Welcome to the June Issue of *CMS Notes*

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Editorial Team

Javad Mashreghi (Université Laval)
CMS President

Twenty years ago, when I joined the Canadian Mathematical Society as a young assistant professor, one of the discussions at the Board of Directors was the creation of a new journal. The Chair of the Publications Committee drafted a brief annual report to discuss the issue with the Board and the directors. It was clear that an immediate decision is not possible and that there are several obstacles to overcome. Almost a decade after, when I became a regular member of the Publications Committee, the topic of a new journal was still being discussed in several committee meetings under the title of "Matters Arising From Previous Meetings". In 2016, I became the Chair of the Publications Committee and, this time with no surprise, we still assessed the possibility of creating a new journal. My mandate was over and the journal was not created. However, the item appears once again under the celebrated title of "Matters Arising from Previous Meetings", this time in the Executive Committee Schedule for Spring 2021! Why such a long history? Let us have a friendly account of this phenomenon.

Canada has a great international reputation in numerous branches of mathematics. Due to my personal interests, I am familiar with several research groups in Harmonic Analysis, Operator Theory and Operator Algebras. I have had the privilege to be close friends with colleagues involved in research groups such as Geometry and Topology, Number Theory, Mathematical Physics, Graph Theory and Combinatorics, etc. One of the earliest ideas was to create a focused journal on one discipline. Even though the idea gained some momentum from time to time, it was never adopted as mainstream in the Publications Committee. There were several reasons for the failure of this approach. First, in most of these areas there are already a couple of reputable journals. Hence, it is rather difficult to introduce a new one. Second, forming such a focused editorial board is not easy. Third, and possibly the most important one, it is uncertain how long an area would be the main research stream. A journal should run for many years to come. An active area of research might lose its importance or, while being still important, be overshadowed by other more active research groups; in either case, it would be extremely difficult to keep the journal alive. When I started my doctoral studies at McGill in the 90s, Montreal was a great centre for classical harmonic analysis. Prominent experts such as K. Gowrisankaran, V. Havin, C. Herz, I. Klemesh, P. Koosis, as well as P. Gauthier with his celebrated Analysis Seminar, had transformed Montreal into the paradise of classical analysis. Montreal continues to be one of the main mathematical centres of Canada with several strong research groups. However, regrettably, its torch of classical analysis is almost extinguished and imagine what would have happened now if the pioneers have had established a focused journal on this topic in 90s. In short, we should not put our eggs in one basket. A general journal is preferable.

The proposal is to launch a new journal, say the Transactions, and adopt two page-limit restrictions. As a rough and not-yet-approved proposition, papers with less than 15 pages go to Bulletin, between 15 and 40 to Journal, and any paper longer than that will be considered for publication in the Transactions.

A second attempt, which has been dominant, is to create a general scope journal, like our current *Bulletin* and *Journal*, for longer papers. Presently, the length limit is fixed at 18 pages. Shorter papers go to *Bulletin*, longer ones to *Journal*. Authors of papers with 18 pages tamper with LaTeX to make it longer or shorter to avoid any conflict. The proposal is to launch a new journal, say the *Transactions*, and adopt two page-limit restrictions. As a rough and not-yet-approved proposition, papers with less than 15 pages go to *Bulletin*, between 15 and 40 to *Journal*, and any paper longer than that will be considered for publication in the *Transactions*.

Despite the above initiatives, the new journal has not launched yet. I can mention at least two main reasons. First, it is a truly difficult task to start from the scratch and launch a new journal. Therefore, it has not been easy for the Publications Committee to find one, or a group of two, editor(s)-in-chief to start the work. It summons a lot of courage. Second, we enter the Open Access era. The CMS has been in regular contact with the Cambridge University Press to better understand this concept and to make appropriate decisions. It has by no means been an easy line of discussion and it is not over yet. Frankly speaking, the future of scientific journal publication is not that transparent, neither for us nor for the publishers. That is why it has not been so easy to launch a new journal.

Last but not least, this item is once again on our agenda in the upcoming summer meeting. This time, let us make it a reality.

Universities Without Mathematics?

Editorial
June 2021 (Vol. 53, No. 3)

Robert Dawson (Saint-Mary's University)
Editor-in-Chief

Laurentian University, in deep financial trouble, has decided to drop their mathematics program as part of what is essentially a bankruptcy proceeding. What are we to make of this?

We may be surprised at the idea that a university *can* declare bankruptcy. But clearly this – or something like it – must be so. Universities can take on debt, and unless you're just slipping $20 to a friend who came out without their wallet, debt involves the question of what happens if it isn't paid back. It is said that King's College, Cambridge, at the suggestion of John Maynard Keynes, mortgaged King's College Chapel and by canny investment of the proceeds set the college up financially. (*Si non è vero, è ben trovato!*) Of course, in such a case, one wonders what recourse the investors would have had if the college had defaulted. No doubt they would have had both legal and practical difficulty turning the chapel into a factory or a dance hall. Similarly, the bricks and mortar of a modern university have few alternative uses, and are often encumbered by zoning restrictions; the most likely use that a creditor could make of them would be to rent them back. Nonetheless, it is unusual for a university to take such a step.

But suppose a university to be in deep enough financial trouble that drastic cuts must be made: what are the options? It's easy to point at another program and say "cut there!" but every department can play at that game. And while we may feel that some of the specialized programs at modern universities are marginal to the traditional role of a university, they tend to bring in students – or outside funding – and pay their way. That's how they got there.

Uniform cutting across all programs sounds like a fair option – but many specialized programs have a closely defined curriculum, few options, and exactly the courses that they need to be viable. Moreover, some external body has usually approved that curriculum. Cutting 25% of the courses might leave the program completely unviable. Of course, the same thing is true of more traditional programs: it's just not quite as obvious. Closing programs is not a pleasant option: and this is especially true of math programs.

