

Cathleen Morawetz 20

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SMC**

CMS NOTES de la SMC

October /
November
octobre /
novembre
2017

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

Javad Mashreghi (Laval)

Vice-President - Quebec / Vice-président - Québec

The Library



When was the last time that you stepped into a library? We could have asked our kids this question, or a friend or colleague, even ourselves. I vividly remember nearly

thirty years ago when I started a master's program in mathematics, we had the privilege of listening to a public lecture in the department of mathematics and computer sciences at the beginning of the academic year. The speaker, a prominent mathematician, gave us priceless advice as newcomers. In his recommendations, he strongly suggested we go to the library each morning and browse the books and journals, in particular the new books that were sorted separately beside the entrance. At the time, sending an email was very fancy and the concept of a Google search could have been found in science fiction books.

For a long time, I was faithful and respected his suggestion. The library was the best place to learn about all aspects of the mathematical community around the globe. The large periodicals of Mathematical Reviews were the main (maybe the only) source of information for research. The blue books of Cambridge University Press, and the yellow series of Springer, were the precious assets of each public or personal library. Having all the issues of Lecture Notes in Mathematics was a sign of the seriousness of any institute.

And then, the whole scientific territory was invaded by computers. All of us have witnessed profound transitions in habits of scientists in less than half a century. Back to my initial question, even though I was a

La bibliothèque

À quand remonte votre dernière visite dans une bibliothèque? On aurait pu poser la même question à nos enfants, à des amis, à des collègues ou se la poser à soi-même. Je me souviens très bien qu'il y a près de 30 ans, lorsque j'ai commencé un programme de maîtrise en mathématiques, nous avons eu le privilège d'assister à une conférence publique au Département de mathématiques et d'informatique en début d'année. Le conférencier, un éminent mathématicien, nous a donné des conseils inestimables en tant que nouveaux étudiants. Entre autres, il nous a fortement suggéré d'aller à la bibliothèque tous les matins et de parcourir les livres et les revues, en particulier les nouveaux ouvrages triés séparément à côté de l'entrée. À l'époque, l'envoi d'un courrier électronique était hors de l'ordinaire, et le concept d'une recherche sur Google aurait pu se trouver dans un roman de science-fiction.

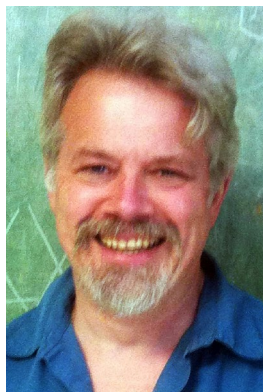
Pendant longtemps, j'ai fidèlement appliqué cette suggestion. La bibliothèque était le meilleur endroit pour se renseigner sur tous les aspects de la communauté mathématique mondiale. Les grands périodiques des *Mathematical Reviews* étaient la principale (peut-être la seule) source d'information pour la recherche. Les livres bleus de la Cambridge University Press et la collection jaune de Springer étaient des atouts précieux pour toute bibliothèque publique ou personnelle. Posséder tous les numéros des *Lecture Notes in Mathematics* témoignait du sérieux de tout institut.

Puis, les ordinateurs ont envahi le milieu scientifique au grand complet. Nous avons tous constaté des transitions profondes dans les habitudes des chercheurs en moins d'un

Of Time And Tide

Robert Dawson, *St. Mary's*

CMS Notes Editor-in-Chief



On Saturday, August 19th, strong currents damaged the nets at a fish farm in Washington State. The next day, about 180,000 Atlantic salmon escaped into the Pacific. Some people have called them an invasive species, and said that they constitute a dire threat to the marine and river environment of Washington and British Columbia. Others have suggested that they are unlikely to survive or breed successfully in the alien environment,

and that the threat is overrated. This is outside my expertise, and probably that of most other CMS members, and I shall give no opinion on the subject.

From a mathematical viewpoint, however, it was interesting to see how many news stories blamed the net damage on the solar eclipse of Monday, August 21. The theory was that the upcoming perfect alignment of moon and sun had caused unusually powerful tides that ripped the nets apart. It sounds almost plausible - until you think about it mathematically.

There are two related fallacies involved. Firstly, the damage took place two days before the eclipse. Now, spring tides do extend for a few days around the time of the new and full moons: see the next paragraph for more on this. But, two days before an eclipse, the sun and moon are roughly 25° apart in the sky: whereas at every new moon they are within at most 5.2° of each other, and usually closer than that. The alignment on the Saturday wasn't even slightly remarkable.

Even more importantly, in terms of tide height, having the sun and moon aligned to within 5° , or even 25° , differs little from a perfect alignment. The solar contribution to the tide is about half that of the Moon, so at a solar eclipse the tide is about 1.5 times what it would be from the Moon alone. Sinusoids add like vectors; a little trigonometry shows that even when they're 25 degrees out of phase the amplitude is about 1.47 times that of the lunar tide. At an ordinary new moon, the ratio is at least 1.4987, so close to the height during an eclipse that tiny variations in atmospheric pressure will hide the difference. From the tidal point of view, even the most perfect eclipse is just another new moon.

The fallacy involved here is a common one. It's the same one that leads people to suppose that perigean tides will be devastating, or that a "supermoon" will be spectacular. Yes, the peak of a sinusoidal wave is higher than the surrounding values. But it's only very slightly so: that's the nature of extrema of smooth functions. Whoever first said that "close only counts with horseshoes and hand grenades" can't have remembered very much calculus.

Contre vents et marées

Le 19 août, de forts courants ont endommagé les filets d'une pisciculture dans l'État de Washington. Le lendemain, quelque 180 000 saumons de l'Atlantique se sont échappés dans le Pacifique. Certains, les considérant comme une espèce envahissante, ont dit qu'elles constituaient une grave menace pour l'écosystème marin et fluvial de l'État de Washington et de la Colombie-Britannique. D'autres ont avancé qu'ils étaient peu susceptibles de survivre ou de se reproduire dans un milieu étranger et que la menace était surestimée. Comme tout ceci dépasse mon domaine d'expertise, et probablement celui de la plupart des membres de la SMC, je ne me prononcerai pas sur le sujet.

Par contre, d'un point de vue mathématique, il était intéressant de voir le nombre d'articles où l'on imputait le bris des filets à l'éclipse solaire du 21 août. On y affirmait que l'alignement parfait de la Lune et du Soleil avait causé des marées exceptionnellement puissantes, qui ont déchiré les filets. Cette théorie paraît plausible - jusqu'à ce qu'on y pense en termes mathématiques.

Il y a deux faussetés dans cette théorie. D'abord, le bris des filets a eu lieu deux jours avant l'éclipse. Bien sûr, les grandes marées printanières durent quelques jours autour de la nouvelle lune et de la pleine lune - j'y reviens au prochain paragraphe. Toutefois, deux jours avant une éclipse, le Soleil et la Lune sont séparés d'environ 25° dans le ciel, alors qu'à la nouvelle lune, ils ne sont qu'à $5,2^\circ$ tout au plus l'un de l'autre, et souvent encore plus proche. L'alignement du 19 août n'avait vraiment rien de remarquable.

Mais surtout, par rapport à la hauteur des marées, il n'y a pas de différence notable entre un écart d'alignement de 5° ou même de 25° entre le Soleil et la Lune et un alignement parfait. L'effet du Soleil sur la marée est à peu près la moitié de celui de la Lune; pendant une éclipse solaire, la marée est donc environ 1,5 fois plus haute que sous l'effet de la Lune uniquement. L'addition des fonctions sinusoïdales est comme l'addition de vecteurs; il suffit d'un peu de trigonométrie pour démontrer que même à un écart de 25° , l'amplitude est d'environ 1,47 fois celle de la marée lunaire. Lors d'une nouvelle lune normale, le ratio est d'au moins 1,4987, donc si proche de la hauteur pendant une éclipse que même de minuscules variations de pression atmosphérique masqueront la différence. Du point de vue de la marée, donc, même l'éclipse la plus parfaite n'a pas plus d'effet qu'une nouvelle lune.

Il s'agit là d'une erreur courante. C'est la même qui amène les gens à supposer que les marées de périgée seront dévastatrices, ou qu'une super Lune sera spectaculaire. Effectivement, le pic d'une onde sinusoïdale est plus élevé que les sommets environnants, mais à peine : c'est la nature des limites extrêmes des fonctions continues. La personne qui a affirmé la première que passer proche ne comptait pas, ou, comme le dit le dicton anglais « close only counts with horseshoes and hand grenades », avait sans doute oublié toutes ses notions de calcul.

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 compresser. 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.

2018 CMS MEMBERSHIP RENEWALS RENOUVELLEMENTS 2018 À LA SMC



The 2018 membership renewal will begin soon! Please renew your membership online as soon as possible at portal.cms.math.ca by logging into your member account. Should you have any questions, please email us at memberships@cms.math.ca

Le renouvellement pour l'an 2018 va commencer bientôt! S'il vous plaît renouveler votre adhésion en ligne dès que possible à portail.smc.math.ca et en vous connectant à votre compte de membre. Si vous avez des questions, s'il vous plaît écrivez-nous à adhesions@smc.math.ca

NOTES DE LA SMC

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

CMS NOTES

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La Société mathématique du Canada appuie l'avancement, la découverte, l'apprentissage et l'application des mathématiques. L'exécutif de la SMC encourage les questions, commentaires et suggestions des membres de la SMC et de la communauté.

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The CMS promotes the advancement, discovery, learning and application of mathematics. The CMS Executive welcomes queries, comments and suggestions from CMS members and the community.

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Continued from cover

library worm and still am an addicted book-lover, possessing a prodigious personal library, I do not recall the last time I went to the scientific library of our faculty which is less than two hundred meters away from my office! Online access to almost anything we wish, despite its great advantages, has imprisoned us in our offices. We rarely move. Even worse, we seldom meet each other in hallways or in the library.

I am concerned about another side effect of online access which has worried me since early 2000 when I was the representative of the math department in the steering committee of our library. In the good old days, we used to buy a physical copy of a book or a journal and keep it for good in the library. Having intermittent volumes of some journals is an indication of difficult financial years when the library committee had no choice but to cut some subscriptions. It would be ideal to have all volumes on the shelf. However, having some issues could still be useful in some cases. These days each library pays a huge sum to buy online access to journals and e-books. Everything goes well as long as the stream line of money transfer works well. But, if a financial crisis happens, like the one we witnessed in 2008, we have access to nothing.

As a library member, the situation is worrisome that every now and then we might lose the access to the paradise that is the library. Hence, we might judge that the current registration policy is not just and the publishers are bribing the scientific communities. But, if we put ourselves in the publisher's shoes, a different set of reasoning appears. I am the current chair of the CMS publications committee. From this vantage point, one can see the perspective of the publisher. Indeed, libraries are a source of income for these publishers. Of course, there is the added issue that not all publishers stay in business forever and when they go out of business, so does their online access. Then the real problems begin for libraries that paid for access all along and then get cut out of the process entirely.

My goal in this short note was two-fold. First, to narrate the nostalgia of the good old days when the location of the library was important in and of itself and a good place to foster an academic community. Second, to highlight the shortcomings of an online contract. There are indeed the stresses of maintaining a physical library with an ever-increasing collection of books. On the other hand, there is the issue of being cut out of the collection if a library is temporarily unable to pay for a subscription.

Here are some possible solutions. First, maintain a core collection of classic books that all can agree every learned collection of mathematicians should own. This creates a culture of knowledge and a place for mathematicians to gather. Second, instead of subscriptions, publishers could provide libraries the data for the papers they publish (perhaps the PDF of the papers). Libraries can store these data on either their own servers or on commercially available servers. This way, libraries have the option of having periodic subscriptions (when times are tough) while maintaining what they paid for. Third, maybe as an idealistic suggestion, universities could cut the publishers out of the loop entirely. Indeed, there are many models here. Certainly, scholarly publishing is not free (copy editing, maintaining an online presence, etc) but universities could offset these fees by charging modest fees to users. This is one model. Another model would be to make better use of the Arxiv. We all post our papers there and so there is no problem with access. With university sponsored journals, once the paper is accepted, the author gets to designate the name of the journal on the Arxiv. Universities could either assume the cost entirely (part of being a university) or by charging an author very modest fee, which can be waived for authors from developing countries, for publishing their paper (to offset the above mentioned fees).

