and commentaries. Although the work seems to pay no attention to Arabic texts, one finds in these texts as well proofs of geometric theorems by what one might call heuristic arguments (more precisely, the ancient method of analysis). There are also expositions of root-extraction algorithms (up to the fifth root!) and methods of interpolation that any competent mathematician of the time would find to be convincing arguments for their correctness.

To a certain extent, of course, one's reaction to these arguments must depend on how broadly one wants to take the conception of proof. There is the case of the famous "proof" of the Pythagorean Theorem in Bhaskar's diagram, where the text is simply 'Behold.' That is to say, because of the author's assumptions about the background and abilities of his audience, very little text in the way of proof may be necessary.

There have also been studies of ancient mathematicians that set their lives and work within the social context of their times. Three such studies are those of Liba Taub on Claudius Ptolemy's philosophical outlook, Michael Deakin's account of Hypatia and Serafima Cuomo's study of Pappus of Alexandria, in which she discusses the practical mathematics of the time, as well as the pure mathematics of Pappus's work. And, very much in the modern spirit, she also pays considerable attention to the ways in which Pappus's use of language established his authority as the person whose works not only must be read but, perhaps, even obviate the need to read the originals of the works he discusses.

Closely related to the general approach I have been discussing is Markus Asper's paper in the *Oxford Handbook of the History of Mathematics.* [3] A considerable part of this paper on 'the two cultures of mathematics in ancient Greece' is devoted to the same group Cuomo discusses, the mathematical practitioners who were skilled in the use of reckoning to do accounts or workers' rations, and who knew the mensurational procedures needed to calculate areas and volumes and survey plots of land. This part of the paper focuses on Hellenistic Egypt, but in the context of an older, middle-eastern background, which, Asper argues, may have entered Greece as early as the fifth century BC.

An important part of this attention to existing sources is the emphasis on the study of their diagrams. Reviel Netz [2] has done as much as anyone to call attention to understanding the role of diagrams in Greek mathematics, where he has gone so far as to say that Greek geometry is about diagrams, perhaps something of an overstatement!

In the study of diagrams, the computer and internet have proved to be useful tools since it is now possible for any scholar with a computer and access to the internet to compare large numbers of diagrams in versions of a single text spanning, as it has in one case, four cultures over hundreds of years. (See the website www.Greekmath.org.)

Some significant ancient mathematics is found embodied in instruments, one example being the ongoing study of the ancient analogue computer known as the Antikythera mechanism. When I first started to work in the history of mathematics as a visitor at Yale, Derek Price was investigating that mechanism, trying to discern the celestial cycles worked into the gear trains. He believed that the task of devising the gear trains to represent the celestial cycles is the sort of task that it would need someone like Archimedes to do. The complicated gearing that modern imaging technology has brought to light suggests that Prof. Price was probably right, and the team investigating the device with the most modern imaging technology has uncovered evidence in the text on the dial that is at least consistent with Archimedean involvement in the design of the device.

Another area in which imaging technology has come to the aid of the history of mathematics is in the study of a Byzantine palimpsest containing Greek texts of a number of Archimedes' works, including his famous work on heuristics, *The Method of Mechanical Theorems*.

Netz and his co-workers have used the Stanford Linear Accelerator to bring out the Archimedean text, which was partially rubbed out and wholly written over in Byzantine times. Two surprising results of this investigation have been Archimedes' use of an actual infinity and a reinterpretation of his Stomachion as a study of a difficult problem in combinatorial enumeration.

One source for scholars wishing to see how mathematics was used in antiquity is to study its use in other ancient sciences. One example is the translation and study of the theoretical parts of Ptolemy's *Geography* (2000) by Alexander Jones and myself, where much of the mathematical interest lies in Ptolemy's explanation of how to draw the three projections of the known world and surrounding cosmos. Another is the translation and study that Robert Thomas and I did of the Greek text of Euclid's treatment of the geometry of circles on the celestial sphere in his Phenomena. As Prof. Thomas has remarked, it is an example of Euclid doing non-Euclidean geometry!

I have had to omit much in this account of the new history of ancient mathematics [4] but have said enough, I hope, to interest some in reading the literature mentioned here. The field needs new people and new ideas to further explore these new directions.