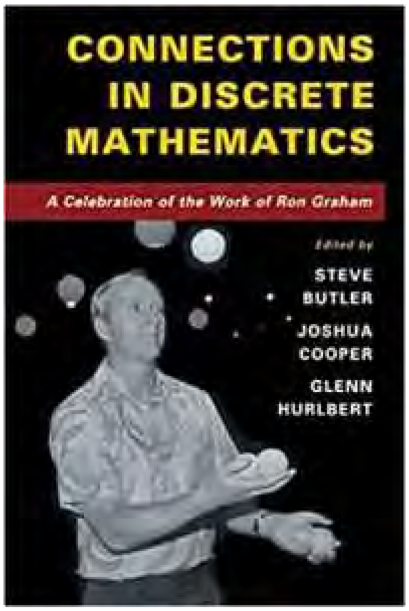
What's so special about mathematics? An institution of higher learning can exist without a mathematics program. In Nova Scotia, for instance, the Atlantic School of Theology, the Nova Scotia College of Art and Design, and the Gaelic College of Cape Breton all do very well without one. But you can see the pattern: these are institutions teaching limited, though important, branches of knowledge. Even the little Université Ste-Anne, with about 400 full-time students, offers ten math courses, supporting their BSc and education programs. Without mathematics, the range of programs that an institution can offer is strictly limited. It may train excellent poets, hairdressers, automobile mechanics, or musicians; but in the twenty-first century it would be hard to think of it as a university.

Of course, it is possible to keep a few mathematics instructors around to teach service courses, without offering any higher level courses or degree programs. But this may be a false economy. Most CMS members know that their teaching will always lean towards calculus, linear algebra, and other service subjects, and we accept this. Varying this with even one course per year on more advanced subjects, however, keeps the instructor fresh – and in a department of any size, this gives the students, at little extra cost, the valuable option of a minor, or even a major, in mathematics. It is hard to imagine an institution without such an option competing successfully for the best instructors, or the best students.

We can offer no solutions ourselves to Laurentian's financial woes, which are clearly all too real. It does seem, however, that by dropping mathematics (more than most other subjects) they are moving onto a dangerous course that will make it impossible to maintain, and difficult to recover, their current status.

Book Reviews bring 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)*



Connections in Discrete Mathematics

A Celebration of the Work of Ron Graham

Edited by S. Butler, J. Cooper, and G. Hurlbert
Cambridge University Press, 2018.
ISBN: 978-1316607886

Reviewed by Karl Dilcher

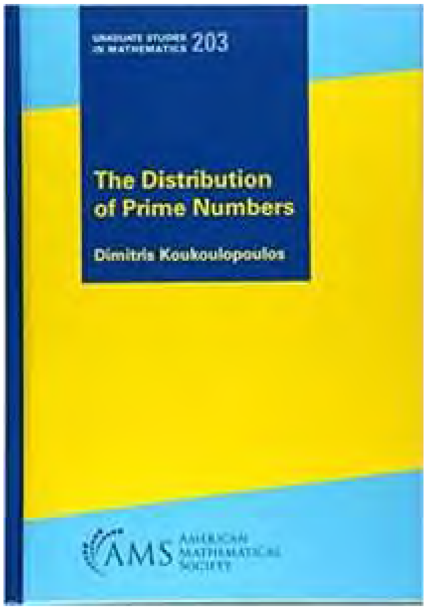
In 2020 the mathematical community lost three of the most influential and best-known researchers in Discrete Mathematics, namely Richard Guy in March, John Conway in April, and Ron Graham in July of that year. All three were well-known beyond the confines of their research areas, and even beyond mathematics.

The volume under review came out of a conference, called *Connections in Discrete Mathematics*, which was held in 2015 at Simon Fraser University, in honour of Ron Graham and at the occasion of his 80th birthday. To quote from the Preface: “This was a chance to bring together many of his friends and colleagues, the best and brightest in discrete mathematics, to celebrate Ron, and also to celebrate discrete mathematics. A major theme of the conference was connections, both the personal connections (as Ron had with so many speakers and participants) was well as the connections between mathematical topics. Both types of connections are what lead to advances in mathematics and open up new ideas for exploration.

“This book came out of the conference, with many of the authors having been featured speakers. The chapters here are across the spectrum of discrete mathematics, with topics in number theory, probability, graph theory, Ramsey theory, discrete geometry, algebraic combinatorics, and, of course, juggling. A beautiful mix of topics and also of writing styles, this book has something for everyone.”

I fully agree. The book is also handsomely produced, which is important – at least for me. I already tagged a few of the articles for reading in detail.

The 20 individual articles and their authors are as follows: *Probabilizing Fibonacci numbers*, by Persi Diaconis; *On the number of ON cells in cellular automata*, by N. J. A. Sloane; *Search for ultraflat polynomials with plus and minus one coefficients*, by Andrew Odlyzko; *Generalized Goncharov polynomials*, by Rudolph Lorenz, Salvatore Tringall and Catherine H. Yan; *The digraph drop polynomial*, by Fan Chung and Ron Graham; *Unramified graph covers of finite degree*, by Hau-Wen Huang and Wen-Ching Winnie Li; *The first function and its iterates*, by Carl Pomerance; *Erdős, Klarner, and the 3x+1 problem*, by Jeffrey C. Lagarias; *A short proof for an extension of the Erdős–Ko–Rado theorem*, by Peter Frankl and Andrey Kupavskii; *The Haight–Ruzsa method for sets with more differences than multiple sums*, by Melvyn B. Nathanson; *Dimension and cut vertices: An Application of Ramsey Theory*, by William T. Trotter, Bartosz Walczak and Ruidong Wang; *Recent results on partition regularity of infinite matrices*, by Neil Hindman; *Some remarks on pi*, by Christian Reiher, Vojtěch Rödl and Mathias Schacht; *Ramsey classes with closure operations*, by Jan Hubička and Jaroslav Nešetřil; *Borsuk and Ramsey type questions in Euclidean space*, by Peter Frankl, János Pach, Christian Reiher and Vojtěch Rödl; *Pick's theorem and sums of lattice points*, by Karl Levy and Melvyn B. Nathanson; *Apollonian ring packings*, by Adrian Bolt, Steve Butler and Espen Hovland; *Juggling and card shuffling meet mathematical fonts*, by Erik D. Demaine and Martin L. Demaine; *Randomly juggling backwards*, by Allen Knutson; *Explicit error bounds for lattice Edgeworth expansions*, by J. P. Buhler, A. C. Gamst, Ron Graham and Alfred W. Hales.