2018 Graham Wright Award for Distinguished Service

In 1995, the Society established this award to recognize individuals who have made sustained and significant contributions to the Canadian mathematical community and, in particular, to the Canadian Mathematical Society. The award was renamed in 2008, in recognition of Graham Wright's 30 years of service to the Society as the Executive Director and Secretary.

Nominations should include a reasonably detailed rationale and be submitted by **March 31, 2018**.

All documentation should be submitted electronically, preferably in PDF format, by the appropriate deadline, to gwaward@cms.math.ca.

Suite de la couverture

demi-siècle. Je reviens à ma question initiale : même si j'étais un rat de bibliothèque et si je suis toujours un grand amoureux des livres, qui possède une prodigieuse bibliothèque personnelle, je ne me rappelle pas la dernière fois que je suis allé à la bibliothèque scientifique de notre faculté, qui est pourtant à moins de 200 mètres de mon bureau! L'accès en ligne à presque tout ce que nous souhaitons, malgré ses grands avantages, nous a emprisonnés dans nos bureaux. Nous nous déplaçons rarement. Pire encore, nous ne nous rencontrons pratiquement plus dans les couloirs ou dans la bibliothèque.

Je suis préoccupé par un autre effet secondaire de l'accès en ligne, qui m'inquiète depuis le début des années 2000, alors que je représentais le Département de mathématiques au comité consultatif de notre bibliothèque. Dans le « bon vieux temps », nous achetions un exemplaire d'un livre ou d'une revue pour le conserver à tout jamais à la bibliothèque. Le fait d'avoir des volumes intermittents de certaines revues est une indication d'années financières difficiles, où le comité de la bibliothèque n'avait d'autre choix que de renoncer à certains abonnements. Il serait idéal d'avoir tous les volumes sur les étagères. Mais avoir seulement certains numéros pourrait tout de même être utile dans certains cas. De nos jours, chaque bibliothèque paie une somme faramineuse pour acheter l'accès en ligne aux revues et aux livres numériques. Tout se passe bien tant que les fonds ne manquent pas. Par contre, en cas de crise financière, comme celle que nous avons connue en 2008, nous n'avons accès à rien.

En tant que membre de la bibliothèque, la situation est inquiétante puisque de temps à autre, nous pourrions perdre l'accès au paradis qu'est la bibliothèque. Par conséquent, nous pourrions juger que la politique d'abonnement actuelle est injuste et que les maisons d'édition font du chantage auprès des communautés scientifiques. Toutefois, si nous regardons les choses du point de vue de l'éditeur, un tout autre ensemble de raisons apparaît. En ce moment, je suis président du Comité des publications de la SMC. De ce point de vue, on peut comprendre la perspective de l'éditeur. En effet, les bibliothèques sont une source de revenus pour ces maisons d'édition. Bien sûr, ajoutons à cela que les maisons d'édition ne sont pas toutes éternelles, et que lorsqu'elles font faillite, l'accès en

ligne à leurs ouvrages disparaît aussi. C'est alors que commencent les vrais problèmes pour les bibliothèques, qui ont payé toutes ces années pour ensuite perdre leur accès soudainement.

J'avais deux objectifs en rédigeant cet article. D'abord, faire part de ma nostalgie des beaux jours où l'emplacement de la bibliothèque était important en soi et un bon endroit pour favoriser la cohésion d'une communauté universitaire. Ensuite, faire ressortir les lacunes d'un contrat d'abonnement en ligne. Le maintien d'une bibliothèque traditionnelle ayant une collection toujours croissante occasionne évidemment un certain stress. Par contre, il est aussi possible de se voir retirer complètement l'accès à une collection si une bibliothèque est temporairement incapable de payer l'abonnement.

Voici quelques solutions possibles. Premièrement, conservez une collection de base d'ouvrages classiques généralement considérés comme essentiels à la collection scientifique de tout mathématicien. Vous créez ainsi une culture du savoir et un lieu de rencontre pour les mathématiciens. Deuxièmement, au lieu des abonnements, les maisons d'édition pourraient fournir aux bibliothèques les données des revues qu'elles publient (p. ex. les versions PDF). Les bibliothèques peuvent stocker ces données sur leurs propres serveurs ou sur des serveurs commerciaux. Ainsi, les bibliothèques peuvent s'abonner de façon périodique (quand les temps sont durs) tout en conservant ce pour quoi elles ont payé. Troisièmement – ce qui est peut-être une suggestion idéaliste –, les universités pourraient éviter complètement les maisons d'édition. En effet, il existe de nombreux modèles de cette formule. Certes, l'édition scientifique n'est pas gratuite (révision, maintien d'une présence en ligne, etc.), mais les universités pourraient compenser ce coût en facturant des frais modiques aux utilisateurs. Voilà un modèle. Un autre serait de mieux utiliser arXiv. Nous publions tous nos articles dans ces archives, et l'accès ne pose aucun problème. Dans le cas des revues parrainées par les universités, c'est l'auteur qui choisit le nom de la revue sur arXiv une fois l'article accepté. Les universités pourraient soit assumer le coût total (selon le mandat d'une université), soit facturer à un auteur des frais très modestes, qui pourraient être éliminés pour les auteurs de pays en développement, pour la publication de leur article (pour compenser les frais mentionnés ci-dessus).

Prix Graham-Wright pour service méritoire 2018

En 1995, la Société mathématique du Canada a créé un prix pour récompenser les personnes qui contribuent de façon importante et soutenue à la communauté mathématique canadienne et, notamment, à la SMC. Ce prix était renommé à compter de 2008 en hommage de Graham Wright pour ses 30 ans de service comme directeur administratif et secrétaire de la SMC.

Pour les mises en candidature prière de présenter des dossiers avec une argumentation convaincante et de les faire parvenir, **le 31 mars 2018** au plus tard.

Veuillez faire parvenir tous les documents par voie électronique, de préférence en format PDF, avant la date limite à prixgw@smc.math.ca.

The Calendar 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,
(managing-editor@cms.math.ca)

Le calendrier annonce 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
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OCTOBER 2017 OCTOBRE

1-6	BIRS Workshop: <i>p</i> -adic Cohomology and Arithmetic Applications, BIRS, Banff, Alta.
2-5	CRM Workshop: Dependence modeling tools for risk management, CRM, Montreal, Que.
8-13	BIRS Workshop: Computational Uncertainty Quantification, BIRS, Banff, Alta.
9-13	CRM Workshop: The Beauty of Discrete Mathematics, CRM, Montreal, Que.
12-15	Symposium for South Asian Women in Mathematics, Tribhuvan University, Kathmandu, Nepal
13-14	61e Congrès de l'Association de Mathématique du Québec (AMQ), Cégep de l'Outaouais, Gatineau, Qué.
13-14	Science Atlantic Math/Stats/CS Conference, University of New Brunswick, Fredericton, N.B.
15	AARMS Workshop: Statistical Learning and Health Data Analytics, University of New Brunswick, Fredericton, N.B.
15-20	BIRS Workshop: New Perspectives in Representation Theory of Finite Groups, BIRS, Banff, Alta.
20-22	Retreat for Young Researchers in Stochastics, BIRS, Banff, Alta.
21-22	Canadian Western Algebraic Geometry Symposium, University of Alberta, Edmonton, Alta.
22-27	BIRS Workshop: Stochastic Analysis and its Applications, BIRS, Banff, Alta.
29-Nov 3	BIRS Workshop: Automorphic Forms, Mock Modular Forms and String Theory, BIRS, Banff, Alta.

NOVEMBER 2017 NOVEMBRE

5-10	BIRS Workshop: Forest and Wildland Fire Management: a Risk Management Perspective, BIRS, Banff, Alta.
6-10	Workshop on Mean Curvature Flow and Ricci Flow, Fields Institute, Toronto, Ont.
12-17	BIRS Workshop: Approximation Algorithms and the Hardness of Approximation, BIRS, Banff, Alta.
17	PIMS-UBC Distinguished Colloquium: Yaniv Plan, University of British Columbia, Vancouver, B.C.
21	Fields Innovation Day, Fields Institute, Toronto, Ont.
25	MathEd Forum: November 25, 2017, Fields Institute, Toronto, Ont.
26-Dec 1	BIRS Workshop: Partial Order in Materials: at the Triple Point of Mathematics, Physics and Applications, BIRS, Banff, Alta.

DECEMBER 2017 DÉCEMBRE

3-8	BIRS Workshop: Inferential Challenges for Large Spatio-Temporal Data Structures, BIRS, Banff, Alta.
8-11	2017 CMS Winter Meeting/Réunion d'hiver de la SMC 2017, University of Waterloo, Waterloo, Ont.
10-15	BIRS Workshop: Mathematics for Developmental Biology, BIRS, Banff, Alta.
11-13	CRM Workshop: Risk Modeling, Management and Mitigation in Health Sciences, CRM, Montreal, Que.

JANUARY 2018 JANVIER

10-13	2018 Joint Mathematics Meetings (JMM), San Diego, Calif., USA
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Election Results

As a result of the 2017 CMS Election that took place in May and approved at the CMS Annual General Meeting that was held on July 25, 2017, the following seventeen (17) officers and directors have been elected to the CMS Board of Directors and Executive:

Executive Committee

President-Elect/President/Past-President:

Mark Lewis (Alberta);

Vice-President – Atlantic:

Sara Faridi (Dalhousie);

Vice-President – Quebec:

Javad Mashregi (Laval);

Vice-President – Ontario:

Juris Steprans (York);

Vice-President – West:

Doug Farenick (Regina); and

Vice-President – Pacific:

Malabika Pramanik (UBC).

Board of Directors

Director – Atlantic:

David Bremner (UNB Fredericton);

Director – Atlantic:

Nancy Clarke (Acadia);

Director – Quebec:

Matilde Lalin (Montreal);

Director – Quebec:

Liam Watson (Sherbrooke);

Director – Ontario:

Barbara Csimas (Waterloo);

Director – Ontario:

Megan Dewar (Carleton/Tutte Institute);

Director – Ontario:

Monica Nevins (Ottawa);

Director – Ontario:

Gary Walsh (Ottawa/Tutte Institute);

Director – West:

Joy Morris (Lethbridge);

Director – Pacific:

Veselin Jungic (SFU); and

Director – Student:

Aaron Berk (UBC).

Résultats des Élections

À la suite de l'élection 2017 de la SMC, qui a eu lieu en mai et ensuite approuvé à l'Assemblée générale annuelle de la SMC qui a eu lieu le 25 juillet 2017, les suivants dix-sept (17) dirigeants et administrateurs ont été élus au Conseil d'administration et Exécutif de la SMC :

Comité exécutif

Président élu/Président/ Président sortant :

Mark Lewis (Alberta);

Vice-Présidente – Atlantique :

Sara Faridi (Dalhousie);

Vice-Président – Québec :

Javad Mashregi (Laval);

Vice-Président – Ontario :

Juris Steprans (York);

Vice-Président – Ouest :

Doug Farenick (Regina); et

Vice-Présidente – Pacifique :

Malabika Pramanik (UBC).

Conseil d'administration

Directeur – Atlantique :

David Bremner (UNB Frédéricion);

Directrice – Atlantique :

Nancy Clarke (Acadia);

Directrice – Québec :

Matilde Lalin (Montréal);

Directeur – Québec :

Liam Watson (Sherbrooke);

Directrice – Ontario :

Barbara Csimas (Waterloo);

Directrice – Ontario :

Megan Dewar (Carleton/Tutte Institute);

Directrice – Ontario :

Monica Nevins (Ottawa);

Directeur – Ontario :

Gary Walsh (Ottawa/Tutte Institute);

Directrice – Ouest :

Joy Morris (Lethbridge);

Directeur – Pacifique :

Veselin Jungic (SFU); et

Directeur – Étudiant :

Aaron Berk (UBC).

