CMS NOTES de la SMC

MESSAGE FROM THE VICE-PRESIDENT - Western provinces

IN THIS ISSUE
DANS CE NUMÉRO

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On March 21, 2005, the Banff International Research Station (BIRS) was evaluated by an international panel of experts on behalf of four governments and their scientific agencies. A large international contingent of mathematical scientists including the Directors of AARMS, CRM, Fields and PIMS; the President of the Clay Institute, the Scientific Director of MITACS, as well as the Presidents of the CMS and Statistical Society of Canada, gathered to help make the case for BIRS. It did not surprise anyone who has participated in a BIRS activity that the evaluation was uniformly positive. It led to:

i) Full NSF funding at a significantly increased level of $2.64 million (US) for five years beginning in 2006.

ii) Increased funding from the Alberta Science and Research Authority (ASRA) to a level of $3.42 million for the five year period.

iii) A pledge of support from the National Council for Science and Technology of Mexico (CONACYT) for $.55 million over the five year period.

iv) an extension of NSERC's $.5 million Major Facilities Access (MFA) grant for one year to 2007.

Such levels of international funding are certainly unprecedented in Canadian mathematics. BIRS is a resource that the Canadian mathematical science community values highly, and one which may need our support at what appears to be a critical time in its development.

The reason for all the funding and support is that doing and communicating mathematics at BIRS is a stimulating and exciting experience. I had the opportunity to co-organize a 5-day workshop at BIRS in 2003, its first inaugural year.

The application process is relatively painless as it entails writing a short and convincing description of the science and workshop, and obtaining tentative commitments from some of the key participants. My own experience, and it appears to be a universal one, was that it is pretty easy to convince anyone on your wishlist to come and do mathematics in the Canadian Rockies.

The facilities do limit the conference size to about 40 participants, making them small enough for all participants to get acquainted. At the meeting itself, the onsite staff are so effective that organizers are actually able to enjoy, and participate in, their own meeting.

The application deadline for the 5-day workshops is Oct. 14, meaning that as you read this you have 10 months to prepare your submission for 2008. However, there are also weekend meetings, Focussed Research Groups (FRG) and Research in Teams Visits (RIT) for which applications can be made at any time, depending on availability. It is best to book at least 6 months in advance but if you can be flexible with timing, applications with 4 months lead time are also possible.

For weekend meetings there is no doubt that the local Alberta universities have a decided advantage, one that they surely deserve as their own provincial government is carrying over 1/3 of the ongoing costs. I am a bit reluctant to share information about the FRG and RIT with you as advertising them too widely will make it only harder to get one, and they are fabulous opportunities. RIT's are composed of 2-4 researchers meeting for 1 to 2 weeks to work on a problem in breath-taking surround-

continued page 15

Future Prospects for Computer-Assisted Mathematics

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Abstract

The recent rise of "computer-assisted" and "experimental" mathematics raises intriguing questions as to the future role of computation in mathematics. These results also draw into question the traditional distinctions that have been drawn between formal proof and computationally-assisted proof. This article explores these questions in the context of the growing consensus among computer technologists that Moore's Law is likely to continue unabated for quite some time into the future, producing hardware and software much more powerful than what is available today.

1 Introduction

Recent years have seen the flowering of what is often termed "computer-assisted" or "experimental" mathematics, namely the utilization of modern computer technology as an active tool in mathematical research. In particular, a combination of commercial software (notably *Mathematica and Maple*), online tools and custom-written computer programs are being used to test conjectures, discover new identities, perform symbolic manipulations, plot data and even conduct formal proofs.

With regards to computer technology, Moore's Law (the observation that computer technology doubles in aggregate power and capacity every 18 months or so) continues unabated, having defied numerous predictions that it will soon end (most recently the 100 nanometer "barrier"). At the present time, industry experts, including Gordon Moore himself, predict that it will continue for at least ten more years [1]. In fact, if some of the promising research in nanotechnology (the science of constructing devices and materials at the molecular level) comes to full flower, Moore's Law may well continue for many more years [18,pg 7-30]. For example, carbon nanotube-based memory devices, which promise to store ten times as much data as conventional devices, may be commercially available as early as 2006 [21]. In another development, researchers at Hewlett-Packard have fabricated "nano-imprint crossbar" devices with half-pitch feature spacing of only 17 nanometers, and plan to reduce this figure by a factor of four within two years [17][16].