The Distribution of Prime Numbers
by Dimitris Koukoulopoulos
Graduate Studies in Mathematics 203, AMS, 2019
ISBN 978-1-4704-6285-7

Reviewed by Karl Dilcher

There is no shortage of books on analytic number theory, from advanced undergraduate textbooks to research monographs, and many of these books are excellent. At least one of them has the same title as the one under review, namely Ingham's classical treatise of 1932, reprinted in 1990.

Of course, there have been substantial advances since Ingham's book and most of the others were published, and it is one of the great strengths of Dimitris Koukoulopoulos's excellent book to make some of the recent spectacular results accessible in textbook form. The author is Professor of Mathematics at the Université de Montréal, and is therefore a member of the extremely strong and active Number Theory Group in Montréal.

Since this is a brief review, I will borrow freely from front and back matter of this book, beginning with the publisher's description: "Prime numbers have fascinated mathematicians since the time of Euclid. This book presents some of our best tools to capture the properties of these fundamental objects, beginning with the most basic notions of asymptotic estimates and arriving at the forefront of mathematical research. Detailed proofs of the recent spectacular advances on small and large gaps between primes are made accessible for the first time in textbook form. Some other highlights include an introduction to probabilistic methods, a detailed study of sieves, and elements of the theory of pretentious multiplicative functions leading to a proof of Linnik's theorem.

> *Throughout, the emphasis has been placed on explaining the main ideas rather than the most general results available. As a result, several methods are presented in terms of concrete examples that simplify technical details, and theorems are stated in a form that facilitates the understanding of their proof at the cost of sacrificing some generality. Each chapter concludes with numerous exercises of various levels of difficulty aimed to exemplify the material, as well as to expose the readers to more advanced topics and point them to further reading sources.*

As far as the goal and possible uses of this book are concerned, the Preface states,

> *The main goal of this book is to introduce beginning graduate students to analytic number theory. In addition, large parts of it are suitable for advanced undergraduate students with a good grasp of analytic techniques.*
>
> *The book borrows the structure of Davenport's masterpiece Multiplicative Number Theory with several short- to medium-length chapters. Each chapter is accompanied by various exercises. Some of them aim to exemplify the concepts discussed, while others are used to guide the students to self-discover certain more advanced topics.*
>
> *The contents of the book are naturally divided into six parts [...]. The first two parts study elementary and classical complex-analytic methods. They could thus serve as the manual for an introductory graduate course to analytic number theory. The last three parts of the book are devoted to the theory of sieves: Part 4 presents the basic elements of the theory of the small sieve, whereas Part 5 explores the method of bilinear sums and develops the large sieve. These techniques are then combined in Part 6 to study the spacing distribution of prime numbers and prove some of the recent spectacular results about small and large gaps between primes. Finally, Part 3 studies multiplicative functions and the anatomy of integers, and serves as a bridge between the complex-analytic and the more elementary theory of sieves. Topics from it could be presented either in the end of an introductory course to analytic number theory, or in the beginning of a more advanced course on sieves.*

The author then mentions that certain portions of the book can be used as a reference for an undergraduate course. The Preface also contains a list of the main results proven in the book, along with their prerequisites, from Chebyshev's and Mertens' estimates in the first few chapters, through the Prime Number Theorem, also quite early on, to the breakthrough of Zhang-Maynard-Tao about the existence of infinitely many bounded gaps between primes. The book then ends with recent work by Ford-Green-Konyagin-Tao and Maynard about large gaps between primes, and work by Maier from the 1980s about irregularities in the distribution of primes.

Let me finish by quoting from the end of an MAA review by Michael Berg (Loyola Marymount University):

> *It's clear that Koukoulopoulos had a marvelous time putting together this beautiful material, and producing a very readable and pedagogically sound text (replete with good exercises). The book is well-paced and reads very well. The careful reader, with pencil and paper in hand, keen to do exercises galore and have fun doing so, will learn a lot of beautiful number theory and find out marvels about the secret life of the set of primes: they are elusive but not unyielding.*

Laurestine Bradford (University of Toronto) and Yuveshen Mooroogen (University of Toronto) (University of Toronto)

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

Kseniya Garaschuk, *University of Fraser Valley (kseniya.garaschuk@ufv.ca)*

Introduction

The Canadian Undergraduate Mathematics Conference (CUMC) is an annual conference intended for undergraduate students of mathematics in universities across Canada. It is held each summer at a Canadian university and is organized by a local committee of undergraduate students at the host institution, with the support of the CMS Student Committee (Studc).

Any student attending the CUMC can choose to give a short talk, usually 25 minutes long, or present a poster at a poster session. These talks typically make up the greater part of the event.

In this article, we discuss what we consider to be the main benefits to students of participating in the CUMC. We also list actions that instructors can take to encourage their students to participate.

We hope that university instructors who read this note will encourage their students to attend. At the same time, we hope that high school instructors will see the value in an academic conference just for students, and find inspiration to plan similar activities.

Why have student conferences?

A mathematics undergraduate's playground.

