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Canadian Mathematical Society
Société mathématique du Canada

CMS NOTES de la SMC

February/
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2015

President's Notes / Notes de la Présidente

Lia Bronsard, *CMS President / Présidente de la SMC*

CMS has had a reboot! In accordance with the government's new law regarding not-for-profit organizations, the CMS has had to rethink all of its bylaws and entire structure. Notably, the board of directors will go from 33 to 23 members and an ad hoc committee will be formed shortly to review the CMS's vision, priorities and issues for the future.

CMS anticipates making changes to how it organizes meetings. The pilot model will be the next CMS Winter Meeting in Montreal in December 2015. A scientific committee made up of national and international members has been formed, as well as a regional scientific committee. CMS hopes to achieve a greater impact and make its meetings even more engaging to improve conference attendance.

The 2014 Winter Meeting held in Hamilton (for the first time since 2000) was a huge success and attendees were able to take full advantage of all the CMS's services. There were approximately 500 participants from around the world, including 340 speakers. Highlights included an exceptional public lecture by Jeffrey Rosenthal; the first Borwein lecture by Ken Davidson; seven plenary lectures, including one on teaching; six CMS awards and a CRM-Fields-PIMS prize presented during the banquet at the Art Gallery of Hamilton. There were 24 scientific sessions and one session on education that was, as always, very well received. Also noteworthy was a scientific session organized and delivered entirely by graduate students (a tradition that the CMS's student committee plans to continue) and the largest student poster session ever, 25! Student participation was also higher than usual (21% compared to 15%), which is a very good sign for the future. We plan to continue our efforts to include new groups in science and in education and to have greater contact with

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La SMC fait peau neuve! En effet, suite à la nouvelle loi gouvernementale sur les organisations à but non lucratif, la SMC a dû repenser tous ses statuts et toute sa structure. En particulier, le comité de direction va passer de 33 membres à 23 membres, et un comité ad hoc va être formé d'ici peu pour réévaluer la vision, les priorités et les enjeux de la SMC au cours des prochaines années.

La SMC prévoit en outre apporter des changements dans sa façon d'organiser des congrès. Le modèle pilote sera la prochaine Réunion d'hiver de la SMC qui se tiendra à Montréal en décembre 2015, où un comité scientifique composé de membres au niveau national et international a été formé en plus du comité scientifique local. La SMC espère ainsi avoir un plus grand impact, rendre ses congrès d'autant plus intéressants et attirer encore plus de participants.

Par ailleurs, la Réunion d'hiver 2014 qui s'est tenue à Hamilton (pour la première fois depuis 2000) fût un très grand succès, et les participants ont beaucoup apprécié tous les services de la SMC. La Réunion a attiré environ 500 participants de partout dans le monde et proposait 340 conférenciers; une conférence publique exceptionnelle de Jeffrey Rosenthal; la première conférence Borwein, donnée par Ken Davidson; sept autres conférences plénières, dont une en didactique; 6 prix de la SMC et un prix du CRM-Fields-PIMS remis au banquet tenu dans la Galerie d'art de Hamilton; 24 sessions scientifiques et une session en didactique qui a été, comme toujours, très bien reçue. En particulier, soulignons une session scientifique entièrement organisée et donnée par des étudiants diplômés (une tradition que le Comité étudiant de la SMC prévoit continuer), et la session de présentations par affiches pour étudiants la plus populaire à ce jour (25 présentations!). La participation des étudiants a aussi été plus élevée qu'à l'habitude (21 %

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The True and the Truthy

Robert Dawson, *Saint Mary's University, Halifax*

Mathematics is about things that are true, things we can prove, yes? Well, not entirely. Fermat's Last Theorem was certainly a mathematical landmark long before anybody knew that it was even possibly a theorem. Today, the Riemann Hypothesis looms equally large, an elephant in the room, even if we do not know for sure what breed of elephant it may be. If a conjecture is tantalizing enough, its implications sufficiently important, then it may shape the landscape around it even before its final status is determined.

Of course, a rigorous proof is still the platinum-iridium standard. And that rigor allows us to go out on limbs that we could not conceive of otherwise, in the same way than a rock climber's rope allows her to attempt climbs that would be suicidal without protection. Things like the Banach-Tarski paradox, the nonconstructability of a 20 degree angle, or the almost-rigid nature of differentiable functions on the complex numbers are genuinely surprising, results not to be fully believed until the proof is understood.

These examples are all fairly elementary, and undergraduates who take the appropriate courses will learn to understand them. But as we progress, new things become surprising. Somebody who knows nothing about differential geometry may not be surprised that a 2-sphere, permitted to pass through itself, can be turned smoothly inside-out in three-dimensional space. ("Well, of course – if it's allowed to pass through itself!") It's only after one comes to understand why a circle cannot be everted in the plane under corresponding rules that the amazing nature of Smale's construction becomes evident.

In contrast, we have the equally numerous things that are "truthy" but possibly not true. Everybody more or less believes them, but nobody knows how to prove them. Is the decimal expansion of π normal, in the sense that every digit appears with asymptotically equal frequency? The thing is so self-evident that in any other discipline it would be accepted without blinking. Nonetheless, it and many other such conjectures resist proof doggedly, and in many cases we don't even know where to start looking.

It is such surprises and paradoxes that give mathematics its unique flavor and will, I hope, provide all of our readers with a pleasant and productive 2015.

Le vrai et le quasi vrai

Les mathématiques étudient des notions qui sont vraies et que l'on peut prouver, n'est-ce pas? Eh bien, pas tout à fait. Le dernier théorème de Fermat était certainement un repère mathématique important bien avant que quiconque découvre qu'il s'agissait peut-être d'un théorème. Aujourd'hui, l'hypothèse de Riemann occupe une place tout aussi importante – telle un éléphant dans une pièce – bien que nous ne sachions pas encore avec certitude de quelle race d'éléphant il s'agit. Si une conjecture est suffisamment attrayante et ses implications, suffisamment importantes, il est possible qu'elle influence son environnement avant même que son statut final ne soit déterminé.

Bien sûr, une preuve rigoureuse demeure la règle d'or – ou, si vous voulez, de platine iridié. Et cette rigueur nous permet de prendre des risques qui nous sembleraient impensables autrement, tout comme la corde permet à l'escaladeur de tenter des ascensions autrement suicidaires. Le paradoxe de Banach-Tarski, la non-constructibilité d'un angle de 20 degrés ou la nature quasi rigide des fonctions dérivables sur les nombres complexes sont véritablement surprenants, et il ne faut pas croire totalement leurs résultats avant que la preuve ne soit comprise.

Ces exemples sont plutôt élémentaires, et les étudiants de premier cycle qui suivent des cours dans ces domaines apprendront à les comprendre. Mais à mesure que nous progressons, de nouveaux éléments nous surprennent. Une personne qui ne connaît rien à la géométrie différentielle ne sera peut-être pas surprise qu'une sphère ordinaire, à laquelle on permettrait de passer à travers elle-même, puisse être retournée à l'envers dans l'espace tridimensionnel. (« Évidemment – si on lui permet de passer à travers elle-même! »). Ce n'est qu'après avoir compris pourquoi un cercle ne peut être retourné sur un plan selon des règles correspondantes que la nature incroyable de la construction de Smale paraît évidente.

D'autre part, nous avons des notions tout aussi nombreuses qui sont « quasi vraies », mais qui sont possiblement fausses. À peu près tout le monde les croit, mais personne n'arrive à les prouver. Le développement décimal de π est-il normal, dans le sens où chaque nombre y apparaît avec une fréquence asymptotiquement égale? Cette question semble si évidente que dans toute autre discipline, on l'accepterait sans broncher. Tout comme bon nombre d'autres conjectures, elle résiste néanmoins aux preuves avec acharnement et, dans bien des cas, on ne sait même pas où commencer à chercher.

Ce sont de telles surprises et paradoxes qui donnent aux mathématiques leur saveur unique et qui, je l'espère, feront de l'année 2015 une année agréable et productive pour lecteurs.

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 www.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 www.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**.

NOTES DE LA SMC

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Rédacteurs en chef

Robert Dawson, Srinivasa Swaminathan (notes-redacteurs@smc.math.ca)

Rédacteur-gérant

Johan Rudnick (jrudnick@smc.math.ca)

Comité de rédaction

Adjointe à la rédaction : Julie Bortolotti

Éducation : John McLoughlin et Jennifer Hyndman (notes-education@smc.math.ca)

Critique de livre: Karl Dilcher (notes-critiques@smc.math.ca)

Réunions : Paul Glover (notes-reunions@smc.math.ca)

Recherche : Florin Diacu, (notes-recherche@smc.math.ca)

SCHPM : Amy Ackerberg-Hastings (aackerbe@verizon.net); Hardy Grant : (hardygrant@yahoo.com)

Calendrier : Johan Rudnick (directeur@smc.math.ca)

Note aux auteurs : indiquer la section choisie pour votre article et le faire parvenir au Notes de la SMC à l'adresse postale ou de courriel ci-dessous.

Les Notes de la SMC, les rédacteurs et la SMC ne peuvent être tenus responsables des opinions exprimées par les auteurs.

CMS NOTES

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Editors-in-Chief

Robert Dawson, Srinivasa Swaminathan (notes-editors@cms.math.ca)

Managing Editor

Johan Rudnick (jrudnick@cms.math.ca)

Contributing Editors

Editorial Assistant: Julie Bortolotti

Education: John McLoughlin and Jennifer Hyndman (notes-education@cms.math.ca)

Book Reviews: Karl Dilcher (notes-reviews@cms.math.ca)

Meetings: Paul Glover (notes-meetings@cms.math.ca)

Research: Florin Diacu, (notes-research@cms.math.ca)

CSHPM: Amy Ackerberg-Hastings (aackerbe@verizon.net); Hardy Grant (hardygrant@yahoo.com)

Calendar: Johan Rudnick (director@cms.math.ca)

The Editors welcome articles, letters and announcements, which can be sent to the CMS Notes at the address below.

No responsibility for the views expressed by authors is assumed by the CMS Notes, the editors or the CMS.

Canadian Mathematical Society - Société mathématique du Canada
209-1725 St. Laurent Blvd., Ottawa, ON, Canada K1G 3V4 **tel 613-733-2662 | fax 613-733-8994**

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CAIMS, SSC and the Canadian institutes and international bodies, such as AMS, SIAM, SMF and the Mathematical Congress of the Americas (MCA).