Notes

[1] Although, for reasons of space, this article focuses on the history of Greek mathematics, most of what is said applies equally to the history of medieval mathematics as well, both Latin and Arabic.

[2] Reviel Netz, review of *La rivoluzione dimenticata. Il pensiero scientifico greco e la scienza moderna*, by Lucio Russo, Historia Mathematica 29, no. 1 (2002): 72–73.

[3] Markus Asper, "The two cultures of mathematics in ancient Greece", in *The Oxford Handbook of the History of Mathematics*, ed. Eleanor Robson and Jacqueline Stedall, 107–132, Oxford, 2008.

[4] Much fuller accounts of recent work in the history of Greek and Arabic mathematics are the papers of Nathan Sidoli, "Research on Ancient Greek Mathematical Sciences, 1998–2012," and Glen Van Brummelen, "A Survey of Research in the Mathematical Sciences in Islam from 1996 – 2011," in *From Alexandria to Baghdad*, ed. N. Sidoli and G. Van Brummelen, 25–50 and 101–138, New York: Springer, 2014.

J. L. Berggren is Emeritus Professor in the Department of Mathematics at Simon Fraser University. His special interests are the history of mathematical sciences in ancient Greece and medieval Islam, areas in which he has authored or co-authored numerous refereed papers. Among his eight books are Pi: A Sourcebook (jointly with J. and P. Borwein) and Episodes in the Mathematics of Medieval Islam (Springer, 1986).

2015 CMS Summer Meeting
Charlottetown - June 5-8
#2015CMSsummer

June 5-8, 2015, Charlottetown (P.E.I.)
Site: University of Prince Edward Island
cms.math.ca/events/summer15

5-8 juin 2015, Charlottetown (Î.-P.-É.)
Site : l'Université de l'Île-du-Prince-Édouard
smc.math.ca/reunions/ete15

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Related Events | Événements liés

The **CMS Annual General Meeting (AGM)** will occur on Saturday, June 6, from 12:30 - 14:00. The CMS Executive inviting all members and meeting participants to join them at an informal luncheon to focus on what was achieved in 2014. There will be a short presentation followed by questions and answers and the **2015 CMS Election. | L'assemblée générale annuelle (AGA) de la SMC** aura lieu le samedi 6 juin de 12 h 30 à 14 h. Le Comité exécutif de la SMC invite tous les membres de la Société et les participants à la Réunion à se joindre à lui pour un dîner informel, question de savoir ce que la SMC a accompli en 2014. Il y aura une brève présentation, suivie d'une période de questions et des **élections de la SMC 2015.**

The Canadian Mathematical Society invites you to their **awards banquet** on Saturday, June 6, to highlight exceptional performance in the area of mathematical research and education at New Glasgow Lobster Suppers. Prizes will be awarded during the event. | La Société mathématique du Canada vous invite à **son banquet** le samedi le 6 juin pour souligner des contributions exceptionnelles en recherche mathématique et en enseignement des mathématiques au New Glasgow Lobster Suppers. Des prix seront remis durant la soirée.

Regular Sessions | Sessions générales

Advances in Nonlinear Partial Differential Equations
Avancées en équations différentielles partielles non linéaires
George Chen (Cape Breton), Scott Rodney (Cape Breton)

Contributed Papers | Communications libres
David Horrocks (UPEI)

Graduate Student Research Presentations
Exposés de recherche par les étudiants gradués
Svenja Huntemann (Dalhousie)

Operators Theory on Analytic Function Spaces | Théorie des opérateurs et espaces de fonctions analytiques
Javad Mashreghi (Laval)

Reaching our Students: Increased Participation and Persistence in First-Year Mathematics Courses | Rejoindre les étudiants: hausse de la participation et de la ténacité dans les cours de mathématiques de première année
Darja Kalajdzievska (Manitoba), Gordon MacDonald (UPEI)

Undergraduate Student Research Presentations
Exposés de recherche d'étudiants au premier cycle
Nathan Musoke (Waterloo)

AARMS-CMS Sessions | Sessions ARRMS-SMC

C*-algebras | C*-algèbres
Cristian Ivanescu (Alberta), Dan Kucerovsky (UNB)

Dynamical Systems with Applications to Biology and Ecology
Systèmes dynamiques avec applications en biologie et en écologie
Lin Wang (UNB), Yuan Yuan (Memorial)