We love it when students play with their math. We hope they will take the tools we give them and tinker around with them for fun, finding new little discoveries suiting their own tastes. One of the rare things about the CUMC is that it provides a perfect framework for students to show off the little discoveries they make when they play – be they weird facts about Pascal's Triangle, neat ways to draw tessellations, obscure proofs of classical theorems, or unexpected connections with their heritage. The most important thing about a CUMC presentation is that it be something the student thinks is cool. The stunning lack of *other* restrictions means that any of their fun math quirks is given time to shine.

At the same time, giving a presentation is more than tinkering around. It is a chance to take an idea and craft it into your own finished piece. The academic conference setting furnishes an implicit set of norms and goals towards which to work. Starting from this baseline, the student can pick and choose which conventions to adopt and which to flout. (Would it be more instructive to abandon a correct argument in favor of a flawed one? Would a particular idea make more sense if the audience were made to interact with it? Would sharing a craft project with the audience help them better appreciate a beautiful object?) Through this decision-making process, they build up something creative, and uniquely theirs: a work of art in their personal style.

Total ownership of a project.

As the presentations are not evaluated in any way, students are free of the usual constraint of having to guess an authority figure's expectations. This can give a real sense of power and control over one's engagement with the subject.

In addition, this freedom can help a student figure out *what* they like in the first place. As students decide what they might enjoy working on later in life, they may want to draw inspiration from work they've been intensely interested in. A CUMC presentation is a good opportunity to feel out potential research or professional interests in a low-stakes setting.

Moreover, other students' presentations are windows into what excites *them*. An attendee gets introduced to new problems and applications they might not encounter in their classes. It's wonderful to see people present on something that they really enjoy, and this can remind jaded students of the many reasons to love and be excited by math.

Undergraduate students are the target community.

Although the CUMC is a busy event complete with keynote lectures, a poster session, and workshops, it fundamentally remains a student event. Thus, whatever the level of an undergraduate student, they belong to the target audience: they are meant to understand what's going on, it's easier to feel like their questions are legitimate, and there is less pressure to fit in with some far more experienced group. In this way, the student gets to have a taste of what conferences are like while engaging with an environment designed to support them.

The event also gives students the chance to network with other junior mathematicians from across Canada. They spend a few days immersed in the conference, getting to know other math students and finding a broader community than just their own university. They also might connect with someone sharing more of their interests than anyone in their own department.

This sense of belonging to a community can also come from the nature of the conference as recurring every year. One can consult with older students who have attended the conference before, and after attending, one can advise younger students who are thinking of going. This can provide a cross-generational connection between math students.

Finally, having something tangible that they've created can help a student feel more connected to the mathematical community as a whole.

Encouraging students to participate

Tell students about the CUMC as early as possible.

It is easier to prepare a presentation when you have plenty of time and no need to rush. A longer period of time leading up to the conference also gives students the chance to talk about it with their peers and coordinate: groups of friends can travel together, and students who intend on giving talks can rehearse them together.

Help students find presentation topics.

Selecting a suitable presentation topic can be difficult. This is perhaps especially true for first-time presenters, who may not know what a typical student talk is like. (Some titles and abstracts from previous years' conferences are available on the CUMC website, which might help students get a sense of the range of possibility.)

Last summer, the second author helped organize a set of workshops to assist students in preparing talks for the CUMC. In a casual survey during the workshops, 18 students indicated that they might be interested in preparing a talk. In the end, 8 of them ended up speaking at the conference. Of the 10 students who did not give a presentation, 5 remarked in conversation that they were not presenting because they had not been able to settle on a presentation topic with which they were satisfied.

If a student brings up a question or an idea to you and you think that it could be turned into a good presentation – encourage them to do so! It is also well-worth reminding students that almost anything mathematics-related can make for a great CUMC talk. This includes, but is certainly not limited to:

- highlights from an undergraduate research project;
- classical problems: just as a demonstration of a famous phenomenon in physics, chemistry, or biology is always fun to watch, a good CUMC presentation can be one that reminds the audience of a famous and interesting mathematical idea;
- anything a student has read or watched, and thinks is exciting;
- intersections of mathematics with other disciplines: mathematical chemistry, mathematics education, ethnomathematics, and mathematical linguistics are all examples of more applied or interdisciplinary topics from recent CUMC presentations.

Provide funding if possible.

Participating in the CUMC typically requires paying for travel, housing, and food, as well as a conference registration fee. Let your students know if your department can sponsor them.

Note: This year's conference will likely be online, so the cost of attending will be lower than usual.

Avoid scheduling problem sets or tests during the week of the conference.

Students can only attend the conference if they have the time to go. If you are teaching summer courses, try to keep the week of the conference free from problem sets and exams if possible.

Encourage students to attend even if they won't be presenting.

It's not mandatory to give a talk to attend the CUMC. Listening to other students' talks is a lot of fun, as is immersing oneself in a conference environment for a few days. There are also keynote lectures, panels, workshops, and social events. Many students will get a lot out of attending the conference even if they do not present any work. They may even be inspired to present at a future CUMC. So, if students can spare the time and money, encourage them to attend the conference anyway.

Recruit help from experienced students.

Invite students who have given presentations before to advise current students. This could be done, for example, through small-group feedback sessions, where presenters can practice their talks in front of a smaller audience. Graduate students, postdocs, and professors who are good at giving and critiquing talks might also want to chime in.

Conclusion

There are many ways by which instructors can help students find the confidence and the resources to attend a student conference. We hope that by implementing some of the above suggestions, the reader will be able to motivate more of their students to participate in this rewarding endeavour.

The 2021 CUMC is organized by Western University. More information is available at the official conference website and on the poster below.

