CMS NOTES de la SMC

December / décembre 2015

IN THIS ISSUE / DANS CE NUMÉRO

Canadian Mathematical Society
Société mathématique du Canada

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

Rahim Moosa, *(Waterloo), Vice-President - Ontario / Vice-président - Ontario*

In Defence Of The Classroom

On-line math courses, to the extent that they remove students from live professor-led classrooms, offer severely diminished educational value and present a considerable threat to our profession. Such courses do have a limited place in the university, namely as a technologically updated form of what used to be called correspondence courses, intended for students who are either geographically distant or are already in the work force. But the largely uncontested growth of on-line offerings to on-campus students is indefensible.

Alright, that's a controversial beginning to my first missive as a CMS executive. And I am certainly no expert on math education (though, like most professors my age, I have been teaching for almost twenty years). Nor have I ever taught an on-line course. So let me retract any suggestion of authority that I may have unintentionally projected. I should also make it clear that I am not representing the views of the CMS here. Nevertheless, the fulsome conversation that we should be having around on-line courses needs to start somewhere, and this seems like a good place.

I begin with the thesis that mathematics is an intellectual discipline. It has to do not just with information, but with ideas, abstract and often technically complex ideas that need to be explained to the majority of our students.

Continued on page 4

À la défense de la salle de classe

Les cours de maths en ligne, de par le fait même qu'ils fassent disparaître les étudiants de salles de classe menées par des professeurs en chair et en os, ont une bien moindre valeur pédagogique et représentent un danger considérable pour notre profession. Ce genre de cours occupe une place limitée à l'université, à savoir une forme technologiquement mise à jour de ce que l'on avait l'habitude d'appeler cours par correspondance, destiné aux étudiants qui sont soit éloignés géographiquement ou déjà sur le marché du travail. Mais la grande et incontestée croissance de ces offres de cours en ligne aux étudiants sur le campus est indéfendable.

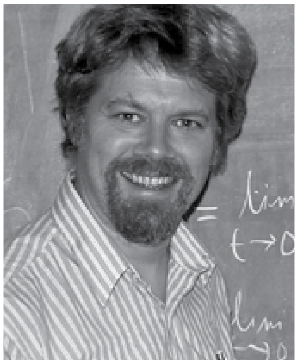
Bon, c'est un début controversé pour ma première lettre en tant que membre exécutif de la SMC. De plus, je ne suis certainement pas un expert en pédagogie adaptée aux mathématiques (bien que, comme la plupart des professeurs de mon âge, j'enseigne depuis presque vingt ans). Je n'ai pas non plus enseigné de cours en ligne. Alors laissez-moi retirer tout soupçon d'autorité que j'aurais pu involontairement projeter. Je dois aussi lever toute ambiguité sur le fait que je ne représente pas l'opinion de la SMC, ici. Néanmoins, la pleine conversation que nous devrions avoir autour des cours en ligne doit bien démarrer quelque part et ici me semble être un lieu adéquat.

Je pars avec la thèse que les mathématiques sont une discipline intellectuelle. Elles ne sont pas qu'informations mais bien des idées, abstraites et souvent techniquement complexes, qui doivent être expliquées à la

Suite à la page 16

The Morning After

Robert Dawson, *St. Mary's University*



The morning after October's election, a lot of students were missing from my eight-thirty calculus class. I joked with those who made it that their classmates must have spent the previous night taking a drink every time the Liberals won a seat. Whether you were watching the Conservative numbers in dismay, cheering the Grits, or comparing the NDP results to the Dieppe Raid, this election was certainly unforgettable.

What will it mean for the mathematical community? For those who are working for the government, it's probably safe to predict a return to greater openness. Research scientists in the civil service will hopefully be able to talk to the media on most subjects, and even engage (like the environmental biologist Tony "Harperman" Turner) in partisan political activity outside of working hours. In most cases, that has not been a problem for university faculty.

What about research funding? Over the last few governments, the number of research grants in my department, and in others nearby, has dropped sharply. This may be partly the result of an aging professoriate, now that mandatory retirement has ended, but surely also has roots in NSERC policies that favor large projects with immediate benefits for industry, and in overall funding that has not kept up with needs.

Will this change? Will our new government return the Canadian research funding system to the one that used to be the envy of our foreign colleagues? It's not clear. There's no evidence of any opposition to pure research, but the Liberals (like the other parties) did not run on a platform of "a theorem in every pot." By the time they have done what they did promise the voters they would do, money will be tight.

A newly elected political party will put their mark on the government by changing what they see as the worst errors of their predecessors. If they are wise, they will accept that the last government were neither total rogues nor total fools, and keep some innovations. But there's also a grey area of sins of omission: policies that they would not have introduced themselves that it is fiscally convenient not to touch, and that can be blamed conveniently on the last government. It is not yet clear where research funding changes fit into this pattern. If the Canadian mathematical community wants a return to better days, we are going to have to make our voices heard.

Le matin d'après

Robert Dawson, *St. Mary's University*

Le matin suivant les élections d'octobre, un bon nombre d'étudiants manquaient à l'appel de mon cours de calcul de 8h30. Je fis la blague, auprès des étudiants présents, que leurs camarades devaient avoir passé la nuit à prendre un verre à chaque fois que les Libéraux avaient gagné un siège. Que vous regardiez les résultats des Conservateurs avec consternation, acclamiez les Grits (Libéraux), ou compariez les résultats du NPD au raid sur Dieppe, cette élection était certainement inoubliable.

Que voudra-t-elle dire pour la communauté mathématique ? Pour ceux qui travaillent pour le gouvernement, il est probablement juste de prédire un retour à une plus grande ouverture.

Les scientifiques en recherche dans le service public pourront espérer pouvoir parler aux médias sur de nombreux sujets et même s'engager (comme le biologiste environnemental Tony « Harperman » Turner) dans des activités politiques partisanes, hors de leurs heures de travail. Dans la plupart des cas, ceci n'a pas été un problème pour les universités.

Qu'en est-il des fonds de recherche ? Au travers des derniers gouvernements, le nombre de subventions de recherche dans mon département, ainsi que dans ceux proches du nôtre, a fortement baissé. Ceci pourrait être le résultat d'un professorat vieillissant, maintenant que la retraite obligatoire n'a plus cours, bien que les racines se trouvent sûrement aussi dans les politiques du CRSNG qui favorisent de grands projets bénéficiant immédiatement à l'industrie et dans le financement général qui n'a pas suivi les besoins.

Cette situation changera-t-elle ? Notre nouveau gouvernement reviendra-t-il au système canadien de financement de la recherche qui faisait pâlir d'envie nos collègues étrangers ? Ce n'est pas encore certain. Nous n'avons la preuve d'aucune opposition des Libéraux à la recherche pure mais ils (comme tous les autres partis) n'ont pas fait campagne sur une plateforme couvrant tous les angles. Lorsqu'ils auront mis en place les promesses effectuées auprès des électeurs, leurs fonds seront amoindris.

Un parti nouvellement élu laissera sa marque au gouvernement en changeant ce qu'il perçoit comme étant les pires erreurs de ses prédécesseurs. S'ils sont sages, ils accepteront que le dernier gouvernement n'était ni totalement sans scrupules ni totalement idiot et garderont quelques innovations. Il se trouve cependant une zone grise dans l'omission : les politiques qu'ils n'auraient introduites eux-mêmes qui sont fiscalement commodes à ne pas toucher et que l'on peut reprocher convenablement à l'ancien gouvernement. Il est difficile de prédire où se trouve les fonds de recherche dans ce schéma. Si la communauté mathématique canadienne souhaite le retour de meilleurs jours, nous allons devoir faire entendre nos voix.

2016 CMS MEMBERSHIP RENEWALS

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

RENOUVELLEMENTS 2016 À LA SMC

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

Letters to the Editors

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

Lettres aux Rédacteurs

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

NOTES DE LA SMC

Les Notes de la SMC sont publiés par la Société mathématique du Canada (SMC) six fois par année (février, mars/avril, juin, septembre, octobre/novembre et décembre).

Rédacteurs en chef

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

Rédacteur-gérant

Denise Charron (denise.charron@smc.math.ca)

Comité de rédaction

Adjointe à la rédaction : Paul Glover

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

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

Réunions : Sarah Watson (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 : Denise Charron (denise.charron@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 pas être tenus responsables des opinions exprimées par les auteurs.

CMS NOTES

The CMS Notes is published by the Canadian Mathematical Society (CMS) six times a year (February, March/April, June, September, October/November and December).

Editors-in-Chief

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

Managing Editor

Denise Charron (denise.charron@cms.math.ca)

Contributing Editors

Editorial Assistant: Paul Glover

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

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

Meetings: Sarah Watson (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: Denise Charron (denise.charron@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**

notes-articles@cms.math.ca | smc.math.ca | cms.math.ca
ISSN :1193-9273 (imprimé/print) | 1496-4295 (électronique/electronic)

Continued from cover

On-line courses may help students to learn for themselves; they may push students in the right direction, organise the material for them, and prod them with cleverly chosen examples and exercises. And indeed, many of our better students can learn the material on their own and will be well served by a good on-line course in much the same way as they would have been by a good book. But I believe that in most cases our role as active teachers is essential, both in directly illlustrating difficult notions and in inspiring students to seek out other sources of explication (on-line or otherwise). Face-to-face there is something that happens in the moment of explanation, aided by gesture, expression, and real-time communication, that brings about a higher level of understanding.

Indeed, if that is not the case, if mathematics can really be taught just as well without professors, then why should the public continue to support an expensive professoriat? Those of us in pure mathematics, where the social good of our research is less tangible, rely all the more on our roles as teachers to commend ourselves to the taxpayer. Shouldn't we as a professional class be worried about the automation that putting courses on-line represents? Maybe our unions and faculty associations should be looking into it.

Let's be honest about the main impetus for on-line courses. There certainly are some true believers, enthusiastic innovative teachers that see real pedagogical benefit in on-line instruction, or conscientious self-motivated students who feel they learn better that way. These are exceptions, however: most proponents are drawn to the convenience and flexibility that on-line courses offer. Students and instructors alike would prefer to not be tied down to a particular place at a particular time. This is understandable; we faculty are juggling teaching with research and service, as well as domestic obligations, and our good students are taking extra courses and getting involved in time-consuming (but beneficial) extra-curricular activities. But coursework is the heart of the university education, and these external pressures do not justify an abrogation of our central responsibilities as teachers and students. It's messy and inconvenient, but to perform our duties properly we do all need to be in the same place at the same time.

