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October 2021 : Vol. 53, No. 5

CMS NOTES 75 1945-2020

No Pressure, No Diamonds

Cover Article October 2021 (Vol. 53, No. 5)

Tim L. Alderson (University of New Brunswick)
VP Atlantic

I am not what one would consider a writer of prose, so when asked to write a cover article for the Notes, there was some trepidation. I sit here as August fades, pondering what issues might concern the CMS membership, or the mathematical community. My perspective is that of a Professor, a Department Chair, and a researcher.

Front of mind of course is the pandemic, the variants, and their inevitable influence on the approaching fall term. Though there is much to be apprehensive about as we prepare to meet our first in-person fall term since 2019, the eternal optimist in me thinks of the positives that have grown out of our recent collective experiences.

For myself, like all faculty and educators across the country, the past year and a half has been one of professional development born of necessity. Many of my colleagues have become Teams/Zoom aficionados – have learned how to use (and troubleshoot) various technological tools of the trade, completed Beamer slides and videos for courses. Many of us have developed resources, skills, and materials, which can serve us well for years to come. Personally, I am glad to have finally updated our WeBWorK server, which had a good workout over this past year. I also enjoyed the efficiency of online meetings, although I did miss the usual post-meeting banter and occasional communal doughnuts.

One unique characteristic of Mathematics is that it builds on the past. In many ways, our courses serve as a litmus test for the successes and failures of the past year's learning modes. 2020/21 carried with it a seemingly infinite echoing of concerns regarding academic integrity. For those returning students who may have taken shortcuts during online studies, the return to in-person classes and assessment, may prove challenging at first, but I am confident that in short order, students will adjust to in-person learning again, and come to appreciate its many advantages.

For the fresh incoming cohort, many of whom may have fallen behind, the return to in-person learning will certainly add to math anxiety which always exists, pandemic or no. They need not worry however, as these students will have direct face-to-face access to their professors, teaching assistants, and Math Help Centre tutors. Access to these resources may lie in such stark contrast to the recent past that these resources will hopefully be embraced by many students who have not utilized them in the past. Here, and on campuses across Canada, I believe we are ready – after all, it is what we do best.

Casting departmental matters aside, and putting on my mathematician hat, I must admit that I am quite optimistic about what we have seen grow out of our global struggles over the past 18 months:

- **The ability to attend multiple conferences on different continents.**
  Living in Saint John, travel invariably involves several "hops" to get to conference destinations. It was simply fantastic to be able to attend three conferences in 10 days this past summer. There were no hotels or flights to book, no layovers, and no stacks of receipts and travel claim documents (the bane of my conference travel) to process afterward.
- **The ability for graduate students, under-funded researchers, and others in visa-restricted countries to attend and participate.**
  During one of the international conferences I attended this summer, I spoke with a bright young PhD. student from Iran. She was thrilled to be attending several conferences this year that were previously impossible for her to join in person because of travel costs and due to various other logistics. I am quite certain that many other researchers have had the opportunity to present research at more meetings than ever before. In some ways, the pandemic has served as the great leveler. For that I am grateful.
- **Who says it's not easy being green?**
  There can be no doubt that there is a lower carbon footprint offered by virtual meetings. Through the online ICAO Carbon Emissions Calculator, I learned that the CO_2 emissions for the relatively short flight from home (Saint John) to Toronto, amounts to 250kg. This gives me one feel good moment for each virtual conference attended.

As incoming VP Atlantic, my first official meetings and email threads had much dedicated to discussions on how to conduct the Winter 2021 meeting, and to some extent all future meetings. As mentioned above, there are indeed benefits to virtual meetings. Moreover, holding future meetings exclusively in person could disadvantage those from countries with low rates of vaccination. Not only might these participants be vulnerable to infection if they chose to travel without full immunization, but some would quite possibly face travel restrictions due to lack of immunization documentation.

This still leaves it far from easy for the CMS to determine the format for the upcoming meetings. Indeed, many would agree that there are significant drawbacks to online meetings, including screen-time fatigue, and time zone scheduling conflicts. Collectively though, we agree that the greatest drawback is a seeming absence of networking opportunities.

The online format makes connecting graduate students with other members of their network, who might one day serve as mentors or collaborators, a significant challenge in many online conference platforms. On the other hand, some early-career mathematicians (especially those with introverted personalities) might find it less intimidating to ask questions during virtual sessions, and may be more inclined to reach out to new people. Bah! Dichotomy after dichotomy, and no clear (to me at least) application of Occam's razor.

So, the IRL vs. URL debate continues. In some sense it would be a lost opportunity to rise from this challenging time just to go straight back to the old way of doing things. In the meantime, the CMS Executive has decided to proceed with a virtual Winter 2021 meeting. What will future CMS meetings.

CMS NOTES

The Numbers are Looking Good

Editorial October 2021 (Vol. 53, No. 5)

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

In the September issue, I wrote that "most Canadian universities are not requiring vaccination for faculty or students who want to be on campus in the fall." I'm glad to say that that line was out of date by the time the issue hit the stands. Many universities across the country have followed Seneca College's example and moved to a robust vaccine mandate, often well beyond anything required by provincial goverments. In some cases, university administrations took the lead; just as often, lobbying by student unions and faculty unions seems to have been the trigger.

Saint Mary's University (and this seems to be a fairly common story) is now requiring vaccination, with twice-weekly testing as the only alternative. I don't want to minimize the difficulty of implementing such policies. Universities have had, at short notice, to interface with many countries' disparate vaccination systems, and to set up timelines that (on the one hand) are fair to all and (on the other hand) will protect everybody. Vaccinations are being provided on campus for those still needing them; hundreds of individuals appear to have taken advantage of this.