If these projections are even partially realized, future computer systems will be many thousands of times more powerful than those being used today. See Figure 1, which plots history and future projections of high-end computer system performance, based on data from the Top500 list (a twice-yearly updated ranking of the world's most powerful computer systems). In this figure, 1 Gflop/s, 1 Tflop/s and 1 Pflop/s denote one billion, one trillion, and one quadrillion, respectively, floating-point operations per second.

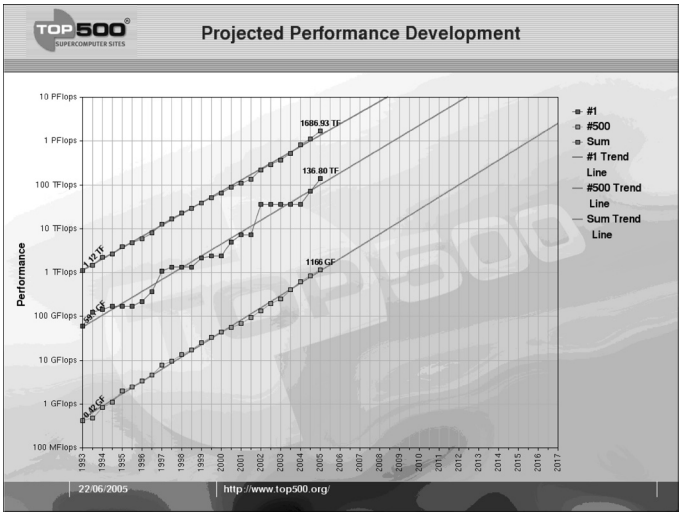

Figure 1: High-end computer performance projections.

These developments have led some mathematicians to wonder whether computers one day will be smarter at math than we are. But in many respects, they already are—*Mathematica* and *Maple* today routinely perform integrals and other types of manipulations that are well beyond what humans can reasonably do. What's more, they normally perform such manipulations without the errors that humans are prone to make.

In this article, we will briefly summarize a few examples of computational mathematics in action, and then consider some of the questions that these developments present to future mathematical research. Some additional examples may be found in [2][11].

2 A New Formula for Pi

Perhaps the best-known result to emerge from experimental mathematics so far is the discovery of a new formula for π (now known as the "BBP" formula) by a computer program in 1996 [5][11,pg 118-125]:

$$\pi = \sum_{k=0}^{\infty} \frac{1}{16^k}\left(\frac{4}{8k+1} - \frac{2}{8k+4} - \frac{1}{8k+5} - \frac{1}{8k+6}\right)$$

This formula has the remarkable property that it permits one to directly calculate binary or hexadecimal digits of π beginning at some position n, without needing to calculate any of the preceding digits. It was discovered by Peter Borwein (brother of Jonathan) and Simon Plouffe, using a computer program written by Bailey that implements Helaman Ferguson's "PSLQ" integer relation algorithm, using high-precision arithmetic (200 digits in this case). An integer relation algorithm is

one that, given n real numbers $(x_1, x_2, \ldots, x_n)$, finds n integers $(a_1, a_2, \ldots, a_n)$, if they exist, such that $a_1 x_1 + a_2 x_2 + \ldots + a_n x_n = 0$ to within available numeric precision.

In a surprising development, it was recently found that the existence of the BBP formula has an intriguing connection to the question of whether or not the binary digits of π are "normal" (statistically random in a certain sense). In particular, it was found that the question of normality of π reduces to the question of whether a certain iteration is a uniform random number generator in the unit interval [8][9][11,pg 148-156]. This line of research is still being actively investigated.