Figure 2: A poster for the 2021 CUMC, to be held at Western University. [1]

Yuveshen (Yuve) Mooroogen recently completed his undergraduate degree at the University of Toronto, and will begin his master's studies in mathematics at the University of British Columbia this fall. He is interested in functional analysis and math education. Yuve was a student presenter at the CUMC in 2019 and 2020.

Laurestine (Lola) Bradford is a master's student in the Department of Linguistics at the University of Toronto, where she also completed a bachelor's degree in Mathematics and Philosophy. Lola has long been involved in math outreach and education, and she hopes to study what language and math can say about each other. Lola was a student presenter at the CUMC in 2020

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[2] Munroe, Randall. 'Math Paper.' (2008). xkcd. 14 April. Retrieved from https://xkcd.com/410/ May 5th, 2021.

The Ethics of Ancient Mathematics: The Case of Claudius Ptolemy

CSHPM Notes June 2021 (Vol. 53, No. 3)

Jacqueline Feke (University of Waterloo)

CSHPM Notes bring 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 (aackerbe@verizon.net)*
Hardy Grant, *York University [retired] (hardygrant@yahoo.com)*

Ptolemy, the 2nd-century mathematician, is remembered most for his astronomy. He composed the *Almagest*, a thirteen-book treatise comprised of astronomical models and tables that explain the movements of the stars and planets and predict where any celestial body will be on any given date. The *Almagest* was so influential that it eclipsed the astronomical texts that preceded it and became authoritative. In medieval Islam and Renaissance Europe, mathematicians studied it as the premier text in astronomy.

Although astronomy was first in importance for Ptolemy, it was just one of the mathematical sciences he studied. He also composed texts on harmonics and geography, for instance, and he approached these fields in a mathematical way. He additionally studied what were then considered physical sciences, including element theory, cosmology, and astrology, but most of his contributions were in the mathematical sciences.

Why was Ptolemy so dedicated to the study of the mathematical sciences? Today many of us take for granted that mathematics and the mathematical sciences are worthy of study, but the high-level study of mathematics was rare in antiquity. At any given time in the ancient Mediterranean, at most a few dozen individuals pursued it. Moreover, we have no evidence of mathematical schools at least until the 4th century CE. Much more common was the study of philosophy, especially in the traditions established by Plato and Aristotle. Advanced mathematics, then, was not an obvious choice, and it is reasonable to ask why anyone would devote his or her life to its study.

I argue in my book, *Ptolemy's Philosophy: Mathematics as a Way of Life*, that the answer to why Ptolemy devoted his life to the mathematical sciences lies in his philosophy [1]. Scattered among his more technical discussions in the mathematical and physical sciences are references to a fully developed and unique philosophical system. He engages with the most fundamental areas of philosophy—metaphysics, epistemology, and ethics—and he even makes claims that would have been highly controversial at the time.

What most motivates Ptolemy's study of mathematics is his ethics, his theory of what it means to be excellent and live the best life possible. He adapts a type of ethical commitment endorsed by Plato, where the principal goal of life is to be as much as possible like the gods. Even though Plato and Ptolemy were Greek, the idea is not to be like any of the Olympian gods we are familiar with from Greek mythology. Instead, the goal is to emulate the divine, where the divine is anything that is eternal. For Ptolemy, the divine entities we specifically are meant to emulate reside in the heavens. In ancient Greek cosmology, a spherical Earth lies at the center of the cosmos and is surrounded by a series of spheres, on which are situated the stars and planets. The cosmos, from the Moon outwards to the sphere of fixed stars, is the heavens.

Figure 1. The cover of *Ptolemy's Philosophy: Mathematics as a Way of Life*. Provided by the author.

What makes Ptolemy's ethical theory different from those of Plato and his other predecessors is how mathematical it is. For Ptolemy, the ethical exemplars are not the stars and planets, or even the heavenly spheres themselves. Rather, the exemplars are specifically the movements and configurations of the stars and planets. We can begin to glean what mathematical objects Ptolemy has in mind from his definition of mathematics in the first chapter of the *Almagest*. He lists a number of objects which are the subject matter of mathematics, including movements from place to place, shape, number, size, place, and time. Astronomy, in particular, studies the movements of the stars and planets.

What about these movements is meant to be emulated? Ptolemy indicates that certain qualities of these movements are exemplary. He explains near the beginning of the *Almagest*:

> With regard to virtuous conduct in actions and character, [mathematics], above all, could make clearsighted men; from the constancy, good order, commensurability, and calm that are contemplated in the case of the divine, it, on the one hand, makes its followers lovers of this divine beauty, and, on the other hand, accustoms and, as it were, reforms their natures to a similar state of the soul [2].

By studying the stars and planets, the mathematician becomes aware of certain qualities of their movements and configurations: their constancy, good order, commensurability, and calm. In ancient philosophy of mathematics, the first three are specifically mathematical terms. In Ptolemy's ethics, one is meant to transform one's soul, the very essence of a person, so that it has these same mathematical qualities. The best condition of the soul, therefore, is mathematical. We are our best selves when we ourselves have the properties of divine mathematical objects. By modeling our souls after the movements and configurations of the celestial bodies, we become as much as possible like the divine.

Ptolemy also discusses his ethics in the *Harmonics*, his treatise on music theory. In the final chapters, he explores how the arithmetic ratios that define the relations among musical pitches exist in the heavens and in human souls. He defines the science of harmonics in a way that is particularly illuminating:

> The theoretical science of [harmonia] is a form of mathematics, the [form] concerned with the ratios of differences between things that are heard, this [form] itself contributing to the good order that arises out of the theory and understanding to people habituated in it [3].