Some argue that a student learns better from an on-line course than from inside a giant first-year lecture hall with a tiny professor way up in the front, droning away. First of all, let me point out that we are not just talking about first-year courses here, on-line math courses for on-campus students are happening at all levels. But even if we restrict our attention to large first-year classrooms, is this not a counsel of despair? Surely the situation cannot be so hopeless. I would argue that even just watching an experienced hand *perform* mathematics has considerable value. And there is always some possibility for interaction with the professor no matter how big the class, not to mention all that can be gained from the very act of taking down notes and talking to the students sitting beside you. In any case, if our large lecture classes really are as awful as these critics would have, then the situation is dire and our responsibility is not absolved by adding a couple of on-line sections.

It is a habit of our contemporary culture to describe all things digital as dynamic. This is very far from the truth about on-line math courses. Once such a course is created there is little incentive to refresh it, indeed it is much too expensive to do so as on-line course designers are given substantial teaching reductions. The pressure to just press play again is far too great. On the other hand, the real-time ephemeral nature of live teaching is a built-in course refresher that even the most work averse professor cannot entirely circumvent.

The advent of on-line courses aimed at on-campus students is going to be difficult to resist as it is backed by a collusion of what I would argue are the short-sighted interests of too many students, teachers, and administrators. But, at the very least, we can do what academics are infamous for doing to a fault: we can talk about it.

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.

Denise Charron, *Canadian Mathematical Society, (denise.charron@cms.math.ca)*

Le calendrier des événements 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.

Denise Charron, *Société mathématique du Canada (denise.charron@smc.math.ca)*

DECEMBER 2015 DÉCEMBRE

4-7 2015 CMS Winter Meeting, Hyatt Regency, Montreal, Que. / Réunion d'hiver de la SMC 2015 Hyatt Regency, Montréal, Qué.

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

7-11 39th Australasian Conference on Combinatorial Math & Combinatorial Computing, Brisbane, Australia

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

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

JANUARY 2016 JANVIER

6-9 AMS/MAA Joint Mathematics Meeting, Washington State Convention Centre, Seattle, WA

9-13 CRM Workshop: Moduli spaces, integrable systems, and topological recursions, Montreal, Que.

10-15 BIRS Creative Writing in Mathematics and Mathematical Sciences, Banff, Alta.

10-16 BIRS 19th Conference on Quantum Information Processing, Banff, Alta.

22-24 AARMS/FIELDS Combinatorial Algebra meets Algebraic Combinatorics, Western University, London, Ont.

31-Feb 5 CANSSI Mathematical and Statistical Challenges in Neuroimaging Data Analysis, BIRS, Banff, Alta.

FEBRUARY 2016 FÉVRIER

18 PIMS/ UBC Distinguished Colloquium: Maria Chudnovsky, University of British Columbia, Vancouver, B.C.

MARCH 2016 MARS

18 PIMS/ UBC Distinguished Colloquium: Jacob Lurie, University of British Columbia, Vancouver, B.C.

18-22 CRM Nirenberg Lectures in Geometric Analysis at the CRM: Gunther Uhlmann (University of Washington), Montreal, Que.

MAY 2016 MAI

9-13 GIREF Workshop: Applications and New Frontiers for the Finite Element Method, Université Laval, Quebec City, Que.

12-24 MBI Summer School on Mathematical Epidemiology, Mathematical Biosciences Institute, Columbus, Ohio

16-20 AARMS/FIELDS Workshop on Homotopy Type Theory, Fields Institute, Toronto, Ont.

16-20 FIELDS Conference on Qualitative Aspects of the Theory of Nonlocal Equations, Fields Institute, Toronto, Ont.

16-20 CRM Workshop: New Challenges for the Calculus of Variations Stemming From Problems in the Materials Sciences and Image Processing, Montreal, Que.

30-Jun 1 CORS 2016 Annual Conference, Banff, Alta.

30-Jun 11 2016 Séminaire de Mathématiques Supérieures: Dynamics of Biological Systems, University of Alberta, Edmonton, Alta.

JUNE 2016 JUIN

2-4 FIELDS Workshop on Nonlinear Optimization Algorithms and Industrial Applications, Fields Institute, Toronto, Ont.

6-10 FIELDS Conference on Recent Trends on Elliptic Nonlocal Equations, Fields Institute, Toronto, Ont.

13-17 FIELDS Conference on Geometry, Algebra, Number Theory, and their Information Technology Applications (GANITA), Fields Institute, Toronto, Ont.

13-17 PIMS Workshop on Nonlocal Variational Problems and PDEs, University of British Columbia, Vancouver, B.C.

20-30 CRM Workshop: Partial Order in Materials: Analysis, Simulations and Beyond, Montreal, Que.

22-25 FIELDS Workshop on Mathematics in the Time of Mathematics Open Online Communities (MOOCs), Fields Institute, Toronto, Ont.

24-27 2016 CMS Summer Meeting / Réunion d'été de la SMC 2016, University of Alberta, Edmonton, Alta.

26-30 CAIMS 2016 Annual Meeting, University of Alberta, Edmonton, Alta.

Continued on page 7

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 littéraires 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)*

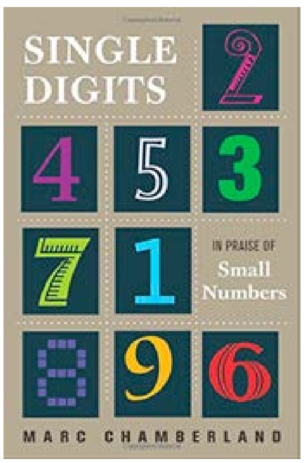
Single Digits - In Praise of Small Numbers

by Marc Chamberland

Princeton University Press, 2015, 216+xii pp.

ISBN: 978-0-691-16114-3

Reviewed by ***Keith Johnson****, Dalhousie University*



Marc Chamberland's "Single Digits" uses the organizing principle of the digits 1 to 9 to present a fascinating and entertaining set of mathematical facts and anecdotes, some elementary and classical, some deep and at the edge of current research.

The idea of organizing a popular mathematics book around a particular sequence of numbers is, itself, a popular idea. Constance Reid's "From Zero to Infinity" is a famous example (published in 1956, and still in print) while a more recent one is Andrew Hodges' "One to Nine" (reviewed in this column October, 2010). These earlier examples aim for slightly different audiences than Chamberland, however. Reid was writing specifically for high school aged students while Hodges, who is an astrophysicist, drew much of his material from the physical sciences. (He also included many comments on sudoku puzzles which were all the rage at the time of publication; an interesting example of how quickly fashion changes.) Chamberland is writing for a more mathematically sophisticated audience, one not scared off by a formula or an explicitly stated theorem, which certainly should include readers of the CMS Notes.

The nine chapters, one for each digit, each contain a collection of short, self-contained essays on topics or results linked in some way to the chapter number. In most cases the link is fairly natural or explicit. The Four Color Theorem is, indeed, in Chapter 4 while the Fano plane (which has 7 points) is in Chapter 7. Why the Fifteen Theorem of Conway, Schneeberger and Bhargava about quadratic forms ends up in Chapter 9 is less clear until you read the account.

In appraising the accuracy of a wide ranging collection of this sort a reasonable strategy for the reader is to first look at the entries on a few topics he or she already knows about (just as to evaluate a collection of restaurant reviews it is not a bad idea to first see what it says about some places you've already eaten at). With this in mind, I can report that the brief accounts of the Brouwer Fixed Point Theorem, the Jordan Curve Theorem and the Ham Sandwich Problem are each accurate and well written. The entry on Knot Theory nicely explains the notion of prime and composite knots and finishes with a very recent result about prime knots and crossing numbers. The slightly longer essay on the Poincaré Conjecture has, inevitably, some fairly drastic simplifications but makes up for it with a nice account of the history of the conjecture.

The range of topics included virtually guarantees that any reader will find new and unfamiliar material to enjoy. Number theory is very well represented (perhaps because it is a subject in which it is a bit easier to describe deep results and unsolved problems) but there are also fascinating accounts of topics in Geometry (angle trisecting, sphere packing), Analysis (Picard's Theorems, the Jacobian Conjectures), Graph theory (Szilassi polyhedra and the Heawood graph), algebra (Quaternions and Octonians, E8) and magic (the details of what has been called the world's best card trick). This of course is a very small sample. The chapters range from 7 to 24 topics each. Interestingly, it seems that it is easier to find material for the smaller digits (Chapter 2 is the longest, Chapter 9 the shortest). The distribution doesn't quite obey Benford's Law (which is very well described in Chapter 1) but almost. The other noticeable pattern in the choice of material is that for each digit Chamberland includes an account of at least one important unsolved problem or conjecture. Some are well known (Catalan's Conjecture, the 3x+1 Problem) but others are less so, but equally intriguing, such as the problem of enumerating even length Barker codes (binary strings having extreme autocorrelation values).

To sum up, this is a very enjoyable book which, at many points, makes some very deep mathematics quite accessible. Highly recommended.

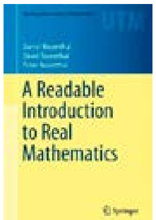
A Readable Introduction to Real Mathematics

by Daniel Rosenthal, David Rosenthal, and Peter Rosenthal

Undergraduate Texts in Mathematics, Springer, 2014

ISBN: 978-3-319-05654-8

*Reviewed by **Keith F. Taylor**, Dalhousie University*



According to the Preface, this book arose out of a course taught at the University of Toronto over 15 years and it is intended to be useful as a text for a variety of undergraduate courses, provided the instructor adjusts the level by controlling the pace and selecting exercises with difficulty level appropriate for the particular course. The first seven chapters, out of 12, build some of the tools of basic number theory up to the RSA method of public key encryption and the Euclidean algorithm. The titles of the final five chapters are Rational and Irrational Numbers; The Complex Numbers; Sizes of Infinite Sets; Fundamentals of Euclidean Plane Geometry; and Constructability.