Numerous other formulas and related results of this general type have now been discovered, using this same methodology, namely a combination of integer relation algorithms and high-precision numerical computations. Here is just a brief sample:

$$\pi^2 = \frac{2}{27}\sum_{k=0}^{\infty}\frac{1}{729^k}\left[\frac{243}{(12k+1)^2} - \frac{405}{(12k+2)^2} - \frac{81}{(12k+4)^2} - \frac{27}{(12k+5)^2} - \frac{72}{(12k+6)^2} - \frac{9}{(12k+7)^2} - \frac{9}{(12k+8)^2} - \frac{5}{(12k+10)^2} + \frac{1}{(12k+11)^2}\right]$$

$$\zeta(8) = \frac{36\cdot 64}{1373}\left[\sum_{k=1}^{\infty}\frac{1}{k^8\binom{2k}{k}} + \frac{9}{4}\sum_{k=1}^{\infty}\frac{1}{k^4\binom{2k}{k}}\sum_{j=1}^{k-1}\frac{1}{j^4} + \frac{3}{2}\sum_{k=1}^{\infty}\frac{1}{k^2\binom{2k}{k}}\sum_{j=1}^{k-1}\frac{1}{j^4}\right]$$

$$\frac{25}{2}\log\left[\frac{781}{256}\left(\frac{57-5\sqrt{5}}{57+5\sqrt{5}}\right)^{\sqrt{5}}\right] = \sum_{k=0}^{\infty}\frac{1}{5^{5k}}\left(\frac{5}{5k+2} + \frac{1}{5k+3}\right).$$

Most of these results have been obtained using very modest computational platforms, typically just a personal computer or workstation, and have involved numeric precision levels of only 100 to 500 digits. However, one such computation required 50,000-digit arithmetic and a 64-CPU parallel computer system to obtain the result [7]. This raises the intriguing question of how many more such formulas will be found when computers many thousands of times more powerful are available.

The computational cost of integer relation detection, using the PSLQ algorithm, grows as roughly n^3, where n is of the number of terms in the relation (in particular, the number of iterations required grows at this rate). When we further take into account the additional numeric precision required to resolve relations when n is large, we obtain a cost that grows as roughly $n^4 \log n$. Today we can usually find integer relations involving 100 terms, typically requiring 5,000-digit precision or so, in a few hours' run time on a personal computer or workstation. Given the $n^4 \log n$ scaling of the computational cost, extending the reach of these methods to say n=1000 seems truly formidable. Yet such power will be available, even in a personal computer, by roughly the year 2020, even assuming no improvement in the underlying integer relation algorithms. If we assume that faster algorithms will be found (which seems very likely), then we may well be able to routinely solve such problems much sooner. Employing highly parallel computer technology will further accelerate this timetable.

3 High-Precision Computations

As we mentioned in the previous section, high-precision numerical computations are a key part of the process of discovering new mathematical identities using integer relation methods. But these same high-precision computations can also be used to verify a relation once it has been discovered by any means, whether by experimental computations or conjectural reasoning.

For example, recently some new techniques have been found to evaluate the numerical value of integrals to very high accuracy (hundreds or thousands of digits), even, in many cases, for functions with singularities [12,pg 306-314]. In one application of these techniques, the present authors established that the relation

$$\frac{24}{7\sqrt{7}}\int_{\pi/3}^{\pi/2}\log\left|\frac{\tan t+\sqrt{7}}{\tan t-\sqrt{7}}\right|dt \stackrel{?}{=} \sum_{n=0}^{\infty}\left[\frac{1}{(7n+1)^s} + \frac{1}{(7n+2)^s} + \frac{1}{(7n+3)^s} + \frac{1}{(7n+4)^s} + \frac{1}{(7n+5)^s} + \frac{1}{(7n+6)^s}\right],$$

which arises in quantum physics, holds to 20,000-digit accuracy (note that the integral has a nasty singularity at $t = \tan^{-1}\sqrt{7}$). This calculation required 46 minutes on 1024 CPUs of an Apple-based parallel computer [3]. The question mark is used here because no formal proof is yet known.

These very high-precision numerical confirmations raise an interesting question: Which would you rather trust, a mathematical theorem that is the final result of a long, difficult paper, fully understood only by a handful of people worldwide, or a formula that has been verified to 20,000-digit accuracy by a computer?