The CMS Summer Meeting will be in Charlottetown from June 5 to 8, 2015. AARMS has generously offered to support the meeting by funding a number of scientific sessions. CMS was pleased to accept the offer and plans to continue partnering with institutes for future meetings, working together to advance the Canadian mathematical community.

I would like to take this opportunity to respond to concerns that have often been raised regarding registration fees for CMS meetings. Too often the CMS's fees are compared to the AMS meetings' fees, which are much lower due to greater financial resources. I suggest that CMS's fees should instead be compared to SIAM's, which are similar. Our meetings are held in Canada and the CMS's services (reception, coffee breaks, banquets, equipment and support) compare very favorably with those offered by the AMS and SIAM. In addition, our meetings are smaller and more intimate than those of the AMS. CMS meetings are much more personal and offer a better opportunity to meet our fellow mathematicians from all disciplines across Canada (and beyond), which creates a sense of belonging in our community.

Finally, I'd like to close by saying a few words on the CMS's *raison d'être* and the feeling of belonging I referred to above. Mathematicians sometimes ask me why they should be members of the CMS, or why there are two meetings per year instead of one. Or why the CMS has meetings at all, when there are already meetings of the AMS and SIAM in addition to those organized by our institutes. Some may even wonder why we continue to publish CMS journals when the AMS and SIAM already have journals.

One answer to these questions lies in the spirit of belonging to the Canadian mathematical community. Our meetings are much smaller than those of the AMS and less specialized than those of the Institutes, which allow us to meet our Canadian colleagues across disciplines. It would be difficult to create a Canadian mathematical community by relying only on meetings of the AMS or on the regional or specialized conferences of the Institutes. In addition, the CMS's prizes and awards recognize exceptional Canadian mathematicians, which give them a better chance of gaining recognition and receiving prizes at the international level. The same goes for the CMS's journals, which are headed by Canadians and recognize certain specialties that may be more important to us. Finally, the CMS relies heavily on the volunteering and enthusiasm of its members, who have included and always will include pioneers and enthusiasts who contribute to making the CMS an organization that represents mathematics in Canada. It is these individuals, and all members, who make the CMS what it is and who give it its sense of purpose.

Suite de la couverture

comparativement à 15 %), ce qui est un très bon signe pour le future. Nous prévoyons continuer nos efforts afin d'inclure de nouveaux groupes en sciences et en didactique, et la SMC prévoit intensifier ses rapports avec la SCMAI, la SSC, les instituts canadiens, ainsi que d'autres organismes internationaux comme l'AMS, la SIAM, la SMF et le CMA (Congrès mathématique des Amériques).

La prochaine Réunion de la SMC se tiendra à Charlottetown du 5 au 8 juin 2015, et l'AARMSA a généreusement offert sa contribution en finançant un certain nombre de sessions scientifiques : la SMC a accueilli avec plaisir cette offre et prévoit continuer de coopérer avec les instituts pour ses prochaines Réunions afin de regrouper les efforts pour faire progresser la communauté mathématique canadienne.

Je profite ici de l'occasion pour répondre aux inquiétudes souvent mentionnées par rapport aux droits d'inscription aux Réunions de la SMC. Trop souvent, on compare les droits de la SMC à ceux des congrès de l'AMS, qui sont beaucoup moins élevés parce que l'organisme a un plus gros fonds de roulement. Il faudrait plutôt les comparer à ceux de la SIAM, qui sont très semblables. En contrepartie, nos Réunions se tiennent au Canada, les services offerts par la SMC sont notoires (réception, pauses-café, banquets, équipements et soutien), et comme nos Réunions sont beaucoup plus petites que celles de l'AMS, elles sont beaucoup plus personnelles et nous permettent de rencontrer des collègues mathématiciens de toutes les disciplines de partout au Canada (et d'ailleurs), ce qui crée un sentiment d'appartenance à notre communauté.

J'aimerais terminer en disant quelques mots sur la raison d'être de la SMC et le sentiment d'appartenance. En effet, des mathématiciens me demandent parfois pourquoi ils devraient être membres de la SMC. Certains me demandent : pourquoi deux Réunions par année plutôt qu'une? Ou même : pourquoi tenir des Réunions de la SMC quand il y a celles de l'AMS et de la SIAM, en plus des congrès organisés par nos instituts? On peut même se demander pourquoi continuer de publier les revues de la SMC quand il y a celles de l'AMS et de la SIAM?

Une réponse à ces questions est justement le sentiment d'appartenance à la communauté mathématique canadienne. En effet, comme je le disais plus tôt, nos congrès sont beaucoup plus petits que ceux de l'AMS et moins spécialisés que ceux des instituts, ce qui nous permet de rencontrer nos collègues canadiens de toutes disciplines à travers le pays. Par ailleurs, il serait difficile de créer une communauté mathématique canadienne en comptant seulement sur les congrès de l'AMS ou les colloques régionaux ou spécialisés des instituts. De plus, la SMC reconnaît par ses prix les mathématiciens canadiens exceptionnels, ce qui leur donne une meilleure chance d'être reconnus et de recevoir des prix au niveau international. Il en est de même pour les revues de la SMC, qui sont tenues par des Canadiens et qui reconnaissent certaines spécialités qui nous tiennent parfois plus à cœur. Finalement, la SMC compte beaucoup sur le bénévolat et l'enthousiasme de ses membres. Il y a toujours eu et il y aura toujours des pionniers et des enthousiastes qui contribueront à faire de la SMC un organisme qui représente les mathématiques au Canada. Ce sont ces gens, et tous les membres, qui forment la SMC et qui sont sa raison d'être.

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 activities 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)*

FEBRUARY 2015

9-13 FIELDS/CANSSI **Workshop on Optimization and Matrix Methods in Big Data**, Toronto, Ont.

16-20 CRM **Workshop: Regulators, Mahler measures, and special values of L-functions**, Montreal, Que.

23-27 FIELDS/CANSSI **Workshop on Visualization for Big Data: Strategies and Principles**, Toronto, Ont.

30 PIMS/UBC **Distinguished Colloquium: Tom Hou**, University of British Columbia, B.C.

MARCH 2015

9-14 CRM **Workshop: p-adic methods in the theory of classical automorphic forms**, Montreal, Que.

13 PIMS/UBC PIMS/UBC **Distinguished Colloquium: Jill Pipher**, University of British Columbia, B.C.

23-27 FIELDS/CANSSI **Workshop on Big Data in Health Policy**, Toronto, Ont.

APRIL 2015

6-10 CRM **Workshop: The Kudla programme**, Montreal, Que.

13-17 FIELDS/CANSSI **Workshop on Big Data for Social Policy**, Toronto, Ont.

15- 18 NCTM **2015 Annual Meeting and Exposition**, Boston, MA

30-M2 SIAM **International Conference on Data Mining**, Vancouver, B.C.

MAY 2015

2 SIAM **Great Lakes Section 2015 Annual Conference**, Grand Rapids, Michigan

4-8 FIELDS Short Thematic Program: **Differential equations with variable delay**, Toronto, Ont.

6-8 FIELDS **Algorithms and Complexity in Mathematics, Epistemology and Science** (ACMES), Western University, Ont.

7-10 FIELDS **Representation Theory and Analysis on Lie Groups over Local Fields**, University of Ottawa, Ont.

11-15 FIELDS Short Thematic Program: **Delay-Differential equations in physical sciences and engineering**, Toronto, Ont.

15-17 CRM **XVIII[e] colloque panquébécois des étudiants de l'Institut des Sciences Mathématiques** (ISM), Montreal, Que.

19-22 FIELDS Short Thematic Program: **Structured delay systems**, Toronto, Ont.

25-29 FIELDS Short Thematic Program: **Delay differential equations in life sciences and medicine**, Toronto, Ont.

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 Annual Meeting, Waterloo, Ont.

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 **Symposium on Mathematics Education And Coding Modelling Mathematics Relationships With Code, 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.

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.

11-15 SIAM **Annual Meeting**, Boston, Mass.

29-A1 Bridges 2015, Baltimore, Maryland

AUGUST 2015

5-8 MathFest, Washington, DC

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

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)*

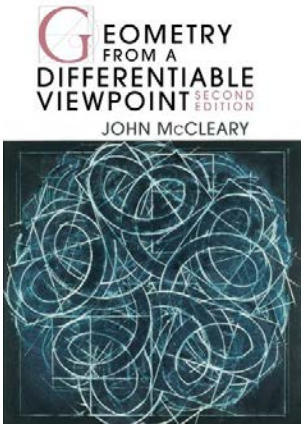
Geometry from a Differentiable Viewpoint

by John McCleary

Cambridge University Press, 2nd Ed., 2012

ISBN: 978-0-521-13311-1

Reviewed by ***Davide Ferrario****, Department of Mathematics and Applications, University of Milano-Bicocca, Milano, Italy*



This book is a remarkable and an excellent introduction to differential geometry. The purpose is, as the author writes in the introduction, "to carry the reader from the familiar Euclid to the state of development of differential geometry at the beginning of the twentieth century." Such a description does not do justice to some features of the book that make it unique and justify the adjective "remarkable."

The book is an attempt to let the reader understand *what* differential geometry is and was –its history, motivations, problems, developments, connections with other topics and fields, perspectives and similarities, inner workings, formalism and potential. Trying to follow a path different from a classical university textbook, the author weaves a thread, a logical and meaningful path through history and through the various topics. These are revealed throughout the chapters, following a tale of theorems and ideas. This narrative follows the Parallel Postulate throughout history, from 300 BCE to the end of the 1800s. The linear story telling is structured like a classical sonata: first the prelude, the introduction and exposition of the main themes and general ideas; then the development, the elaboration of the ideas and themes; and finally, the conclusion, the recapitulation and the coda. This is actually the structure of the book, which by following the Parallel Postulate, makes it possible to smooth the way for the reader, in order to possibly understand the current formulation of differential geometry. This "smoothing," with the help of embedding mathematical theorems in a meaningful historical flow, is explicitly stated at the end of the book. Gauss's motto from his Copenhagen Preisschrift of 1822 is quoted "Ab his via sternitur ad maiora" (From here the way to greater [accomplishments] is smoothed). This is almost the last sentence of Newton's "Tractatus de quadratura curvarum" of 1704, where the basis of differential calculus was posed and even more interesting, Riemann's motto for his Paris Price submission of 1861. The role and importance of "paving the road" is rooted in the history of mathematics itself.