Is it working? The university has set up a check-in system, and are publicly tracking vaccination numbers on campus. Yesterday, a goodly 93% of the people on campus were fully vaccinated; with numbers like these, we can have confidence that the term will proceed with some semblance of normality for most of us. Not everybody is so lucky; we have some foreign students who have been unable to travel, who will have to take what courses they can online. But, for a large majority of students, this year should be far more normal. And news coverage suggests that we're not atypical: that most Canadian universities are taking vaccination and other pandemic precautions seriously.

I'm writing this in September. When you read it, you will know whether I have been overoptimistic or not. But, right now — the numbers are looking good for many universities.

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Growing Pains: Becoming a University Student

Education Notes October 2021 (Vol. 53, No. 5)

Andrijana Burazin (University of Toronto Mississauga), Veselin Jungic (Simon Fraser University), and Miroslav Lovric (McMaster University)

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.

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

The COVID pandemic has magnified many of the challenges that universities have been facing for quite some time. Although administrators and instructors might rank these challenges differently, they will agree that the concerns about the psychological and personal well-being of their students and faculty top the list.

Post-secondary institutions have developed strategies and created resources in an effort to help their students (for instance, by hiring additional wellness and mental health counselors). We believe that such efforts will have positive effects on some of their students' overall well-being. However, there remains an obvious, but hard, question to answer: What is it in an incoming undergraduate student's life that may negatively affect their motivation, cause frustration, stress, and anxiety, and jeopardize their academic success?

Needless to say, we are not in the position to provide a comprehensive answer to this question. Instead, based on our experiences in working with thousands of students over many years, and supported by research (see, for instance, [1, 2]), we suggest a component that could shed some light onto it. Our premise is that a number of challenges that novice undergraduate students face are related to, or exacerbated by, the expectations that they successfully navigate through academic and non-academic situations which require a certain level of emotional, cognitive, and/or psychosocial maturity (*maturity*, for short).

In our view, recognizing that the process of increasing maturity is an important part of becoming a university student is an step forward. Why? Because *we can help* our students (and we have been doing it, routinely) to better manage their own abilities and overall potential in the university setting, and thus help them to respond to their academic and non-academic challenges in more adequate, appropriate, and satisfying ways.

What do we mean by *maturity*? Researchers in education have conceptualized the transition from high school to university using the anthropological notion of the *rite of passage* [3,4]. A rite of passage involves events in an individual's life (such as the birth of a child, graduation, or entering a spousal relationship), where their customary life routines are disrupted or distorted, thus creating a "life crisis." With the help of their community, and through an experiential and/or learning process (which could, and often does, take a long time), the individual makes necessary modifications to their life routines to overcome the "crisis." As a result, they become more mature, with an enhanced understanding of themselves and the world around them, and thus, better prepared to face future challenges.

Incoming university students, typically in their late teenage years, enter their institution with a set of habits and expectations brought from, and affected by, their high school education, family and other personal and societal experiences. The forces of the rite of passage into becoming university students disrupt many of these habits and expectations, and this is, in our view, a significant cause of growing pains, anxiety, and frustration that our students experience.

To illustrate what this disruption brings in, we mention two common scenarios.

We need to iterate that at a university, the final course grade is calculated based on the course outline, written before the course starts, and agreed upon by students, instructors, and the institution. However, some students are surprised that their requests to "boost" their grade (for instance, by completing extra work) are flat out rejected, in order to ensure equity and fairness of the course assessment.

Some of our first-year students are not prepared to accept the post-secondary culture of a strict academic integrity conduct. Unlike high school, the sanctions for cheating in university may be severe even for the first offence, and could range from a mark of zero, to a failed course grade, or even suspension.

The rite of passage to university demands a mature approach to a real struggle, or to an anticipation of challenges when students question their ability to negotiate them successfully. Instead of accepting it as a necessary step in their learning process and an integral part of growing up, students dread – what they deem is – a failure. Not facing it earlier in life or school (due to, for example, "helicoptering" by their teachers and parents), they feel paralyzed by a failed test or a low course grade. This inability to effectively face real, or anticipated, failure and to move on, or not reacting quickly enough at the signs of a problem and postponing until it's too late, are in our view, a significant cause of students' distress. Instead of proactively reacting to the first signs of trouble, or attempting to learn from their mistakes, some students are quick to blame their instructors.

We have seen students, including those who are committed, hardworking and academically capable, experiencing serious crises. There may be many reasons for this: from the pressure to obtain good grades, to overestimating their abilities by signing up for a larger than manageable course load, to not knowing how to study effectively, to the

pursuit of a subject that really does not resonate with them. On top, often unknown to their instructors, students might be dealing with financial problems, or with a break-up in their family or in their relationship, or with a serious illness or death of someone close to them; they might be saying that they are depressed, or silently suffering from a (learning) disability or possibly not even being aware of it; or they might be experiencing boredom and loneliness due to the lack of meaningful social contacts.

Anthropology teaches us that a rite of passage can succeed only when the individual undergoing it is supported by their community (by seeing its member in crisis, the entire community is in crisis and needs to react). But who constitutes this community in our students' transition to university?

Students frequently turn to their instructors, who they see for 3 to 4 hours a week, for help and assistance with both academic and non-academic challenges. One of the reasons is that the "system" (e.g., student support, mental health, or wellness programs and assistance), students say, is often too slow to respond, or too complicated to navigate [5]. Thus, we, the course instructors, must become a part of that community, even though we are not trained nor equipped to handle many of the challenges that our students face. We are also aware (or fear) that, if we do not respond to a student's plea or concerns, academic or not, and something happens, we may be held liable for not taking the necessary steps to prevent it. Not to mention how such an event would affect us mentally and otherwise.