One sees that the promise of the title, an "Introduction to Real Mathematics," is not of some comprehensive introduction to all meaningful mathematics. Rather, what the authors attempt to do is introduce the reader/student to the deductive approach to mathematics and some of the standard methods of proof by presenting examples of interesting mathematical statements together with proofs based on what a good high school graduate is likely to know. They do not use a rigid axiomatic approach, but present a narrative in the style which working mathematicians might use in a seminar. Results are clearly stated and full proofs are provided, connected by text providing historical context and interesting examples. The flow of the content is smooth, so the "readable" claim of the title may be justified.

How would one use this book? I am not sure if many universities have a course for which this would fit as a textbook. Many universities have bridge courses, usually offered in second year, where the goal is to introduce techniques of writing proofs. The book under review could serve as supplementary reading for such a course or as a resource for the instructor, but it does not systematically discuss the various methods of proofs. Many universities have math courses aimed at students who are not in the physical or mathematical sciences. I fear the content, interesting as it may be to the mathematically inclined, may leave most arts students lost and bored. Again, the instructor of such a course would find sections of this book that could be adapted for use in such a general interest math course.

There is one audience for which I think this book would be a great read. That is high school students who are good enough to be seriously bored with their high school mathematics courses. It would be accessible, with a good amount of challenging material, to such students. Each of us becomes aware of such a student from time to time. I recommend you consider directing them towards this book.

Continued from page 5

JULY 2016 JUILLET

3-9	CRM 12th International Conference on Symmetries and Integrability of Difference Equations (SIDE12), Hotel Le Chantecler, Sainte-Adèle, Qué.
4-8	CRM Workshop: Complex Boundary and Interface Problems: Theoretical models, Applications and Mathematical Challenges, Montreal, Que.
	Formal Power Series and Algebraic Combinatorics, University of British Columbia, Vancouver, B.C.
4-14	CRM Summer School: Spectral Theory and Applications, Université Laval, Quebec City, Que.
11-15	FIELDS World Congress of Probability and Statistics, Fields Institute, Toronto, Ont.
18-22	CRM Workshop: Computational Optimal Transportation, Montreal, Que.
18-22	Conference on Geometry, Representation Theory and the Baum-Connes Conjecture, Fields Institute, Toronto, Ont.
18-22	EMS 7th European Congress of Mathematics, Technische Universität Berlin, Berlin, Germany
24-31	International Commission on Mathematical Instruction (ICME-13), U of Hamburg, Hamburg, Germany
25-29	New Trends in Approximation Theory: A Conference in Memory of André Boivin, Fields Institute, Toronto, Ont.
27-Aug 5	PIMS Summer School and Workshop on Geometric and Topological Aspects of the Representation Theory of Finite Groups, University of British Columbia, Vancouver, B.C.

AUGUST 2016 AOÛT

3-6	MAA MathFest 2016, Columbus, Ohio
15-19	FIELDS 2016 Industrial Problem Solving Workshop, Fields Institute, Toronto, Ont.
15-26	Two Weeks in Vancouver - A Summer School for Women in Math, University of British Columbia, Vancouver, B.C.
21-26	24th International Congress of Theoretical and Applied Mechanics (ICTAM 2016), Palais des congrès, Montreal, Que.
22-26	FIELDS/CRM Conference on Methods of Modern Mathematical Physics, Fields Institute, Toronto, Ont.
28-Sep 1	CRM/FIELDS Frontiers in Mathematical Physics, CRM, Montreal, Que.

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)*

Notes pédagogiques présentent 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 les 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)*

For many young people mathematics feels sterile and disconnected from the world. In this edition of the Education Notes George Gadanidis provides several ideas and resources for connecting abstract mathematics to concrete activities that children can tell stories about. These activities allow children to talk about mathematics and stay engaged.

Math that feels good

George Gadanidis, *Western University, ggadanid@uwo.ca*

Despite popular views to the contrary, school math can be an aesthetic experience, full of surprise, insight and beauty. What's holding us back?

Kids these days!

One obstacle is our negative view of what young children are capable of. We remember the good old days, when kids worked hard, were polite, paid attention, and they knew their math facts. And, of course, in those days we walked 10 miles to school and back, uphill both ways, and we never complained. If only the new generation measured up. Maybe then we could do some cool math with them, instead of the basic skills they seem to lack.

But if we step back and look at the generations that precede ours, we realize that our parents had the same views of us, and their parents of them, and so forth. Daniels (1983) documents this generational pattern as far back as ancient Sumeria. So, it's not surprising that as adults we are attracted to educational theories of what children *cannot do*, such as Piaget's stages of cognitive development, which "absolutely dominate in education" (Egan, 2002, p. 105).

Fig. 1. Grade 4 students in Brazil share the math surprise that "odd numbers hide in squares!"

Papert (1980), who worked with Piaget, disagrees with the linear progression of his developmental stages, suggesting it does not exist in children's minds but in the learning culture we create for them. "Children begin their lives as eager and competent learners. They have to *learn* to have trouble with learning in general and mathematics in particular" (Papert, 1980, p. 40). Dienes, in an interview with Sriraman and Lesh (2007), comments that "Children do not need to reach a certain developmental stage to experience the joy, or the thrill of thinking mathematically and experiencing the process of doing mathematics" (p. 61). Egan (1997), Fernandez-Armesto (1997) and Schmittau (2005) challenge Piaget's notion that young children are not capable of abstract thinking, which Egan identifies as an integral element of language development.

Movshovitz-Hadar (1994) notes the need for non-trivial mathematical relationships in eliciting mathematical surprise, and Gadanidis, Hughes & Cordy (2011) point to challenging mathematics as a co-requisite for aesthetic mathematics experience.

Tell me a math story

A second obstacle to school math as an aesthetic experience is that we have not developed a capacity for framing math ideas as stories that can be shared beyond the classroom. When I ask parents what their children say when asked "What did you do in math today?" the common responses are "Nothing", "I don't know" or the mention of a math topic, like fractions.

Story is not a frill that we can set aside just because we have developed a cultural pattern of ignoring it in mathematics (Gadanidis, 2012). Story is a biological necessity, an evolutionary adaptation that "train(s) us to explore possibility as well as actuality, effortlessly and even playfully, and that capacity makes all the difference" (Boyd, 2009, p. 188). Story makes us human and adds

Fig. 2. Grades 1-2 students use comics to share with parents their learning about "linear functions".

humanity to mathematics. Boyd (2001) notes that good storytelling involves solving *artistic* puzzles of how to create situations where the audience experiences the pleasure of surprise and insight. Solving such artistic puzzles in mathematics pedagogy results in tremendous pleasure for students, teachers, parents and the wider community (Gadanidis, 2012).

Dots, clocks and waves

my daughter explained
how to conduct experiments
and make bar graphs
plotting the results

she was amazed
by the wave pattern
excited to explain it
to her brothers at home

a dot on a car tire
makes a wave pattern
at first I thought
it would be a spiral

the wave pattern
is still there
even if the wheels
even if they are square

it's great to see my son excited
about school and about math
it's great to see enthusiasm
and interest in school math

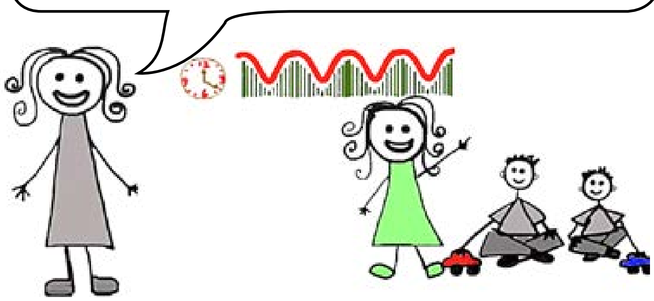
my son enjoyed
testing his hypothesis
he was surprised
surprised by the result

he shared his comics
of what he learned
about math waves
on tires and clocks

the height of every hour
on a grandfather clock
plotted on a bar graph
makes a wave shape

like the height of a dot
on a rolling tire
or seasonal temperatures
or sunrise and sunset times

it's great to see my daughter excited
about school and about math
it's great to see enthusiasm
and interest in school math



What did you do in math today?

For several years I have been spending 50-60 days annually in elementary school classrooms, collaborating with teachers to develop aesthetic experiences for young mathematicians.

Here's how we work together:

1. We start with teacher needs. For example, when teachers asked for help with teaching area representations of fractions, we collaborated to develop an activity which covered this topic in the context of infinity and limit (see Figure 3).
2. We don't change the curriculum. We simply add a richer mathematical context for teaching mandated content.
3. Our pedagogical goal is to prepare students to share their learning with family and friends in ways that offer mathematical surprise and insight, emotional engagement, and visceral sensation of mathematical beauty.

We seek to occasionally (say once a unit) create mathematics experiences worthy of attention, worthy of conversation, worthy of children's incredible minds, which thirst for knowledge and for opportunities to explore, question, flex their imagination, discover, discuss and share their learning.

To the left are lyrics to a song that shares parent comments after grade 3 children shared their learning of "circular functions". You can view an animated music video of the grade 3 students singing this song at http://researchideas.ca/wmt/c2d4.html.

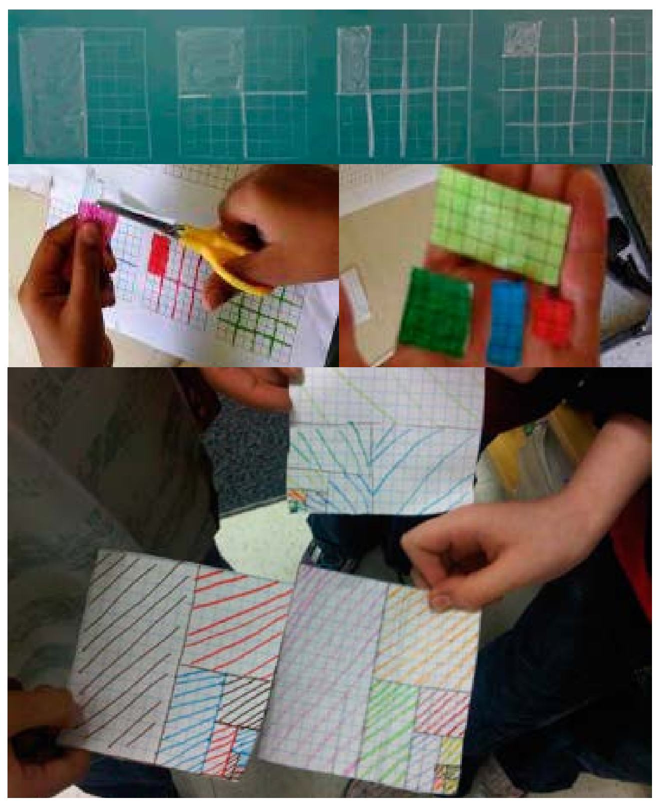
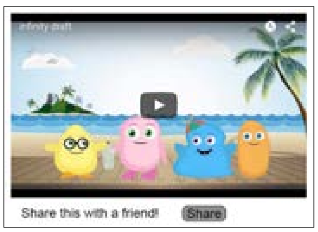


Fig. 3. Grades 2-3 students in Canada and Brazil discover that the infinite set of fractions 1/2, 1/4, 1/8, 1/16 and so forth fit in a single square, and share the surprise "I can hold infinity in my hand!"