The first part, as prelude and exposition of themes, gives the basic notions of Euclidean geometry and the main motivation in terms of synthetic geometry; it focuses on the first speculative approaches of synthetic non-Euclidean geometry (Bolyai, Lobachewskj). This part begins with spherical geometry and trigonometric functions, and ends with hyperbolic geometry and exponential functions, thus drawing an important parallel. The second part, where the themes are expanded and developed, is a more classical exposition of elementary differential geometry, with some nice historical additions. The theory of differential curves (in the plane and in space) and the theory of surfaces in Euclidean spaces are done by local coordinates. Plane curves are introduced first following Huygens, Leibniz, Newton and Euler, keeping the historical thread alive. For curves in space, the Frenet-Serret apparatus and its properties are the main topics. Then, an interesting and motivating digression on map projections and cartography is the content of Chapter 7^{bis}. Here Euler's proof of the nonexistence of ideal map projections can give a background understanding of later developments by Gauss. Next, Gaussian curvature for surfaces is defined in Chapter 8, and in Chapter 9 the Theorema Egregium is finally proved, giving another proof to the non-existence of an ideal map projection. Geodesics, the exponential map, the Hopf-Rinow Theorem, the Gauss-Bonnet Theorem and Euler-Poincaré characteristic are the contents of Chapters 10 and 11. This second part ends with a chapter on constant-curvature surfaces, with Hilbert's Theorem of the non-existence of complete surfaces of constant negative curvature in $\mathbf{R}^3$. This ending is an elevation in tension, to be resolved in the final part of the book, since with the new tools and techniques it is possible to return to the problems exposed in the first part, and address them.

The third part, termed "Recapitulation and coda," is more properly the "ad majora" part, introducing the reader to the modern point of view (that is, Riemann's point of view). In the last three chapters, abstract surfaces are defined as manifolds (with charts and an atlas) and a Riemannian metric is introduced. After that, it is possible to study and exhibit models of non-Euclidean planes (Beltrami, Poincaré) and new connections with complex analysis are uncovered, via Moebius Transformations. In Chapter 15 ("Epilogue: where from here") a few main topics are indicated to the reader, as a further step into higher dimensions and more abstract generalizations.

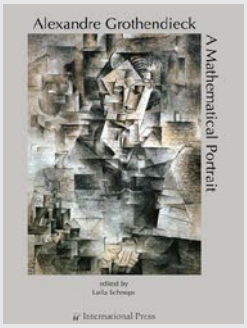
The book is a very elegant and clear mathematical text which fulfills its claims to smooth the way for the reader in a meaningful, deep and appreciable way. This is the second edition of a book first published in 1995; it is well written, and it has a variety of well-chosen exercises at the end of each chapter. This is definitively a book to keep on your bookshelf and to consider when teaching or learning differential geometry on the undergraduate or sometimes graduate level.

Alexandre Grothendieck: A Mathematical Portrait

Edited by Leila Schneps

International Press of Boston, Inc., 2014

ISBN 978-1-57146-282-4

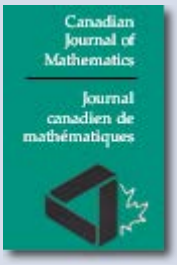


Alexandre Grothendieck's death on November 13, 2014, was widely reported in the print and online media, with headlines such as "*[…], Math Enigma, Dies at 86*" (The NY Times) or "*[…], le plus grand mathématicien du XX^e siècle, est mort*" (Le Monde). The book under review was published only a few months earlier; it is best described by quoting some excerpts from the foreword by the Editor, Leila Schneps:

"[This is] a collection of articles, each devoted to one or another aspect of Grothendieck's work. Far from the usual sort of math publication, however, these articles were not to concentrate on the actual mathematical content of Grothendieck's contribution […] but on the features which constitute in some sense his personal mathematical signature. […] Written by people who knew him personally, some by mere acquaintance and others extremely well, some as students and others as colleagues or latecomers to the Grothendieckian scene, the articles in this book contain a wealth of personal memories, explanations and anecdotes about the effect that Grothendieck's personality, ideas and mathematics had on those who came near him. Like a cubist work of art, the mathematical portrait of Grothendieck painted in this book is made up of a multiplicity of different planes and different angles."

The authors and titles of the individual articles are: Joe Diestel: *Grothendieck and Banach space theory*; Max Karoubi: *L'influence d'Alexandre Grothendieck en K-théorie*; Michel Raynaud: *Grothendieck et la théorie des schemas*; Steven L. Kleiman: *The Picard scheme*; David Mumford: *My introduction to schemes and functors*; Carlos T. Simpson: *Descent*; Jacob P. Murre: *On Grothendieck's work on the fundamental group*; Robin Hartshorne: *An apprenticeship*; Luc Illusie: *Grothendieck et la cohomologie étale*; Leila Schneps: *The Grothendieck-Serre correspondence*; Frans Oort: *Did earlier thoughts inspire Grothendieck?*; Pierre Cartier: *A country of which nothing is known but the name: Grothendieck and "motives"*; Yuri I. Manin: *Forgotten motives: The varieties of scientific experience.* – Karl Dilcher

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

FRANÇAIS PAGE 9

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)*

What went well and what could be done differently?

Jennifer Hyndman, *University of Northern British Columbia*

Recently I had the privilege to attend the workshop *Connecting Women in Mathematics across Canada* as a speaker, role model, adviser, and colleague. The event was held October 3-5, 2014 at the Banff International Research Station (BIRS) and was funded by PIMS, CRM, Fields, and AARMS, as well as two NSERC Chairs for Women in Science and Engineering - the chair for the Prairie Region, Annemieke Farenhorst, and the chair for Ontario, Catherine Mavriplis. Twenty-four women came together to discuss mathematics and careers in mathematics. Seventeen of these women were doing their PhD and the rest of us brought experience.

1. The Talks

At this event the students gave short research presentations and the professors gave talks on a variety of subjects relating to being a successful mathematician. Each student was paired with a professor and received constructive criticism on their presentation.

Rachel Kuske gave a talk, *Complex Dynamics, Research, Connections and Community*. One of her early ideas in the talk was the question *Why am I on this path? Was thought involved?* We all have our stories about the path we are on, how we got to it, and why we stay on it. An idea that Rachel presented was that there are many possibilities and that we need to keep many options open while acknowledging the tensions between being ambitious and realistic.

Keika Mynhardt's talk was on the whole process of developing a research talk. Her main idea was that a talk does not consist of just the time standing in front of the audience. That will actually be a small portion of the time involved in the life of a talk. Her five main stages were choosing the topic, preparing the talk, rehearsing the talk, delivering the talk, and the aftermath (self evaluation). In the many interesting ideas that were brought forward in this talk, one that stood out to me is that key ideas should be sketched and that examples illustrate more than detailed proofs do.

2. My Teaching Talk

I was on sabbatical for the calendar year 2014 so this workshop interrupted my research time. Despite this I leapt at the opportunity to be involved. I was given a block of time and asked to talk about teaching. I decided to give a really bad ten minute lecture. As a group we then took apart what I did well and what I could have done differently. One of the things that I did in the initial ten minutes was have a bad attitude which included being slightly hostile. When this was brought up (late in the discussion) some of the students and most of the professors indicated that they had noticed this but most of the students had missed this. This really surprised me. Is hostility the norm in our classrooms so that my attitude was not unusual and thus not worthy of note? Or is the range of socially accepted behaviour quite different across the diverse group of students? Or is it simply that what bothers one person is not even noticed by another?

The key message in my presentation was that you can always improve your teaching by analyzing it. Ask the questions *What went well?* and *What could be done differently?* immediately after a lecture. Either get a colleague to ask you or ask yourself. My choice of vocabulary in these questions is extremely important to me. I want to keep what went *well* and do other things *differently*. I am not interested in dwelling on how things went *badly* or *wrong* or any other negative idea. I want to think about how to make the next presentation even *better*.

Photo : Keika Mynhardt

3. Do Bother Your Professor

At various times we had some really candid discussions about the process of getting educated. The thing that surprised me most was that many of the students mentioned that they "did not want to bother their Professor with that." I was the student who bothered her professors about anything that I thought of. However, in hindsight, there were many things that I did not know to ask. Some of the students seemed to know they should ask questions about how to give a research talk; or about how to apply for a job; or even how to write a CV. Despite this they still did not ask for help at their primary educational institutions. It may be that supervisors do not know how to answer these questions but faculty should know to send their students to someone who can answer these questions. The universities should be providing resources for graduate students and insisting that those graduate students avail themselves of the resources. I would be very happy if my institution instituted a policy that all graduate students had to partake in something equivalent to an Instructional Skills Workshop (ISW) for teaching; a job application (including CV writing) workshop; as well as a research presentation workshop. We do have a research seminar but what the students do varies with the instructor. The other two topics are entirely optional when available.

4. My Opinions

It is clear to me that we do not do enough to educate our graduate students. They may be brilliant at doing mathematics but to be successful today they need to be able to communicate both their research mathematics and basic calculus. What this weekend at BIRS clearly demonstrated was that our students want to know how to succeed, they can improve research presentations when given guidance, and they are interested in being better teachers. Yes, the group involved was all women but I will be daring and suggest that information observed with these women will apply to male graduate students as well.

The title of this article comes from the teaching related talk that I gave at the workshop but we can apply the questions to the workshop itself.

What went well? Participants, myself included, left with an incredible sense of validation and a desire to get their research done, their theses finished, and their job applications submitted; and a better idea on how to do these things.

What could be done differently? One thing that was not scheduled was a session on writing a Curriculum Vita or a Teaching Philosophy statement. Despite this, the participants found some time to discuss these issues. The impromptu discussion led people to suggest their experiences with cooking, playing instruments, speaking multiple languages, coaching sports, or working with the disabled could be the focus of their Teaching Philosophy statements.

What I am most concerned about is whether this will be done again. It should be. We are still in a transitional time where many women academics have had little experience of situations where they are not the minority. Having peers and role models like oneself makes it easier to believe in oneself and makes one a better mathematician.

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

ENGLISH PAGE 7

Julie Bortolotti, *Communications & Special Projects Officer*

Almost 500 mathematicians came together in Hamilton from Dec. 5 to 8 for the 2014 CMS Winter Meeting. Attendees participated in lectures, scientific sessions and professional development during the four day meeting.