Clearly some caution must be exercised in this regard, since examples of high-precision "frauds", namely relations that appear to hold to unusually high accuracy but which are not precisely equal, are known in the mathematical literature [12,pg 11-15]. One particularly perplexing example is the following [4]:

$$\int_0^{\infty}\cos(2x)\prod_{n=1}^{\infty}\cos\left(\frac{x}{n}\right)dx =$$

0.392699081698724154807830422909937860524645434187231595926812285162...

One is tempted to conclude from this numerical value that the integral in question is equal to π/8. But a careful comparison with a high-precision value of π/8, namely,

0.392699081698724154807830422909937860524646174921888227621868074038...

discloses that the two differ after the 42nd decimal place! However, such instances are highly exceptional, and only a handful of rather contrived examples are known that hold beyond 100 digits or so.

4 A Computer-Assisted Proof of Kepler's Conjecture

In 1611, Kepler described the stacking of equal-sized spheres into the familiar arrangement we see for oranges in the grocery store. He asserted that this packing is the tightest possible. This assertion is now known as the Kepler conjecture, and has persisted for centuries without rigorous proof. David Hilbert included the Kepler conjecture in his famous list of unsolved problems in 1900.

In 1994, Thomas Hales, now at the University of Pittsburgh, proposed a five-step program that would result in a proof. In 1998, Hales announced that the program was now complete [15]. This project involved extensive computation, using an interval arithmetic package, a graph generator, and *Mathematica*. The computer files containing the source code and computational results are here: **http://www.math.pitt.edu/~thales/kepler98**.

The journal *Annals of Mathematics* has decided to publish Hales' paper, but with a cautionary note, because, as they explain, although a team of referees is "99% certain" that the computer-assisted proof is sound, they have not been able to verify every detail [22]. One wonders if every other article in this journal has implicitly been certified to be correct with more than 99% certainty! In an attempt to resolve the remaining uncertainty, Hales has decided to embark on a project to construct a computer-based formal proof and anticipates completion by 2010. However, even this is not likely to quell the controversy among some traditional mathematicians regarding computer-based proofs.

5 Probabilistic Primes versus Provable Primes

Today whenever one uses a credit card to make a purchase over the Internet, it is quite likely that at some point in the process, one's Internet browser constructs a pair of large prime numbers. Through the years numerous efficient computational algorithms have been found to provably certify that an integer is prime, culminating with the recent discovery by three Indian mathematicians of a "polynomial time" scheme [12,pg 3023].

However, the most widely used scheme in practice is the Monier-Rabin probabilistic primality test [13][12,pg 300-303]. This test specifies that a certain numerical computation be repeated in several trials, with a certain auxiliary parameter chosen pseudorandomly in each trial. If the integer passes one trial, it is prime with probability at least 3/4, so that m trials increase this probability to $1 - 1/4^m$. In fact, for large test integers n, the probability is even closer to unity. For instance, if n has 500 bits, then this probability is greater than $1 - 1/4^{28m}$. Thus a 500-bit integer that passes this test even once is prime with prohibitively safe odds-the chance of a false declaration of primality is less than one part in Avogadro's number (6×10^{23}). If it passes the test four times, then the chance of false declaration of primality is less than one part in a googol (10^{100}).

It is worth pointing out that such tiny probabilities are many times more remote than the chance that an undetected hardware error occurs during the calculation, not to mention the possibility of a computer program bug. Given these realities, what is the point of distinguishing between a "provable" primality test (performed on a computer) and a probabilistic primality test (also performed on a computer)?

6 Validity Checks for Large Computations

In several recent mathematical computations, computer runs of many hours were required, sometimes on highly parallel computers. Given the many possible sources of error in such calculations (computer program, processor, memory, network, disk, compiler, operating system, etc.), one can rightly ask why anyone would ever have confidence in the results.