Ergodic Theory, Dynamical systems and Applications
Théorie ergodique, systèmes dynamiques et applications
Pawel Gora (Concordia), Shafiqul Islam (UPEI)

Games and Pursuit Games on Graphs
Jeux et jeux de poursuite sur des graphes
Richard Nowakowski (Dalhousie)

Graphs, Designs and Hypergraphs
Graphes, designs et hypergraphes
Robert Bailey (Grenfell Campus, Memorial), Andrea Burgess (UNB Saint John), Margaret-Ellen Messinger (Mount Allison)

Interplay of Convexity and Geometric Analysis | Interactions entre la convexité et l'analyse géométrique
Jie Xiao (Memorial), Deping Ye (Memorial)

Number Theory | Théorie des nombres
Amir Akbary (Lethbridge), Karl Dilcher (Dalhousie)

Recent Advances in the Mathematics of Electromagnetic and Acoustic Imaging | Avancées récentes dans les mathématiques de l'électromagnétisme et de l'imagerie acoustique
Peter Gibson (York), Michael Haslam (York)

Optimization and Nonlinear Analysis
Optimisation et analyse non linéaire
Mohamed Tawhid (Thompson Rivers University)

Rigorous computation for differential-equation problems
Calcul rigoureux pour les problèmes d'équations différentielles
Roberto Castelli (VU Amsterdam), Holger Teismann (Acadia)

Singularities and Phase Transitions in the Calculus of Variations and PDE | Singularités et changements de phase dans le calcul des variations et les EDP
Lia Bronsard (McMaster), Ihsan Topaloglu (McMaster)

Poster Session | Présentations par affiches

AARMS-CMS Student Poster Session | Présentations par affiches pour étudiants - AARMS-SMC
Muhammad Ali Khan (Calgary)

CMS Notes
Volume 47 No. 3, June 2015

2015 CMS Winter Meeting
Montreal - December 4-7
#CMSwinter

December 4-7, 2015, Montreal (Quebec)
Site: Hyatt Regency Montreal
cms.math.ca/events/winter15

4-7 Décembre 2015, Montréal (Québec)
Site : Hyatt Regency Montréal
smc.math.ca/reunions/hiver15

Prizes | Prix

Adrien Pouliot Award

Prix Adrien-Pouliot
recipient to be announced | lauréat à confirmer

Doctoral Prize
Prix de doctorat
Yuval Filmus (Toronto), Hector H. Pasten Vasquez (Queen's)

G. de B. Robinson Award
Prix G. de B. Robinson
recipient to be announced | lauréat à confirmer

Graham Wright Award for Distinguished Service
Prix Graham Wright pour service méritoir
recipient to be announced | lauréat à confirmer

Jeffery-Williams Prize
Prix Jeffery-Williams
Alejandro Adem (UBC)

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John Baez (U. C. Riverside, California; Centre for Quantum Technologies, Singapore)
Isabelle Gallagher (Université Paris-Diderot)

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The CMS Town Hall meeting will occur on Saturday, December 5, from 12:30 - 14:00. All CMS members and meeting participants are invited to join the CMS Executive and to engage on upcoming plans and to discuss any interests or concerns that members of our community may have. | La **Séance de discussion de la SMC** aura lieu le samedi 5 décembre de 12 h 30 à 14h. Tous les membres de la SMC et participants à la réunion sont invités à se joindre à l'exécutif de la SMC à s'engager sur les plans à venir et de discuter des préoccupations ou des intérêts que les membres de notre communauté peuvent avoir.

The Canadian Mathematical Society invites you to their **awards banquet** on Saturday, December 5, to highlight exceptional performance in the area of mathematical research and education. Prizes will be awarded during the event. | La Société mathématique du Canada vous invite à son **banquet** le samedi 5 décembre pour souligner des contributions exceptionnelles en recherche mathématique et en enseignement des mathématiques. Des prix seront remis durant la soirée.