There was a large crowd for Jeffrey Rosenthal's (University of Toronto) public lecture, estimated at approximately 200 people. The lecture was accessible to all audience members and Rosenthal explored topics such as lottery retail scandals, casinos, polls and Monte Carlo. At the end of his lecture, Rosenthal took questions from the audience. When asked what game he would play if given $100 at a casino, he paused and replied, "I would take the money and walk out."

There was an exceptional student participation rate in Hamilton, with students making up over 25 per cent of attendees. Historically, CMS Meetings have a 15 per cent rate of student participation. Twenty-four posters were presented at the AARMS-CMS Student Poster Session, where students had an opportunity to showcase their work.

Kenneth R. Davidson (University of Waterloo) gave the inaugural David Borwein Distinguished Career lecture and covered noncommutative dilation theory in his talk.

The CMS Awards Banquet recognized individuals with exceptional performance in the area of mathematical research and education. The event also included the CRM-Fields-PIMS Prize awarded to Kai Behrand (University of British Columbia).

CMS Winter Meeting by the numbers:

- Over 340 speakers providing a public, plenary lecture or session talk
- 25 Scientific Sessions (including one mathematics education session)
- 24 poster presenters at the AARMS-CMS Student Poster Session
- 2 Student Committee hosted workshops
- 6 CMS presented awards

Près de 500 mathématiciens se sont réunis à Hamilton du 5 au 8 décembre pour assister à la Réunion d'hiver de 2014 de la SMC. Les personnes présentes ont assisté à des exposés, à des séances scientifiques et à des séances de perfectionnement professionnel pendant la réunion de quatre jours.

L'exposé public de Jeffrey Rosenthal (University of Toronto) a attiré de nombreux participants, soit environ 200 personnes selon les estimations. L'exposé était de niveau accessible à tous les participants, et M. Rosenthal a entretenu son auditoire au sujet, notamment, des scandales au détail liés à la loterie, des casinos, des sondages et de Monte Carlo. À la fin de l'exposé, M. Rosenthal a répondu à des questions des personnes présentes. Lorsqu'un participant lui a demandé quel serait le jeu qu'il choisirait dans un casino si on lui donnait 100 $, il a fait une pause et répondu : « je prendrais le 100 $ et je quitterais le casino ».

Le taux de participation étudiante était exceptionnellement élevé à Hamilton. Les étudiants représentaient plus de 25 p. cent des participants. Le taux de participation habituel des étudiants aux réunions de la SMC est de 15 p. cent. Vingt-quatre affiches ont été présentées au cours de la séance d'affiches étudiantes AARMS-SMC, où les étudiants ont eu l'occasion de montrer leur travail.

Kenneth R. Davidson (University of Waterloo) a donné le tout premier exposé du Prix David Borwein de mathématicien émérite pour l'ensemble d'une carrière et a traité de la théorie de la dilatation non commutative dans son exposé.

On a reconnu, au cours du banquet de remise de prix de la SMC, des personnes au rendement exceptionnel dans le domaine de la recherche et de l'enseignement des mathématiques. On a également décerné au cours du banquet le Prix CRM-Fields-PIMS à Kai Behrand (University of British Columbia).

Quelques statistiques concernant la réunion d'hiver de la SMC :

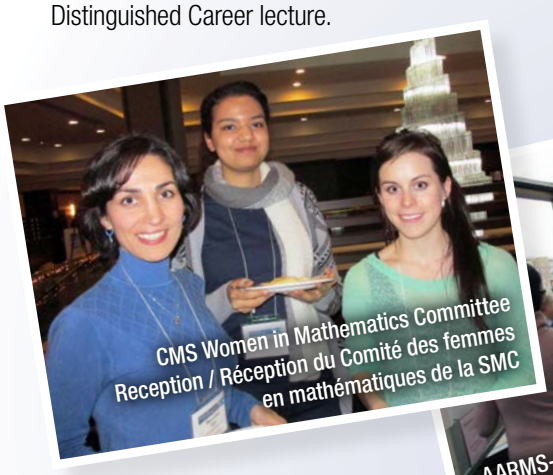
- Plus de 340 présentateurs ont donné un exposé, une séance plénière ou une allocution au cours d'une séance
- 25 séances scientifiques (y compris une séance d'enseignement des mathématiques)
- 24 présentateurs d'affiches au cours de la séance d'affiches étudiantes AARMS-SMC
- 2 ateliers animés par des comités d'étudiants
- 6 prix remis par la SMC


CMS meeting attendees / Participantes à la réunion de la SMC


CMS Banquet / Le Banquet de la SMC

The photos below capture just some of the CMS Winter Meeting highlights including the public lecture, AARMS-CMS Student Poster Session, CMS Awards Banquet and the inaugural David Borwein Distinguished Career lecture.

Voici ci-dessous quelques images des grands moments de la Réunion d'hiver de la SMC, y compris l'exposé public, la séance d'affiches étudiants AARMS-SMC, le banquet de remise des prix de la SMC et l'exposé inaugural du Prix David Borwein de mathématicien émérite pour l'ensemble d'une carrière.



CMS Women in Mathematics Committee Reception / Réception du Comité des femmes en mathématiques de la SMC

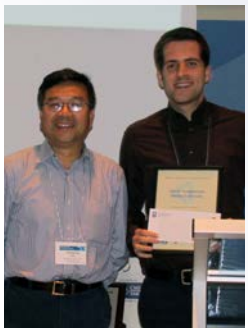
AARMS-CMS Student Poster Session / Séance d'affiches étudiants AARMS-SMC

Kenneth R. Davidson speaks at the inaugural David Borwein Distinguished Career lecture / Kenneth R. Davidson s'adresse à l'auditoire au cours de l'exposé inaugural du Prix David Borwein de mathématicien émérite pour l'ensemble d'une carrière

Award Presentations

The following research and education awards were presented at the CMS banquet to honour and recognize exceptional performance.

Les prix suivants ont été décernés au cours du banquet de remise des prix de la SMC afin de souligner le rendement exceptionnel des lauréats dans le domaine de la recherche et de l'enseignement des mathématiques :



AARMS Poster Award – Alessio Sammartano (Purdue University) with presenter Xiaoqiang Zhao (AARMS) Prix pour l'affiche de la AARMS – Alessio Sammartano (Purdue University) en compagnie du présentateur Xiaoqiang Zhao (AARMS)

Doctoral Prize – Xiangwen Zhang (McGill) with CMS President Lia Bronsard / Prix du doctorat – Xiangwen Zhang (McGill) en compagnie de la présidente de la SMC, Lia Bronsard

CMS President's Award – Arman Sadreddin (Concordia University) with CMS President Lia Bronsard / Prix du président de la SMC – Arman Sadreddin (Université Concordia) en compagnie de la présidente de la SMC, Lia Bronsard

Jeffery-Williams Prize - Askold Khovanskii (Toronto) with CMS President Lia Bronsard / Prix Jeffery-Williams – Askold Khovanskii (Toronto) en compagnie de la présidente de la SMC, Lia Bronsard

Adrien Pouliot Award – Frédéric Gourdeau (Laval) with presenter Miroslav Louric (McMaster) / Prix Adrien-Pouliot – Frédéric Gourdeau (Laval) en compagnie du présentateur Miroslav Louric (McMaster)

David Borwein Distinguished Career Award – Kenneth R. Davidson (Waterloo) with CMS President Lia Bronsard / Prix David Borwein de mathématicien émérite pour l'ensemble d'une carrière – Kenneth R. Davidson (Waterloo) en compagnie de la présidente de la SMC, Lia Bronsard

Continued on page 13

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.

Florin Diacu, *University of Victoria (notes-research@cms.math.ca)*

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.

Florin Diacu, *University of Victoria (notes-recherche@smc.math.ca)*

Self-Collective Behaviour In Biological Aggregations

Razvan Fetecau, *Self-collective behaviour in biological aggregations*

Swarming and self-organization have been buzz words in certain applied mathematics communities lately. The interest started from the spectacular formations of animal groups that we often see in nature (e.g., flocks of birds, schools of fish, swarms of insects). But research in self-collective behaviour quickly reached far beyond biology, with applications in robotics, opinion formation, social networks, pedestrian flow.

This short note regards a certain differential equation model for aggregation that has attracted a lot of interest due to its simplicity and its rich behaviour of solutions. The model considers an interaction potential K which incorporates inter-individual social interactions such as long-range attraction and short-range repulsion.

Denote by ρ the macroscopic density of a group of individuals in $\mathbb{R}^N$. The model consists in the following active transport equation for ρ:

$$\rho_t + \nabla \cdot (\rho v) = 0, \tag{1a}$$

$$v = -\nabla K * \rho, \tag{1b}$$

where the asterisk $*$ denotes convolution.

Despite its simplicity, the model can capture a wide variety of "swarm" behaviour. A provoking gallery of solutions that can be obtained with model (1) is presented for instance in [4]. It contains aggregations on disks, annuli, rings, soccer balls, and others.

The choice of the aggregation potential K is essential for both analysis and applications of model (1). We focus here on a simple potential in the form of a power-law:

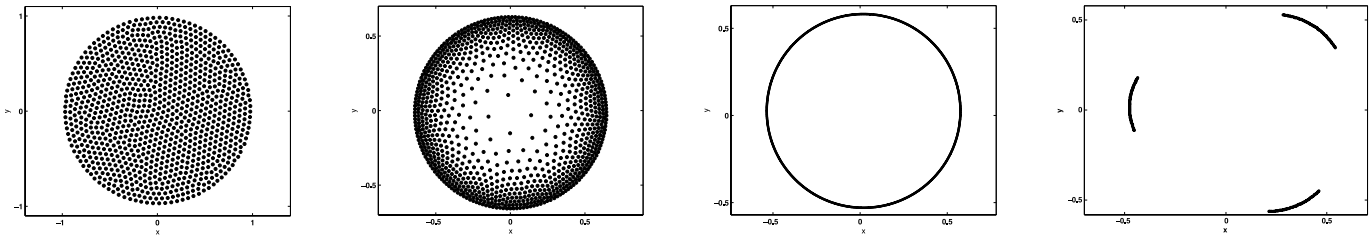
$$K(x) = \frac{1}{q}|x|^q - \frac{1}{p}|x|^p, \qquad \text{for } -N < p < q, \tag{2}$$

where the exponents p and q correspond to repulsion and attraction, respectively.

Figure 1 shows some equilibria in two dimensions for model (1) with K in power-law form. We observe a variety of possible steady states: (a) constant density on a disk, (b) non-uniform density on a disk with higher concentration toward the boundary, (c) aggregation on a circle, and (d) non-symmetric aggregation on three arcs.