Book Reviews 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)

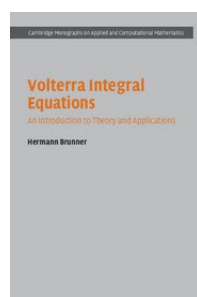
Volterra Integral Equations: An Introduction to theory and applications

By Hermann Brunner

Cambridge University Press, 2017

ISBN: 9-781-107098725

Reviewed by S. I. Zaman, Concordia University



The solution methods for many mathematical problems have their foundation in two distinct but related approaches – differential and integral equations. The method employed by the integral equation approach specifically includes boundary conditions, which renders the problem a valuable advantage – and indeed in many cases, has the distinct advantage of including the time delay situation of some natural phenomena. Also, the

integral equation approach leads naturally to the solution of a given problem, under suitable conditions, in the form of an infinite series.

Hermann Brunner presents an authoritative, well-written treatment of the subject. Indeed, this book is geared towards upper level graduate research students who would certainly benefit from the extended list of references and discussions on the subject. The first chapter begins with a straightforward account with examples; however, the inclusion of some run-of-the-mill examples of a variety of integral equations and the methods of their solution would have been more beneficial to the first-time reader of the subject.

In the introductory paragraph of the preface, the author sets out the content, aim and the motivation for this book. The book presents an introduction to the theory of linear and non-linear Volterra integral equations, beginning with Volterra's fundamental contributions and the resulting classical theory, to more recent developments. The book manages to introduce the reader to the current state of the art in the theory of Volterra integral equations. It also illustrates — by means of a representative selection of examples — the increasingly important role Volterra integral equations play in the mathematical modeling of phenomena where memory effects play a key role. The book is intended also as a 'stepping stone' to the plethora of literature on the advanced theory of Volterra integral equations. The notes at the end of each chapter and the annotated references point the reader to such papers and books. However, the book does suffer from numerous typographical errors, presentational errors and omissions.

Thematically the book is divided into two main topics. The first three chapters and Chapter 6 discuss the classical theory of linear and

Les comptes-rendus de livres présentent 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)

non-linear Volterra integral equation, with examples and exercises. The other chapters deal with more recent developments, results and further research possibilities. Indeed, the theory of Volterra integral equation is not necessarily complete and there are many challenging problems that are yet to be addressed. Interestingly, among other themes, the book deals with the recently developed theory of "cordial" Volterra integral equations. This theory allows for an analysis of the existence of solutions of certain classes of Volterra integral equations of the third kind. Also discussed are the idea of a Volterra integral operator in the setting of Banach Spaces, on Hölder spaces and on L^p spaces. Finally, Chapter 9 deals with the wide spectrum of applications of Volterra integral equations.

At the end of each chapter the reader will find exercises and extensive notes. These range from problems that directly illustrate the theory, to research topics of various degrees of difficulty, i.e., challenging research problems. The extensive notes contain remarks complementing the contents of the given chapter and serve as a guide to papers and books on the more advanced theory of Volterra integral equations. A good number of topics have been included in the Appendix, such as Linear operators on finite dimensional vector spaces, as well as Banach, Hölder, Sobolev and Lebesgue spaces. This will be of great benefit to first-time readers of the subject.

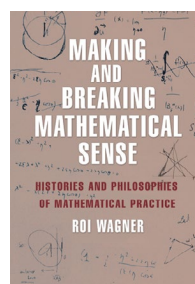
Making and breaking mathematical sense: Histories and philosophies of mathematical practice.

By Roi Wagner

Princeton University Press, 2017

ISBN: 9-781-400883783

Reviewed by Nicolas Fillion and Zoe Ashton, Simon Fraser University



Philosophy of mathematics has traditionally been concerned with foundational questions about the status of mathematical theories and their objects. However, over the last few decades, such questions have increasingly had to share the field with questions arising from a philosophical examination of mathematical practice. Wagner's book *Making and Breaking Mathematical Sense* falls squarely within this

emerging subdiscipline which, in Wagner's words, "tries to explain what it is that mathematicians do when they do mathematics, and to shift the focus from 'what it is' to 'how it works'" (p. 4). Wagner's book

distinguishes itself from other contributions to this area by its style, its selection of topics, and its frequent bold references to and use of concepts from the German idealist tradition and the post-structuralist tradition.

Most of the book follows a dialectic between general facts and particular case studies that seeks to draw a compelling picture of mathematics as a field of knowledge navigating a number of real-world constraints, this navigation marking no contrast from other fields like post-structuralist philosophy or theology (see pp. 88-89 for example). This is preceded by a first chapter presenting “histories of philosophies of mathematics” whose objective is to set this book apart from canonical philosophies of mathematics. The chapter is not meant to be a systematic historical work on philosophy of mathematics, but rather a collection of narratives that are “highly selective and superficial” (p. 13). Historians will perhaps find this editorial choice questionable; they will also find some of the content of those narratives problematic—e.g. the patently false claims that “Frege did not allow mathematics to be tied to any form of experience” (p. 26) (see his works on geometry) or that logical positivists “allowed only empirical synthetic a posteriori assertions, and logical analytic a priori ones” (p. 21) (see for instance Reichenbach’s work on the relativized a priori). Be that as it may, the point of this chapter is to demonstrate why the traditional debates can be rearranged into what Wagner calls a “Yes, Please!” approach according to which different philosophies of mathematics describe different features of mathematical practice.

The philosophical attitude developed in the book is that we need not choose whether to bar monsters or allow them (so that the tension between natural order and conceptual freedom need not be resolved once and for all), nor should we choose between mathematical statements being synthetic or analytic, we need not even choose who should set the standards for mathematics. All of these choices should be regarded as constraints on practice rather than dividing lines. After illustrating the “Yes, Please!” approach with a case study of the 16th century Italian abacists, four narratives meant to ground this constraint-based philosophy of mathematical practice are outlined in Chapter 3. One of those narratives, to give but one example, revolves around a process Wagner calls ‘dismotivation’—the “gradual loss of a mathematical statement’s empirical content and grounding” (p. 60). That such a process takes place in mathematics is clear, but Wagner is led from there to conclude that mathematical statements such as ‘ $25 \times 25 = 625$ ’ are analytic a posteriori, i.e., that they derive from synthetic a posteriori judgments but have been dismotivated. Readers may find this analysis somewhat difficult to stomach, unless they are willing to dismotivate the concept of analyticity itself. Later, in Chapter 4, the author elaborates on the role of other constraints that relate to familiar topics using a “semiotic” method: partial formalization as a tool for consensus, common interpretation of symbols, translatability, maximizing productivity in application, and also social constraints. This chapter also contains two extended case studies. The first expands on the allegedly shifting meanings of the variable ‘ x ’ in generating functions of a power series $\sum_{n=0}^{\infty} a_n x^n$ to show that seemingly indispensable concepts like consistency in symbol meaning are just one constraint among many (though one should deplore the fact that the point of view that is arguably the most historically pertinent—that

of Hardy—is not part of the story). The second case study examines a social constraint, specifically, how gender-roles play a part in the algorithms used to solve the marriage problem in combinatorics.

Chapters 5 and 6 shift the focus to mathematical cognition and metaphors, using as an anchor the work of Lakoff & Núñez, and with the aim of providing an account applying Deleuze’s concept of “haptic vision” to mathematical practice. From chapter 5 onwards, Wagner’s argument heavily relies on a “post-structuralist jargon” that is admittedly “impenetrable to the untrained” (p. 163). Wagner maintains that the process of drawing integrates the body into mathematical practice and creates a kind of embodied cognition, as the drawing incorporates an intended abstract gesture of diagram construction and a bodily ‘noise’ component. We are told that the ability to handle the multi-level diagrams is haptic vision. In our opinion this view is unlikely to take over the dominant philosophical approach over that originating in the work of Manders. Chapter 6 provides two additional case studies highlighting the limitations of mathematical metaphors in cases of historical transfers between algebra and geometry. Finally, in chapter 7, Wagner proposes an approach to the applicability of mathematics that promises to put in check Wigner’s worries by drawing on the writings of German idealists. The proposed view sees mathematics as a real activity that accomplishes three things: it fits natural phenomena, it is fundamental to how we shape new phenomena, and it defines what we take to be scientific reality. It seems to us that the author provides a rather obscure treatment of the least controversial of Wigner’s worries, without addressing the more substantive questions relating to the uncanny accuracy of successful mathematical models more generally.

Wagner identifies three groups of people potentially interested in the approach to the philosophy of mathematical practice he proposes: philosophers, mathematicians, and people who engage with mathematics in everyday life. While the mathematical content of the book will be accessible to all three groups, the philosophical jargon drawn from the German idealist and French post-structuralist traditions will alienate with few exceptions members of at least groups one and three. In addition, a side effect of the “Yes, Please!” philosophical view put forward is that the normative dimension of mathematical practice, which would underly a picture of progress in mathematical practice, has been underemphasized. The book offers an admirable diversity of case studies—as diverse as the early modern abacists tradition, the Black-Scholes model of derivative pricing, the gendered perspectives on Hall’s theorem; but the question of what, exactly, mathematical practice is remains unresolved. Is what economists do with mathematics, what pure mathematicians do, and what was done in the 16th century and later discarded for allegedly good reasons, all on the same footing? That is, no picture of what the *best practices* in mathematics are is drawn, either in an abstract way or through a historical narrative, a thing that is arguably necessary in order to “paint a richer picture of mathematics, which tries to affirm, rather than dispel, its ambiguities, humanity, and historicity” (p. 4). Nonetheless, given the topical, historical, and cultural diversity of mathematical practices the author examines, the book certainly succeeds in contributing to its stated objective of “reposition[ing] mathematics as a humanly accessibly endeavor” (p. 5).

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.

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Jennifer Hyndman, University of Northern British Columbia
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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.

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Jennifer Hyndman, University of Northern British Columbia
(hyndman@unbc.ca)

This issue of Education Notes features a contribution concerning first year mathematics, or so called level 1 courses. One of the focal points of attention for Education Notes in upcoming issues is the matter of first year mathematics at the tertiary level. The editors welcome your comments, contributions, and ideas concerning this matter. Veselin Jungic and Miroslav Lovric offer an opening to the discussion including an update on some upcoming initiatives to bring people together around this topic.

Call for National Dialogue: The Present and Future of Teaching First Year Mathematics at Canadian Universities

Veselin Jungic, Simon Fraser University
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Miroslav Lovric, McMaster University
(lovric@mcmaster.ca)

Canada's university mathematical teaching community is facing a number of significant challenges and opportunities. These range from managing increasingly diverse classes of incoming students, to understanding and addressing the impact of modern technology on teaching and delivering courses, to keeping course content relevant for various academic programs and, most importantly, to effectively supporting students to achieve their personal, academic and career goals.

To our knowledge, there is no source of any kind which provides a comprehensive picture of the current state of teaching mathematics at the first-year undergraduate level in Canada. We believe that only by sharing experiences, gathering data, and looking at research-based decisions and strategies, our mathematical teaching community can come up with ideas and suggestions for university faculty and instructors to move forward.

Hence this note. Its main purpose is to initiate a national dialogue, focused on the following themes and questions:

- Teaching level 1 math courses in Canada: What is common, what is different, and what are the driving forces behind the current situation?
 - » Horizontal perspective - comparison of goals and practices at different universities
 - » Vertical perspective - comparison of goals and practices at the high school and university levels

» Cross-cutting perspective - examination of the roles that level 1 math courses play in various academic programs

- How can we create a set of level 1 math courses that keep the necessary mathematical rigour; are accessible to a wide range of students; are relevant for a spectrum of academic programs; and are general and flexible enough to allow mobility across different programs, institutions, provinces and countries?
- What else, if anything, beyond math content should be done in level 1 math courses?

Context

Every year, for tens of thousands of first-year university students across Canada, taking a math course, most often calculus, is one of their first university academic experiences. Serving as both a gatekeeper and a requirement for programs ranging from economics to science to engineering, first year math courses come with numerous challenges for students, instructors, mathematics departments, university administrators, and academic programs.

A large number of entry-level university students are going through a bumpy transition, commonly referred to as the *secondary to tertiary transition*. Taking a fast-paced, topic-packed first-year math course that is often taught under the assumption that students more or less know all of high school mathematics presents significant challenges, and a good number of students cannot successfully meet the demands such courses, and their instructors, place on them.