Réunion d'hiver de la SMC 2015
Montréal - 4-7 décembre
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Regular Sessions | Sessions générales

Algebraic Combinatorics | Combinatoire algébrique
Christophe Hohlweg (UQAM), Hugh Thomas (UNB), Franco Saliola (UQAM)

Algebraic Number Theory | Théorie algébrique des nombres
Antonio Lei (Laval)

Analysis on Singular Manifolds | Analyse sur des variétés singulières
Alexey Kokotov (Concordia), Frédéric Rochon (UQAM)

Analytic Number Theory | Théorie analytique des nombres
Daniel Fiorilli (Ottawa), Nathan Jones (UIC), Dimitris Koukoulopoulous (Montréal), Matilde Lalin (Montréal)

Bridging the Gap between Mathematical Approaches and Biological Problems | Combler le fossé entre les approches mathématiques et problèmes biologiques
Fred Guichard (McGill), Erik Cook (McGill), Lea Popovic (Concordia)

Cohomological Methods in Quadratic Forms and Algebraic Groups | Méthodes cohomologiques pour les formes quadratiques et les groupes algébriques
Stefan Gille (Alberta), Nikita Karpenko (Alberta)

Combinatorics on Words | Combinatoire des mots
Alexandre Blondin Massé (UQAM), Srecko Brlek (UQAM), Christophe Reutenauer (UQAM)

Complex Analysis and Operator Theory | Analyse complexe et théorie des opérateurs
Javad Mashreghi (Laval), Thomas Ransford (Laval)

Computational and Topological Methods in Dynamical Systems | Calcul et méthodes topologiques en systèmes dynamiques
Tomasz Kaczynski (Sherbrooke), Jean-Philippe Lessard (Laval)

Descriptive Set Theory | Théorie descriptive des ensembles
Marcin Sabok (McGill)

Differential Geometry | Géométrie différentielle
Ailana Fraser (UBC), Regina Rotman (Toronto)

Diophantine Problems | Problèmes diophantiens
Scott Parsell (West Chester University of Pennsylvania)

Discrete and Continuous Optimization | Optimisation discrète et continue
Bruce Shepherd (McGill)

Fibrations, Mirror Symmetry and Calabi-Yau Geometry | Fibrations, symétrie miroir et géométrie de Calabi-Yau
Charles Doran (Alberta), Andreas Malmendier (Colby College), Alan Thompson (Waterloo)

Geometric Spectral Theory | Théorie géométrie spectrale
Alexandre Girouard (Laval)

Graph Theory | Théorie des graphes
Hamed Hatami (McGill), Sergey Norin (McGill)

History and Philosophy of Mathematics | Histoire et philosophie des mathématiques
Tom Archibald (SFU)

Logic, Category Theory and Computation | Logique, théorie des catégories et calcul
Prakash Panangaden (McGill)

Low Dimensional Topology and Geometric Group Theory | Topologie en basse dimension et théorie géométrique des groupes
Mark Powell (UQAM), Piotr Przytycki (McGill), Adam Clay (Manitoba)

Mathematical Finance | Finance mathématique
Cody Hyndman (Concordia), Alexandre Roch (UQAM), Alexandru Badescu (Calgary)

Mathematics Education | Enseignement des mathématiques
Org: to be announced | Org : à venir

Mathematics: Source of New Solutions to Old Problems in Pharmaceutical Research and Therapy | Mathématiques: source de nouvelles solutions à de vieux problèmes en recherche pharmaceutique et en pharmacothérapie
Fahima Nekka (Montréal), Jun Li (Montréal)

Measure-Valued Diffusions | Diffusions à valeurs mesurées
Xiaowen Zhou (Concordia)

Nonlinear Evolutionary Equations | Équations d'évolution non linéaires
Dong Li (UBC), Xinwei Yu (Alberta)

Operator Algebras | Algèbres d'opérateurs
Mikael Pichot (McGill)

Probability and Statistical Mechanics | Probabilités et statistique mécanique
Alex Fribergh (Montréal), Louis-Pierre Arguin (Montréal)

Representation Theory | Théorie des représentations
Clifton Cunningham (Calgary), David Roe (UBC)

Stochastic Partial Differential Equations | Équations aux dérivées partielles stochastiques
Lea Popovic (Concordia), Don Dawson (Carleton)

Symplectic Geometry, Moment Maps and Morse Theory | Géométrie symplectique, applications moment et théorie de Morse
Lisa Jeffrey (Toronto)

AARMS-CMS Student Poster Session | Présentations par affiches des étudiants - AARMS-SMC
Org: to be announced | Org : à venir

Contributed Papers | Communications libres
Org: to be announced | Org : à venir

CMS Notes
Volume 47 No. 3, June 2015

University of Victoria - Department of Mathematics and Statistics

The Department of Mathematics and Statistics at the University of Victoria invites applications for two Assistant Teaching Professor positions, leading to continuing positions, to commence August 1, 2015, or as soon as possible after that date. Successful applicants will be welcomed into a stimulating, collegial department with an outstanding record in both research and teaching, and a University community that is strongly supportive of mathematical sciences training across a wide range of disciplines.