In fact, these computations typically employ very rigorous validity checks. For example, Richard Crandall, Ernst Mayer and Jason Papadopoulos recently determined that the Fermat number $F_{24} = 2^{2^{24}} + 1$ is composite. This calculation employed a "wavefront" scheme, where a faster computer system computed a chain of squares modulo F_{24}, such as $3^{21000000} \bmod F_{24}$, $3^{22000000} \bmod F_{24}$, $3^{23000000} \bmod F_{24}$, …. Then each of a set of slower computers started with one of these intermediate values, squared it 1,000,000 times modulo F_{24}, and checked to see if the result (a 16-million-bit integer) precisely reproduced the next value in the chain. If it did, then this is very strong evidence that both computations were correct. If not, then the process was repeated [14,page 187].

Along this line, Yasumada Kanada of the University of Tokyo recently computed the first trillion hexadecimal digits of π (and also the first trillion decimal digits). To validate his results, he first computed the first trillion hexadecimal (base-16) digits of π, using two different formulas. Both of these computations precisely agreed to over one trillion digits. Then he used a variant of the BBP formula for π to independently calculate 24 hexadecimal digits beginning at position one trillion. The result precisely agreed with the two earlier calculations. Needless to say, it is exceedingly unlikely that independent computations, employing a completely different technique, would each produce the same 24-long hexadecimal digit sequence, unless each is in fact correct (the probability of such an accidental agreement, in a heuristic sense, is $16^{-24} \approx 1.26 \times 10^{-29}$).

In a similar way in 1999, Colin Percival, then an undergraduate student at Simon Fraser University, harnessed a worldwide network of personal computers to calculate a segment of binary digits of π beginning at the quadrillionth place, using a variant of the BBP formula for π. Such calculations can be checked by computing two closely overlapping sections of digits, and verifying that the overlapped digits precisely agree (although Percival's actual scheme was somewhat different).

Again, this raises the question: Which would you rather trust, a mathematical theorem that is the final result of a long, difficult paper, fully understood only by a handful of people worldwide, or a computational result that has been confirmed by multiple independent, exacting validity checks?

7 Mathematical Knowledge Management

The global **MKM Interest Group** founded in 2005 writes:

> *Mathematical Knowledge Management is an exciting new field in the intersection of mathematics and computer science. We need efficient, new techniques–based on sophisticated formal mathematics and software technology for taking fruit of the enormous knowledge available in current mathematical sources and for organizing mathematical knowledge in a new way. On the other side, due its very nature, the realm of mathematical information looks as the best candidate for testing innovative theoretical and technological solutions for content-based systems, interoperability, management of machine understandable information, and the Semantic Web.* **(www.mkm-ig.org/index.html)**

Twenty-five years ago, the best theorem-proving systems could return a proof of the *Cantor diagonal theorem*, when fed a careful diet of axioms. Today, as suggested by Hale's project, we stand on the edge of an extraordinary ability to both discover and confirm formal mathematics. The French system COQ, has apparently been used to provide formal proofs of the *Prime number theorem* and the *Four color theorem*-two of the luminous highlights of pure mathematics [20,19].

Similarly, early work by Herbert Simons and others on computational scientific-theory construction is also showing rapid development, as instanced by the health of software such as *Graffiti*, which can conjecture and often dispose of graph-theoretic results using databases of graph structure.

While many of the issues in mathematical knowledge management are shared by all disciplines, the need for reliable mathematical optical character recognition (OCR) stands out separately. There are still no reliable, scalable methods of identifying mathematics in documents. Some of the most interesting current projects arise in Japan, where the spatial demands of the language recognition are closer to those of mathematics. Nonetheless, it is reasonable to assume that within five to ten years mathematical OCR will be generally accessible. This will further facilitate the computerization of the entire mathematical research process. At that point its future relies more on commercial than technical issues.

8 What We Cannot Do

Even given such examples, it should not be presumed that amassing huge amounts of processing power can solve all mathematical problems, even those that are amenable to computational analysis.

For one thing, it is quite likely that some mathematical computing problems are in a class that fundamentally cannot be solved except by schemes that scale exponentially in cost with the size of the problem (assuming the widely believed inequivalence of P and NP, a conjecture from the field of theoretical computer science). For such problems, once they are sufficiently large in size, no amount of advanced computing technology or parallel processing is likely to solve them.