An instructor teaching a first-year math course faces two seemingly contradictory tasks. On the one hand, they have a responsibility to teach the course at the appropriate level of rigour, making sure that all topics, as mandated by the university calendar, are covered. On the other hand, the course instructor plays an important role in welcoming, encouraging, and supporting students during one of the major transitions in their lives. Instructors are also expected to keep up with teaching and learning technologies: from handling ever-evolving learning management systems, to creating electronic learning resources, to using in-class technology for delivering or

enhancing their lectures, to facing competition from a variety of freely available online resources.

For administrators, there are different kinds of challenges. After working hard to enroll students into their programs, they see students' hardships in math courses as one of the major factors that contributes to dropout rates. A further challenge is managing a large number of students taking math courses. This may include choosing between teaching a course in large classrooms and teaching multiple smaller sections; these decisions are often based on factors that have nothing to do with pedagogy.

Mathematics departments are forced to reassess the content of their courses and academic programs. This includes modifying existing, and/or creating new courses that address the needs of various (new) programs. For example, a computer science program may request an introductory discrete math course; a school of interactive arts may prefer a course that offers a brief introduction to geometry and linear algebra; or an economics program may choose an introductory game theory, or data analysis course. Moreover, there are academic units that are creating and teaching their own "math" courses, claiming that mathematicians do not have expertise to address, in the ways they see as adequate, mathematical aspects of their particular fields.

Still, the most important set of questions is the same as it has always been: To what degree do university math courses realistically contribute to developing students' problem solving and analytical skills; to increasing their awareness about the role that mathematics and numeracy play (and will continue to play) in both their private and professional lives; to further expanding students' intellectual and academic capabilities; and to widening students' career options?

Rationale

Our consultations with colleagues have confirmed our belief that, with some variations, the situation described above is common at universities across Canada. At the same time, there is an array of approaches and practices, at the provincial and institutional levels, addressing the same set of issues. The fact that level 1 math courses are *the* common factor for a number of university programs across the world suggests that the successful completion of these courses contributes to educating students to become global (academic) citizens.

The sequence presented in the previous paragraph

*identical/similar set of issues →
array of approaches → global/broad impact*

in our opinion, requires a national dialogue about the present and future of teaching mathematics at Canadian universities.

We would like to underline the urgency for a national dialogue about teaching mathematics by stating that, to safely and responsibly navigate through our increasingly big-data-driven world, every Canadian citizen will need *deeper* knowledge and understanding of

various mathematical aspects of the reality and an enhanced and probably highly personalized mathematical toolkit.

Goals

We envision this proposed national dialogue as part of a longer-term project, during which data about level 1 mathematics courses offered at Canadian universities will be collected, organized and disseminated. It is our belief that the project will unite Canadian teaching and research faculty in their efforts to provide the best post-secondary math education possible, and will provide a forum for all involved to learn about the complexity of issues related to teaching level 1 mathematics at universities across Canada.

Collecting data: In addition to creating a comprehensive list of level 1 courses offered at Canadian universities, we see a need to establish how these courses are interconnected with other courses:

- *Vertically:* To what degree, and how, is the structure of level 1 math courses driven by current high school math curricula? How strictly is the content of level 1 math courses determined by the requirements of higher level courses? What fraction/how many of all level 1 math courses are terminal?
- *Horizontally:* How do level 1 math courses compare across Canadian post-secondary institutions, in terms of overall structure, modes of instruction, and content?
- *Across:* What are the roles that level 1 math courses play in various academic programs?

Community: The national dialogue will present an opportunity for Canadian university math instructors to share their experiences about developing and teaching introductory math courses with their peers. We invite mathematics faculty at all levels and across the pure-applied divide, including department chairs and faculty in charge of undergraduate teaching, to join the dialogue.

Learning and Solutions: The dialogue will be an open forum in which participants will discuss existing and upcoming challenges in teaching mathematics at this level and search for possible strategies to meet those challenges. The authors of this note are convinced that this kind of critical exchange of information, opinions, and practices will lead to a joint action and thus benefit all involved, their institutions and students, and Canadian society more broadly.

Means

We envision *National Dialogue: The Present and Future of Teaching First Year Mathematics at Canadian Universities* as a grass roots movement that will involve faculty, including adjunct faculty, departments, the regional institutes (AARMS, CRM, Fields, ISM, and PIMS) and relevant pan-Canadian groups and societies (CAIMS, CMESG, and CMS). The dialogue would take different forms, from informal meetings of a group of colleagues from the same department to discussions and exchanges of ideas over social media, and from conducting surveys and writing academic papers to regional and national workshops and conferences.

Two significant events that will affect the present and future of first year math courses at Canadian universities are scheduled in the next several months. Malgorzata Dubiel from Simon Fraser University and Kseniya Garaschuk from the University of the Fraser Valley will organize an education session at the 2017 CMS Winter Meeting, (Waterloo, ON, December 8-11, 2017). The session will be titled *Rethinking first year experience*. The authors of this note are the co-organizers of the Fields Institute's sponsored conference *First Year University Mathematics Across Canada: Facts, Community and Vision*. This conference is scheduled for April 27-29, 2018, in Toronto, ON.

We see the CMS education session and the conference at Fields as the beginning of a sequence of events that will strengthen the community of Canadian university math instructors around our common goal: to develop and teach math courses relevant to our times; to future academic programs; and, most importantly, to our students.

Follow-up events (conferences, workshops, online and local discussions) will further the agenda by investigating pedagogical approaches that support teaching (modified, or potentially new) mathematics courses at level 1, as well as finding ways to provide opportunities for an increasingly diverse student body to succeed in math courses. This will, for example, include a search for balance between the use of technology in teaching mathematics and face-to-face in-class and out-of-class student-instructor interaction.

We are aware that we are addressing a global problem that has only local and short-term solutions, due to diverse and evolving circumstances. Still, those local solutions, that by the nature of things, may substantially differ from institution to institution and from province to province, will share many common elements. Those elements include overlapping sets of constraints and the same desired outcome of creating a learning environment that enables students to further explore and develop their mathematical talents and skills.

Therefore, we do not think about this national dialogue as a limited project that ends up with some kind of final report containing a list of recipes. Quite opposite: we see the national dialogue about level 1 math courses as an outgoing process that will, as part of strengthening our community, create a sharable dynamic online repository. This repository will contain extensive data about level 1 math courses offered at Canadian post-secondary institutions; informal descriptions of various practices in teaching level 1 math courses and instructors' reflections about their experiences; a searchable list of academic publications on related topics; and summaries of discussions and meetings.

Conclusion

It is the responsibility of mathematical community to keep iterating that current and future developments of Canadian and global societies are connected to advances in mathematics.

Traditionally, first-year math courses represent one of the strongest links between secondary and post-secondary education. A lack of success in high school mathematics probably means that a student's academic options are significantly narrowed or that the student would need additional investment of money, time, and effort to bring their mathematical knowledge to the required level. For those students who take a first-year math course, the course may act as a railroad switch, either keeping them on the intended direction or diverting them towards another academic program. For many students, first-year university math courses are their first real opportunity to discover and explore their mathematical talents and interests.

Therefore, first-year math courses present unique opportunities and challenges to substantially influence Canadian students regarding their attitude towards, and knowledge and significance of mathematics. To use this opportunity and meet the challenge in this fast-changing academic world, all of us who teach, or are otherwise involved in post-secondary math courses in Canada have to communicate, share our experiences, coordinate our efforts, and work together.

Did You Know that CMS Membership has several benefits including discounts?

- Math departments can sponsor students
- Dues are an eligible expense from NSERC Discovery Grants
- Discounted registrations fees at meetings
- 50% off reciprocal memberships
- Up to 50% off publications
- Includes *CMS Notes* newsletter

Saviez-vous que l'adhésion à la SMC offre plusieurs avantages, notamment des réductions ?

- Les départements peuvent parrainer l'adhésion de leurs étudiants
- Les frais sont une dépense admissible pour les Subventions à la découverte du CRSNG
- Réductions sur les frais d'inscriptions aux Réunions de la SMC
- 50% pour joindre à d'autres sociétés ayant un accord de réciprocité avec la SMC
- Jusqu'à 50% réduction sur les publications
- Inclus notre bulletin — *Notes de la SMC*

2018 CMS Summer Meeting

June 1 – 4, 2018

Deadline: November 15, 2017

University of New Brunswick, New Brunswick, Fredericton

CALL FOR SESSIONS

The Canadian Mathematical Society (CMS) welcomes and invites session proposals for the 2018 CMS Summer Meeting in Fredericton from June 1 to 4, 2018. 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:

Colin Ingalls (University of New Brunswick)
cingall@unb.ca

Alexandre Girouard (Université Laval)
alexandre.girouard@mat.ulaval.ca

Réunion d'été de la SMC 2018

1 – 4 juin, 2018

Date limite : 15 novembre 2017

l'Université du Nouveau Brunswick, Nouveau-Brunswick, Fredericton

APPEL DE PROPOSITIONS DE SESSIONS

La Société mathématique du Canada (SMC) vous invite à proposer des sessions pour la Réunion d'été de la SMC qui aura lieu à Fredericton du 1 au 4 juin 2018. Ces propositions doivent présenter une brève description de l'orientation et des objectifs de la session, 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 sessions seront annoncées dans les Notes de la SMC, sur le site Web et dans les notices de l'AMS. 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 session est priée de faire parvenir une proposition à un des directeurs scientifique.

Directeur scientifique :

Colin Ingalls (l'Université du Nouveau Brunswick)
cingall@unb.ca

Alexandre Girouard (Université Laval)
alexandre.girouard@mat.ulaval.ca



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.

Patrick Ingram, York University (notes-research@cms.math.ca)

Qualitative Analysis of Quantum Signals

Artur P. Sowa, Department of Mathematics and Statistics, University of Saskatchewan

An approach to the analysis of quantum observables: The rich and beautiful discipline of Harmonic Analysis offers methods for the study of general qualities of functions and, in the context of applications, signals. The presently emerging reload of quantum science and technology prompts a rethink of some of its traditional techniques as, indeed, in the quantum realm signals morph into quantum states or observables. This creates a need to discuss the qualitative properties of linear operators as carriers of information. The problem comes to the fore quite explicitly in many ongoing pursuits, e.g. when discussing the dominant characteristics of quantum states pervading the Universe, [17], when considering conditions at which quantum computing may be essentially different than its classical counterpart, [13], [7], [5], or when extending the technological frontiers via such inventions as the quantum metamaterials, [15], [16].

The leading tool traditionally used toward qualitative examination of quantum states has been the Wigner transform, [4]. However, it is not always sufficient in and of itself. An alternative approach is based on representation of observables via the Q-transform proposed in [12]. In essence, the Q-transform establishes a linear correspondence between functions or distributions on a two-dimensional torus \mathbb{T} on the one hand and operators in a fixed Hilbert space, say \mathbb{H} , on the other. It has the property of assigning self-adjoint operators to real-valued distributions. Moreover, the Q-transform is used to endow operator spaces with topology, e.g. the Sobolev space denoted H_Q^α consists precisely of those operators whose Q-transform counterpart falls into the classical Sobolev space $H^\alpha(\mathbb{T})$. Generally the Q-transform depends on the choice of an orthonormal basis in \mathbb{H} , we fix it as $(e_n)_{n \in \mathbb{Z}}$ for further use below. Most importantly, the notion of Sobolev regularity enables one to discuss states and observables in a manner appropriate for the discussion of quantum signals.