Building capacity

Towards the goal of "math that feels good", with funding from SSHRC, KNAER, the Fields Institute, and Western's Teaching Support Centre, we have been developing online resources that publicly share ideas from research classrooms. Below are some examples. See more at http://researchideas.ca.

1. **What will you do in math today?** (www.researchideas.ca/wmt) This resource shares math activities from classroom-based research. It is used as a classroom resource by teachers, for professional development, and for mathematics teacher education courses. It includes lesson development, interactive content, simulations, interviews with mathematicians working on the same math tasks, and classroom documentaries.



2. **Math e-Cards** (www.researchideas.ca/randomacts) This online tools allows you to share short videos of the math surprises in the above resource as math e-Cards. Teachers can send these to parents, to inform them of what their children are studying. They can also be used to share cool math ideas more widely.

3. **Short courses for teachers** (www.researchideas.ca/wmt/courses.html) In collaboration with the Fields Institute, we offer short courses for teachers on Number, Pattern & Algebra, Measurement & Geometry, and Data & Probability. The courses are freely available. Teachers can register and receive certificates of completion for a minimal fee of $30/course. Or, school districts can use these courses to offer their own certificates of completion.

4. **Math + Coding** We have been exploring the intersection of coding and mathematics education, as another way to model, investigate, and experience mathematical beauty. The following are some resources we have made available:

   a. ***Math + Coding 'Zine*** (www.researchideas.ca/mc). An online magazine offering ideas for incorporating coding in mathematics teaching and learning.

   b. ***Math + Coding Events*** (www.researchideas.ca/coding-events). A Fields-funded project that offers support for organizing student-led, math + coding community events.

   c. ***Math + Coding Symposium*** (www.researchideas.ca/coding). Videos of keynotes by Celia Hoyles, Yasmin Kafai and Richard Noss, at a recent symposium funded by Fields and SSHRC.

   d. ***Math + Coding Resources*** (http://researchideas.ca/mathncode). Math + coding simulations, games and more.

5. **Math Music** (www.researchideas.ca/jx) Funded by the Fields Institute, we have been performing math songs from research classrooms for elementary schools across Ontario. Songs and music videos are available at this website.

References

[1] Boyd, B. (2001). The origin of stories: Horton hears a Who. *Philosophy and Literature 25*(2), 197-214.

[2] Boyd, B. (2009). *On the origin of stories: evolution, cognition, and fiction.* Cambridge, MA: Harvard University Press.

[3] Daniels, H. (1983). *Famous last words: The American language crisis reconsidered*. Carbondale, IL: Southern Illinois University Press.

[4] Egan, K. (1997). *The educated mind: how cognitive tools shape our understanding.* Chicago: University of Chicago Press.

[5] Egan, K. (2002). *Getting it wrong from the beginning: Our progressive inheritance from Herbert Spencer, John Dewey, and Jean Piaget*. New Haven: Yale University Press.

[6] Fernandez-Armesto, F. (1997). *Truth: A history and a guide for the perplexed.* London: Bartam.

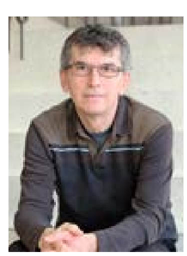
[7] Gadanidis, G. (2012). Why can't I be a mathematician? *For the Learning of Mathematics, 32*(2), 20-26.

[8] Gadanidis, G., Hughes, J. & Cordy, M. (2011). Mathematics for gifted students in an arts- and technology-rich setting. *Journal for the Education of the Gifted, 34*(3), 397-433.

[9] Papert, S. (1980). *Mindstorms: Children, Computers, and Powerful Ideas.* Basic Books, New York, 1980.

[10] Schmittau, J. (2005). The development of algebraic thinking - A Vygotskian perspective. *ZDM* , *37*(1), 16-22.

[11] Sriraman, B. & Lesh, R. (2007). A conversation with Zoltan P. Dienes. *Mathematical Thinking and Learning, 9*(1), 57-75.



George Gadanidis *is professor of education at Western University.*

email: **ggadanid@uwo.ca**
website: **www.researchideas.ca**
twitter: **@georgegadanidis**

Global Dynamics for Semilinear Schrödinger Equations

Slim Ibrahim, *Department of Mathematics and Statistics, University of Victoria*

Nonlinear *Schrödinger* equations appears frequently as a model of propagation of light in nonlinear optics. In the last two decades, the study of the well-posedness theory (both local and global in time) of the Cauchy problem has known an impressive progress in terms of low regularity to achieve the "critical" Sobolev regularity, the one dictated by the scaling invariance of the equation, or in terms of asymptotic behaviour of the solutions as time tends to infinity, and in terms of the stability of certain types of solutions. Therefore, many highly non-trivial tools and techniques have been developed like the *energy induction argument* due to Bourgain, *linear and multilinear Strichartz* estimates (in $X^{s,b}$ spaces) due to Bourgain and Burq-Gérard-Tzvetkov, the *mollified energy* method elaborated by the I-team Colliander-Keel-Staffilani-Takaoka-Tao, and more recently the Concentration-Compactness method initiated by Bahouri-Gérard, Merle-Vega, and established by Kenig-Merle.

This note's main goal is to give a brief description of recent results on the global dynamics of the solutions. More specifically, we focus on the following nonlinear Schrödinger equation:

$$i\frac{\partial\psi}{\partial t}+\Delta\psi+|\psi|^{p-1}\psi+|\psi|^{\frac{4}{d-2}}\psi=0, \quad \text{(NLS)}$$

where $\psi=\psi(x,t)$ is a complex-valued function on $\mathbb{R}^d\times\mathbb{R}$ ($d>3$), Δ is the Laplace operator on $\mathbb{R}^d$ and p satisfies

$$2_*:=2+\frac{4}{d}<p+1<2^*:=2+\frac{4}{d-2}. \qquad (1)$$

Solutions to (NLS) may have various types of behaviour in time ranging from *blow-up*, to *scattering* (global with dispersion) or time periodic (*standing wave*). Recall that a *standing wave* is a solution $\Psi(t,\cdot)=e^{it\omega}u(\cdot)$, where u solves the elliptic equation

$$\omega u-\Delta u-|u|^{p-1}u-|u|^{\frac{4}{d-2}}u=0, \quad u\in H^1(\mathbb{R}^d)\setminus\{0\}. \quad (\omega\text{-SP})$$

Defining the mass and the Hamiltonian by

$$\mathcal{M}(u):=\frac{1}{2}\|u\|_{L^2}^2, \quad \text{and} \quad \mathcal{H}(u):=$$
$$\frac{1}{2}\|\nabla u\|_{L^2}^2-\frac{1}{p+1}\|u\|_{L^{p+1}}^{p+1}-\frac{1}{2^*}\|u\|_{L^{2^*}}^{2^*},$$

then a solution to $(\omega\text{-SP})$ with minimal action $\mathcal{S}_\omega:=\omega\mathcal{M}(u)+\mathcal{H}(u)$ is called *ground state*. In [1,2], Akahori-Ibrahim-Kikuchi-Nawa proved that for any $d\geq 4$, any $p\in(2_*,2^*)$ and any $\omega>0$, the variational problem

$$m_\omega:=\inf\left\{\mathcal{S}_\omega(u)\colon u\in H^1(\mathbb{R}^d)\setminus\{0\},\ \mathcal{K}(u)=0\right\}, \quad (1)$$

with $\mathcal{K}(u)=\|\nabla u\|_{L^2}^2-\dfrac{d(p-1)}{2(p+1)}\|u\|_{L^{p+1}}^{p+1}-\|u\|_{L^{2^*}}^{2^*}$,

has a minimizer; any minimizer for m_ω becomes a *ground state* of $(\omega\text{-SP})$ and vice versa. Recently in [3], we showed that for any $\omega>0$, there is a positive, radial ground state Φ_ω, which is unique if ω is sufficiently small.

The variational characterization (2) easily splits the set of initial data having an action smaller than that of the ground state into two invariant subsets defined by the $\pm$ signs of $\mathcal{K}$ i.e. a *potential well* PW_ω. Now thanks to the "virial identity":

$$\frac{d^2}{dt^2}\int_{\mathbb{R}^d}|x|^2|\psi(x,t)|^2\,dx=8\mathcal{K}(\psi(t)),$$
$$and \quad \mathcal{H}(u)>\frac{1}{2}\mathcal{K}(u),$$

in the *potential well*, solutions with negative $\mathcal{K}$ blow-up in finite time while the others scatter. This was done in the pioneer works of Kenig-Merle for the pure power critical case and $\omega=0$. Moreover, in an elaborative work, Nakanishi and Schlag [4] studied (NLS) without the critical power, and taking $\omega=1$. They have split the set of radial initial data slightly above the "ground state threshold", into nine non-empty regions, pairwise disjoint and leading to solutions with different long-time (forward/backward) behaviours: scattering, trapped to the orbit of *ground states* or finite-time *blow-up*. Here, "scattering forward in time" means that the maximal lifespan of a solution ψ is infinity and there exists $\phi\in H^1(\mathbb{R}^d)$ such that $\lim_{t\to\infty}\left\|\psi(t)-e^{it\Delta}\phi\right\|_{H^1}=0$; "trapped by the orbit $\mathcal{O}(\Phi_\alpha)$ forward in time" means that the maximal lifespan of a solution is infinity and the solution stays in some neighbourhood of $\mathcal{O}(\Phi_\alpha)$ in $H^1(\mathbb{R}^d)$ after some time, and "blowup forward in time" means that the maximal lifespan of a solution is finite. Similarly, one can define the corresponding behaviours "backward in time."