There isn't only one mathematical science that can lead to the ethical transformation of the soul. In addition to astronomy, harmonics can put one's soul in good order. What is interesting in this quote is that Ptolemy indicates that harmonics is not simply a theoretical area of inquiry. It is something that people do; people become habituated to it. In the case of harmonics, one does not simply study the ratios; one furthermore creates them on musical instruments, especially the monochord, which allows for the more precise measurement and creation of musical relations. The term 'habit', however, indicates that there is more to doing harmonics than playing musical pitches, since it was a keyword in ancient virtue ethics. The habit that mathematicians acquire in doing harmonics is to act in a well-ordered way not just when studying harmonics and the other mathematical sciences, but also when engaging in the ordinary affairs of life. As the quote from the *Almagest* indicates, the study of the mathematical sciences transforms one's soul so that one's conduct in general becomes virtuous, or excellent.

How does Ptolemy's ethics relate to the work of today's mathematicians? Perhaps it invites us to explore why we choose to study mathematics and what is involved in its study. Why did you decide to study mathematics? Do you admire the content of mathematics, as Ptolemy loved the divine beauty of the movements and configurations of the stars and planets? What habits have you acquired in studying mathematics? How does its study affect your engagement in the ordinary affairs of life? Ptolemy thought deeply about these sorts of questions, and perhaps we should, too.

Jacqueline Feke is an associate professor in the Department of Philosophy at the University of Waterloo. Her research examines the history, philosophy, and rhetoric of the ancient mathematical and physical sciences.

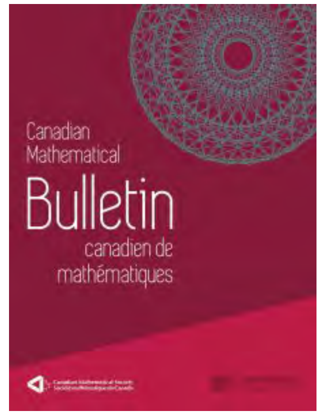
References

[1] Feke, Jacqueline. (2018) *Ptolemy's Philosophy: Mathematics as a Way of Life.* Princeton University Press.

[2] Ptolemy, *Almagest* 1.1, H7. Translation by the author.

[3] Ptolemy, *Harmonics* 3.4, D94-5. Translation by the author.

2022 CJM/CMB Associate Editors



The Publications Committee of the CMS solicits nominations for Associate Editors for the *Canadian Journal of Mathematics* (CJM) and the *Canadian Mathematical Bulletin* (CMB). The appointment will be for five years beginning January 1, 2022. There are eight associate editors on the CJM/CMB Editorial Board whose mandates are ending at the end of December.

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

Expressions of interest should include your curriculum vitae and your cover letter and sent electronically to: cjmcmb-ednom-2021@cms.math.ca **before September 15, 2021.**

The CMS Research Committee is inviting nominations for three research prizes. These prizes are intended to recognize members of the Canadian mathematical community.

Coxeter-James Prize

The **Coxeter-James Prize** recognizes young mathematicians who have made outstanding contributions to mathematical research. The recipient shall be a member of the Canadian mathematical community. Nominations may be made up to ten years from the candidate's Ph.D. A nomination can be updated and will remain active for a second year unless the original nomination is made in the tenth year from the candidate's Ph.D. The selected candidate will deliver the prize lecture at the 2022 Winter Meeting.

Jeffery Williams Prize

The **Jeffery-Williams Prize** recognizes mathematicians who have made outstanding and sustained contributions to mathematical research. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for three years. The prize lecture will be delivered at the 2022 Summer Meeting.

Krieger-Nelson Prize

The **Krieger-Nelson Prize** recognizes outstanding research by a female mathematician. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for two years. The selected candidate will deliver the prize lecture at the 2022 Summer Meeting.

CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues for research in the mathematical sciences regardless of race, gender, ethnicity or sexual orientation. A candidate can be nominated for more than one research prize in the applicable categories; several candidates from the same institution can be nominated for the same research prize.

CMS research prizes are gender-neutral, except for the Krieger-Nelson prize, which is awarded to women only. Nominations of eligible women for the general research prizes in addition to the Krieger-Nelson Prize are strongly encouraged.

Nomination Requirements

The deadline for nominations, including at least three letters of reference, is **September 30, 2021**. Nomination letters should list the chosen referees and include a recent curriculum vitae for the nominee. Some arms-length referees are strongly encouraged. **New: the nominator most include a full citation of approximately 500 to 700 words.** Nominations and the reference letters from the chosen referees should be submitted electronically, preferably in PDF format, to the corresponding email address and **no later than September 30, 2021**:

Coxeter-James: cjprize@cms.math.ca

Jeffery-Williams: jwprize@cms.math.ca

Krieger-Nelson: knprize@cms.math.ca

2022 Cathleen Synge Morawetz Prize

Nominations are invited for the 2022 **Cathleen Synge Morawetz Prize** for an author(s) of an outstanding research publication. A series of closely related publications can be considered if they are clearly connected and focused on the same topic. The recipient(s) shall be a member of or have close ties to the Canadian mathematical community, and will receive a commemorative plaque.

The Cathleen Synge Morawetz Prize will be awarded according to the following 6-year rotation of subject areas:

1. Geometry and Topology *(2027, and every six years thereafter)*,
2. Combinatorics, Discrete mathematics, Logic and foundations, and Mathematical Aspects of Computer Science *(2022 , and every six years thereafter)*,
3. Applied mathematics, including but not limited to Numerical Analysis and Scientific Computing, Control Theory and Optimization, and Applications of Mathematics in Science and Technology *(2023, and every six years thereafter)*,
4. Probability and Mathematical Physics *(2024, and every six years thereafter)*,
5. Algebra, Number theory, Algebraic geometry (2025, and every six years thereafter),
6. Analysis and Dynamical systems *(2026, and every six years thereafter)*.