In the Heisenberg picture of quantum mechanics the state of the system remains static while any given quantum observable, say, $\mathcal{A} : \mathbb{H} \rightarrow \mathbb{H}$ keeps evolving. In the case of a quantum system that is not effectively isolated from the influence of external environment, $\mathcal{A} = \mathcal{A}(t)$ satisfies the master equation in Lindblad form:

$$\partial_t \mathcal{A} = i[\mathcal{H}, \mathcal{A}] + \sum_j \{L_j^\dagger \mathcal{A} L_j - \frac{1}{2} L_j^\dagger L_j \mathcal{A} - \frac{1}{2} \mathcal{A} L_j^\dagger L_j\} \quad (1)$$

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

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Here, the Hamiltonian $\mathcal{H} : \mathbb{H} \rightarrow \mathbb{H}$ is Hermitian and characterizes the system of interest, while the finite collection of operators $L_j : \mathbb{H} \rightarrow \mathbb{H}$ that need not be Hermitian characterize the influence of the environment. Many aspects of the basic theory concerning the master equation are already classical, [1], [2], [8]. However, an introduction of the Q-transform enables one to formulate regularity results, such as the following:

Theorem 1. [12] Let $\alpha \geq 0$. Assume $L_j \in H_Q^\alpha$ for all j . Also assume that $\mathcal{C} \in H_Q^\alpha$ is self-adjoint. Denoting the orthogonal projection onto the line of e_n by Π_n , we define the Hamiltonian

$$\mathcal{H} = \sum_{n \in \mathbb{Z}} (an + b) \Pi_n + \mathcal{C} \quad (a, b \in \mathbb{R}).$$

Then, the solution of (1) with the initial condition $\mathcal{A}(0) \in H_Q^\alpha$ satisfies $\mathcal{A}(t) \in H_Q^\alpha$ for all times $t > 0$. Moreover, the dependence of solutions on their initial value is continuous in the α -norm.

This shows how the Q-transform enables a qualitative description of the propagation of *quantum signals* (observables or states). The result also suggests that some quantum processes are indeed *compressible*. This may be used to estimate resources needed to carry out any particular quantum information processing tasks.

Separately, it is easily seen that whenever $\alpha \geq 0$ the Q-transform endows $H^\alpha(\mathbb{T})$ with a nontrivial Lie bracket, giving an example of a nested family of infinite-dimensional Lie algebras.

The phenomenon of broadband redundancy: The core definition of the Q-transform incorporates the Fourier series. However, a broader perspective is gained when it is modified by replacing the trigonometric basis for $L_2[0, 1]$ with a basis of the form $(f_m)_{m \in \mathbb{Z}}$, where $f_0(x) \equiv 1$, while

$$f_m(x) = \sum_{n>0} a_n \exp 2\pi i n m x \quad (m > 0),$$

and $f_{-m}(x) = \overline{f_m(x)}$. The change of basis transformation may be viewed as a matrix operator $D : \ell_2(\mathbb{Z}) \rightarrow \ell_2(\mathbb{Z})$. It has block structure subordinate to the decomposition $\ell_2(\mathbb{Z}) = \ell_2(-\mathbb{N}) \oplus \text{span} f_0 \oplus \ell_2(\mathbb{N})$. The block corresponding to the third factor is representative and has the form:

$$\begin{array}{cccccccc} a_1 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \dots \\ a_2 & a_1 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \dots \\ a_3 & \cdot & a_1 & \cdot & \cdot & \cdot & \cdot & \cdot & \dots \\ a_4 & a_2 & \cdot & a_1 & \cdot & \cdot & \cdot & \cdot & \dots \\ a_5 & \cdot & \cdot & \cdot & a_1 & \cdot & \cdot & \cdot & \dots \\ a_6 & a_3 & a_2 & \cdot & \cdot & a_1 & \cdot & \cdot & \dots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots \end{array}$$

Here, we have substituted dots for zeros to de-clutter the appearance of the matrix. Such matrices form a commutative algebra isomorphic to the algebra of formal Dirichlet series, [9]. In every particular instance the first essential problem is continuity of operator D . There is a convenient simple estimate of the operator norm, namely $\|D\| \leq \max\{1, \sum_n |a_n|\}$. If, however, the sequence (a_n) is not summable one needs to abandon ℓ_2 and instead work in the framework of weighted Hilbert spaces, alternatively Banach spaces, in order to obtain useful information, [10]. Moreover, to constitute a bona-fide change of basis D needs to be a linear homeomorphism. This means that together with the sequence (a_n) one needs to pay attention to its Dirichlet inverse which, indeed, defines D^{-1} . Once a homeomorphism D of this kind is in hand one readily obtains a corresponding generalized Q-transform, [12].

Of particular interest are operators D related to the Riemann zeta function ζ . They are obtained by taking $a_n = n^{-s}$, where $s = \sigma + i\tau$. We will denote such operators D_s . This choice of coefficients makes control of the norms of D_s and D_s^{-1} in $\ell_2(\mathbb{Z})$ an easy task; in particular these depend only on σ .

There is a well known phenomenon related to the nontrivial zeros of ζ : uniform distribution of the fractional parts of their ordinates $0 < \tau_1 \leq \tau_2 \leq \dots$; it was first observed in [6], and well-honed strengthened versions were later given in [3], with further improvements in [14]. When applied in the context of D_s operators and/or the corresponding Q-transforms it has implications for the harmonic analysis of classical as well as quantum signals. To give an example, let us consider the sequence of operators $D_{\sigma+i\tau_n}$ and the resulting $Q^{[\sigma+i\tau_n]}$. Retaining the symbol Q for the original Q-transform (i.e. one based on the trigonometric basis) we have the following

Theorem 2. [12] Let $\alpha > 1/2$ and $\sigma > \alpha + 1$. For $h \in H^{2\alpha}(\mathbb{T})$ we have

$$\left\| \frac{1}{N(T)} \sum_{\tau_n \leq T} Q^{[\sigma+i\tau_n]} h - Qh \right\|_0 \rightarrow 0$$

as $T \rightarrow \infty$, and the rate of convergence depends on h only via its 2α -norm.

Here, $N(T) = \max\{n : \tau_n \leq T\}$, and $\|\cdot\|_0$ is the well-known Hilbert-Schmidt norm. It may be argued that the optimal convergence result should be much stronger, [11].

So it happens that functions $Q^{-1}[Q^{[\sigma+i\tau_n]}h]$ typically have more high-frequency contents than h itself. Therefore, the theorem points at the existence of large ensembles of quantum channels that, while being noisy on their own, suppress noise when set in unison.

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Cryptographers Prepare for a Possible Post-Quantum Future

Neal Koblitz and Alfred Menezes

Sophisticated mathematics plays a crucial role in the security of e-commerce because it is needed to construct and analyze so-called *public-key* systems of encryption, key agreement, and authentication. Public-key cryptography is what makes it possible, for example, for (i) customers' computers to establish a shared secret key with any merchant in order to encrypt their purchase information and credit card number; and (ii) a software manufacturer to digitally sign an upgrade so that millions of customers' computers can efficiently verify that the upgrade is authentic.

Central to any public-key system is a *one-way function* that is easy to compute but infeasible to invert. The oldest widely-used system, RSA, is based on the following one-way procedure: Randomly generate two large primes p and q , and multiply them to form the RSA modulus $N = pq$. The inverse procedure is a version of the Integer Factorization Problem (IFP). Another widely-deployed type of public-key cryptography, Elliptic Curve Cryptography (ECC), is based on the following one-way function: Given a fixed point P on an elliptic curve defined over a finite field, for a large random integer k evaluate $Q = f(k) = kP$. The problem of inverting this function, that is, determining k from Q , is called the Elliptic Curve Discrete Log Problem (ECDLP).

Both RSA (invented in 1977) and ECC (invented in 1985) have stood the test of time quite well. There have, however, been important advances affecting the use of both types of systems. In the early years of RSA the best algorithms known for factoring an n -bit modulus N took roughly $2^{n^{1/2+\epsilon}}$ computer operations. But the Number Field Sieve, proposed by J. Pollard in the late 1980s and developed and improved by many number theorists in the 1990s, cut down the running time for the IFP to roughly $2^{n^{1/3+\epsilon}}$ operations. Replacing $\frac{1}{2}$ by $\frac{1}{3}$ in the exponent might not seem like much, but the practical effect was that for standard applications the recommended value of the bitlength n increased from 512 (in the early 1990s) to 3072 today.

In the case of ECC there has been no analogous mathematical breakthrough; the running times of the best ECDLP algorithms are roughly $2^{n/2}$, where n is the bitlength of the elliptic curve group order, and this hasn't changed in thirty years. Certain (easily-avoided) families of elliptic curves have been found to be weak. But if one avoids such curves and works with a curve over a prime field or over a prime-degree extension of the field of 2 elements (as one usually does), then for most applications the recommended value of n is only 256. For this reason, starting in the late 1990s many of the newer technologies have been using ECC and some of the older technologies have switched from RSA to ECC. In 2005 the National Security Agency (NSA) recommended the gradual replacement of RSA by ECC.

With this as background, we next discuss the threat from quantum computation. The idea of a quantum computer was proposed independently by Yuri Manin and Richard Feynman around 1980, but the potential impact on cryptography became clear only in 1994, when Peter Shor developed quantum algorithms — that is, ones that cannot be performed by a classical computer but, at least in theory, could be carried out by a quantum computer — that efficiently factor integers and find discrete logs on elliptic curves. A large-scale quantum computer would be able to break both RSA and ECC. Cryptographers became especially concerned about this threat about 15 years ago when major institutions started investing large sums of money into research on quantum computing.

A commonly-cited prediction [3] is that there's a 50%-50% chance that a large-scale quantum computer will be built in 15 years. However, many are skeptical about this timeline, and some doubt (for theoretical and practical reasons) that it will be built in the foreseeable future. Certainly progress has been very slow.

However, whether or not one is a skeptic, it would be wrong not to plan for post-quantum cryptography (PQC). First of all, a general principle is that cryptographers should base plans on a worst-case analysis whenever possible. Even if there's only a small chance that a quantum computer capable of breaking RSA and ECC will be built in the next 15 or 20 years, that is a chance we should not take, because too much is at stake. In the second place, it would not make sense to say "let's cross that bridge when we come to it," and then wait until quantum computers are clearly on the horizon. Then it would be too late, because there is a great time lag between the invention of a new type of cryptography and its eventual adoption and deployment. Proposals for PQC are at an early stage; it will take many years for a consensus to emerge on which of the proposed systems are best, for extensive theoretical research and experimental testing, and for standardization and commercialization. In the case of both RSA and ECC — which are conceptually simpler and easier to study than the leading candidates for PQC — this process took about 15 years.

The prudent course is to follow two tracks. On the one hand, PQC should be a major focus of cryptographic research. On the other hand, in order to meet short- and middle-term needs, users who have not already done so should be encouraged to move from RSA to ECC, and ECC parameters should continue to be improved. For example, new elliptic curves that have greater efficiency and offer resistance to certain side-channel attacks should be tested and standardized. Indeed, the U.S. National Institute of Standards and Technology has been following this two-pronged approach. But, surprisingly, the NSA has not. Rather, they have somewhat distanced themselves from ECC, a stance that has given rise to much speculation about the NSA's motives. In [2] we summarize some of the theories and present our own analysis.

The most widely-discussed and aggressively-promoted candidate for PQC has been lattice-based cryptography. There are two classes of conjecturally difficult mathematical problems that serve

as a basis for the security of this type of cryptography. One class consists of variants of the Shortest-Vector Problem (SVP), which asks: Given a set of basis vectors for an n -dimensional integer lattice, find a shortest nonzero vector in the lattice. The other class consists of variants of the Learning With Errors (LWE) problem, which asks: Given an integer q and a set of linear equations modulo q that are satisfied by an unknown vector to within an error that follows a certain probability distribution, find the unknown vector. The LWE problem or a variant of it can be used to construct one-way functions for public-key cryptography.

The main argument that has been advanced to support adoption of lattice-based PQC is that its security is supported by a worst-case/average-case reduction. This argument, often referred to as a “proof of security,” goes as follows. First of all, if an adversary has a computer program that mounts a successful attack on the lattice-based protocol, then that program can be used to solve an “average” instance of the LWE-type problem. Moreover, if an average instance of that problem can be solved, then so can a worst-case instance of a certain kind of SVP problem. But it is believed that no efficient algorithm exists for the hardest instances of these SVP-like problems.

However, there are several problems with this argument, as there have been with many “provable security” claims in cryptography (see <http://anotherlook.ca> for more examples). Most glaringly, the literature on the subject in general provides only asymptotic results and no concrete analysis using recommended parameters. Indeed, in [1] it was found that for a certain recommended choice of parameters the provable-security guarantee is vacuous.