Along this line, consider Clement Lam's 1991 proof of the nonexistence of a finite projective plane of order ten [11,pg 4]. This involved a search for a configuration of $n^2 + n + 1$ points and equally many lines. Lam's computer program required thousands of hours of run time on a Cray computer system. Lam estimates that the next case ($n = 18$) susceptible to his methods would take millions of years on any conceivable architecture.

Some mathematical computations are "naturally parallel" and thus readily suited for implementation on highly parallel computer systems. However, these tend not to be problems of central interest in mathematics. The majority of interesting large-scale calculations in computational mathematics, like their counterparts in computational physics and chemistry, require significant communication between independent computing nodes. Parallel implementations of such calculations require considerable programming effort, in addition to a well-designed parallel system with a strong interconnection network.

More importantly, such calculations are subject to fundamental limits of parallel computing, especially *Amdahl's Law*, namely the observation that the serial portion of a computer program will dominate the run time unless it constitutes an extremely small portion of the program. Along this line, it appears that integer relation detection is one example of a demanding computation that possesses only limited concurrency. Variants of PSLQ that are suitable for parallel processing are known, but even in the best schemes, concurrency is limited to less than $n/2$, where n is the length of the test vector [6]. Thus, while PSLQ variants have been successfully implemented on systems with up to 64 CPUs (for problems where n was well over 100), much more highly parallel implementations, for reasonably-sized n, will be a challenge.

9 What Does the Future Hold?

In spite of the difficulties mentioned in the previous section, it seems clear that computation is destined to assume a much more important role in future mathematical research than at the present time. For one thing, present-day mathematical software is greatly improved over what was available just a few years ago, and as a result many mathematicians are just now beginning to be fully skilled and experienced in using these tools. For this reason alone, we believe that we will see much greater usage of computational math facilities in the future.

It also seems inevitable that mathematicians will need to rethink the distinction between human-proven results and computer-proven results. As we have seen, it is increasingly difficult to distinguish between a purely human proof, and a proof that has utilized computational resources for at least part of the overall process of discovery and validation. We may even need to reconsider the distinction between computer-proven results and experimentally discovered results that have been confirmed with very strong numerical

evidence. Such distinctions will only fade further as computer-based mathematical tools become more widely utilized.

As we mentioned in the introduction, experts are now confident that Moore's Law, which to date has sustained 40 years of exponential growth, will continue for at least another ten years, and, given some of the recent interesting developments in nanotechnology, it may continue much longer. Even more interesting is the possibility of quantum computing, which is based on quantum superposition, an eerie effects of quantum theory. Quantum computation, if fully realized, will dramatically accelerate certain classes of mathematical computation. At present, only a few small demonstrations have been done (such as the factoring of $15 = 3 \cdot 5$), but scientists worldwide are exploring ways to extend the reach of these demonstrations to significantly larger achievements.

If even some of these predictions of future computing technology are realized, future mathematical computing facilities will be thousands or even millions of times more powerful than they are today. We may well see the day when virtually every mathematical question can be explored on the computer, using much more comprehensive and powerful software and hardware than any that is available today. We can only dimly imagine such a future at the present time. But perhaps it is not too early to try. Certainly there are many philosophical implications [10].

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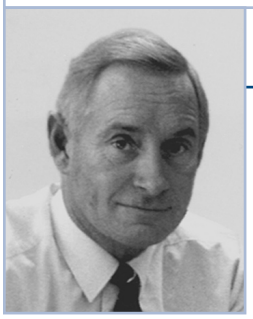
MESSAGE FROM THE EXECUTIVE DIRECTOR

Graham Wright



NEW DIRECTIONS

At the 2005 Winter Meeting in Victoria, the Board of Directors and the Publications Committee will be considering a new pricing model for our periodicals that may take effect in 2007 or 2008. Subscription revenues from CMS periodicals are by far the largest component of the Society's annual revenues and any change in pricing must be done with extreme care and consideration of the possible impact on those revenues.