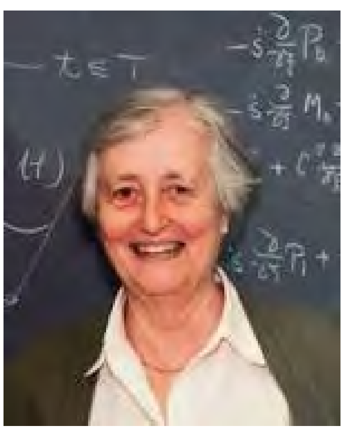
All of the above fields will be understood most broadly, to ensure that any outstanding publication can be considered under at least one of the categories. A paper (or a series of papers) which has significantly impacted more than one of the listed fields can be nominated more than once in the six-year rotation. The nomination must focus on a single topic, rather than a broad body of work by the nominee.

This call for nominations is for an author(s) of a publication or a series of closely related publications in the field of Combinatorics, Discrete Mathematics, Logic and Foundations, and Mathematical Aspects of Computer Science.

CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues for research in the mathematical sciences regardless of race, gender, ethnicity or sexual orientation.

The nomination letter should highlight the research paper(s) being nominated, providing evidence of its impact and significance. The nomination letter should list the chosen referees, and should include a recent curriculum vitae of the nominee(s), if available. Up to three reference letters in support of the nomination should be sent directly to the CMS. All documents should be submitted electronically, preferably in PDF format and **no later than September 30, 2021**, to **csmprize@cms.math.ca**.

About the Award



The prize was established in 2020 in honour of Cathleen Synge Morawetz (1923-2017), to reflect the remarkable breadth and influence of her research achievements in pure and applied mathematics. Professor Morawetz completed her undergraduate studies at the University of Toronto. She was encouraged to pursue a PhD in Mathematics by Cecilia Krieger (of Krieger-Nelson Prize). She went to MIT for a master's degree, and then got her PhD at NYU, where she would spend the bulk of her career, becoming the director of Courant Institute in 1984. Her main research contributions were in the field of partial differential equations. Cathleen Synge Morawetz was a recipient of the Jeffery-Williams Prize in 1984 (the only woman to win the Prize up to date), the National Medal of Science (1998), the Leroy P. Steele Prize for Lifetime Achievement (2004) and the George David Birkhoff Prize in Applied Mathematics (2006). Through its explicit rotation among subject areas, this prize highlights the enormous spectrum of research in the Canadian mathematical sciences community.

The Canadian Mathematical Society (CMS) invites nomination for the 2022 **David Borwein Distinguished Career Award**. This prize recognizes mathematicians who have made exceptional, broad, and continued contributions to Canadian mathematics and is awarded every four years.

The award presentation will take place at the CMS Winter Meeting in December 2022 and a plenary lecture given by the recipient.

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 more 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.

CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues regardless of race, gender, ethnicity or sexual orientation.

The complete nomination and all documentation should be submitted electronically, preferably in PDF format, **no later than November 15, 2021**, to **dbaward@cms.math.ca**.

2018 David Borwein Distinguished Career Award Recipient

Anthony To-Ming Lau
University of Alberta

Prof. Lau is the most recent recipient of the award. Please read the Media Release. For a list of past recipients and to read their citations, please visit the official David Borwein Distinguished Award page.

2021 Endowment Grants

The Canadian Mathematical Society is pleased to announce the ***2021 Endowment Grants Competition***. The CMS Endowment Grants fund projects that contribute to the broader good of the mathematical community. Projects funded by the Endowment Grants must be consistent with the interests of the CMS: to promote the advancement, discovery, learning and application of mathematics.

An applicant may be involved in only one proposal per competition as a principal applicant. Proposals must come from CMS members, or, if joint, at least one principal applicant must be a CMS member.

The deadline for applications is **September 30, 2021.** Successful applicants will be informed in January 2022 and the grants issued in February 2022.

Further details about the endowment grants and the **application process are available on the CMS website here**.

The Endowment Grants Committee (EGC) administers the distribution of the grants and adjudicates proposals for projects. The EGC welcomes questions or suggestions you may have on the program. Please contact the Committee by e-mail at chair-egc@cms.math.ca.

2022 CMS Math Competition Grants

The CMS is now accepting applications for the ***2022 CMS Math Competition Grants*** program. The CMS supports activities that promote the learning of mathematics among Canadian youth. In addition to the Society's math competitions, the CMS offers math competition grants for activities at the elementary and secondary school levels.

The deadline for submissions is **November 15, 2021**. Successful applicants will be informed in January 2022 and the grants issued in February 2022.

Further details and guidelines about the math competitions grants and the **application process are available on the CMS website here**.

The Committee on Grants for Provincial Competitions (CGPC) adjudicates proposals for support. Should you have further questions or comments, please contact the Committee by e-mail at **chair-grants-pc@cms.math.ca**

Applications should be submitted electronically using the online application form and additional documents preferably in PDF format, **no later than November 15, 2021** to **mathgrants@cms.math.ca**.


Canadian Mathematical Society
Société mathématique du Canada
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Canadian Mathematical Society
Société mathématique du Canada

CMS MEETINGS

WINTER 2021

Vancouver, British Columbia - Sheraton Wall Centre - December 3-6

SUMMER 2022

St. John's, Newfoundland - Memorial University - June 3-7

WINTER 2022

Toronto, Ontario - December 2-5

SUMMER 2023

Halifax, Nova Scotia - June 2-5

WINTER 2023

Montreal, Quebec - Hilton Double Tree - December 1-4

SUMMER 2024

Saskatoon, Regina, University of Saskatoon - June 2-5

The Canadian Mathematical Society (CMS) welcomes and invites session proposals and mini-course proposals for the 2021 CMS Winter Meeting held in Vancouver on **December 3-6.**

Call for Sessions

Proposals should include

1. names, affiliations, and contact information for two (or more) session co-organizers,
2. a title and brief description of the focus and purpose of the session,
3. a preliminary list of potential speakers with their affiliations and if they have agreed to participate, along with a total number of expected speakers.