It is important to notice that in [4], the extension of the *potential well* to slightly above the *ground state threshold* uses the scaling invariance of the equation they studied ((NLS) without the critical power and $\omega=1$). Despite the fact that this property breaks down for (NLS), in [3], we extended Nakanishi-Schlag result to the critical case with small frequencies. Our main result reads as follows.

Theorem. Assume $d\geq 4$ and (1). Then, there exists $\omega_*>0$ such that for any $\omega\in(0,\omega_*)$, there exists a positive function $\varepsilon_\omega\colon[0,\infty)\to(0,\infty)$ with the following property: Set

$$\widetilde{PW}_\omega:=\left\{u\in H^1(\mathbb{R}^d)\colon \mathcal{S}_\omega(u)<m_\omega+\varepsilon_\omega(\mathcal{M}(u))\right\}.$$

Then, any radial solution ψ starting from $\widetilde{PW}_\omega$ exhibits one of the above nine scenarios.

Continued on page 13

Polynomial approximation in analytic function spaces

Javad Mashreghi, *Département de mathématiques et de statistique, Université Laval*

Introduction. Polynomials make the building blocks of approximation theory. Their essential role stems from the fact that, along with the rational functions, they form the only family of functions we can *explicitly* compute. For any other function in mathematical analysis we need to design a procedure to get into its vicinity, ideally by exploiting polynomials or rational functions. The most classical result is due to Weierstrass (1885) which settles the possibility of polynomial approximation to continuous functions on closed intervals of the real line. At the same time, Runge (1885) presented his approximation theorem by rational functions. These two results were the starting point of the rapidly developing field of approximation theory. We just mention two outstanding achievements: 1) Stone's generalization (1937) of the Weierstrass theorem, known as the Stone--Weierstrass theorem. 2) Mergelyan's theorem (1951) which is the best possible generalization of the Weierstrass and Runge theorems in the complex plane. In this note, we investigate polynomial approximation in analytic function spaces on the open unit disc $\mathbb{D}$.

The classical approach. The family of all analytic functions on the open unit disc, $\mathrm{Hol}(\mathbb{D})$, equipped with the topology of uniform convergence on compact subsets, is a complete Fréchet space. There is a standard technique, which also applies to many other function spaces, to show that polynomials are dense in $\mathrm{Hol}(\mathbb{D})$. To briefly review this procedure, fix any $f \in \mathrm{Hol}(\mathbb{D})$. The first obstacle is that f could have a very wild behavior at the boundary $\mathbb{T}$. There are various types of examples of analytic functions to show that approaching the boundary can be very problematic. We content ourselves with the following example: An infinite Blaschke product whose zeros cluster at all points of $\mathbb{T}$ has no limit at any point of the boundary and still at almost all points of the boundary behaves well and has a finite limit if we approach them non-tangentially. Quite contradictory and confusing, indeed! Hence, the first step in our approximation process is to replace f by its dilation f_r, where $f_r(z) = f(rz)$, $r < 1$. The advantage of this simple-looking act is to work with a function which is defined on a larger disc, and hence no longer has a problem on $\mathbb{T}$, and at the same time is not far away from our original function f. More explicitly, f_r converges to f in the topology of $\mathrm{Hol}(\mathbb{D})$. The next step is to approximate f_r by the partial sums of its Taylor series. These sums are naturally close to the original function f too. Done.

Odds and ends. The above elegant method also works in many Banach spaces of analytic functions. The list includes, but is not restricted to, *Hardy spaces* H^p, *Bergman spaces* A^p and the classical *Dirichlet space* $\mathcal{D}$. However, it cannot be applied to an arbitrary Banach space in $\mathrm{Hol}(\mathbb{D})$. The first shortcoming is easy to detect. There are function spaces $\mathcal{X}$ which are not closed under dilation, i.e. $f \in \mathcal{X}$ but $f_r \notin \mathcal{X}$. Therefore, the approximation procedure breaks at the first step. For example, if θ is an inner function, the *model space* $K_\theta := H^2 \ominus \theta H^2$ is closed under dilation if and only if $\theta(z) = z^n$. Hence, for the rest of the huge lattice of inner functions we obtain an appropriate example. However, the main problem rests much deeper and has been discovered just recently: there are function spaces $\mathcal{X}$ which are closed under dilation, polynomials are dense in them, and yet f_r does not converge to f in the topology of the space. As a matter of fact, we can even construct $\mathcal{X}$ with an $f \in \mathcal{X}$ such that $\lim_{r\to 1} \|f_r\|_{\mathcal{X}} = \infty$. Note that f_r still converges to f in the topology of $\mathrm{Hol}(\mathbb{D})$ and $\|f\|_{\mathcal{X}} < \infty$. We further discuss these peculiar spaces.

De Branges–Rovnyak spaces. These are a family of subspaces $\mathcal{H}(b)$ of the Hardy space H^2, parametrized by elements b of the closed unit ball of H^∞ [1,2]. The initial motivation for the creation of these objects was to provide canonical *models* for certain types of contractions on Hilbert spaces. However, they also have several interesting connections with other topics in complex analysis and operator theory. To explain their Hilbert space structure, let $\psi \in L^\infty(\mathbb{T})$. Then the corresponding Toeplitz operator $T_\psi : H^2 \to H^2$ is defined by $T_\psi f := P_+(\psi f)$, $f \in H^2$, where $P_+ : L^2(\mathbb{T}) \to H^2$ denotes the othogonal projection of $L^2(\mathbb{T})$ onto H^2. We know that T_ψ is a bounded operator on H^2 with $\|T_\psi\|_{H^2\to H^2} = \|\psi\|_{L^\infty(\mathbb{T})}$ (Brown–Halmos). For $b \in H^\infty$ with $\|b\|_{H^\infty} \le 1$, the associated *de Branges–Rovnyak space* $\mathcal{H}(b)$ is the image of H^2 under the operator $(I - T_b T_{\bar b})^{1/2}$. We define a norm on $\mathcal{H}(b)$ making $(I - T_b T_{\bar b})^{1/2}$ a partial isometry from H^2 onto $\mathcal{H}(b)$, namely $\|(I - T_b T_{\bar b})^{1/2} f\|_{\mathcal{H}(b)} := \|f\|_{H^2}, f \in H^2 \ominus \ker(I - T_b T_{\bar b})^{1/2}$. If b is non-extreme, then there is an outer function a such that $a(0) > 0$ and $|a|^2 + |b|^2 = 1$ a.e. on $\mathbb{T}$. Then, for each $f \in \mathcal{H}(b)$, there exists a unique twin function $f^+ \in H^2$ such that $T_{\bar b} f = T_{\bar a} f^+$, and

$$\|f\|^2_{\mathcal{H}(b)} = \|f\|^2_{H^2} + \|f^+\|^2_{H^2}. \qquad (1)$$

This formula provides a very useful way to compute the norm of f in $\mathcal{H}(b)$. The price is paid in computing the twin function f^+, a task which can be performed only in a few cases. See [4, 5] for the theory of $\mathcal{H}(b)$ spaces.

Exploding dilations in $\mathcal{H}(b)$. The density of polynomials in $\mathcal{H}(b)$ was first proved by showing that their orthogonal complement in $\mathcal{H}(b)$ is zero (Sarason Theorem [5]). The proof is non-constructive in the sense that it gives no clue how to find polynomial approximants to a given function. In the first attempt to exploit the classical approach, the following highly strange phenomenon was discovered [3]. Let us remind that the Cauchy-Szegö kernel is $k_a(z) := 1/(1 - \bar a z)$.

Theorem 1. *Let* $b := b_0 B^2$, *where* $b_0(z) := \dfrac{\tau z}{1 - \tau^2 z}$, $\tau := (\sqrt{5} - 1)/2$, *and* B *is a Blaschke product with exponential zeros, e.g.* $w_n := 1 - 8^{-n}$ $(n \ge 1)$. *Let* $f := \sum_{n\ge1} 4^{-n} k_{w_n}$. *Then* b *is non-extreme,* $f \in \mathcal{H}(b)$, *and we have* $\lim_{r\to 1^-} \|f_r\|_{\mathcal{H}(b)} = \infty$.

Polynomial approximation in $\mathcal{H}(b)$. Despite the above pathological behavior, operator theory helps us to develop a new procedure for polynomial approximation. The Brown–Halmos theorem provides the norm of a Toeplitz operator as a mapping on H^2. However, it can be restricted to invariant subspaces, equipped with new structures, and thus giving the operator a new norm too. Here is an estimation which we need: if b is non-extreme and if (b, a) is a pair with $h \in aH^\infty$, then $T_{\overline{h}}$ is a bounded operator from H^2 into $\mathcal{H}(b)$ and

$$\|T_{\overline{h}}\|_{H^2 \to \mathcal{H}(b)} \leq \|h/a\|_{H^\infty}.$$

This estimation in the main ingredient in the following *constructive* polynomial approximation in $\mathcal{H}(b)$ [3].

Theorem 2. Let b be non-extreme and let (b, a) be a pair. For $n \geq 1$, let h_n be the outer function satisfying $h_n(0) > 0$ and $|h_n| = \min\{1, n|a|\}$ a.e. on $\mathbb{T}$, explicitly:

$$h_n(z) := \exp\Big(\int_0^{2\pi} \frac{e^{i\theta}+z}{e^{i\theta}-z} \log\big(\min\{1, n|a(e^{i\theta})|\}\big)\, \frac{d\theta}{2\pi}\Big) \quad (z \in \mathbb{D})$$

Given $f \in \mathcal{H}(b)$, let (p_n) be a sequence of polynomials such that $\|f - p_n\|_{H^2} < 1/n^2$. Then $T_{\overline{h}_n} p_n$ is a polynomial, for each n, and $\lim_{n\to\infty} \|T_{\overline{h}_n} p_n - f\|_{\mathcal{H}(b)} = 0$.