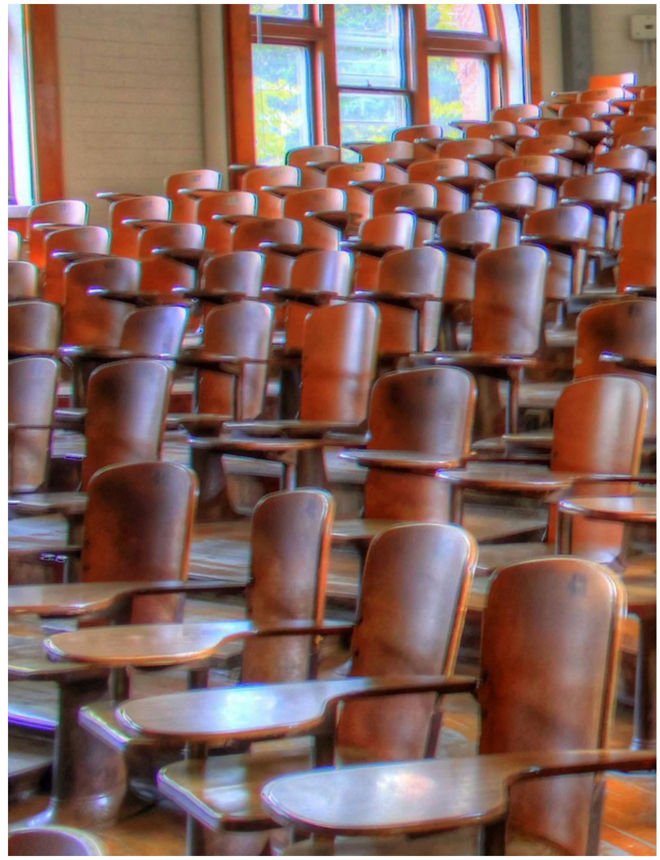
A Ph.D. in Mathematics or Statistics is preferred, although outstanding candidates holding a Master's degree may be considered. Successful applicants will demonstrate a passion for teaching and will provide documented evidence of excellence in the delivery of mathematical sciences courses at the first- and second-year level. Demonstrated ability to teach a wide range of Mathematics or Statistics courses will be considered an asset. For one of the two positions, a Ph.D. degree in Statistics and substantial teaching experience in Statistics courses are preferred. Successful applicants will be expected to teach and co-ordinate multi-section courses, to engage in curriculum development and scholarship of teaching and learning (SoTL), and to contribute through service to the Department and University. Assistant Teaching Professors with a strong record in both teaching and SoTL may apply to become a tenured Teaching Professor after their eleventh year.

Information about the department, including descriptions of courses offered, can be found at its website: http://www.uvic.ca/science/math-statistics/

Applications should be made through MathJobs.org, and should include: a cover letter detailing interest in and experience pertaining to the position; a curriculum vitae; a teaching dossier (or equivalent documentation) that outlines teaching experience, philosophy and effectiveness; and at least three letters of reference in support of the application.

Questions about this position are welcomed and can be addressed to the Chair of Mathematics and Statistics, Dr. Roderick Edwards (mschair@uvic.ca).

Review of applications will begin after June 15, 2015 and will continue until the position is filled



The University of Victoria is an equity employer and encourages applications from women, persons with disabilities, visible minorities, Aboriginal Peoples, people of all sexual orientations and genders, and others who may contribute to the further diversification of the University. All qualified candidates are encouraged to apply; however, in accordance with Canadian immigration requirements, Canadians and permanent residents will be given priority.

University of Victoria

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www.uvic.ca/science/math-statistics

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