Sessions will take place December 4, 5, and 6. Sessions will be advertised in the *CMS Notes*, on the website and in the *AMS Notices*. Speakers will be requested to submit abstracts, which will be published on the website and in the meeting program. Those wishing to organize a session should send a proposal to the Scientific directors and copy the CMS office. Potential organizers are encouraged to consider diversity in their selection of session invitees.

Proposals should be submitted by **May 30, 2021.**

Call for Mini-Courses

The CMS is organizing three-hour mini-courses to add more value to meetings and make them attractive for students and researchers to attend.
The Mini-courses will be held on Friday afternoon, December 3rd, before the public lecture, and include topics suitable for graduate students, postdocs and other interested parties.

Proposals should include names, affiliations, and contact information for all the mini-course organizers and title and brief description of the focus of the mini-course.

Scientific Directors:

Nils Bruin (Simon Fraser University) nbruin@sfu.ca
Nilima Nigam (Simon Fraser University) nigam@math.sfu.ca

CMS Office: meetings@cms.math.ca

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Alfonso Gracia-Saz

Alfonso Gracia-Saz was a very well-loved and innovative professor at University of Toronto who was due to receive the 2021 Excellence in Teaching Award from the Canadian Mathematical Society. He passed away on May 6, 2021 in Toronto.

Alfonso was born in Zaragoza, Spain, in 1976. His love of mathematics and physics was clear from a young age. He competed in the 1993 and 1994 International Physics Olympiads, earning an honourable mention in the second year. In 1994, he also won the Spanish Physics Olympiad. He went to the University of Zaragoza for his undergraduate education, earning a BSc in Mathematics in 2000 and a BSc in Physics in 2001. He won the Primer Premio Extraordinario Fin de Carrera, an award granted yearly by the Ministry of Education to the top student in each major. Remarkably, he won it in two subjects: mathematics in 2000 and for physics the next year.

In 2001, Alfonso moved to the United States for a PhD in Mathematics at UC Berkeley, where his advisor was Alan Weinstein. While in Berkeley, he made many friends with his unique blend of whimsy and seriousness. Alfonso had a habit of touching people's noses as a greeting (instead of handshakes). A friend's officemate took offence to this practice, leading to an evening visit from the Berkeley Police. Alfonso was extremely generous and loyal to his friends. Once, he lent a fellow student thousands of dollars to help support him during his final PhD year. While in Berkeley, he also volunteered as an instructor for the Prison University Project at San Quentin State Prison (now Mount Tamalpais College).

He completed the PhD in 2006; his thesis was titled "the symbol of a function of an operator" and concerned computations in deformation quantization. He moved on to postdoc at Keio University in Japan (2006-2007) and then at the University of Toronto (2007-2010). During these postdocs, his research focus changed and he began studying Lie algebroids and multiple vector bundles, working with collaborators Kirill Mackenzie and Rajan Mehta.

After these postdoc positions, Alfonso moved to a career in teaching, first at the University of Victoria (2010-2013) and then at the University of Toronto in 2013, as a teaching-stream professor. Alfonso compared this move to teaching to coming out as gay: in both cases he was defying expectations, and in both cases making this public brought an enormous sense of relief.

He took on some of the most challenging teaching assignments at the University of Toronto. For many years, he coordinated MAT137 (Calculus with proofs), a course with over 1000 students, 7 instructors, and dozens of TAs. Alfonso brought an inverted classroom and active learning approach to this course. He created a video library with over 200 video lectures for students to watch before class, so that class time could be devoted to working on carefully prepared activities. These videos have been extremely popular with Toronto students and beyond, with over 3 million views. This year, working with Beatriz Navarro Lameda (a former PhD student and MAT137 instructor), he prepared extensive notes on these activities so that they could be easily used by other instructors.

As course coordinator and as a service to the University, Alfonso played a central role in training incoming instructors and TAs. He also always had a regular group of undergraduate and graduate students who worked as TAs with him and whom he mentored through formal class observations or chats in the hallway. Some of these undergraduate students were not intending on majoring in math when they took MAT137, but under Alfonso's influence, they fell in love with math and with teaching.

Alfonso's love for teaching mathematics led him to become a long time staff member at Mathcamp (2003-2017), an intensive summer camp for mathematically talented high school students. At Mathcamp, Alfonso was a teacher, mentor, and friend to countless campers and staff. His contributions to Mathcamp were incalculable, from leading a staff workshop on inquiry-based learning, to improving the system for running relays, to orchestrating the best April Fool's prank in Mathcamp's history. His nose touching greeting even became a regular part of Mathcamp for more than a decade.

Throughout all these activities, Alfonso was passionate, principled, and caring. Alfonso's passion was evident in his legendary classroom teaching, where he inspired students. In committee meetings, Alfonso had a strong sense of justice and always pushed for what he believed was right. When a colleague was being mistreated, or his students weren't being given the resources they needed to learn, Alfonso always stood up for them. He pushed the university very hard to develop a more robust academic integrity system. When it came to his students, he was a self-described "Momma Bear". If a student was caught cheating, he would meet with them and set them back on the correct path. Alfonso always gave his best and brought out the best in his students and colleagues.

Alfonso died in hospital, a week after receiving a COVID-19 diagnosis. He leaves behind his beloved partner of six years, Nick Remedios. Alfonso and Nick enjoyed contra dancing, complex board games, and cooking together. In Spain, Alfonso is mourned by his mother, Carmen; his father, Antonio; his sister, Rebeca, and her children, Mario and Carla. All around the world, he is mourned by his many friends and the many people whom he taught and inspired.

A scholarship fund has been set up in Alfonso's memory. The scholarship will be used to fund undergraduate mathematics students at University of Toronto. To contribute, please visit the website.

CMS Notes

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