These days, university is expected to be that "community" that will guide students through their rite of passage, and even beyond. Universities are becoming all-inclusive spaces whose mission is to address a wide diversity of students' needs, from academic, to mental and physical health, to social interactions, and beyond. Universities regulate their students' relationships and sexual behaviour, give advice about recreational substance use, provide social spaces (e.g. student clubs), offer financial advice and support, create safe environments, and so on. The proverbial village that is supposed to raise a child seems to have shrunk to the boundaries of a university campus.

University instructors have realized that teaching their beloved subject only does not suffice to help their students reach the next stage of their professional and personal lives. To support students' psychological and personal well-being, the instructor needs to find the means to guide their students on their path to maturity. Sometimes this includes causing growing pains, by insisting on high academic standards. Sometimes the instructor needs to become a surrogate life-coach, in an effort to educate and support students in dealing with issues that are well outside of a course curriculum.

Acting responsibly and effectively dealing with challenges takes time, thought, energy, and experience. As we work through these challenges, we learn and become more serious and prepared, that is, more mature. This is why, in our opinion, it is crucial that university instructors persuade their first-year students that completing a university degree is not a race. It is important to spend time figuring things out (including figuring out who we are!), when we are unsure of what our next step should be. A good first step is to spend time to mature and to grow up.

Andie Burazin is a passionate university mathematics educator at University of Toronto Mississauga who enjoys supporting students and instructors in any capacity. You might catch her watching sports, or travelling somewhere.

Veselin Jungić is a Teaching Professor at the Department of Mathematics, Simon Fraser University and the coordinator of the Math Catcher Outreach Program.

Miroslav Lovrić is a professor in the Department of Mathematics and Statistics at McMaster University. In spite of his age, or maybe because of it, he is still very passionate about teaching and everything teaching related.

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CMS NOTES 75 1945–2020

Hidden Mathematics

CSHPM Notes October 2021 (Vol. 53, No. 5)

Duncan K. Melville (St. Lawrence University)

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)*

Where does the historian of mathematics turn for sources? There is the published record, where authors typically present a definitive view of their research at that stage of their intellectual journey. Such public documents allow for tracing both individual and social developments of mathematics. But we see only what the authors wish to show the public.

Behind the published works may be an archive or *Nachlass*. Here the historian can find drafts, diaries, notebooks, scribbled calculations, correspondence: the unpublished artefacts that may enable a finer, more detailed understanding of the author's intellectual journey, the false starts, the explorations before the public unveiling of the final product. But then there is the question of curation. We see what was chosen to be retained by the principals or their executors.

What does the historian seek? If mathematics is viewed as part of intellectual history, then the historian seeks novelty. What new ideas, theorems, definitions did the subject produce? What is new must then be explained both internally and in terms of its context and significance. Those who did not contribute significantly to the development of mathematics in this narrative become marginalized.

Significance depends on what the historian seeks. If we aim to understand the place of mathematics in a culture, perhaps we should study mathematics education. Who learned mathematics, what did they learn, how did they learn it, where did they learn it, and who was left out? In this case, much of the published record is in the form of textbooks, although these must be evaluated judiciously. Not every student studies, let alone retains, all the material in a text. Much of the history of mathematics education focuses on institutions, since it is the schools, universities, and academies that record and preserve their records. Studies of an individual's education are more difficult to accomplish and rely on the random survival of the kinds of ephemera most people (or their executors) discard. At a deeper level is the question of what the mathematics they learned actually meant to people — how did they perceive and respond to it?

These pathways to history assume the historian has a research agenda. Armed with questions, the historian turns to particular kinds of resources to find answers, or at least a fuller understanding and maybe better questions. Often, however, archives contain hidden gems and sometimes they throw up something completely unexpected, surprise source material that provokes its own questions.

I have had this experience myself. Rummaging around in the catalogue of the National Archives at Kew one day, I stumbled across an entry for a "treatise on mathematics" from the early 19th century by a female author I had never heard of. I yield to no one in my ignorance, but further research revealed that she was completely unknown to the history of mathematics. No questions we had asked and no answers we had sought had ever unearthed her. Such finds are archival gold. I was intrigued. Who was this woman? Why did she care about mathematics? What had she done? How had it lain undiscovered for two hundred years?

Figure 1. Rachael Frances Antonina Lee, sculpted by John Bacon the Younger, c. 1820 The Metropolitan Museum of Art.

Please allow me to introduce Rachael Frances Antonina Lee (née Dashwood) (1774–1829) and her mathematics. She was an intelligent, forceful and somewhat eccentric woman, who unfortunately attracted notoriety. RFA, as we shall call her, was the illegitimate daughter of Francis Dashwood, Baron Le Despencer, one of the most illustrious rakes in 18th-century England, a period that had no shortage of claimants to the title. At various times he was friend of the Prince of Wales, Chancellor of the Exchequer, devotee of the arts, and reviser of the *Book of Common Prayer* with Benjamin Franklin. He died when his daughter was six.

Dashwood left his children, RFA and her older brother Francis, well provided for. Her mother remarried, and the children were packed off to school, Francis to Eton, and RFA to an upscale convent, the Abbaye Royale de Panthémont in Paris, until its closure in 1789. Presumably, she was mostly educated in the accomplishments suitable to her class.

Back in England, the teenage RFA attempted relationships with several young men, but these suitors were rejected by her mother as insufficiently eligible. Eventually, she eloped to Scotland with Matthew Lee, whose only redeeming feature was his extreme good looks. The marriage was a disaster and the couple soon separated, although it took the lawyers two years to sort out the financial arrangements. RFA was now in a socially anomalous position and her circle contracted. Worse was to come. Ten years later, she was at the center of a sensational abduction-and-rape case. The tabloid press of the era recounted every salacious detail with their customary disregard for veracity. The subsequent trial of her abductor collapsed on a technicality and RFA's reputation was in ruins. She rarely appeared in public again.