One danger with all the “provable security” claims that have been published for lattice-based protocols and other types of largely untested cryptosystems is that they could lead to a false sense of security. There might be a tendency to underestimate the importance of concrete analysis and experimental testing for vulnerabilities. Theoretical results linking LWE and SVP are nice to have, but they do not provide a sound basis for confidence in lattice-based PQC.

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Faculty Positions in Combinatorics and Optimization University of Waterloo

The Department of Combinatorics and Optimization (<https://math.uwaterloo.ca/co>) at the University of Waterloo invites applications for two tenure-track faculty positions at the rank of Assistant Professor. Associate or Full Professors with tenure will be considered in special cases that enhance the research and teaching needs of the Department. Applicants should have research interests in one of the following areas: Algebraic Combinatorics, Continuous Optimization, Cryptography, Discrete Optimization, and Graph Theory. Emphasis will be given to candidates in the areas Continuous Optimization and Cryptography.

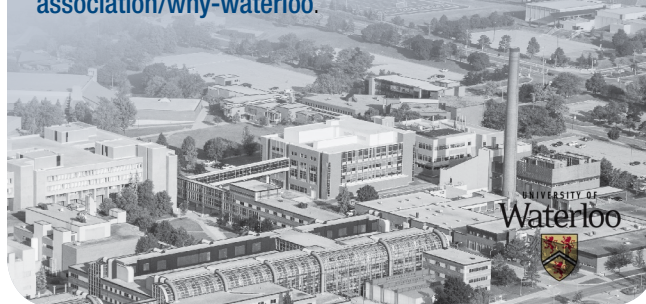
A Ph.D. degree and evidence of excellence in research and teaching are required. Successful applicants are expected to maintain an active program of research, to attract and supervise graduate students, and to participate in undergraduate and graduate teaching. The salary range for the position is \$105,000 to \$155,000. Negotiations beyond this salary range will be considered for exceptionally qualified candidates. The effective date of appointment is July 1, 2018.

Interested individuals should apply using the MathJobs site (<https://www.mathjobs.org>). Applications should include a curriculum vitae, research and teaching statements, and up to three reprints/preprints. In addition, at least three reference letters should be submitted.

Inquiries may be addressed to combopt@uwaterloo.ca or to Jochen Koenemann, Chair, Department of Combinatorics and Optimization, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1. Closing date for receipt of applications is December 1, 2017.

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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, Independent Scholar

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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:

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Learning Mesopotamian Mathematics

Duncan J. Melville, St. Lawrence University

Mesopotamian mathematics spanned a wide geographical area, centered in modern Iraq, and lasted for roughly 3000 years. Until about 150 years ago, it was forgotten. The task of recovering an understanding of the culture continues. Writing in Mesopotamia was introduced in an administrative context, in order to record and monitor the flow of goods. Since quantities as well as types of goods needed to be recorded, numeracy and literacy were intertwined from the very beginning.

The accidents of archaeology—what happens to be found—mean that our knowledge and understanding of Mesopotamian mathematics across its 3000-year life is very unevenly distributed. The best-documented time is the Old Babylonian period (ca. 2000–1600 BCE), and I concentrate on that period here.

Our knowledge of Mesopotamian mathematics is based almost exclusively on the written record, clay tablets incised with cuneiform (wedge-shaped) characters made by a sharpened reed stylus. The tablets were then retained or discarded according to the writer's needs. Many have been found by archaeologists after being dumped or used as building fill (or floors or walls) and are broken and out of context. The record must sometimes be quite literally pieced together.

One of the largest Old Babylonian collections was discovered in the late 19th century in the ancient city of Nippur. Some 50,000 tablets were found, of which eight or nine hundred texts and fragments had mathematical content. From a careful analysis of this spectacular find scholars have recently managed to draw a fairly detailed picture of the Nippur curriculum of the 18th century BCE. Although these tablets were excavated over a century ago, many languished unread in museum collections for decades.

Building on earlier work by Steve Tinney and Niek Veldhuis, the mathematical portion of Old Babylonian education at Nippur was reconstructed by Eleanor Robson and Christine Proust. Scribal education at the time was aimed at gaining proficiency in Sumerian, then a dead language but still used in scholarly and religious contexts. Young scribes began with the basics of making cuneiform marks on clay tablets and gradually worked through texts of

increasingly complex Sumerian vocabulary and grammar. Beginning mathematical education formed a small part of this overall process.

Pedagogical strategy was based on copying and memorization of lists. Long lexical lists of thematically related words, such as the names of plants, birds, or things made from wood, were copied and recopied. Then the student moved on to lists of Sumerian proverbs to gain understanding of basic grammar, before copying out Sumerian literature, hymns, letters, and contracts in a more advanced stage. On the mathematical side the student's first encounter came with metrological lists, learning the notation and units for capacity measurement, then the systems for weights, areas, and finally lengths, apparently always in that order.

Once the student was well versed in the common metrological systems, the next step was the metrological table, and with it the student's first exposure to the famed sexagesimal (base-60) place value system, the abstract numerical scheme using a single vertical wedge to stand for 1, a corner wedge for 10, then a vertical for 60 and, indeed, for 60^n , for all n . The metrological tables gave conversions from the metrological units into sexagesimal multiples or fractions of some base unit. At this stage there is still no hint of calculation or mathematical problem-solving.

Next came purely numerical tables, written in the abstract sexagesimal system. First, students learned the reciprocal table (division being treated as multiplication by the reciprocal), then a collection of tables giving multiples of 'head' numbers x : x , $2x$, ..., $20x$, then $30x$, $40x$, $50x$, and (written sexagesimally as '1x') $60x$. Robson has estimated that it took about a year for a student to learn the multiplication tables. Finally, right at the end of the elementary-education phase documented at Nippur, comes calculation, mostly calculation of the area of some surface given the lengths of the sides. The process involved conversion of length units to sexagesimal, multiplication of the sexagesimal numbers, and conversion back into area units, conveniently using all the material the student had been studying.

To modern eyes it may seem startling that a student's first steps in arithmetical problem-solving involved multiplication. In fact, Christine Proust has argued that elementary computation involved only multiplication. The sexagesimal place-value system is a floating-point system where numbers are best regarded as strings rather than integers, and give no indication of units and fractions. For us, the distinction between 123.456 and 1234.56 lies of course in the placement of the decimal point, but in Old Babylonian you would just

have (the equivalent of) 123456. As such, a floating-point system is ideal for multiplication and terrible for addition. The evidence shows that problems involving multiplication and addition belonged to a more advanced level of education.

The more advanced stages of Sumerian literary education are quite well understood; those of mathematics much less so. Texts including mathematical problems come in a wide variety of shapes, sizes, and contents. There are texts that contain a single problem with a fully worked-out solution; texts with multiple problems, sometimes related, sometimes different; texts with problem and answer but no solution procedure; and texts with problems but no solutions. The first, decipherment, phase of the history of Mesopotamian mathematics concerned the mathematical content and the procedures or algorithms used in solving different classes of problems. More recently, scholars have been questioning the function and use of the texts themselves. Originally, they were all seen as 'school-texts', in either student or teacher possession. That assumption is no longer tenable, although there is lively debate among scholars about exactly how certain texts should be categorized.

Indeed, we still do not know how many students learned how much mathematics. Certainly enough learned sufficient administrative mathematics to keep the system going. And of course, there must have been a range of both training and interest in mathematics. For some, mastering complex mathematics, well beyond the utilitarian requirements of administrative bookkeeping, seems to have been a source of great pride, and for some, the urge to explore mathematics was irresistible. The witnesses are two classes of texts that have only recently been understood. The first is a group of so-called 'recombination' texts. Many Old Babylonian problem texts contain a series of thematically-related problems, such as digging ditches or canals, or making bricks. The recombination texts are compilations of favorite problems, from a variety of sources, beautifully written on very large tablets. They can be thought of as presentation copies, or coffee-table books, and were clearly not intended as everyday textbooks for students. At the other extreme are tablets containing extremely compressed statements of related problems. One example contains 240 problems on 30 x 20 rectangles (i.e., all the *answers* are the same) and claims to be the 10th in a series. Proust has shown that these problems are arranged in a tree-like structure with several levels of branching, such that later problems can only be fully understood by referring back to problems closer to the trunk. These texts display a systematic exploration of an area of mathematics and again were not intended as sources of exercises for beginners.

There were both students and scholars in Old Babylonian Mesopotamia, and we are still unravelling their history. Almost half the known mathematical tablets have been published in the last 20 years or so, and new sources bring new questions; the field is active.

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La Société mathématique du Canada (SMC) est fière d'annoncer...

Après 35 ans, le Congrès international de physique mathématique (CIPM) reviendra en Amérique du Nord en 2018 et se déroulera au Canada pour la première fois. Tenu tous les trois ans, le CIPM est l'événement le plus important de l'Association internationale de physique mathématique. Le XIX^e CIPM aura lieu à Montréal en 2018 et, selon la nouvelle tradition, il sera précédé du Symposium des jeunes chercheurs. Ce Symposium se tiendra à l'Université McGill les 20 et 21 juillet, et le CIPM se déroulera au Centre Mont-Royal et à l'Université McGill du 23 au 28 juillet. Le Canada se réjouit à l'idée d'accueillir le monde de la physique mathématique en 2018!

Le CIPM 2018 sera organisé par la SMC en collaboration avec de nombreuses associations des domaines de la physique et des mathématiques, notamment : le CRM, l'Université McGill, le PIMS, l'Institut Fields, l'ISM, l'AARMA, le CANSSI, la SRIB, l'Institut Périmètre, l'Université de Montréal et l'UQAM.

<https://icmp2018.org/fr>

The Canadian Mathematical Society (CMS) is pleased to announce...

After 35 years, the International Congress on Mathematical Physics (ICMP) will return to North America in 2018, which will also mark the first time that Canada will host the congress. The ICMP, on its three year cycle, is the most important event of the International Association of Mathematical Physics. The XIXth ICMP will take place in Montreal, 2018, and, following recent tradition, it will be preceded by the Young Researchers Symposium (YRS). The YRS will be held at McGill University from July 20 to July 21 and the ICMP will be held at the Centre Mont-Royal and McGill University from July 23 to July 28. Canada is looking forward to welcoming the world of mathematical physics in 2018!

ICMP 2018 will be staged by the CMS in collaboration with many physics and mathematics organizations, including: CRM, McGill University, PIMS, FIELDS, ISM, AARMS, CANSSI, BIRS, Perimeter Institute, U. Montréal, and UQAM.

<https://icmp2018.org/en/welcome>

Cathleen Morawetz

Cathleen Morawetz passed away on August 8, 2017 at age 94. A native of Toronto and a student at the University of Toronto, she spent most of her career at the Courant Institute, NYU. Her honors were many: Fellow of the Royal Society of Canada, Krieger-Nelson Prize, President of the AMS, U.S. National Medal of Science, U.S. National Academy of Science, Jeffery-Williams Prize Lecturer, Gibbs Lecturer, Emmy Noether Lecturer, Steele Prize, Birkhoff Prize, and many honorary degrees including at Toronto and Waterloo.

Her early work on the theory of transonic fluid flow remains still today the most fundamental mathematical work on this subject. This refers to PDEs that possess both elliptic and hyperbolic regions. The elliptic region is the region where the flow is supersonic, while the boundary between the elliptic and hyperbolic regions is where a shock wave is created. In the 1950's she used functional-analytic methods to study boundary value problems for such transonic problems. One of her theorems predicts that if there is a smooth steady irrotational flow around an aerodynamic profile, then there cannot exist a smooth steady transonic flow around any slightly perturbed profile. Thus while shock-free transonic flows exist, she proved that they cannot be stable. Her predictions were subsequently confirmed through both numerical simulations and actual experiments. What happens physically is that shock waves appear in the flow past the perturbed profile. This aspect of her work has had an important impact on airfoil design, which attempts to minimize the shocks. She also did fundamental work on magnetohydrodynamic shock structure and other related problems.