The model being proposed would "bundle" the CJM and CMB with CRUX with MAYHEM and the CMS Notes at a very competitive price. For subscribers currently taking the CJM and CMB the bundled price for all four periodicals *would be less than* the current price for just the CJM and CMB. For those libraries taking only the CMB there would be two options. The first would be for the library to pay somewhat more but receive substantially more content, both in *electronic and print* format. The second option would be for the library to pay slightly more than the current rate for just the CMB but receive *electronic access to all four periodicals*. Subscribers to just CRUX with MAYHEM would still have this option but could also subscribe to the entire bundled package.

If the Society adopts this model, which is similar to ones used by other societies and publishers, it would increase the visibility of the CMB and CRUX with MAYHEM and, to a lesser extent, the CJM.

In addition, an active campaign would be conducted to inform libraries, departments of mathematics and subscription agents of the change and of the benefits from the new pricing model. In this way, the CMS would be positioned to offer a better level of service to all subscribers.

The proposed pricing model will be made available on the CMS web site, after the Board of Directors and the Publications Committee have had the opportunity to consider the model. If members or subscribers have any questions or concerns about the proposal please email `director@cms.math.ca`.

Attendance at the Society's summer and winter meetings has been increasing markedly over the past few years and the plans are underway for a number of joint meetings in the future.

Representatives from the CMS and the Sociedad Matemática Mexicana (SMM) met in Mexico City on October 24, 2005 to explore the possibility of joint meetings between the two societies. The meeting was very productive and it is intended that CMS/SMM joint meetings would be in addition to the regular summer and winter meetings of the CMS. Subject to approval by the Board of Directors, the first joint meeting will be held in September 2006, in Mexico and the second joint meeting in the fall of 2009, probably in Toronto or Vancouver.

The 2007 Summer Meeting in Winnipeg will be joint meeting between the CMS and MITACS. The 2008 Summer Meeting, the second Canada-France Meeting, is scheduled to take place from June 2-6 in Montréal. The 2008 Meeting will be a joint meeting between the CMS, the Canadian Applied and Industrial Mathematics Society, MITACS, la Société Mathématique de France (S.M.F.), and la Société de Mathématiques Appliquées et Industrielles de France (S.M.A.I.). The Statistical Society of Canada and la Société Française de Statistique (S.F.d.S) will be meeting in Ottawa just before the joint meeting in Montréal.

Also being considered is a joint meeting with the AMS, a joint meeting with the Australian and New Zealand Mathematical societies as well as the possibility of a joint Canada/India meeting.

As has been described in previous issues of the CMS Notes, the Society is undertaking a significant fund raising effort. This effort is being directed by the President, H.E.A. (Eddy) Campbell (Memorial), with assistance from an expert partner, Queen's Advancement External Services, and the staff at the Executive Office in Ottawa. In addition, the CMS will be appointing a Development Coordinator whose major duties will be to develop appropriate materials, arrange for visits to potential donors, and coordinate the various aspects of the campaign.

Several members have been contacted to help identify potential sponsors and, where possible, provide the names of individuals sympathetic to the goals and needs of the CMS. Support from the membership at large is a crucial component of a successful fund raising drive and members will be contacted in 2006 to help support their society. 2005 has been a very productive year and, as is evident from above, the new initiatives being proposed will provide both members and subscribers with a high level of mathematical services and opportunities.

français page 28

Letters to the Editors / Lettres aux Rédacteurs

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

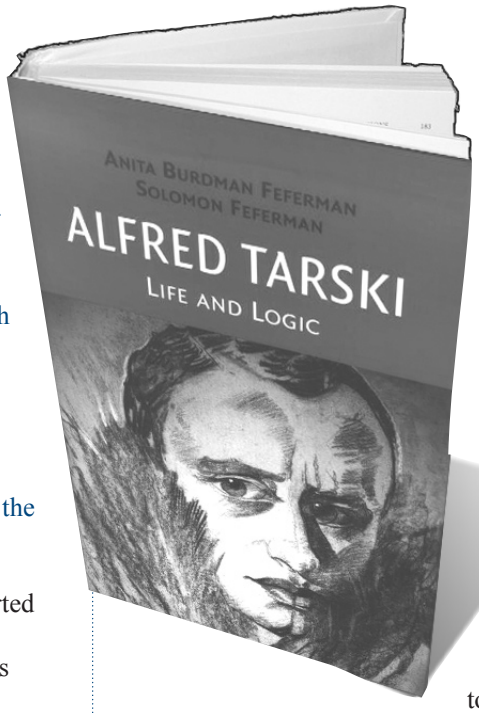
Les rédacteurs des *Notes* acceptent les lettres en français ou anglais portant sur un sujet d.intérêt mathématique, mais ils se réservent le droit de les comprimer. Les lettres acceptées paraîtront dans la langue soumise. Les lecteurs peuvent nous joindre au bureau administratif de la SMC ou a l'addresse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