RFA thenceforth lived a secluded and peripatetic life. She studied, read, and wrote incessantly. Her main interests seem to have been theology and philology, especially of ancient languages. The high spot was the publication of the first edition of her *Essay on Government* in 1808, shortly after her estranged husband committed suicide. At around the age of forty, she turned her pen to mathematics.

Over a period of some ten years, RFA produced three drafts of a proposed 'Course of Mathematics', an unfinished and unpublished textbook of some 300 pages that covered the standard curriculum of school mathematics. Topics included the geometry of lines and circles, select extracts from Euclid, arithmetic, algebra, fractions both common and decimal, proportions, the rule of three, and the extraction of roots. RFA disclaimed much originality in the basic mathematical content. As she wrote in her preface, "In the following Course of Mathematics, many of the Laws and principles above defined previously discovered and established must necessarily be introduced. This is the Case with all Works of a similar kind." She did, however, argue that the arrangement and presentation of the results was "the result of profound meditation" and derived from "a deep investigation into the properties of Numbers."

Figure 2. A page from RFA's first draft. Provided by the author.

Figure 3. The title page of RFA's second draft. Provided by the author.

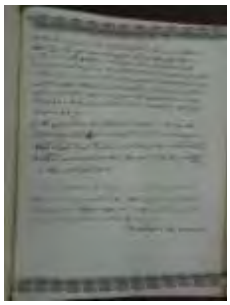

Figure 4. A page from the fair copy third draft, including a note by the copyist with date and signature in Hebrew. Provided by the author.

It is in the arrangement and presentation that RFA displays her originality in her engagement with mathematics and her mathematical philosophy or metaphysics. Declaring that mathematics begins with the notion of extension and motion of a point, she placed geometry before arithmetic, "The first and most simple idea connected with the mathematics appears to be Extension, because if there were no extension, there could not be length, breadth, and height." Numbers require division, and division presupposes the existence of something to divide, therefore extension is the more primitive concept: "Extension may therefore rationally be denominated the primary and most simple idea connected with mathematics; Extension is produced from Motion from which lines are generated."

For RFA, mathematics was grounded in a physical, Newtonian world, therefore, "motion has a tendency to be circular" due to the actions of a projectile force and perpendicular force of gravity. Thus, from a consideration of the natural world, we have lines, right angles, diagonals, and circles.

What of numbers? Taking the Biblical stance that, "All the mysteries of Nature are founded on the principle that every thing was created in number, weight, and measure," RFA began with the notion of unity, "The idea of Unity is the first which arises in tracing the origin of number." Given addition, "It is evident that all numbers, from Unity, to the most complicated are in reality produced by the addition of Unity, to which they are as one, because it is the source of them." Apart from this mechanical production, numbers, at least the first few, have metaphysical properties; "The Dual or the Number 2 is the principle of Creation in Substance; the number 3 is produced from the Unity and Dual; this is the mystical Triune which not only the Nazarenes, but also many of the ancient Philosophers particular among the Easterns, acknowledged; no other number can, in a literal metaphysical sense exist per se." Numbers beyond three are largely arbitrary.

What were her sources? Whence came her mathematics and her sense of the overall shape and significance of it? We do not know. When she wanted to learn Hebrew, she hired a tutor. Mathematics sprang forth fully formed. There is no record of any mathematics education, either institutional or with a private tutor. Her recent biographer makes but a passing mention of mathematics, implying she studied alone [2]. She could have learned the mathematical content on her own from books. For instance, by 1820 she possessed a copy of Charles Hutton's *Course of Mathematics*, which was first published in 1798 and quickly went through numerous revisions, but it is not clear which edition she had nor when she acquired it. Her style and presentation are distinctive, and clearly in her own voice (she was addicted to footnotes).

The work was never finished and never published. We know of it only through a singular accident of history. She died alone, suddenly and unexpectedly in her room in the hotel in which she was staying. She had no will and no heirs, but she was wealthy. The state swooped in and claimed everything, including every scrap of paper she had. These fill 75 boxes in the National Archives at Kew, England [1].

How unusual was she? It certainly *appears* unusual that a woman in the early years of the 19th century would have sufficient education and interest in mathematics to pursue writing a 300-page manuscript not once but through three drafts. Without the actions of the state, we would have no hint of RFA's extensive engagement with mathematics. How much other mathematics lies hidden from our usual sources?

Duncan J. Melville is a historian of mathematics and the Martha E. '62 and Gregg E. Peterson Professor of Mathematics at St. Lawrence University. Recent publications include "Computation in Early Mesopotamia," in A.Volkov and V. Freiman (eds.) Computations and Computing Devices in Mathematics Education Before the Advent of Electronic Calculators, *Springer, 2018, and "John Marsh and the Curious World of Decimal Arithmetic," in Maria Zack and Dirk Schlimm (eds.),* Research in History and Philosophy of Mathematics, *The CSHPM 2017 Annual Meeting in Toronto, Ontario, Birkhäuser, 2018, 23–42.*

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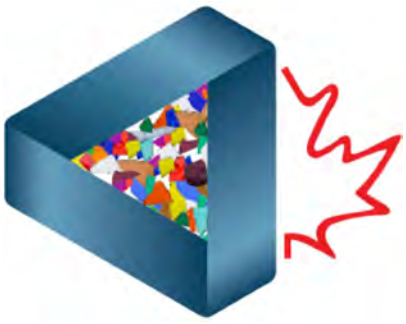
Connecting Women in Math Across Canada Workshop An effective on-line networking conference

CMS NOTES

MOSAIC

October 2021 (Vol. 53, No. 5)

Karen Meagher (University of Regina)



MOSAIC, Outreach, Society, Accessibility, and Inclusiveness Column is directed by the CMS EDI committee and touches upon issues concerning equity, diversity, and inclusion in mathematics. Comments, suggestions and submissions are welcome.