Beginning in the 1960's Morawetz investigated the scattering of linear acoustic and electromagnetic waves off obstacles. This work involved studying the asymptotics of the wave equation in an exterior domain with Dirichlet boundary conditions. She developed a

series of remarkable energy identities, now collectively known as Morawetz Identities, which imply a priori that solutions must decay at certain rates. Some of these identities are related to the conformal invariance of the wave equation. In particular, she proved that the waves decay at an exponential rate if the obstacle is star-shaped.

Her estimates were key ingredients in the development of mathematical scattering theory in collaboration with Peter Lax and Ralph Phillips. In the 1970's her estimates inspired the development of microlocal methods at boundaries to guarantee the local exponential decay of energy. In 1968 she also proved a novel radial estimate, which provides decay for positive-mass equations.

It is remarkable that her energy estimates, originally developed for linear problems, have also played critical roles in the analysis of nonlinear waves. The conformally invariant estimates have been used by many mathematicians in the theory of small-amplitude hyperbolic waves, culminating ultimately in the analysis of Einstein's equations of general relativity. The estimates, and especially the radial estimate, have also been instrumental in the study of large-amplitude waves, including her remarkably subtle work with Walter Strauss on the nonlinear Klein-Gordon equation. The use of close analogues of her estimates continues to the present day, for instance for nonlinear Schrödinger and other nonlinear dispersive waves.

Cathleen Morawetz was an open and charming person. It is remarkable that she was able to bring up four lovely children simultaneously as her mathematical career was taking off. She was one of the key personalities who set the tone of openness, generosity and scientific excellence at the Courant Institute over many years. She has been a terrific role model for the mathematical community. She will be sorely missed.



2018 David Borwein Distinguished Career Award

The **David Borwein Distinguished Career Award** recognizes mathematicians who have made exceptional, broad, and continued contributions to Canadian mathematics.

A complete nomination dossier consists of:

- A signed nomination statement from a present or past colleague, or collaborator (no more than three pages) having direct knowledge of the nominee's contribution;
- A short curriculum vitae, no than five pages;
- Two to four letters of support in addition to the nomination;
- Other supporting material may be submitted, no more than 10 pages.

A nomination can be updated and will remain active for three years.

The complete nomination dossier must arrive at the CMS Executive Office **no later than November 15, 2017**.

All documentation should be submitted electronically, preferably in PDF format, by the appropriate deadline, to dbaward@cms.math.ca.

Prix David-Borwein de mathématicien émérite pour l'ensemble d'une carrière 2018

Le **prix David-Borwein de mathématicien émérite pour l'ensemble d'une carrière** rend hommage à un mathématicien qui a fait une contribution exceptionnelle et soutenue aux mathématiques canadiennes.

Le dossier de candidature comprendra les éléments suivants :

- une lettre de mise en candidature signée par un collègue ou un collaborateur actuel ou des années passées (trois pages maximum) qui connaît très bien les réalisations de la personne proposée;
- un bref curriculum vitae, maximum de cinq pages;
- de deux à quatre lettres d'appui, en plus de la mise en candidature;
- tout autre document pertinent, maximum de 10 pages.

Toute mise en candidature est modifiable et demeurera active pendant trois ans.

Le dossier complet doit parvenir au bureau administratif de la SMC **au plus tard le 15 novembre 2017**.

Veuillez faire parvenir tous les documents par voie électronique, de préférence en format PDF, avant la date limite à prixdb@smc.math.ca.

2018 CMS Excellence in Teaching Award

The CMS Excellence in Teaching Award Selection Committee invites nominations for the **2018 Excellence in Teaching Award**.

The Excellence in Teaching Award recognizes sustained and distinguished contributions in teaching at the post-secondary undergraduate level at a Canadian institution. The award focuses on the recipient's proven excellence as a teacher at the undergraduate level as exemplified by unusual effectiveness in the classroom and/or commitment and dedication to teaching and to students.

Nomination letters, *including at least three letters of reference*, should list the chosen referees and include a recent curriculum vitae for the nominee, if available.

Nominations and reference letters should be submitted electronically, preferably in PDF format, to: etaward@cms.math.ca no later than the deadline of **November 15, 2017**.

Prix d'excellence en enseignement de la SMC 2018

La Comité de sélection du Prix d'excellence en enseignement de la SMC invite un appel de mises en candidatures pour le **Prix d'excellence en enseignement 2018**.

Le Prix d'excellence en enseignement récompense des contributions exceptionnelles et soutenues en enseignement au collégial et au premier cycle universitaire dans un établissement canadien. Le Prix récompense l'excellence reconnue d'un enseignant ou d'une enseignante au niveau postsecondaire telle qu'illustrée par son efficacité exceptionnelle en classe ou son engagement et son dévouement envers l'enseignement et les étudiants.

Le dossier de candidature, *comprenant au moins trois lettres de référence*, doit comprendre le nom des personnes données à titre de référence ainsi qu'un curriculum vitae récent du candidat ou de la candidate, dans la mesure du possible.

Veuillez faire parvenir les mises en candidature et lettres de référence par voie électronique, de préférence en format PDF, à : prixee@smc.math.ca avant la date limite du **15 novembre 2017**.

2018 Doctoral Prize

The **CMS Doctoral Prize** recognizes outstanding performance by a doctoral student. The prize is awarded to one or two recipients of a Ph.D. from a Canadian university whose overall performance in graduate school is judged to be the most outstanding. Although the dissertation will be the most important criterion (the impact of the results, the creativity of the work, the quality of exposition, etc.) it will not be the only one. Other publications, activities in support of students and other accomplishments will also be considered.

Nominations that were not successful in the first competition will be kept active for a further year (with no possibility of updating the file) and will be considered by the Doctoral Prize Selection Committee in the following year's competition.

The CMS Doctoral Prize will consist of an award of \$500, a two-year complimentary membership in the CMS, a framed Doctoral Prize certificate and a stipend for travel expenses to attend the CMS meeting to receive the award and present a plenary lecture.

Nominations

Candidates must be nominated by their university and the nominator is responsible for preparing the documentation described below, and submitting the nomination to the address below. No university may nominate more than one candidate and the deadline for the receipt of nominations is **January 31, 2018**.

The documentation shall consist of:

- A curriculum vitae prepared by the student.
- A résumé of the student's work written by the student and which must not exceed ten pages. The résumé should include a brief description of the thesis and why it is important, as well as of any other contributions made by the student while a doctoral student.
- Three letters of recommendation of which one should be from the thesis advisor and one from an external reviewer. A copy of the external examiner's report may be substituted for the latter. More than three letters of recommendation are not accepted.

All documentation, including letters of recommendation, should be submitted electronically, preferably in PDF format, by the appropriate deadline, to docprize@cms.math.ca.

Prix de doctorat 2018

La SMC a créé ce **Prix de doctorat** pour récompenser le travail exceptionnel d'un étudiant au doctorat. Le prix sera décerné à une personne qui aura reçu son diplôme de troisième cycle d'une université canadienne l'année précédente (entre le 1er janvier et le 31 décembre) et dont les résultats pour l'ensemble des études supérieures seront jugés les meilleurs. La dissertation constituera le principal critère de sélection (impact des résultats, créativité, qualité de l'exposition, etc.), mais ne sera pas le seul aspect évalué. On tiendra également compte des publications de l'étudiant, de son engagement dans la vie étudiante et de ses autres réalisations.

Les mises en candidature qui ne seront pas choisies dans leur première compétition seront considérées pour une année additionnelle (sans possibilité de mise à jour du dossier), et seront révisées par le comité de sélection du Prix de doctorat l'an prochain.

Le lauréat du Prix de doctorat de la SMC aura droit à une bourse de 500 \$. De plus, la SMC lui offrira l'adhésion gratuite à la Société pendant deux ans et lui remettra un certificat encadré et une subvention pour frais de déplacements lui permettant d'assister à la réunion de la SMC où il recevra son prix et présentera une conférence.

Candidatures

Les candidats doivent être nommés par leur université; la personne qui propose un candidat doit se charger de regrouper les documents décrits aux paragraphes suivants et de faire parvenir la candidature à l'adresse ci-dessous. Aucune université ne peut nommer plus d'un candidat. Les candidatures doivent parvenir à la SMC au plus tard le **31 janvier 2018**.

Le dossier sera constitué des documents suivants :

- Un curriculum vitae rédigé par l'étudiant.
- Un résumé du travail du candidat d'au plus dix pages, rédigé par l'étudiant, où celui-ci décrira brièvement sa thèse et en expliquera l'importance, et énumérera toutes ses autres réalisations pendant ses études de doctorat.
- Trois lettres de recommandation, dont une du directeur de thèse et une d'un examinateur de l'extérieur (une copie de son rapport serait aussi acceptable). Le comité n'acceptera pas plus de trois lettres de recommandation.

Veuillez faire parvenir tous les documents par voie électronique, de préférence en format PDF, avant la date limite à prixdoc@smc.math.ca.

2018 Adrien Pouliot Award

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

Nominations must be received by the CMS Office **no later than April 30, 2018**.

Please submit your nomination electronically, preferably in PDF format, to apaward@cms.math.ca.

Nomination requirements

- Include contact information for both nominee and nominator.
- Describe the nominated individual's or team's sustained contributions to mathematics education. This description should provide some indication of the time period over which these activities have been undertaken and some evidence of the success of these contributions. This information must not exceed four pages.
- Two letters of support from individuals other than the nominator should be included with the nomination.
- Curricula vitae should not be submitted since the information from them relevant to contributions to mathematics education should be included in the nomination form and the other documents mentioned above.
- If nomination was made in the previous year, please indicate this.
- Members of the CMS Education Committee will not be considered for the award during their tenure on the committee.

Renewals

Individuals who made a nomination last year can renew this nomination by simply indicating their wish to do so by the deadline date. In this case, only updating materials need be provided as the original has been retained.

Prix Adrien Pouliot 2018

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

Les mises en candidature doivent parvenir au bureau de la SMC **avant le 30 avril 2018**.

Veuillez faire parvenir votre mise en candidature par voie électronique, de préférence en format PDF, à prixap@smc.math.ca.

Conditions de candidature

- Inclure les coordonnées du/des candidat(s) ainsi que du/des présentateur(s).
- Décrire en quoi la personne ou le groupe mis en candidature a contribué de façon soutenue à des activités mathématiques. Donner un aperçu de la période couverte par les activités visées et du succès obtenu. La description ne doit pas être supérieure à quatre pages.
- Le dossier de candidature comportera deux lettres d'appui signées par des personnes autres que le présentateur.
- Il est inutile d'inclure des curriculum vitae, car les renseignements qui s'y trouvent et qui se rapportent aux activités éducatives visées devraient figurer sur le formulaire de mise en candidature et dans les autres documents énumérés ci-dessus.
- Si la candidature a été soumise l'année précédente, veuillez l'indiquer.
- Les membres du Comité d'éducation de la SMC ne pourront être mis en candidature pour l'obtention d'un prix pendant la durée de leur mandat au Comité.

Renouveler une mise en candidature

Il est possible de renouveler une mise en candidature présentée l'année précédente, pourvu que l'on en manifeste le désir avant la date limite. Dans ce cas, le présentateur n'a qu'à soumettre des documents de mise à jour puisque le dossier original a été conservé.