Open problems. The failure of the classical approximation method in some $\mathcal{H}(b)$ spaces has opened the venu for further investigation. We mention the following three challenging problems for interested readers.

i. Which function spaces in $\mathrm{Hol}(\mathbb{D})$ are closed under dilation, have polynomials as a dense subset, and yet contain elements f whose dilations f_r do not converge? If so, do we necessarily have $\|f_r\|_{\mathcal{X}} \to \infty$ as $r \to 1$?

ii. As a sub-problem of the previous case, for which symbols b in the unit ball of H^∞, does the corresponding de Branges-Rovnyak space $\mathcal{H}(b)$ fall into the above category? What are the algebraic and analytic properties of such symbols?

iii. Assuming $\mathcal{X}$ to be a function space of the above type, which elements of $\mathcal{X}$ have *bad* dilations? How badly do they behave when we locally approach the boundary?

References

[1] De Branges, L., Rovnyak, J.: Canonical models in quantum scattering theory, in Perturbation Theory and its Applications in Quantum Mechanics (Proc. Adv. Sem. Math. Res. Center, U.S. Army, Theoret. Chem. Inst., Univ. of Wisconsin, Madison, Wis., 1965), 295–392, Wiley, New York (1966).

[2] De Branges, L., Rovnyak, J.: Square Summable Power Series, Holt, Rinehart and Winston, New York (1966).

[3] O. El-Fallah, E. Fricain, K. Kellay, J. Mashreghi, T. Ransford, *Constructive approximation in de Branges–Rovnyak spaces*, Constructive Approximation, to appear.

[4] Fricain, E., Mashreghi, J.: Theory of $\mathcal{H}(b)$ Spaces, New Mathematical Monographs vols 20 and 21, Cambridge University Press, Cambridge, 2015.

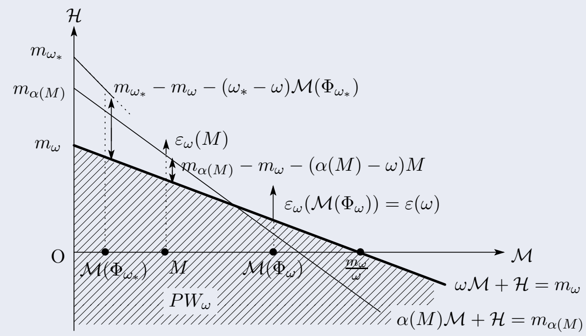
[5] Sarason, D.: Sub-Hardy Hilbert Spaces in the Unit Disk, John Wiley & Sons Inc., New York (1994).

Continued from page 11

The extension $\widetilde{PW}_\omega$ of the *potential well* PW_ω is explained in Figure 1. We end this note by pointing that the main heuristic of the proof is the following observation. If u is a solution to $(\omega\text{-SP})$ and $\omega < \omega_\star$ is small enough, then $v = T_\omega u := \omega^{-\frac{1}{p-1}} u(\frac{\cdot}{\sqrt{\omega}})$ satisfies

$$v - \Delta v - |v|^{p-1} v - \omega^{\frac{2^* - (p+1)}{p-1}} |v|^{\frac{4}{d-2}} v = 0,$$

and therefore has properties similar to that of $v - \Delta v - |v|^{p-1} v = 0$.



References

[1] Akahori T., Ibrahim S., Kikuchi H. and Nawa H., Existence of a ground state and blow-up for a nonlinear Schrödinger equation with critical growth. Differential and Integral Equations 25 (2012) 383–402.

[2] Akahori T., Ibrahim S., Kikuchi H. and Nawa H., Existence of a ground state and scattering for a nonlinear Schrödinger equation with critical growth. Selecta Mathematica (2013).

[3] Akahori T., Ibrahim S., Kikuchi H. and Nawa H., Global dynamics above the ground state energy for the combined power-type nonlinear Schrödinger equations with energy-critical growth at low frequencies. arXiv:1510.08034 [math.AP] (2015).

[4] Nakanishi, K. and Schlag, W., Global dynamics above the ground state energy for the cubic NLS equation in 3D. Calc. Var. and PDE 44 (2012) 1–45.

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

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

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

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

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

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

History of Mathematics and the Forgotten Century

Glen Van Brummelen, *Quest University*

The history of mathematics is being reinvented. Over the past few decades, we have started to realize how delicate a matter it is to portray historical mathematics without distorting it with our modern viewpoints, especially if the subject is centuries old. For instance, we are now careful to avoid expressing, say,

> *Elements* II.4: "If a straight line be cut at random, the square on the whole is equal to the squares on the segments and twice the rectangle contained by the segments."

as its algebraic equivalent, $(a+b)^2 = a^2 + b^2 + 2ab$. This representation changes the impact the theorem would have had on Euclid's audience, in this case obscuring its applications to irrational magnitudes and conic sections. This new sensitivity is a good thing. History isn't about translating ancient accomplishments into modern equivalents; it's about understanding how other communities and cultures thought differently from ours.

But we still have a long way to go. There is more to representing history than our choice of language. For instance, we still often select what mathematical topics in history to study by their interest and accessibility to us. As a result, the broader mathematical community considers the story of European mathematics to be not far off from the story of the development of today's university mathematics curriculum. We talk a great deal about the origins of calculus (not a bad thing, on its own!) and the associated pivotal transition of mathematics from its Euclidean life in the Platonic realm to interactions with the physical world. We also hear of the beginnings of analytic geometry, and more recent topics such as 19th-century analysis, the rise of abstractions resulting in abstract algebra, and so forth. To some extent, by what we choose to discuss, we are still talking about *us*, not *them*.

Putting this to the test: quickly, name a 16th-century European mathematician. Names like Newton, Fermat, Descartes, and Leibniz roll off our tongues easily . . . but they were all active in the 17th century. If pressed, some of us might come up with Girolamo Cardano, who solved the cubic equation, or François Viète, who is associated with the establishment of symbolic algebra. But that's about it. Was the 16th century really so sparse?

In fact, there is a flourishing community of scholars who focus on this period, but their efforts have not entered easily into the popular mathematical imagination. What has filtered through, in addition to Cardano and Viète, are several contributions to the emergence of algebra and the beginning of various notations, Rafael Bombelli's early discovery of complex numbers, and the invention of decimal fractions. Again, these are topics related to the modern mathematics curriculum. Behind this, the literature contains crucial developments, many yet to be discovered. Some of the most important of these should lead us to reconsider whether or not it was calculus that brought European mathematics in contact with the physical world.

My own recent readings in my research area, the history of trigonometry, have brought these points home. Of course, I may well fall victim to my own critique that we tend to focus on historical topics selected by our own interests! However, most of this story is not well known. Spherical trigonometry and early approaches to mathematical astronomy, alas, are not on everyone's lips these days. This is a clear instance where shifting tides in today's school mathematics have obscured for us significant historical events in mathematics.

The fundamental work in trigonometry of the 16th century was Regiomontanus's *De triangulis omnimodis*, written in 1464 but not published until 1533. As the title indicates, it provided solutions to all types of triangles, both plane and spherical. His purpose, as with all such writings at the time, was to provide effective tools for mathematical astronomy. In fact, he referred to his book as "the foot of the ladder to the stars". Unlike surveying, the sciences, or other applications, astronomy was considered to be a fit subject for higher mathematics. When mathematics was needed for earthly matters, more elementary tools from "practical geometry" were used.

The middle of the century saw the appearance of the six now-standard trigonometric functions in Georg Rheticus's 1551 *Canon doctrinae triangulorum*, and in this same work, a hint of the discovery of the ten standard identities for right-angled spherical triangles. These results appeared explicitly in Viète's first mathematical work, *Canon mathematicus seu ad triangular* (1579), where, incidentally, we first see his propensity toward symbolic representations. But still, authors' eyes were fixed firmly on the goal of astronomy.

This began to change just a couple of years later. In 1581 Maurice Bressieu hesitantly included an appendix to his *Metrices astronomicae* that showed how to use trigonometry to find the altitude of a castle. Just two years later, Thomas Fincke's influential *Geometria rotundi* included an entire chapter devoted to the use of trigonometry in surveying. Mathematicians' enthusiasm for these new benefits of their work continued to accelerate; Bartholomew Pitiscus's 1600 *Trigonometriae* (the first appearance of the word) lists prominently on its title page geodesy, altimetry, and geography, along with the more conventional astronomy and sundials.

Figure 1 Title page, Bartholomew Pitiscus, *Trigonometriae*, rev. ed. (1600), Rare Book & Manuscript Library, Columbia University in the City of New York. See www.maa.org/press/periodicals/convergence/a-collection-of-mathematical-treasures-index.

Around the same time, Edmund Gunter and others were building instruments, such as his quadrant and his scale, to solve problems that could be used in navigation and other practical arts. These tools became popular, but they were not immediately accepted by the mathematical establishment. Interviewed by Henry Savile for the first post of Savilian chair of geometry at Oxford, Gunter demonstrated the amazing powers of his instruments. It is reported that Savile responded, "Do you call this reading of geometry? This is showing of tricks, man!"

Broader acceptance of mathematical methods received a major boost with John Napier's introduction of logarithms in his 1614 *Mirifici logarithmorum canonis descriptio*. Napier's purpose in this work was to streamline calculations especially in spherical trigonometry, which frequently requires the multiplication of irrational trigonometric quantities. Laplace later said that Napier, "by shortening the labours, doubled the life of the astronomer." But the biggest impact of logarithms was not heavenly, but earthly. It accelerated the acceptance of mathematics by practitioners. Authors like John Norwood started writing manuals demonstrating the use of the combined trigonometry and logarithms to facilitate calculations for topics such as military architecture. The world, truly, was becoming mathematized.