Steven Rayan (he/him), University of Saskatchewan (rayan@math.usask.ca)

On June 2nd and 3rd the CMS Women in Math Committee organized, along with two local organizers, Dr. Campbell and Dr. Moura, the 6th Connecting Women in Math Across Canada (CWiMAC) Workshop. This is a workshop aimed at young female-identified researchers in mathematics, with the primary goals of building research and support networks and developing professional skills.

As a PhD student, I attended the first CWiMAC in 2003. It was a valuable experience for me and I wanted to make sure the next generation had the same opportunity. One aspect of this workshop that was particularly effective is that it was held in the days before the CMS summer meeting. In the smaller CWiMAC workshop, we quickly made connections with the other researchers. Once these connections were made, it was much easier to meet more people at the larger CMS meeting and to become part of the mathematics community.

The Planning

The original plan for this workshop, first put in to motion in October 2019, was to have the CWiMAC in person in the days before the CMS 75th anniversary in Ottawa. As this was scheduled for the ill-fated summer of 2020, it did not happen as planned! First the CMS delayed the 75th anniversary meeting by a year, so we did the same with the CWiMAC; next, the CMS announced the meeting would be entirely on-line, so we also did the same.

Once we had committed to an all on-line event the main concern was how to build networks when we would be spread across the country and only able to see each other in those tiny little Zoom windows we have now spent too much time in! But we felt that building community was even more important after all being so separated during the pandemic lock downs. Graduate school can be a stressful and lonely experience for students at the best of times; experiencing this while not being able to leave your home could be unbearable!

Beyond the isolation, parents were trying to do their classes and research with children out of school or care, and many of us were attempting to care for elderly parents at a distance. There are many studies and reports on how women have been more adversely affected by the pandemic, as these care-giving duties disproportionately go to women. This was another reason why we felt it was so important to hold the CWiMAC, despite not being able to meet in person.

The Event

The first event was a talk by Dr. Anita Layton, the Canada 150 Chair in Mathematical Biology and Medicine, University of Waterloo. Dr. Layton gave a very personal presentation about her own struggles with the networking aspects of her career. She gave very sympathetic advice on how to embrace this potentially uncomfortable, but very necessary skill to advance our careers. Half way through the talk, we used the breakout rooms feature of Zoom to practicee giving an "Elevator Speech". So in just a few minutes the students in the breakout rooms had to outline their research and career plans. This also ensured that every student talked in a smaller group and got us started on networking.

Alexandra McSween, President of the AWM student chapter and Women in Math Club at the University of Ottawa, gave a presentation on the history of Women in Math. This was a very engaging talk that introduced many different topics. After this presentation we met using the platform GatherTown to discuss the many issues that came up in Alexandra's presentation. (Special thanks to Dr. Erin Meger for setting up a lovely space in which we could virtually wander and have conversations.) This was surprisingly effective, as participants could talk in larger groups if they wanted, or move off to speak privately if they preferred. This room was available for the entire meeting and it worked well for networking.

On the second day of the workshop, Dr. Gerda de Vries, University of Alberta, gave a presentation on how to give effective math talks. This was followed by research talks from five early career researchers. This was an important part of the workshop, since we are trying to build research networks. The students had only a short time for their presentations, despite this the talks were really great, I was impressed at how accessible they were.

We also had two panel discussions. One on how to move your career to the next stage, and the other on coping during Covid.

Take-Aways

There were definitely some advantages to doing the event on-line. Everything was much cheaper, no travel expenses or coffee to pay for. The organizers didn't have to do some of the tedious tasks involved in planning an event, like ordering food or booking rooms. Parents of young children didn't have to find childcare (and the children in the background of some presentations were pretty cute, at least for those in the audience!). Our attendance was record-breaking and we had people from all across Canada and also from many different countries. In the future we will definitely do other events on-line. Perhaps the impact is less with an on-line event, as it is hard to be personal over Zoom.

It was challenging to organize this event, since at each point we had no idea what to expect. We had to think about how to reorganize once it was clear the workshop would be on-line. We also had to learn how to host an event on-line, both the technical and the social aspects had to be worked out. It was a steep learning curve, but now we know better what we are doing! Beyond this, the organizing committee, like everyone, was struggling with working from home and often with children in the room—hopefully this will not happen again.

In future events I think we should have more student panels. More seasoned academics need to know what concerns and challenges students face! We also found that breaking into smaller groups worked well to get conversations started and to allow more people to talk. This is something we will do more with future on-line events. In retrospect our focus was too much on academic careers, so we will look to have more involvement with mathematicians in industry. At an on-line event we are not restricted by geography, we can invite people from all over the world without concern for the travel costs and hassle, so in future events we will work to have more diversity in the panelists and speakers. There was a strong interest from the graduate students in getting advice on how to find a work-life balance and having a family and a career, so this will be a topic (hopefully with sound advice) at future events.

The Next Event

The next event the CMS WIM committee is planning comes straight out of a suggestion from an attendee at CWiMAC. Next summer we will have an on-line event focused on how to get a job. The goal will be to develop skills like how write a strong research statement, what to expect at a job interview and how to assemble a strong application package. Announcements for this workshop will come out closer to the date. The CMS WIM will be looking for volunteers to help with this event!