In [2] and [3] the authors investigate the case when $p = 2 - N$, i.e., when the repulsion is Newtonian. The equilibria in Figures 1(a) and 1(b) correspond to Newtonian repulsion, with attraction exponents $q = 2$ and $q = 10$, respectively. Note that in two dimensions the Newtonian repulsion is given by $-\log|x|$ instead. The focus in [2], [3] is the intricate balance between the power-law attraction and the singular repulsion, which yields a very interesting and at the same time biologically relevant set of equilibria for model (1).

It is shown in [2], [3] that for $p = 2 - N$ and for all values of $q > 2 - N$, the aggregation model has a unique steady state supported on a ball. This steady state is radial and monotone in the radial coordinate, with an interesting demarcation at $q = 2$. More specifically, the equilibria are decreasing about the origin for $2 - N < q < 2$ and increasing for $q > 2$ (Figure 1(b)), while $q = 2$ corresponds to a constant equilibrium density (Figure 1(a)). Numerical simulations suggest that all these equilibria are global attractors for the dynamics.



(a) *(b)* *(c)* *(d)*

Figure 1. Various equilibria for aggregation model (1) in two dimensions, with K in power-law form (2).

The limits $q \to \infty$ and $q \searrow 2-N$, i.e., when attraction becomes infinitely strong or as singular as the (Newtonian) repulsion, are investigated in [2]. As $q \to \infty$, the radii of the equilibria approach a constant, but the qualitative features change dramatically, as mass aggregates toward the edge of the swarm, leaving an increasingly void region in the centre --- the onset of this effect can be observed for $q = 10$ in Figure 1(b). As $q \searrow 2-N$, the radii of equilibria approach 0 and mass concentrates at the origin.

Alternatively, the steady states of (1) can be investigated by variational methods. Indeed, PDE (1) is the gradient flow of the energy

$$E[\rho] := \int_{\mathbb{R}^N} \int_{\mathbb{R}^N} K(x-y)\rho(x)\rho(y)\,dxdy \tag{3}$$

with respect to the 2-Wasserstein metric.

In [1] the authors establish, via Lions concentration compactness principle, the existence of global minimizers of $E[\rho]$ for potentials K in the power-law form (2). Minimizers are sought in various minimization classes, depending on the sign of the repulsion exponent p. A major distinction is that for $p < 0$ the minimizers are sought among bounded and integrable density *functions*, while for $p > 0$ the minimization class consists of probability *measures*. These choices of minimization classes are supported by numerical simulations. Indeed, Figures 1(a) and 1(b) correspond to $p = 2-N < 0$, while the measure accumulations in Figures 1(c) and 1(d) correspond to $p > 0$ ($p = 1$, $q = 10$ for (c) and $p = 1.5$, $q = 7$ for (d)).

In the last decade various other swarming models have been proposed and investigated. Lots of qualitative features of biological aggregations have been captured by these models, but solid quantitative studies are still lacking. We end this glimpse into the subject by noting that understanding collective behaviour in nature or otherwise surely has a long and exciting road ahead.

Acknowledgment. The author is supported in part by an NSERC Discovery Grant.

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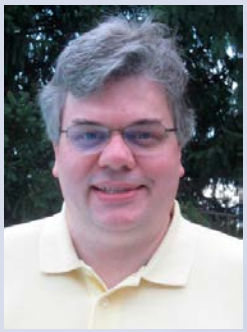
2014 CMS Winter Meeting Recap, continued from page 11

The following individuals were recognized at the Winter Meeting.
Les personnes suivantes ont été reconnus à la Réunion d'hiver.



Graham Wright Award for Distinguished Service / Prix Graham Wright pour service méritoire - Shawn Godin





2014 G. de B. Robinson Award / lauréats du Prix G. de B. Robinson de 2014 - Jonathan M. Borwein (Newcastle, NSW), Armin Straub (Illinois), James Wan (Newcastle, NSW), Wadim Zudilin (Newcastle, NSW) and/et Jan Nekovář (Université Pierre et Marie Curie)

Jeffrey Rosenthal's public lecture
L'exposé public de Jeffrey Rosenthal

CMS Notes
Volume 47 No. 1, February 2015

Arithmetic Methods In Complex Dynamics

Patrick Ingram, *Department of Mathematics Colorado State University, Fort Collins*

Early in the study of the iteration of rational funcions, Pierre Fatou, Gaston Julia, and their contemporaries realized that the orbits of the critical points indicate much of the general dynamical structure. As an example of this phenomenon, the Julia set of a polynomial turns out to be connected if and only if the orbits of the critical points are bounded in the complex plane. The famous Mandelbrot set is best defined as the set of parameters $c \in \mathbb{C}$ such that the Julia set of $z^2 + c$ is connected, but this equivalence gives a simpler way to compute it.

Another example comes from a result of Fatou. In studying iterative processes like Newton's Method, one might wish to understand which fixed points and periodic cycles of $f(z)$ are *attracting*, in the sense that f acts as a contraction in a neighbourhood of that point or cycle.

Theorem 1 (Fatou [3]). *Every attracting cycle of a rational function of degree at least 2 is the limit of a critical orbit.*

Since a rational function has infinitely many periodic cycles, it might *a priori* have infinitely many attracting ones, but Fatou's result gives a bound which depends only on the number of critical points, and hence only on the degree of f.

Given the focus on critical orbits, the case in which every critical point eventually ends up in a periodic cycle is of particular interest. A rational function $f(z) \in \mathbb{C}(z)$ of degree $d \geq 2$ is called *post-critically finite* (PCF), if the post-critical set, that is the union of the orbits of the critical points, is finite.

The family $f_c(z) = z^2 + c$ of quadratic polynomials is a frequent test-bed in dynamics, and it is easy to construct examples of PCF polynomials of this form, simply by solving the polynomial $f_c^n(0) - f_c^m(0) \in \mathbb{C}[c]$, for any $n \neq m$. This family, with only one (affine) critical point, turns out to be a deceptively simple case, as the reader can confirm by trying to write down a few more general PCF rational functions.

A more formulaic construction of examples is provided by the theory of elliptic functions. If $\Lambda \subseteq \mathbb{C}$ is a lattice, $\wp$ is the associated Weierstrass function, $m \geq 2$ is an integer, and $2b \in \Lambda$, then there is a rational function $f(z) \in \mathbb{C}(z)$ of degree m^2 such that

$$\wp(mz + b) = f \circ \wp(z).$$

It is not hard to show from the functional equation that these so-called *Lattès examples* are PCF. This class of function is very special, however (ultimately related to power maps and Tchebyshev polynomials), and in general one should expect PCF maps to be rare. Indeed, a deep theorem of Thurston [2] shows that these Lattès examples offer the only non-trivial parametrized families.

A natural question from the point of arithmetic geometry is, "How many PCF rational functions of degree d have coefficients in $\mathbb{Q}$?" Of course, changing coordinates allows one to turn a single example into infinitely many, and it turns out that infinitely many Lattès examples of a given degree will be defined over $\mathbb{Q}$, so one must cast out the Lattès functions, and work modulo change of coordinates. But given these two caveats, one might be tempted to speculate that there are very few, even finitely many.

One reason for this is the aforementioned result of Thurston; it is a general theme in number theory that geometry dictates arithmetic, and so the paucity of algebraic families of these objects might suggest a similar shortage of instances over $\mathbb{Q}$. For another, we might appeal to an analogy with the theory of complex multiplication (CM) for elliptic curves. Attached to every elliptic curve is a Galois representation, and it is a celebrated result of Serre [8] that the image of this representation is essentially as large as possible if and only if the elliptic curve does not admit CM. Similarly, to each rational function one may associate a Galois representation, and it is at least conjectured that the image of this representation is essentially as large as possible if and only if the function is not PCF (see the recent excellent survey of Jones [5], in particular Theorem 2.5 and Theorem 3.1). This analogy, coupled with the classical fact that there are only finitely many CM elliptic curves defined over $\mathbb{Q}$, might offer further heuristic evidence for some sort of finiteness of PCF maps over $\mathbb{Q}$. This evidence prompted a conjecture at a conference in 2010.

Conjecture 2 (Silverman [9]). *There are only finitely many PCF $f(z) \in \mathbb{Q}(z)$ of given degree, up to change of coordinates and excluding Lattès examples. Indeed, if $B \geq 1$ then there are only finitely many PCF $f(z) \in \mathbb{C}(z)$ of given degree whose coefficients generate an extension of $\mathbb{Q}$ of degree at most B, up to change of coordinates and excluding Lattès examples.*

This conjecture is easy to prove for the family $f(z) = z^2 + c$, which unfortunately turns out to be atypically simple. Suppose that $c \in \mathbb{Q}$. If there exists a prime p dividing the denominator of c, then a simple induction shows that p divides the denominator of $f^n(0)$ to ever-increasing powers. So f cannot be PCF unless we have $c \in \mathbb{Z}$. But if $|c| > 2$, then

$$|f^2(0)| \geq |c|^2 - |c| > \frac{1}{2}|c|^2 > |f(0)|,$$

and so another induction shows that the orbit of the critical point $z = 0$ cannot be finite unless c is between -2 and 2. The two parts of the proof are fundamentally the same, since having a p in the denominator is the same as being large in the p-adic absolute value. With only a little more work, one can show that the values $c \in \mathbb{Q}$ such that $z^2 + c$ is post-critically finite are exactly $c \in \{-2, -1, 0\}$.

The case of cubic polynomials already introduces some of the difficulties seen in higher degree. If we write

$$f(z) = z^3 - 3a^2z + b,$$

then the critical points of f are $z = \pm a$. Mimicking the argument above, one might hope to show that if a and/or b is relatively large (in complex or p-adic absolute value), then

$$f(a) = -2a^3 + b$$

is even larger. Of course, by varying a and b, it is easy to make this quantity as small as you like, but a little algebra shows that, although one of $f(a)$ and $f(-a)$ can be small, it is not possible for *both* of these values to be small without the coefficients of the polynomials themselves being small. It turns out that this argument can be extended to polynomials of arbitrary degree, and the ingredient which shows that the algebra always works out is Hilbert's Nullstellensatz. Indeed, one need not even exclude Lattès examples, which turn out never to be polynomials.