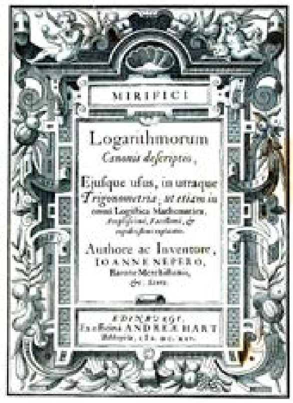


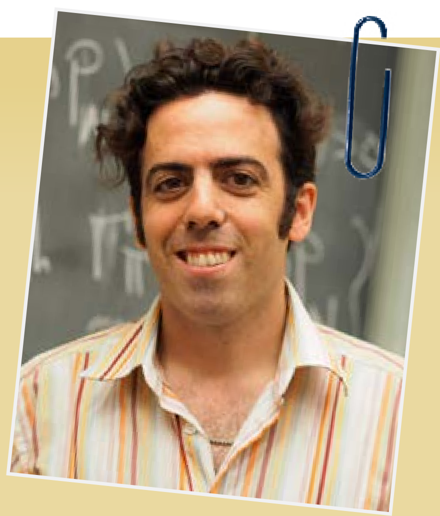
Figure 2 Title page, John Napier, *Mirifici logarithmorum canonis descriptio* (Edinburgh, 1614), Wikimedia Commons.

It was in this context that Galileo's famous quotation from *The Assayer* (1623), that the universe is written in the language of mathematics, was written. The inventions of analytic geometry, and later the calculus, were just around the corner. But the integration of mathematics into the physical world was well on its way before these innovations came along. With this episode, along with others, we might enrich our understanding of the history of mathematics by following a few paths that are now overgrown with weeds, but were once major thoroughfares.

Glen Van Brummelen is founding faculty member and coordinator of mathematics at Quest University (Squamish, BC). He is author of The Mathematics of the Heavens and the Earth *(Princeton, 2009) and* Heavenly Mathematics *(Princeton, 2013), and has served twice as CSHPM president. In January, he will receive the MAA's Haimo Award for distinguished teaching.*

CMS Member Profile / Profil membre de la SMC

Louigi Addario-Berry



HOME: Montreal, Quebec.

CMS MEMBER SINCE: 2011

RESEARCH: Discrete probability; phase transitions; random graphs and random trees; Markov chains and mixing times.

HOBBIES: These days, my free time is spent with my family. Camping is a recent hit with our kids.

LATEST BOOK READ: Last children's book: "Danny, the Champion of the World", by Roald Dahl. Last non-children's book: "On the Move: A Life", by Oliver Sacks. I'm currently reading "Curiosity: How Science Became Interested in Everything", by Philip Ball.

LATEST PUBLICATION: Exceptional Rotations of Random Graphs: A VC Theory. Louigi Addario-Berry, Shankar Bhamidi, Sebastien Bubeck, Luc Devroye, Gabor Lugosi and Roberto Imbuzeiro Oliveira. Journal of Machine Learning Research. Volume 16, Page 1893-1922, September 2015.

WHAT I WOULD CHANGE (ABOUT THE CMS): Lots of things, but change takes effort, and consensus, and compromise, and we all have busy and full lives. I'd like us to have a more active discussion about barriers to access and inclusiveness in our community. This includes but is not limited to gender issues. I'd also think we should work on our journals' open access policies.

MEMORABLE "MATH MOMENT": I'm not sure what this means. But my favourite math moments are the moments of mathematical discovery. These always feel magical, particularly so when they occur through collaborative research.

CMS ROLES: Scientific Director, 2015 CMS Winter Meeting. Previously: Vice President for Quebec; executive committee member; research committee member; doctoral prize committee chair.

WHY I BELONG TO THE CMS: I really value knowing the members of my community more broadly than just those with whom I share research interests.

Suite de la couverture

majorité de nos étudiants. Les cours en ligne peuvent aider des étudiants à apprendre par eux-mêmes ; ils peuvent pousser les étudiants dans la bonne direction, organiser la matière pour eux et les engager intellectuellement à travers des examples et exercices choisis astucieusement. Et en effet, nombre de nos meilleurs étudiants peuvent apprendre la matière par eux-mêmes et seront bien servis par un bon cours en ligne quasiment de la même manière qu'ils l'auraient été par un bon livre. Cependant, je crois que dans la plupart des cas, notre rôle de professeur est essentiel que ce soit en illustrant directement des notions difficiles ou en inspirant les étudiants à rechercher d'autres sources explicatives (en ligne ou ailleurs). L'exposition de la matière, quand elle a lieu en personne, fait naître quelque chose, aidé par la gestuelle, l'expression et la communication en temps réel qui produit un niveau plus élevé de compréhension.

Bien sûr, si tel n'est pas le cas, si les mathématiques pouvaient être aussi bien enseignées sans professeurs, pourquoi le public devrait-il continuer à soutenir un coûteux professorat ? Ceux d'entre nous en mathématiques pures, où le bien social de notre recherche est moins tangible, se fions davantage à notre rôle de professeur afin d'être louangés par le contribuable. Ne devrions-nous pas, en tant que groupe professionnel, être inquiet de l'automatisation représentée par le fait de mettre nos cours en ligne ? Peut-être que nos syndicats et associations universitaires devraient y jeter un oeil.

Soyons honnête à propos de l'élan principal des cours en ligne. Il existe sûrement des partisans, professeurs enthousiastes et innovants, croyant réellement au bénéfice pédagogique de l'enseignement en ligne, ou des étudiants, consciencieux et déterminés, qui sentent qu'ils apprennent mieux de cette façon. Ils sont des exceptions cependant, la plupart de ces adeptes sont attirés par la praticité et la flexibilité que les cours en ligne offrent. Les étudiants autant que leurs instructeurs préféreraient ne pas être attachés à un endroit et un moment particuliers. C'est compréhensible ; étant professeurs universitaires, nous jonglons l'enseignement avec la recherche, la correction ainsi que les obligations domestiques, et nos bons étudiants prennent des cours supplémentaires et s'impliquent dans des activités extrascolaires, chronophages bien que bénéfiques. Cependant, les cours sont au coeur de l'éducation universitaire et ces pressions extérieures ne justfient pas l'abrogation de nos responsabilités centrales en tant que professeurs et étudiants. C'est compliqué et ne nous arrange pas, mais afin d'effectuer nos devoirs adéquatement, nous devons être présents au même endroit, au même moment.

Certains plaident qu'un étudiant apprend mieux grâce aux cours en ligne plutôt qu'en étant dans un énorme amphithéâtre de première année face à un professeur marmonnant, minuscule à l'avant. Tout d'abord, laissez moi préciser que nous ne parlons pas seulement de cours de première année ici, mais de cours pour des étudiants de campus de tous niveaux. Même si nous ne concentrions notre attention que sur les énormes classes de première année, ne serait-ce pas un constat desespérant ? La situation ne peut certainement pas être aussi desespérée. Je plaiderais même que la simple observation d'une main expérimentée réalisant des mathématiques est d'une valeur considérable. Tout en ajoutant la possibilité permanente de pouvoir interagir avec le professeur, peu importe la grandeur de la classe, sans parler de tous les bénéfices possibles par le simple fait de prendre des notes et de parler aux étudiants à côté de soi. Dans tous les cas, si nos grands amphithéâtres sont aussi horribles que ces critiques les dépeignent, alors la situation est terrible et nous ne serons pas déchargés de nos responsabilités en ajoutant quelques sections de cours en ligne.

Il est devenu une habitude de notre société contemporaine de décrire toutes les entités digitales comme étant dynamiques. Ceci est bien loin de la réalité pour les cours de math en ligne. Une fois qu'un cours de ce genre est créé, il se trouve peu d'incitatifs à le mettre à jour, il est en effet bien trop coûteux de faire ainsi vu que les créateurs de cours en ligne se voient offrir une substantielle économie de leur enseignement. La pression de n'avoir qu'à appuyer sur "Lecture" de nouveau est bien trop grande. D'un autre côté, la nature éphémère et en temps réel de l'enseignement en personne, est une mise à jour de cours inhérente à cette manière d'enseigner que même les professeurs les moins enclins à travailler ne peuvent pas complètement contourner.

L'avènement des cours en ligne visant les étudiants sur le campus s'avérera difficile à résister étant soutenue par une collusion, que je soutiendrais comme étant les intérêts à courte vue de bien trop nombreux étudiants, professeurs et administrateurs. Mais, au moins, nous pouvons faire ce que les universitaires sont reconnus comme faisant à outrance : nous pouvons en parler.

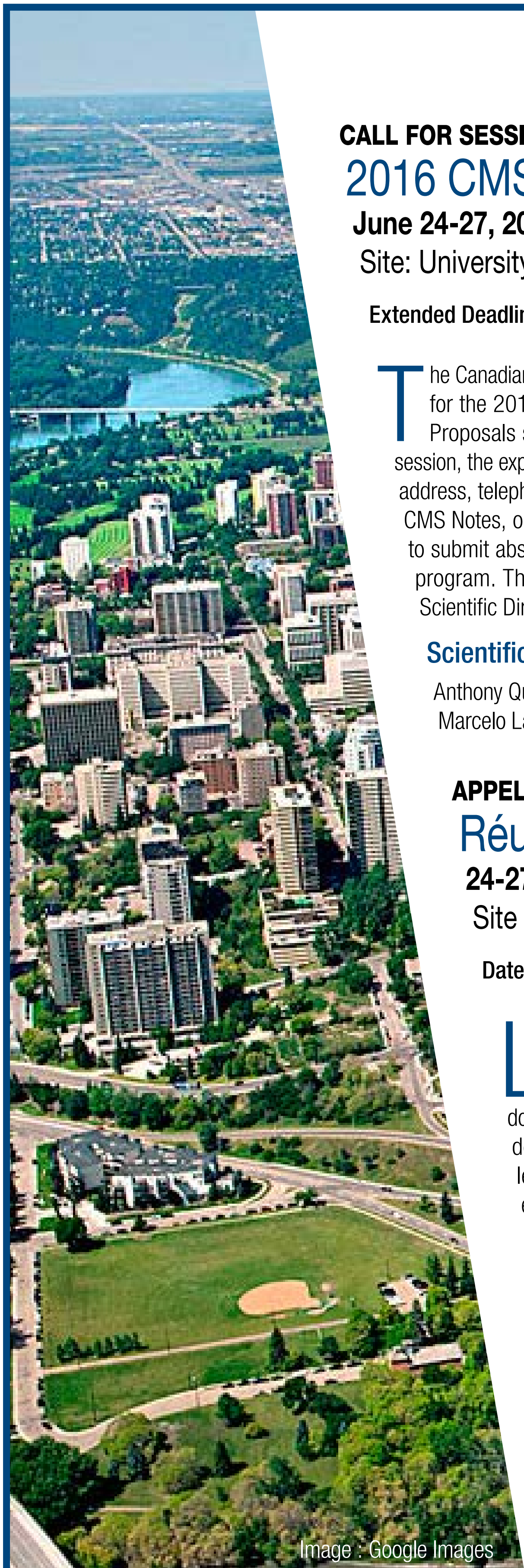


Image : Google Images

CALL FOR SESSIONS

2016 CMS Summer Meeting

June 24-27, 2016

Site: University of Alberta, Edmonton, Alberta

Extended Deadline: January 31, 2016

The Canadian Mathematical Society (CMS) welcomes and invites session proposals for the 2016 CMS Summer Meeting in Edmonton from June 24 to 27, 2016. 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. 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.