Final Note

One final note, is that almost the entire CMS WIM committee changed while this event was planned, and then re-planned. The organizers of the CWiMAC were: Lucy Campbell, Carleton University, Ailana Fraser, University of British Columbia, Matilde Lalín, Université de Montreal, Karen Meagher, University of Regina, and Lucia Moura, University of Ottawa. I just want to say that it was an excellent experience to organize an event with such awesome women!

We are grateful for the funding that we received from PIMS and the Fields Institute, also for the funding that was offered from AARMS and CRM that was not needed in the end.

Here are some of the feedback we received from participants:

"Women, along with other SOGIESC minorities, have been disproportionately affected by the pandemic. Thus, it was an uplifting experience to be a part of the coming together of women mathematicians in Canada, not only to talk about Mathematics, but also to check on each other, and discuss the unprecedented impact of CoVid-19 to women at large. Events like CWiMAC 2021 that serve as safe spaces for women, as well as avenues for women to express solidarity for other women, are always a step in the right direction."

Hermie Monterde
Graduate student, University of Manitoba

"CWiMAC was a really fantastic experience for me. It came at a time when I was nearly finishing my MSc after working at home alone for over a year so it was especially valuable to me to be able to connect with other women. I've managed to stay in contact with many of the women I met there and I'm really thankful I got to meet them! I thought that GatherTown worked really well and I had a couple really great spur of the moment conversations in there, much like an in person setting."

Alexandra McSween
Graduate student, University of Ottawa

"The workshop was excellent. Having such a diverse group of women across career stages was very beneficial. As an early career researcher who was on the job market at the time of the conference, it was very useful getting advice not that wasn't restricted to only career balance. Discussing mathematics with women feels much safer to bring forward my ideas, it feels easier to make big outlandish claims and work together to prove them -- the collaboration and support mathematically is very different from a general conference. It was great to talk about the struggles in the mathematics itself, and learn how to be a better researcher from the perspective of women."

Erin Meger
Post-Doctoral Researcher, LACIM

Karen Meagher is a full professor in the Department of Mathematics and Statistics at the University of Regina and the Chair of the CMS Women in Math Committee. My research area is in discrete math, focusing on algebraic graph theory and extremal problems in combinatorics.

CMS NOTES

2022 David Borwein Distinguished Career Award

Calls for Nominations October 2021 (Vol. 53, No. 5)

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.

2022 Excellence in Teaching Award

Calls for Nominations October 2021 (Vol. 53, No. 5)

The CMS Excellence in Teaching Award Selection Committee invites nominations for the **2022 Excellence in Teaching Award**.

The **Excellence in Teaching Award** focuses on the recipient's proven excellence as a teacher at the undergraduate level, including at universities, colleges and cégeps, as exemplified by unusual effectiveness in the classroom and/or commitment and dedication to teaching and to students. The dossier should provide evidence of the effectiveness and impact of the nominee's teaching. The prize recognizes sustained and distinguished contributions in teaching at the post-secondary undergraduate level at a Canadian institution. Only full-time teachers or professors who have been at their institution for at least five years will be considered. The nomination will remain active for three years, with a possibility to update.

The 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.

A nomination will consist of:

- a signed nominating statement from a present or past colleague, or collaborator (no more than three pages) having direct knowledge of the nominee's contribution;
- a curriculum vitae (maximum five pages);
- three letters of support, at least one from a former student (who has followed a course more than a year ago) and one from the chair of the nominee's unit. The letter of the Chair of the nominee's unit could include a one-page summary on information from student evaluations, or similar information;
- other supporting material (maximum 10 pages).

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, 2021**.

2021 Excellence in Teaching Award Recipient

Alfonso Gracia-Saz
University of Toronto

Dr. Gracia-Saz is the most recent recipient of the award. For a list of past recipients and to read their citations, please visit the official Excellence in Teaching Award page.

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**.

CMS NOTES

Competitions October 2021 (Vol. 53, No. 5)

June 3-6, 2022, St. John's, Newfoundland

The Canadian Mathematical Society (CMS) welcomes and invites session proposals and mini course proposals for the 2022 CMS Summer Meeting in St. John's from **June 3-6, 2022**.

CALL FOR SESSIONS

Proposals should include (1) names, affiliations, and contact information for all session co-organizers, (2) 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 June 4-6. 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 and copy the CMS office. Those submitting proposals are encouraged to pay attention to the diversity of both the session invitees and the proposed session organizers.

Proposals should be submitted by **January 31, 2022.**

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, June 3, 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 co-organizers and title and brief description of the focus of the mini course

Scientific Directors:

Chunhua Ou (Memorial)
Marco Merkli (Memorial)

CMS Office:

meetings@cms.math.ca

SAVE THE DATE

Canadian Mathematical Society
Société mathématique du Canada

WINTER 2021

Online Meeting - December 2-7

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, Saskatchewan, University of Saskatoon - June 2-5

CMS MEETINGS

CMS NOTES 75 1945-2020

The Solitude of the Twin Primes

Contributed Articles October 2021 (Vol. 53, No. 5)

Renzo A. Piccinini

Over the past twelve or so years, two books have taken the Italian literary scene by storm: "L'amica geniale" ("My brilliant friend") by Elena Ferrante and "La solitudine dei numeri primi" ("The solitude of the prime numbers") by Paolo Giordano.
I read the first book while spending a month in a Tuscan vineyard close to San Gimignano. The protagonists of this novel are two girls, Lila and Len, who live in a neighbourhood of Naples, that had been impoverished long before the war. Lila is a brilliant, excellent student, who dreams of becoming a writer and escaping poverty, while Lenù tries to keep up with her friend, to no avail. The book ultimately became a tetralogy, which was made into an acclaimed television series produced by HBO and RAI. Elena Ferrante's identity is unclear; apparently it is the pseudonym of a writer who wants to safeguard his or her privacy.