Theorem 3 (Ingram [4]). *There are only finitely many PCF $f(z) \in \mathbb{Q}[z]$ of given degree, up to change of coordinates. Indeed, if $B \geq 1$ then there are only finitely many PCF $f(z) \in \mathbb{C}[z]$ of given degree whose coefficients generate an extension of $\mathbb{Q}$ of degree at most B, up to change of coordinates.*

Attempts to extend this argument to rational functions failed, and probably with good reason: it is unclear at what point in the argument the Lattès examples would be distinguished, and they really do present exceptions to Conjecture 2. Nonetheless, Silverman's claim turns out to hold in the more general case of rational functions as well, albeit by a completely different proof.

Theorem 4 (Benedetto-Ingram-Jones-Levy [1]). *For any $B \geq 1$, there are only finitely many PCF $f(z) \in \mathbb{C}(z)$ of given degree whose coefficients generate an extension of $\mathbb{Q}$ of degree at most B, up to change of coordinates and excluding Lattès examples.*

The proof here is more subtle and technical, making crucial use of the machinery introduced by Thurston [2] and extended by McMullen [6], as well as the theory of Berkovich analytic spaces, a recent and invaluable development in p-adic analysis. Perhaps the most interesting detail of the proof, however, is that it boils down to proving an analogue of Theorem 1, the century-old result of Fatou, in the context of p-adic analysis. So Theorem 4 is an instance of arithmetic geometry shedding new light on a question in complex dynamics, but at the same time, the arithmetic tools are heavily influenced by the classical complex theory.

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Obituary
James D. Stewart, PhD

Robert Dawson, *Editor-in-chief*

James D. Stewart, PhD, died on December 3, 2014. Dr. Stewart was an emeritus professor of mathematics at McMaster University, where he had taught for many years. He was an extremely dedicated teacher, known for the care and effort he put into has classes. He is best known in other Canadian and American mathematics departments for authoring the first- and second-year calculus textbook that bears his name. It has been through many editions, marked always by the emblematic violin on its cover.

The violin was not chosen only for its elegantly differentiable curves, the periodic functions it produces when played, or for the resemblance of its f-holes to integral signs. James Stewart was an exceptionally talented musician – not a gifted amateur, but a professional-level violinist, who played with the Hamilton Philharmonic Orchestra, as well as being Concertmaster of the McMaster Symphony Orchestra. He was fascinated by the interplay between music and mathematics; and sales of his textbook enabled him to build "Integral House," an architecturally adventurous residence with its own concert hall.

While teaching and writing dominated his academic life, he also published a number of research papers, alone and with co-authors. His early work was on Fourier analysis, positive definite functions and summability. His later research was still in the general area of functional analysis, but focused more on linear function spaces.

Dr. Stewart was well-known as a philanthropist, with the University of Toronto (his alma mater, along with Stanford), McMaster University and the Fields Institute being among the many recipients of his generosity.

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.

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.

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

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

Why Use History in a Mathematics Classroom?

Glen Van Brummelen, *Quest University*

We've all experienced the problem. Given the mass of material we are required to cover in our math classes, it seems all but impossible to find avenues for creativity in our lectures. When small time windows open up, we tend to show extra problems, or new applications, or some favourite theoretical wrinkle that we had been saving for such an occasion. Why bring in history? It takes time and effort, and displaces other subjects. What's the advantage?

Simply put, history provides a path for the *entire* mathematical experience. Typically, our students are asked to solve problems and prove theorems, a limited part of what mathematicians do. The full story involves *motivation:* what is the context within which the subject arose, and why is it so appealing that it deserves our attention? Next is *research:* once the problem is identified, how do we articulate lines of attack that have already been made that might be adapted to the new situation? Third is *critical thinking:* how do we transition from received knowledge to new situations? Finally, we have *implications:* how does the solution affect us, the academic community, or society? Good history of mathematics synthesizes all these aspects. Bringing it into the classroom can provide for our students a much broader and deeper mathematical experience. Most crucially, history is a *natural* means to attain these goals: we follow real people, who struggled as our students do, and eventually (usually) triumphed. We learn best through stories, and true stories are often the best ones.

Some examples:

Motivation: All mathematical subjects arose due to some need, either from within mathematics or from outside of it. Trigonometry was invented in ancient Greece to convert geometric models of the motions of the planets into quantitative predictions. Today, it is still a significant tool for moving back and forth between geometry and numerical measurement. Now, the need for some subject may not have been the same in the past as it is today. Logarithms, for example, were invented in the early 17th century as a calculation device for astronomers to reduce the work involved in finding products and roots of numbers. Today our computing power renders this use obsolete. Nevertheless, this historical route can provide a meaningful context for students' first exposure to the subject; the benefits of the theory are obvious, even if its original motivation is no longer active.

Research: Coming to terms with methods that have been devised to attack difficult problems is, by definition, a study in history. Examples begin as early as ancient Babylon, where the geometric practice of "completing the square" seems to have led to solutions of problems related to quadratic equations. In differential equations, the discovery of a function that is its own derivative ($f(x) = e^x$) was exploited repeatedly to solve many problems from the early 18th century onward, and it even helped lead to a unification of exponential and trigonometric functions through complex analysis.

Critical thinking: Every mathematical community makes shared decisions about the validity and power of various competing approaches. For instance, medieval Indian mathematics valued solutions that we might describe as approximate or iterative, while ancient Greek and medieval Islamic mathematicians preferred direct arguments and calculations. One of the most difficult concepts for modern students to understand is that such commitments are also present today. In order to think creatively, one needs to make informed judgments about alternate avenues of attack; one must know what the community's rules are before one decides to bend or break them. An example of such a struggle is the work of the 12th-century Iranian astronomer al-Samaw'al, who rejected an instance of ancient Greek use of approximation to calculate trigonometric tables. Nevertheless, he still needed to produce the tables. His creative solution was to redefine the base circle to contain not 360, but 480 degrees, which bypassed the need for approximation!

Implications: It is often said that the most powerful mathematical results are those that lead to new and interesting questions or that open mathematics to new applications. Witnessing the enlargement of the social role of certain types of mathematics can be a meaningful lesson in measuring its cultural significance. For instance, in early modern Europe the unification of trigonometry with logarithms brought mathematics into the hands of surveyors, architects, and navigators. This transformed mathematics from a primarily theoretical discipline into an engine that eventually helped to reshape modern culture through science and technology. Students aware of these cosmic shifts are better able to place themselves in the intellectual landscape, and to act in their profession with more reflectiveness.

There is one additional aspect of mathematical work that history can support: *communication.* Since history encompasses entire

narratives from initial conception to final product and societal impact, there is a unique opportunity here to improve students' ability to write and otherwise present ideas. Students can write essays; they can make presentations on the background and significance of sub-disciplines; they can write short-answer responses to questions about the significance of and interconnections between theories. It is usually difficult to find opportunities to improve mathematics students' rhetorical skills; history provides a powerful solution.

Challenges: Although the potential benefits of history are diverse, several dangers must be avoided.

- **Misunderstanding history as mere biography:** Textbooks often give snapshots of mathematicians' lives and works in the page margins, mistakenly believing they have done a service to history. They have not. Many of these biographies are unrelated in any direct way to the narrative in the text, and so they unintentionally reinforce the tacit misconception that the mathematics itself is ahistorical. Genuine history in the classroom should be *part* of the presentation of the mathematics; its benefits can only be realized with deeper integration.
- **Entering history without sufficient depth:** The history of mathematics is a deeply challenging endeavour, requiring sophistication in two disciplines with very different aims and modes of thought. Unfortunately, not everything one finds in the library or online is reliable, either historically or mathematically. The mathematics teacher should consult reliable sources; looking up reviews in professional journals is an effective way to screen out low-quality content.
- **Assuming that history is a universal panacea:** Although history is helpful in learning many mathematical concepts, assuming that it *always* leads to positive results is dangerous. Choose moments where the historical context genuinely interacts with the subject, and is appropriate to students' concerns and maturity levels.

Places to start: For topics in the undergraduate curriculum, there is no better place to begin than Victor Katz's history of mathematics textbooks. For accuracy, mathematical rigour, and thorough coverage, they are unsurpassed; and they provide many connections to the rest of the literature. At an elementary level, consider William Berlinghoff and Fernando Gouvea's *Math Through the Ages* (2nd edition). Finally, the *MAA Notes* series has published a number of volumes of historical episodes ready for classroom use, edited by Victor Katz, Amy Shell-Gellasch, Dick Jardine, and others.

Many modern theories of education attempt to address the plague of passivity in our students by promoting active educational experiences, such as the Moore method and inquiry-based learning. History provides the kind of engagement these innovations attempt to foster. However, history can also enhance the traditional mathematics classroom. By considering the entire cycle of mathematical development, and by asking students not merely to perform calculations but also to reflect upon them, history makes students more powerful, more thoughtful, and more significant. In short, it makes them better mathematicians.

Glen Van Brummelen is coordinator of mathematics at Quest University in Squamish, BC. He is (twice) past president of the Canadian Society for History and Philosophy of Mathematics, and is currently the MAA governor-at-large for Canadian members. He is author of The Mathematics of the Heavens and the Earth: The Early History of Trigonometry *(Princeton, 2009) and* Heavenly Mathematics: The Forgotten Art of Spherical Trigonometry *(Princeton, 2013), the latter based on his course at Quest.*

CMS Member Profile

Karl Dilcher

HOME: Dalhousie University, Halifax, NS

RESEARCH: Elementary and combinatorial number theory; special functions; classical analysis.

CMS MEMBERSHIP: Since 1981.

SELECT ACHIEVEMENTS: "Motivator of the Year" award (Dalhousie Math); Department Chair from 2006 to 2013.

HOBBIES: Reading; languages; collecting limerick books.

LATEST BOOK READ: Memoirs of German political cabaret artist Dieter Hildebrandt.

LATEST PUBLICATION: "Reducibility and irreducibility of Stern (0,1)-polynomials" (with Larry Ericksen).

WHAT I WOULD CHANGE: I'm not sure if I should mention politics. But everything else is secondary at the moment.

CMS ROLES: Chair, Publications Committee. Earlier: VP Atlantic; chair of the Endowment Grants Committee; member of the Board and of various committees.

WHY I BELONG TO THE CMS: The CMS is our national organization, and there is strength in numbers (pun intended).

As Canadian mathematicians we need a CMS. To quote Edgar Goodaire (one of my role models): It has never occurred to me not to be a member.