Scientific Directors:

Anthony Quas: **aquas@uvic.ca**
Marcelo Laca: **laca@math.uvic.ca**

APPEL DE PROPOSITIONS DE CONFÉRENCES

Réunion d'été de la SMC 2016

24-27 juin 2016

Site : Université de l'Alberta, Edmonton, Alberta

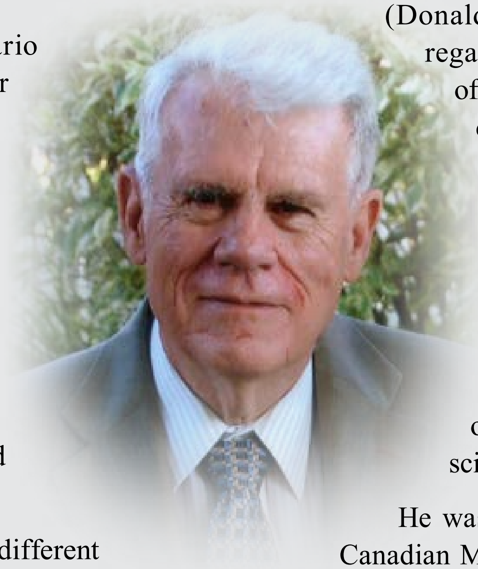
Date limite prolongée : 31 janvier 2016

La Société mathématique du Canada (SMC) invite les gens à proposer des conférences pour la Réunion d'été de la SMC 2016 qui se tiendra à Edmonton du 24 au 27 juin 2016. Ces propositions doivent présenter une brève description de l'orientation et des objectifs de la conférence, le nombre de conférenciers prévu, de même que le nom, l'adresse complète, le numéro de téléphone et l'adresse électronique de l'organisateur. Tous les conférences seront annoncés 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 un conférence est priée de faire parvenir une proposition au directeurs scientifiques.

Directeurs scientifiques :

Anthony Quas : **aquas@uvic.ca**
Marcelo Laca : **laca@math.uvic.ca**

F. Arthur SHERK



Born in Stayner, Ontario on May 20, 1932, Arthur passed away peacefully on September 23, 2015. The son of a pastor, he grew up in Stayner, Sunnidale, Aylmer, Stouffville, Markham, and Kitchener (Centreville). He attended McMaster University and received a Ph.D from the University of Toronto. He and Anne were married in 1954.

Arthur straddled a number of different worlds. Foremost came his family, to whom he was devoted. He loved playing with his four children and numerous grandchildren and great grandchildren, and he and Anne created a warm and closeknit family who enjoyed being together. Arthur played the ukulele with great verve.

He was also a vigorous member of his community, where he was known as "Doc" Sherk. A deeply religious man, he was for many years a member of Banfield Memorial Missionary Church (now Wellspring Worship Centre), filling various leadership roles and participating actively as a deacon and Bible class teacher. He was a member of the Board of Emmanuel Bible College.

But he also had a wide range of friends. Many of them he met through his professional life, and quite a few shared his passion for golf. After his retirement, he and Anne spent much of the winter in South Carolina, visiting friends they had met during two sabbatical years at Clemson University, and playing golf whenever the weather permitted.

Professionally, Arthur was a professor of Mathematics at the University of Toronto and a member of University College. In addition to his scientific work, he filled a wide range of posts in the University, including Assistant Dean of Graduate Studies, Member of Governing Council, and Vice-Principal of University College.

He was a student of Professor H. S. M. (Donald) Coxeter, who is generally regarded as the greatest geometer of the twentieth century. Arthur's doctoral thesis was entitled "Regular Maps". He worked on questions about projective geometry, especially finite projective geometries: finite sets of points that satisfy the axioms of projective geometry. He published two books and a score of articles about them in various scientific journals.

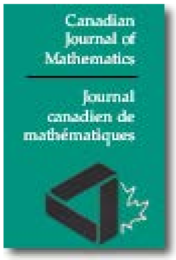
He was also a longtime member of the Canadian Mathematical Society, serving in a number of executive roles, including Managing Editor of the Canadian Mathematical Bulletin, Managing Editor of the Canadian Journal of Mathematics, and as the Society's Treasurer. He was given the Society's Distinguished Service Award in 2000.

He was much respected by his colleagues, who found him wise and supportive, always kind and a gentleman. However, his kindness and gentlemanly behavior never prevented him from trouncing a rival at chess. Retaining a mathematician's fascination with complex mechanisms, Arthur also established for himself an unofficial role as self-appointed custodian of University College's antique clocks, which he coddled with great skill.

Arthur had a dry but lively wit. When an Anglican friend tried to start a theological conversation by observing that Mennonites had never persecuted anybody, Arthur replied gently, "I don't suppose we ever got the chance".

Arthur Sherk understood the value of working together with people with shared interests and vision, and he was extremely effective at creating this miraculous form of community, not only in his family and his religious community, but also in his professional work in the University of Toronto, University College, and the Canadian Mathematical Society. He will be sorely missed by a great many people.

CJM Editor-In-Chief (EIC)



The CMS invites expressions of interest for the Editor-In-Chief (EIC) of the CJM; **two EICs are being solicited, with a term scheduled to commence January 1, 2017.** Funding support from the CMS is available for both these EIC positions.

Since 1949, the **Canadian Journal of Mathematics** has been committed to publishing original mathematical research of high standard following rigorous academic peer review. New research papers are published continuously online and are collated into print issues six times each year.

Expressions of interest should include a cover letter, your curriculum vitae, and an expression of views regarding the publication. Since being EIC of CJM is a large responsibility that may require a lessening of responsibilities in an individual's normal work, individuals should review their candidacy with their university department and include a letter of support.

Please submit your expression of interest electronically to: CJM-EIC-2015@cms.math.ca **before May 15, 2016**.

Current 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 (Princeton)	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

Rédacteur en chef pour le JCM

La SMC invite les personnes intéressées par un poste de rédacteur en chef au JCM à lui faire part de leur intérêt. **Deux postes de rédacteurs en chef sont à pourvoir, pour un mandat qui commencera le 1 janvier 2017.** La SMC offre du soutien financier pour ces deux postes.

Depuis 1949, le **Journal Canadien de Mathématiques** s'engage à publier des recherches en mathématiques, originales et de haut niveau, suivant de rigoureux examens par des pairs. Les articles de recherches sont disponibles en tout temps en ligne et sont rassemblés en six éditions imprimées par année.

Les propositions de candidature comprendront les éléments suivants : une lettre de présentation, votre curriculum vitae et un texte dans lequel vous exprimez votre opinion et vos idées par rapport à la publication. Puisque devenir rédacteur en chef de la JCM est une grande responsabilité qui peut nécessiter une réduction dans la charge normale de travail, les individu(e)s devraient vérifier leur candidature avec leur département et veuillez ajouter une preuve du soutien.

Veuillez faire parvenir votre candidature par courriel à : CJM-EIC-2015@smc.math.ca **au plus tard le 15 mai 2016**.

Conseil de redaction pour le JCM et le BCM à présent :

Henry Kim (Toronto)	12/2016	Rédacteur en chef du JCM
Robert McCann (Toronto)	12/2016	Rédacteur en chef du JCM
Jie Xiao (Memorial)	12/2019	Rédacteur en chef du BCM
Xiaoqiang Zhao (Memorial)	12/2019	Rédacteur en chef du 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 (Princeton)	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

Mathematical Congress of the Americas
Congrès Mathématique des Amériques

MCA 2017

July 24-28 juillet Montréal, Canada

The second Mathematical Congress of the Americas (MCA) will take place on July 24-28, 2017, at Centre Mont-Royal and McGill University, Montreal, Canada. The congress is expected to attract mathematicians and students from throughout North America, Central America, South America and the Caribbean.

MCA 2017 highlights mathematical achievements of the Americas and fosters collaboration between the continents' mathematical communities. The congress is a collective initiative of the **Mathematical Council of the Americas** (MCofA). MCA 2017 is being supported by a Canadian organizing committee that includes the Pacific Institute for the Mathematical Sciences (PIMS), the Fields Institute (FIELDS), le Centre de recherches mathématiques (CRM), the Atlantic Association for Research in the Mathematical Sciences (AARMS) and the CMS, which is staging the event.

Le deuxième Congrès mathématique des Amériques (CMA) aura lieu du 24 au 28 juillet 2017 au Centre Mont-Royal et l'Université McGill, à Montréal, Canada. L'événement devrait attirer des mathématiciens et mathématiciennes ainsi que des étudiantes et étudiants de partout à travers l'Amérique du Nord, l'Amérique centrale, l'Amérique du Sud et les Caraïbes.

Le CMA 2017 met en lumière les accomplissements mathématiques des Amériques et encourage la collaboration entre les différentes communautés mathématiques du continent. Le congrès est une initiative collective du **Mathematical Council of the Americas** (MCofA). Le CMA 2017 est financé par un comité canadien incluant le Pacific Institute for the Mathematical Sciences (PIMS), l'institut Fields (FIELDS), le Centre de recherches mathématiques (CRM), l'Atlantic Association for Research in the Mathematical Sciences (AARMS) et la SMC, qui organise aussi l'événement.

mca2017.org

mca2017.org/fr

If undelivered, please return to:
Si NON-LIVRÉ, veuillez retourner à :

CMS Notes / Notes de la SMC
209 - 1725 St. Laurent Blvd Ottawa, ON K1G 3V4 Canada