On the other hand, "La solitudine dei numeri primi" is the story of two young people, Alice and Mattia, each with serious personal problems, who connect and disconnect romantically over the course of their lives, two similar souls who are nonetheless unable to establish a more permanent relationship. Paolo Giordano wrote the book in 2008 while finishing a Ph.D. thesis in Physics at the University of Turin. The book was a tremendous success, quickly selling more than a million copies, earning the author the prestigious "Strega" Literary prize, and was made into a full-length movie. Actually, the original title of Paolo Giordano's book was "Dentro e fuori l'acqua" (Inside and outside the water); the title "La solitudine dei numeri primi" was suggested by Antonio Franchini (editor of the Mondadori company, publisher of the book) as a sort of publicity stunt. I found the title of Giordano's book quite intriguing: what does it mean to say that "prime numbers are *solitary* "? Yes, Alice and Mattia could come as close as possible, but never get together; to my taste that sounded more like twin primes rather than just primes. While pondering the question I came across a video on YouTube featuring my friend Piergiorgio Odifreddi delivering a talk at the University of Turin, in which he tries to give a mathematical definition of "solitary primes" inspired by the title of Giordano's book.

The Greek mathematician and philosopher Euclid (also known as Euclid of Alexandria) lived in Alexandria around the year 300BC; he wrote a collection of 13 books entitled "Elements", largely a compilation of results by other earlier mathematicians. There we find a proof of the existence of infinitely many prime numbers and a proof of the *Fundamental Theorem of Arithmetic*, namely that any positive integer is a product of powers of prime numbers in a unique way except for ordering. So, we can say that primes are the building blocks of the whole number system.

Now Pythagoras of Samos enters. He was born in 570BC and knew a great deal about numbers and geometry. Pythagoras had several disciples, and together they formed a kind quasi-religious sect, whose members were supposed to guard with their lives the results they obtained. The Pythagoreans discovered (or at least knew) the "Pythagorean formula" for right triangles. The proof, easily illustrated with a picture, was already known to the Babylonians and Indians.

The Pythagoreans noticed that a triangle with sides of length 1 would have a hypotenuse of length $\sqrt{2}$. This was clearly not an integer, but was it a fraction? A member of the group named Hippasus found the proof by contradiction that $\sqrt{2}$ was not a rational number, a proof still taught today. Legend has it that this was not popular with the brethren, and Hippasus was invited to a journey on a boat, thrown overboard, and drowned. The number $\sqrt{2}$ is the first example of an *irrational number*.

Piergiorgio Odifreddi defines a set of numbers to be *solitary* if the series of its reciprocals is convergent. This definition is not empty: the powers of $2 form a solitary set. Take the sequence $G = \{2^n : n \in \mathbb{N}\}$; the series of its reciprocals $\sum_{n=0}^{\infty} 2^{-n} = 1 + 1/2 + 1/4 + 1/8 + \cdots$ is geometric with ratio $1/2$, hence sums to 2.

The classical example of a nontrivial divergent series is the *harmonic series* $\sum_{n=1}^{\infty} 1/n$. The name derives from the *harmonics* or *overtones* in music: the wavelengths of the harmonics of a vibrating string are $1, 1/2, 1/3, 1/4, \cdots$ of the string's fundamental wavelength. Pythagoras was active in this field. Although the Greeks certainly knew the harmonic series, it seems that the first convincing proof of its divergence was given by Nicholas Oresme (1325?–1382), Bishop of Lisieux in France. Oresme concentrated on those terms of the harmonic series whose denominator is a power of 2; he noticed that between $1/2^p$ and $1/2^{p+1}$ there are exactly 2^p factors; replacing each of these terms by $1/2^{p+1}$ and adding, we have $1/2$. Since the factors $1/(2^p + 1), \cdots 1/(2^{p+1}–1)$ are larger than $1/2^{p+1}$ their sum is larger than $1/2$. Let us give two examples:

$$(1/3 + 1/4) > (1/4 + 1/4) = 1/2;$$

$$(1/5 + 1/6 + 1/7 + 1/8) > (1/8 + 1/8 + 1/8 + 1/8) = 1/2.$$

Proceeding in this way, we conclude that the harmonic series summed from 1 to 2^n is larger than $1/2 + 1/2 + \cdots + 1/2 = n/2$. Since the latter series diverges as $n \to \infty$, so does the former. The manuscript with Oresme's proof was lost, but eventually it was reconstructed in the seventeenth century by Pietro Mengoli. As a result of this result (also still widely taught today!) the set of integers is not solitary according to Odifreddi's definition. In 1881 the mathematician C.W. Merrifield proved that the series of the reciprocals of prime numbers is divergent; his work was published in the Proceedings of the Royal Society of London, vol. 33 (1881-1882). Thus – alas! – neither are the prime numbers solitary.

Odifreddi, however, rather than abandon his definition, shifted his consideration to the *twin* primes: primes that come in pairs $\{p, p + 2\}$. It is not known if there are infinitely many such pairs, and the "twin prime conjecture" that there are is a longstanding and stubborn problem in number theory. As a step toward this, the Norwegian mathematician Viggo Brun (1885-1978) proved that the sum of the reciprocals of the twin primes is a constant $B = 1.90216054 \cdots$, known as the *Brun Constant*. His proof was published in the paper "La série [lates]\frac{1}{5} + \frac{1}{7} + \frac{1}{11} + \frac{1}{13} + \frac{1}{17}[/latex] + où les dénominateurs sont nombres premiers

jumeaux est convergente ou finie" , Bull.Sci. Math.,(2) 43, 1919, pages 100-104 and 124-128. The Brun constant B can be an irrational number only if there are infinitely many twin primes. In either case, this shows that twin primes are solitary, according to Odifreddi's definition.