Smaller Board, Another Region, And A Few Good Measures

Johan Rudnick, *Corporate Secretary*

At the December 2014 Board meeting, a number of motions were passed that will set the stage for changing how CMS will be governed. Effective July 1, 2015, the CMS Board of Directors will:

- shrink from 33 members to 23 members;
- include a new Vice-President – Pacific along with three Pacific directors;
- have one instead of two Student members; and
- have a Board chair elected by the Board instead of automatically being the CMS President.

As a result of the Board decisions, the 2015 election to be held at the June AGM in Charlottetown will be staged to elect only twelve Board members, including the President-Elect and Vice-presidents. Before the election, CMS will be holding an advance electronic poll to be tallied with the vote at the AGM.

As part of the interest to improve CMS governance, the Board also endorsed a first step review of the CMS vision, mission, values and strategic priorities. The review is expected to be fuelled by a stakeholder retreat and developed by subsequent community outreach and consultations.

And finally, the Board endorsed a new approach to the organization of CMS meetings, one based on the selection of a high-quality scientific committee for each meeting, rather than a regional scientific committee. This committee would seek out first-rate national and international plenary speakers, in addition to scientific and educational sessions that meet the CMS's high quality standards. Lastly, the CMS will encourage the participation of other scientific societies and groups.

Un plus petit Conseil d'administration, davantage de régions et quelques bonnes mesures

Johan Rudnick, *secrétaire exécutif*

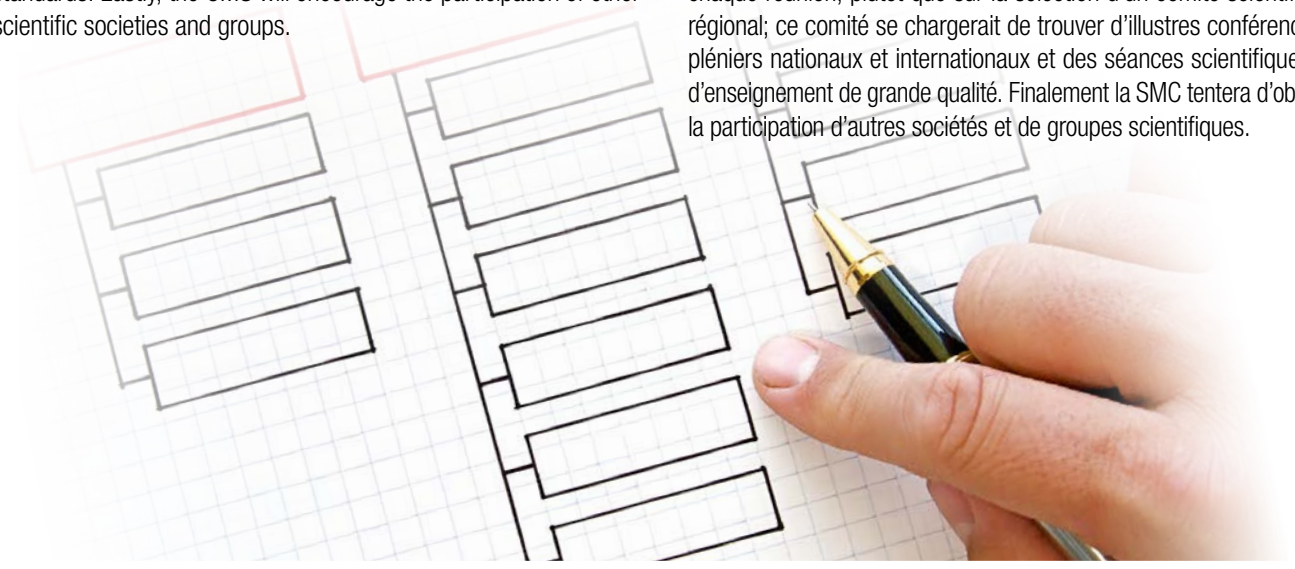
Au cours de la réunion du Conseil d'administration du mois de décembre 2014, les membres ont adopté un certain nombre de motions qui ouvrent la voie à une nouvelle formule d'administration de la SMC. Voici les changements qui seront apportés dès le 1er juillet 2015 au Conseil d'administration de la SMC :

- le Conseil passera de 33 à 23 membres;
- on y nommera un nouveau vice-président – Pacifique, de même que trois administrateurs pour le Pacifique;
- on y comptera un plutôt que deux membres étudiants;
- son président sera élu par le Conseil d'administration; ce ne sera plus automatiquement le président de la SMC.

En raison des décisions du Conseil d'administration, les élections de 2015 qui auront lieu au cours de l'AGA du mois de juin, à Charlottetown, seront organisées de manière à n'élire que 12 membres du Conseil d'administration, y compris le président élu et les vice-présidents. Avant le scrutin, la SMC offrira le vote par anticipation en ligne, dont les résultats seront ajoutés aux voix obtenues au cours de l'AGA.

Conformément à l'intérêt qu'il porte à l'égard d'une administration améliorée de la SMC, le Conseil d'administration a autorisé un examen préliminaire de la vision, de la mission, des valeurs et des priorités stratégiques de la SMC. On s'attend à ce que l'examen soit appuyé par une séance de réflexion des intervenants et à ce qu'il soit développé au cours de séances de participation et de consultation de la communauté qui suivront.

Enfin, le Conseil d'administration appuie une nouvelle démarche relative à l'organisation des réunions de la SMC, démarche qui est fondée sur la sélection d'un comité scientifique de qualité supérieure pour chaque réunion, plutôt que sur la sélection d'un comité scientifique régional; ce comité se chargerait de trouver d'illustres conférenciers pléniers nationaux et internationaux et des séances scientifiques et d'enseignement de grande qualité. Finalement la SMC tentera d'obtenir la participation d'autres sociétés et de groupes scientifiques.



This year the CMS will be electing twelve (12) officers and directors. Candidates have to agree to the nomination and provide the committee with biographical information.

You are invited to nominate members to be candidates. Nominations will be accepted by the Nominating Committee, provided that each person nominated: (i) is supported in writing by at least five (5) other members of the CMS; and (ii) has given written acceptance to stand for office and to supply biographical information.

Nominations together with supporting materials should be emailed to **nominations-2015@cms.math.ca** or mailed to the address below by April 4, 2015:

Nominating Committee Chair
Canadian Mathematical Society
209 - 1725 St. Laurent Blvd.
Ottawa, ON K1G 3V4 Canada

Nominations are being solicited for the following slate of candidates for the Executive Committee:

- President-Elect;
- Vice-President – Atlantic Provinces (N.B., P.E.I., N.S., N.L.);
- Vice-President – Quebec;
- Vice-President – Ontario;
- Vice-President – West (Alta., Sask., Man., N.W.T., Nunavut);
- Vice-President – Pacific (B.C., Yukon).

Nominations are also being solicited for Board of Directors members:

- Quebec – 1 member to be elected;
- West – 2 members to be elected;
- Pacific – 2 members to be elected;
- Student – 1 member to be elected.

For 2015, the CMS will hold an advance electronic poll to be tallied at the June AGM in Charlottetown, P.E.I. Information and voting instructions will be communicated to all individual CMS members. Updated information will be periodically e-mailed to members and posted on the CMS website at **http://cms.math.ca/Elections/2015/**.

Tom Salisbury
Chair, CMS Nominating Committee

Cette année, la SMC élira douze (12) dirigeants et administrateurs. Les candidats doivent s'entendre sur la nomination et de fournir au Comité des informations biographiques.

Vous êtes invités à nommer des membres à titre de candidat. Le Comité des mises en candidature acceptera les candidatures, à condition que chaque personne nommée : (i) ait reçu l'appui par écrit d'au moins cinq (5) autres membres de la SMC et (ii) ait accepté par écrit d'être candidat(e) et de fournir ses renseignements biographiques.

Les candidatures et les documents d'appui doivent être transmis par courrier électronique à **nominations-2015@smc.math.ca** ou envoyés par la poste au plus tard le 4 avril 2015:

Président du Comité des mises en candidature
Société mathématique du Canada
209 – 1725, boul. St. Laurent
Ottawa (Ontario) K1G 3V4 Canada

On demande des candidatures aux postes suivants au sein du Comité exécutif :

- Président élu;
- Vice-président – provinces de l'Atlantique (N.-B., N.-É., T.-N.-L., Î.-P.-É.);
- Vice-président – Québec;
- Vice-président – Ontario;
- Vice-président – Ouest (Alb., Sask., Man., N.W.T., Nunavut);
- Vice-président – Pacifique (C.-B., Yukon).

On demande également des candidatures aux postes suivants au sein du Conseil d'administration :

- Québec – 1 membre à élire;
- Ouest – 2 membres à élire;
- Pacifique – 2 membres à élire;
- Étudiant – 1 membre à élire.

Pour 2015, la SMC tiendra un scrutin d'anticipation par voie électronique, dont les résultats seront analysés au cours de l'AGA de juin à Charlottetown, à l'Île-du-Prince-Édouard. Les renseignements et les consignes du scrutin seront communiqués à tous les membres de la SMC. Des mises à jour seront communiquées régulièrement par courrier électronique aux membres et affichées sur le site Web de la SMC au **http://cms.math.ca/Elections/2015/f**.

Tom Salisbury
Président du Comité des mises en candidature

Counting Mathematicians

Johan Rudnick, *Corporate Secretary*

Earlier this summer, the CMS undertook a web-based inventory of university math and stat department faculty. While the results are certainly not earthshattering, they do start to paint a general picture of the Canadian math faculty population. As a first cut at a demographic profile, CMS looked at the number of universities with math and stats programs, math degree program distribution, math faculty composition and math faculty gender.

70 departments (Table 1)

The survey looked at all universities that offered a degree in mathematics from a mathematics or statistics program and found 70 universities. The survey did not look at the universities with standalone stats departments.

With 10 or 14.3% of the departments and 23.1% of the national population, the province of Quebec has significantly fewer departments than its provincial population might warrant. At the same time, Nova Scotia, with 6 or 8.6% of the departments and 2.7% of the national population, has significantly more departments than its provincial population might warrant.

From a regional perspective, Quebec again has fewer departments than its regional population might warrant. Similar to the Nova Scotia provincial situation, Atlantic Canada as a region with 13 or 18.5% of the departments and 6.7% of the national population, has significantly more departments than the regional population might warrant.

2,925 faculty (Table 2)

For the purposes of the survey, the 2,925 faculty were divide into seven categories and where the faculty title was ambiguous or missing, they were simply counted as 'other or unknown.'