**December 8-11, 2017**

University of Waterloo – Waterloo, Ontario

cms.math.ca/Events/winter17**Prizes | Prix**

2017 Excellence in Teaching Award | Prix d'excellence en enseignement

Bernard Hodgson (Laval)

2017 Adrien Pouliot Award | Prix Adrien-Pouliot

Richard Hoshino (Quest)

2017 Coxeter-Jame Prize | Prix Coxeter-James et conférence

Sabin Cautis (UBC)

2017 Doctoral Prize | Prix de doctorat

Konstantin Tikhomirov (Princeton)

2017 Graham Wright Award for Distinguished Service | Prix Graham Wright pour service méritoire

Recipient to be announced | Lauréat à confirmer

2017 G. de B. Robinson Award | Prix G. de B. Robinson

Alan Beardon (formerly Cambridge)

Scientific Directors | Directeurs scientifique

Kenneth Davidson, University of Waterloo

Cameron Stewart, University of Waterloo

8-11 décembre 2017

Université de Waterloo – Waterloo, Ontario

cms.math.ca/Reunions/hiver17**Plenary Lectures | Conférences plénières**

Bill Cook, University of Waterloo

Ilijas Farah, York University

Joel Kamnitzer, University of Toronto

Niky Kamran, McGill University

Natalia Komarova, UC-Irvine

Public Lecture | Conférence publique

Edward Burger, Southwestern University

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Regular Sessions | Sessions générales

Algebraic Graph Theory | Théorie algébrique des graphes

Org: Chris Godsil (University of Waterloo)

Analytic Number Theory | Théorie analytique des nombres

Org: Kevin Hare, Wentang Kuo and Yu-Ru Liu (University of Waterloo)

Application of Mathematics to Medicine & Biology | Application des mathématiques à la médecine et à la biologie

Org: Sivabal Sivaloganathan (University of Waterloo)

Applications of Combinatorial Topology in Commutative Algebra | Applications de la topologie combinatoire en algèbre commutative

Org: Sara Faridi (Dalhousie University) and Adam Van Tuyl (McMaster University)

Arithmetic Dynamics | Dynamique arithmétique

Org: Jason Bell (University of Waterloo) and Patrick Ingram (York University)

Contributed Papers | Communications libres

Org: to be announced | Org : à venir

Cyclic homology and noncommutative geometry | Homologie cyclique et géométrie non commutative

Org: Masoud Khalkhali (Western University) and Ilya Shapiro (University of Windsor)

Design Theory | Théorie de la conception

Org: Hadi Kharaghani (University of Lethbridge) and Doug Stinson (University of Waterloo)

Dynamics of Microbial Systems | Dynamique des systèmes microbiens

Org: Gail Wolkowicz (McMaster University)

Environmental and Geophysical Fluid Dynamics | Dynamique des fluides en géophysique et en science de l'environnement

Org: Kevin Lamb, Francis Poulin and Marek Stastna (University of Waterloo)

Explicit finiteness of integral points on hyperbolic curves | Finitude explicite des points entiers sur les courbes hyperboliques

Org: David McKinnon and Jerry Wang (University of Waterloo)

Geometric Analysis | Analyse géométrique

Org: Benoit Charbonneau and Spiro Karigiannis (University of Waterloo)

History of Mathematics | Histoire des mathématiques

Org: Maritza M. Branker (Niagara University)

Logic and Operator Algebras | Logique et algèbres des opérateurs

Org: Ilijas Farah (York University) and Marcin Sabok (McGill University)

Low dimensional topology and geometric group theory | Topologie en basses dimensions et théorie des groupes géométriques

Org: Adam Clay (University of Manitoba) and Tyrone Ghaswala (University of Waterloo)

Mathematical aspects of quantum information | Aspects mathématiques de l'information quantique

Org: David Kribs, Rajesh Pereira and Bei Zeng (University of Guelph)

Model Theory | Théorie des modèles

Org: Rahim Moosa (University of Waterloo) and Sergei Starchenko (University of Notre Dame)

Operator algebras | Algèbres des opérateurs

Org: Matthew Kennedy (University of Waterloo) and Paul Skoufranis (York University)

Symmetric functions and generalizations | Fonctions symétriques et généralisations

Org: Angele Hamel (Wilfrid Laurier University) and Stephanie van Willigenburg (University of British Columbia)

Toric geometry | Géométrie torique

Org: Matthew Satriano (University of Waterloo) and Greg Smith (Queen's University)

Variational Analysis and Monotone Operator Theory | Analyse variationnelle et théorie des opérateurs monotones

Org: Heinz Bauschke and Xianfu Wang (University of British Columbia Kelowna)

Graduate Student Poster Session

Présentations par affiches pour étudiants

Org: to be announced | Org : à venir

Using Digital Assets in Mathematics Education and Outreach | Utiliser les outils numériques en éducation et en sensibilisation aux mathématiques

Brian and Barbara Forrest (Waterloo)



2017



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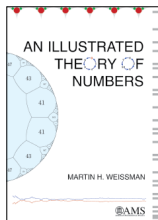
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AMERICAN MATHEMATICAL SOCIETY

NEW BOOKS

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AMS



An Illustrated Theory of Numbers

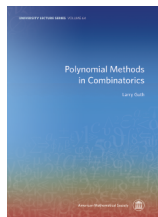
Martin H. Weissman, *University of California, Santa Cruz, CA*

An Illustrated Theory of Numbers is a textbook like none other I know; and not just a textbook, but a work of practical art. This book would be a delight to use in the undergraduate classroom, to give to a high school student in search of enlightenment, or to have on your coffee table, to give guests from the world outside mathematics a visceral and visual sense of the beauty of our subject.

—Jordan Ellenberg, *University of Wisconsin-Madison, author of How Not to Be Wrong: The Power of Mathematical Thinking*

This comprehensive introduction to number theory, with complete proofs, worked examples, and exercises, reflects the most recent scholarship in mathematics and its history and includes historical notes that curate primary sources and secondary scholarship to trace the development of number theory within and outside the Western tradition.

2017; 323 pages; Hardcover; ISBN: 978-1-4704-3493-9; List US\$69; AMS members US\$55.20; Order code MBK/105



Polynomial Methods in Combinatorics

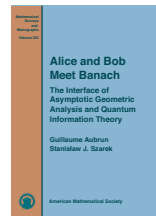
Larry Guth, *Massachusetts Institute of Technology, Cambridge, MA*

In the 273 page long book, a huge number of concepts are presented, and many results concerning them are formulated and proved. The book is a perfect presentation of the theme.

—Béla Uhrin, *Mathematical Reviews*

The book contains approximately 100 exercises that further the reader's understanding of the main themes of the book.

University Lecture Series, Volume 64; 2016; 273 pages; Softcover; ISBN: 978-1-4704-2890-7; List US\$48; AMS members US\$38.40; Order code ULECT/64



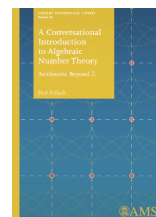
Alice and Bob Meet Banach

The Interface of Asymptotic Geometric Analysis and Quantum Information Theory

Guillaume Aubrun, *Université Claude Bernard Lyon 1, Villeurbanne, France*, and Stanislaw J. Szarek, *Case Western Reserve University, Cleveland, OH*, and *Sorbonne Université, Paris, France*

By building a bridge between two distinct but intensely interacting fields, asymptotic geometric analysis and quantum information theory, this book presents deep insights into the behavior of entanglement and related phenomena in a high-dimensional setting.

Mathematical Surveys and Monographs, Volume 223; 2017; 414 pages; Hardcover; ISBN: 978-1-4704-3468-7; List US\$116; AMS members US\$92.80; Order code SURV/223



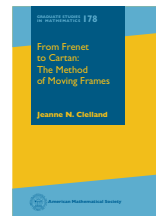
A Conversational Introduction to Algebraic Number Theory

Arithmetic Beyond \mathbb{Z}

Paul Pollack, *University of Georgia, Athens, GA*

Written in a conversational style, this introduction to algebraic number theory lays out the three classical "fundamental theorems": unique factorization of ideals, finiteness of the class number, and Dirichlet's unit theorem, while also frequently alluding to recent developments within the field.

Student Mathematical Library, Volume 84; 2017; 312 pages; Softcover; ISBN: 978-1-4704-3653-7; List US\$52; AMS members US\$41.60; Order code STML/84



From Frenet to Cartan: The Method of Moving Frames

Jeanne N. Clelland, *University of Colorado, Boulder, CO*

Primarily intended for 'beginning graduate students,' this book is highly recommended to anyone seeking to extend their knowledge of differential geometry beyond the undergraduate level.

—Peter Ruane, *MAA Reviews*

Written in a reader-friendly style, this introduction to the method of moving frames as developed by Cartan includes detailed guidance regarding the use of computer algebra system Maple(TM) in performing many of the computations involved in the book's exercises.

Graduate Studies in Mathematics, Volume 178; 2017; 414 pages; Hardcover; ISBN: 978-1-4704-2952-2; List US\$73; AMS members US\$58.40; Order code GSM/178

◆ = Textbook ◆ = Applied Mathematics □ = eBook

Will you be attending the 2017 CMS Winter Meeting in Waterloo, Ontario from December 8–11? Make sure to stop by the AMS Booth to peruse our latest publications and meet Megan Turcotte, our Director of Membership.

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Fundraising Key to CMS Success

In the spring of 2017, a Fundraising and Communications Officer, Patricia Dack, was hired with the goal of expanding the funds available to support CMS activities. With a full-time staff member responsible for Fundraising, the CMS hopes to obtain more regular donations from foundations, corporations, governments, institutions, friends of the CMS and members who are interested in supporting CMS programs and activities.

Sponsorships and donations from foundations and corporations often have programs that match their employee's donations. Fundraising efforts will continue to support on-going CMS programs such as the Math Competitions, Math Camps, CMS Meetings and Publications.

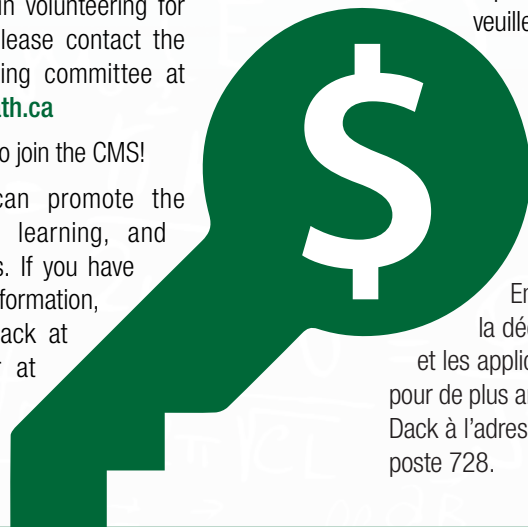
The CMS encourages you to consider donations by **Planned or Estate Giving**.

You can help:

Contributing to the CMS. What is most important is your support for the society through regular donations - not necessarily the size of the gift. You can donate online at cms.math.ca

- If you have contacts in private industry who we can contact to explore partnerships, please let Patricia know.
- If you are interested in volunteering for a CMS committee, please contact the chair of the nominating committee at chair-nomc@cms.math.ca
- Encourage colleagues to join the CMS!

Working together, we can promote the advancement, discovery, learning, and application of mathematics. If you have questions or want more information, please contact Patricia Dack at pdack@cms.math.ca or at 613-733-2662 ext. 728.



Les collectes de fonds : essentielles à l'essor de la SMC

À u printemps 2017, la SMC a embauché une agente de la collecte de fonds et des communications, Patricia Dack, dans le but d'intensifier la recherche de financement pour ses activités. Grâce à cet ajout à son personnel à plein temps, la SMC espère recueillir des dons plus réguliers de fondations, d'entreprises, de gouvernements, d'établissements, d'amis de la SMC et de membres désireux de soutenir ses programmes et ses activités.

Les fondations et les entreprises qui font des commandites et des dons ont souvent des programmes qui permettent de jumeler la contribution de leurs employés. Les collectes de fonds permettront à la Société de continuer à financer ses programmes, notamment ses concours et ses camps mathématiques, ses Réunions et ses publications.

La SMC vous invite à réfléchir à la possibilité de faire un don **planifié ou par planification successorale**.

Ce que vous pouvez faire :

Contribuer à la SMC. Ce qui compte le plus pour la Société, c'est la régularité de votre don, pas nécessairement le *montant* que vous donnez. Pour faire un don en ligne, passez à la page smc.math.ca.

- Si vous connaissez des gens dans le secteur privé que nous pourrions contacter pour discuter de partenariats, veuillez en informer Patricia.
- Si vous avez le goût de faire du bénévolat au sein d'un comité de la SMC, veuillez communiquer avec le président du comité des mises en candidature à l'adresse chair-nomc@smc.math.ca.
- Encouragez vos collègues à adhérer à la SMC!

Ensemble, nous pouvons promouvoir l'avancement, la découverte et l'apprentissage des mathématiques, et les applications qui en découlent. Pour toute question ou pour de plus amples renseignements, veuillez contacter Patricia Dack à l'adresse pdack@smc.math.ca ou au 613-733-2662 poste 728.

If undelivered, please return to:

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CMS Notes / Notes de la SMC

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