As for the prime numbers themselves, a non-twin prime is called "isolated" (Richard L. Francis, "Isolated Primes", J. Rec. Math., 11 (1978), 17-22.) An easy corollary of Brun's result is that almost all prime numbers have this property. But we must concede that the title "The solitude of the prime numbers" suggested by Giordano's editor is a catchy one. Neither "The solitude of the twin prime numbers" nor "The isolation of most prime numbers" would be as good!

CMS NOTES

Remarks on David Borwein as PhD Supervisor

Obituaries October 2021 (Vol. 53, No. 5)

Bruce Watson (Memorial University)

On Sept. 3, with the death of David Borwein, the CMS lost one of its oldest and longest-serving members. He was president of the Society from 1985 to 1987; our Distinguished Career Award is named for him.

David was born in Lithuania in 1924. He did his graduate work at University College, London, a student of L.S. Bosanquet (and thus a grandstudent of G.H. Hardy.) His thesis was in summability theory, a subject in which he continued to work for many years, although he also did important work in (among other areas) measure theory, probability theory, number theory, and sinc integrals.

After a thirteen-year stint at Saint Andrew's University in Scotland, David moved to Canada and joined the mathematics department of the University of Western Ontario in 1963. Four years later he became head of the department, an appointment cut short twenty-two years later by mandatory retirement. During that time he served on many national and international committees.

His sons Jon and Peter, who, tragically, both predeceased him, were also well-known in the CMS. He is survived by his wife Bessie, his daughter Sarah, and a number of grandchildren and great-grandchildren. One of his graduate students, Bruce Watson, shares some personal reminiscences with us below.

Robert Dawson, Editor-in Chief

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David Borwein, who passed away on September 3, 2021 at the age of 97 was my PhD supervisor at Western University from 1970 to 1974. I have been asked to make a few remarks about my experience as his student. But there was rather more to our involvement than that. I was pleased to have David as an undergraduate (as well as graduate) lecturer, research collaborator and friend in addition to doctoral supervisor.

In 1968 I sat his fourth-year undergraduate course in Lebesgue Measure and Integration in R^n. His lecture notes, which he seemed to reproduce on the blackboard verbatim, were complete and appeared hand-written. I thought at the time that he must be planning to write a textbook. But, as far as I know, he never followed up. Years later, when I taught the same subject matter, I realized that he had made clever use of ordinate sets
rather than the more common simple function approach to measurability. This saved a lot of generalization when moving from R^1 to R^n.

The following year I registered for David's graduate course called "Introduction to Summability Theory." At that time, summability theory was David's main research area. And he used classical, as opposed to functional analytic, techniques. This course was a scary experience for the four graduate students registered. For starters, the textbook was G. H. Hardy's classic book "Divergent Series," which is not the easiest read. Then, the students did all the lecturing and the audience consisted not only of David, but of all faculty, visiting faculty and post-docs in the summability research group at Western. Each student felt considerable angst before and during his or her turn at the blackboard.

Following that year I asked, with some trepidation, if David would take me on as a doctoral student. He agreed, suggesting I apply to various sources for funding. At our initial meeting he mentioned that there were some tauberian questions involving the A_λ scale of summability methods that I could look at if I didn't have a problem picked out. I didn't. A_λ methods are examples of what are called power series methods. Without going into the definitions, A_0 is the ordinary Abel method discussed in some undergraduate analysis books. The Logarithmic method, L, is another power series method and it also played a role in my thesis. I have always admired David's 1957 paper "On methods of summability based on power series" *Proc. Royal Soc. Edinburgh*, **64**. David had been studying power series methods since the mid-1950s, developing their abelian properties. It was known, for example, for $\lambda > -1$ and $\varepsilon > 0$ that $A_{\lambda+\varepsilon} \subseteq A_\lambda \subseteq L$ and that the inclusions are strict. That is, any series summable to s by one method in the list is summable to s by any method to the right. A tauberian condition is an extra requirement which forces inclusion in the reverse direction.

To get me started, he gave me a few papers to read and suggested I look at some other results in the literature. David, in my experience, was a laissez-faire type of supervisor. Rather than having regular meetings, he expected me to make an appointment (he was department head at this time) whenever I had something to discuss.

During my second year into the program he gave me my introduction to undergraduate teaching from the instructor's point of view. He had a meeting conflict during his calculus lab and asked me to take it. I asked what I would have to do. "Nothing" he said. "Just answer a few questions. You might want to review what they are working on now." In the first minute or so I realized that Peter Borwein was registered for the class. "Don't screw up" I thought. "Otherwise, this is getting back to dad!"

I did get some early results for the thesis. But things dragged in the middle. The proof technique I had used for the $A\lambda$ scale did not work between $A\lambda$ and L. Plus, David knew I was addicted to playing bridge. Rather than sit me down for a stern talking-to, he invited me over to his house for a rubber bridge session. He and his other son, Jon, were both good players. Anyway, I eventually found another approach to the crucial step and finished the degree.

David and I collaborated on some papers in the days before LATEX. Before anything went to the typist (IBM Selectric) he insisted on hand-written pages which he would go through line-by-line with me. This was, I suspected, because of his low regard for my writing skills. But I think I did learn to be precise and, when possible, to be concise with written mathematics. Subsequently, I tried to remember his teachings with my own writing. I remember my time as his student as a turning point in my career. He gave me many life lessons, not all mathematical.

CMS Notes

The editors welcome articles, letters and announcements. Indicate the section chosen for your article, and send it to *CMS Notes* at the appropriate email address indicated above.

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