3 Degree levels (Table 3, 4)

Most departments offer either just a BA or the full spectre of BAs, MAs, and PhDs for degree offerings.

Of the 70 departments, 32 or 45.7% offer only one degree level, a math BA, 10 or 14.3% offer math BA and MA programs, while 28 or 40% of the departments offer BA, MA, and PhD programs.

Not surprisingly, the majority of math faculty (77.6%) are in university departments offering a full progression of math degrees.

2 GENDERS (Table 5)

Based solely on the web survey and a small degree of gender assumptions, the Canadian math faculty has a gender split of 16.8% female and 83.2% male, or roughly one female faulty member for every five male faculty members.

As a point of reference, the Thomson Reuters Global Gender Index 2013 found that the proportion of women in Canadian and US academia is 35-40%. Furthermore, other select points of reference also indicate significantly higher levels of female participation than reflected within the Canadian mathematics faculty population.

Not surprising, Full, Associate, and Assistant professors comprise 45% of the faculty population. At the same time, there appear to be more Instructors or Lecturers (17.9%) than Associate Professors (14.5%) or Assistant Professors (6.3%).

While the CMS web survey is by no means rigorous or scientifically accurate, it does however start to paint a picture of the current basic demographics of math departments and faculty across Canada. With 70 departments and almost 3,000 faculty, the community is already substantive, even without counting CEGEPS and colleges.

Table 1 Math departments by province and region

Province	Provincial distribution			Regional distribution			Region
	Departments		% Population	Departments		% Population	
	#	%		#	%		
British Columbia	10	14.3%	13.0%	10	14.3%	13.0%	Pacific
Alberta	6	8.6%	11.6%				
Saskatchewan	2	2.9%	3.2%	13	18.6%	18.4%	West
Manitoba	5	7.1%	3.6%				
Ontario	24	34.3%	38.5%	24	34.3%	38.5%	Ontario
Quebec	10	14.3%	23.1%	10	14.3%	23.1%	Quebec
New Brunswick	5	7.1%	2.1%				
Prince Edward Island	1	1.4%	0.4%	13	18.5%	6.7%	Atlantic
Nova Scotia	6	8.6%	2.7%				
Newfoundland and Labrador	1	1.4%	1.5%				
CANADA	**70**	**100%**	**97.7%**	**70**	**100%**	**97.7%**	**CANADA**

Table 2 Math faculty by rank and region

Region	Emeritus professor	Full professor	Associate professor	Assistant professor	Adjunct or PT professor	Instructor or lecturer	Post-doc	Other or unknown
Pacific	60	81	43	12	20	80	44	49
West	83	114	72	38	11	91	35	24
Ontario	205	238	183	93	136	153	154	28
Quebec	48	187	73	10	52	138	69	0
Atlantic	32	85	52	31	24	57	6	14
Total	428	705	423	184	243	519	308	115
%	**14.6%**	**24.1%**	**14.5%**	**6.3%**	**8.3%**	**17.9%**	**10.5%**	**3.9%**

Table 3 Math degree programs by province and region

Province	Provincial Distribution			Regional Distribution			Region
	BA	BA/MA	BA/MA/PhD	[BA]	[BA/MA]	[BA/MA/PhD]	
British Columbia	5	1	4	5	1	4	Pacific
Alberta	3	1	2	7	1	5	West
Saskatchewan	0	0	2				
Manitoba	4	0	1				
Ontario	8	6	9	9	6	10	Ontario
Quebec	3	0	7	3	0	7	Quebec
New Brunswick	3	1	1	8	2	3	Atlantic
Prince Edward Island	1	0	0				
Nova Scotia	4	1	1				
Newfoundland and Labrador	1	0	1				
CANADA	**32**	**10**	**28**	**32**	**10**	**28**	**CANADA**

Table 4 Math faculty by rank and degree program

Degree	Emeritus professor	Full professor	Associate professor	Assistant professor	Adjunct or PT professor	Instructor or lecturer	Post-doc	Other or unknown	% all faculty
BA	16	94	83	49	9	180	17	34	16.5%
MA	23	65	30	7	6	37	6	0	5.9%
PhD	389	546	310	128	228	302	285	81	77.6%
Total	**428**	**705**	**423**	**184**	**243**	**519**	**308**	**115**	**100.0%**

Table 5 Math faculty by gender

Gender	CMS math faculty Web search 2013		AMS math faculty survey 2012		Statistics Canada 2011 Stem grads		Statistics Canada 2013 Canadian population ('000)	
Female	491	16.8%	1,422	23%	22,600	30.4%	17,726	50.4%
Male	2,434	83.2%	4,767	77%	51,800	69.6%	17,432	49.6%
Total	**2,925**	**100.0%**	**6,189**	**100%**	**74,400**	**100.0%**	**35,158**	**100.0%**

December 4-7, 2015, Montreal (Quebec)
Site: Hyatt Regency Montreal
Host: McGill University

CALL FOR SESSIONS
2015 CMS Winter Meeting

The Canadian Mathematical Society (CMS) and McGill University welcome and invite proposals for sessions for the 2015 Winter Meeting in Montreal from December 4 to 7, 2015. Proposals should include a brief description of the focus and purpose of the session, the expected number of speakers, as well as the organizer's name, complete address, telephone number, e-mail address, etc. All sessions will be advertised in the CMS Notes, on the web site and in the AMS Notices. Speakers will be requested to submit abstracts, which will be published on the web site and in the meeting program. Those wishing to organize a session should send a proposal to the Scientific Director by April 15, 2015.

Scientific Director:

Louigi Addario-Berry: louigi.addario@mcgill.ca

Du 4 au 7 décember 2015, Montréal (Québec)
Site : Hyatt Regency Montréal (Québec)
Hôte : Université McGill

APPEL DE PROPOSITIONS DE SÉANCES
Réunion d'hiver 2015 de la SMC

La Société mathématique du Canada (SMC) et l'Université McGill vous invitent à proposer des séances pour la Réunion d'hiver 2015 qui se tiendra à Montréal du 4 au 7 décember 2015. Ces propositions doivent compter une brève description de l'orientation et des objectifs de la séance, le nombre de conférenciers prévu, de même que le nom, l'adresse complète, le numéro de téléphone et l'adresse électronique de l'organisateur. Toutes les séances seront annoncées dans les Notes de la SMC, sur le site web et dans les AMS Notices. Les conférenciers devront présenter un résumé, qui sera publié sur le site web et dans le programme de la réunion. Toute personne qui souhaiterait organiser une séance est priée de faire parvenir une proposition au directeur scientifique au plus tard le 15 avril 2015.

Directeur scientifique :

Louigi Addario-Berry: louigi.addario@mcgill.ca

Réunion d'été 2015 de la SMC
Charlottetown - 5-8 juin

2015 CMS Summer Meeting
Charlottetown - June 5-8

June 5-8, 2015, Charlottetown (PEI)

Site: University of Prince Edward Island

Hosts: University of Prince Edward Island and the Atlantic Association for Research in the Mathematical Science (AARMS)

CALL FOR SESSIONS
2015 CMS Summer Meeting

The Canadian Mathematical Society (CMS), the University of Prince Edward Island and the Atlantic Association for Research in the Mathematical Science (AARMS) welcome and invite proposals for sessions for the 2015 CMS Summer Meeting in Charlottetown from June 5th to 8th, 2015. Proposals should include a brief description of the focus and purpose of the session, the expected number of speakers, as well as the organizer's name, complete address, telephone number, e-mail address, etc. All sessions will be advertised in the CMS Notes, on the web site and in the AMS Notices. Speakers will be requested to submit abstracts, which will be published on the web site and in the meeting program. Those wishing to organize a session should send a proposal to the Scientific Directors. Deadline: February 28, 2015.

Scientific Directors:

Gordon MacDonald: gmacdonald@upei.ca
Shannon Fitzpatrick: sfitzpatrick@upei.ca

Du 5 au 8 juin 2015, Charlottetown (Î.-P.-É.)

Site : L'Université de l'Île du Prince-Édouard

Hôtes : Université de l'Île-du-Prince-Édouard et l'Association pour l'avancement de la recherche mathématique en Atlantique (AARMS)

APPEL DE PROPOSITIONS DE SÉANCES
Réunion d'été de la SMC 2015

La Société mathématique du Canada (SMC), l'Université de l'Île du Prince-Édouard et l'Association pour l'avancement de la recherche mathématique en Atlantique (AARMS) vous invitent à proposer des séances pour la Réunion d'été 2015 qui se tiendra à Charlottetown du 5 au 8 juin 2015. Ces propositions doivent compter une brève description de l'orientation et des objectifs de la séance, le nombre de conférenciers prévu, de même que le nom, l'adresse complète, le numéro de téléphone et l'adresse électronique de l'organisateur. Toutes les séances seront annoncées dans les Notes de la SMC, sur le site Web et dans les AMS Notices. Les conférenciers devront présenter un résumé, qui sera publié sur le site Web et dans le programme de la réunion. Toute personne qui souhaiterait organiser une séance est priée de faire parvenir une proposition aux directeurs scientifiques. Date limite : 28 février 2015.

Directeurs scientifiques :

Gordon MacDonald : gmacdonald@upei.ca
Shannon Fitzpatrick : sfitzpatrick@upei.ca

Fields Institute Director Search

The Fields Institute for Research in Mathematical Sciences invites applications or nominations for the position of Director for a three- to five-year term (once renewable) beginning July 1, 2015 or as soon as convenient afterwards.

The Fields Institute is an independent research institute located on the downtown campus of the University of Toronto. The Institute's mission is to advance research and communication in all areas of the mathematical sciences. With 4000 registered annual participants from around the world, its programs bring together researchers and students, commercial and industrial users, and an interested public. See **www.fields.utoronto.ca**.

Candidates should be researchers in the mathematical sciences with high international stature, strong interpersonal and administrative skills, and an interest in developing the activities of the Fields Institute.

A letter of application addressing the qualities above, together with a CV and names of three references should be sent **directorsearch@fields.utoronto.ca**. Expressions of interest or nominations are welcome and may also be sent to this address. Women and members of underrepresented groups are encouraged to apply.

Applications or nominations will be considered until the position is filled, but the Search Committee plans to examine dossiers starting March 1, 2015. The members of the Search Committee are Edward Bierstone (Chair), Sheila Embleton, Susan Holmes, Stephen Kudla, Matthias Neufang, Duong Phong and Cameron Stewart.

If undelivered, please return to:
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