BOOK REVIEW Small but Mighty

by Peter A. Fillmore
Dalhousie University, Halifax, NS

Alfred Tarski: Life and Logic

by Anita Burdman Feferman and Solomon Feferman
Cambridge 2004 vi + 425 pages



In 1901, in Warsaw, was born Alfred Titelbaum, who as Alfred Tarski was to become one of the giants of twentieth century mathematical logic. The new name—which was also assumed by his brother in the same year, 1924—was partly a career move, partly an expression of Polish pride. This was the same year that Tarski completed his PhD, under the supervision of Stanislaw Lesniewski, and published the famous paper in *Fundamenta Mathematicae* on the Banach-Tarski paradox.

But the job situation remained difficult, and Tarski supported himself by teaching in a private school, while continuing to do research and attend seminars at the university. As his reputation grew, he was invited to visit various European centres, Vienna, Paris and Berlin among them, and in 1939 he accepted a fortuitous invitation from Willard Quine to visit Harvard for a conference. Undoubtedly this saved Tarski's life, but his wife Maria and their two children were unable to get out and spent the war in Poland. After a period of uncertainty, Tarski received in 1942 an offer from UC Berkeley, and there he remained until his death in 1983, charting new directions in mathematical logic and, as the authors say, "creating a mecca to which the logicians of the world made pilgrimage".

This exhaustive biography, a labour of love by a former student and his wife, nevertheless gives us a "warts and all" portrait of the great man. Starting in 1993, they interviewed seemingly everyone who knew him, and with Tarskian thoroughness have anticipated—and answered— nearly every conceivable question about him. Along the way we get a fascinating account of the times, of its mathematics and mathematicians and frequently beyond that, to its politics and sociology, particularly in Europe before the war and in the United States during and after it. Tarski's personality is brilliantly evoked, giving the reader the feeling that we know this man, how he thinks, works, even moves. He was small in stature, but charismatic, ambitious, passionate, energetic, devoting all to his mathematical programme. His lectures were models of "elegant clarity", but with his students he was an "authoritarian taskmaster", subjecting the women among them (6 of the 25) to persistent and usually unwelcome amorous attentions. But they received excellent preparation and many became leading logicians in their own right.

A noteworthy feature of the book is that the fifteen chapters of biography are intertwined with six "interludes" describing Tarski's work in some detail but in nontechnical terms. The work as a whole is of a high professional standard–something one does not necessarily expect in writing about mathematics by mathematicians. It is a pleasure to read and deserves the widest possible readership.

CALL FOR SITES
DEMANDES DE PROPOSITIONS D'EMPLACEMENTS

Interested in hosting a CMS Meeting?

The summer and winter meeting sites are confirmed to the year 2008 (Summer Meeting - see Calendar of Events). The CMS Research Committee invites requests from departments interested in hosting a CMS Meeting for Winter 2008 onwards. The head of the department should write to the chair.

Êtes-vous intéressés à être l'hôte d'une réunion de la SMC?

Les lieux des réunions d'été et d'hiver sont confirmés jusqu'à l'an 2008 (réunion d'été - voir le calendrier des événements). Le Comité de la recherche de la SMC invite les départements intéressés à tenir l'une de ces réunions en hiver 2008 ou plus tard à soumettre une proposition. Les chefs de département intéressés doivent soumettre leur propositions au président.

Dr. Finnur Lárusson, Chair/Président
CMS Research Committee / Comité de recherches de la SMC
Department of Mathematics
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London, Ontario N6A 5B7 Canada

The Music of the Spheres

by Nicky Kamran
McGill University

Mathematics and Music

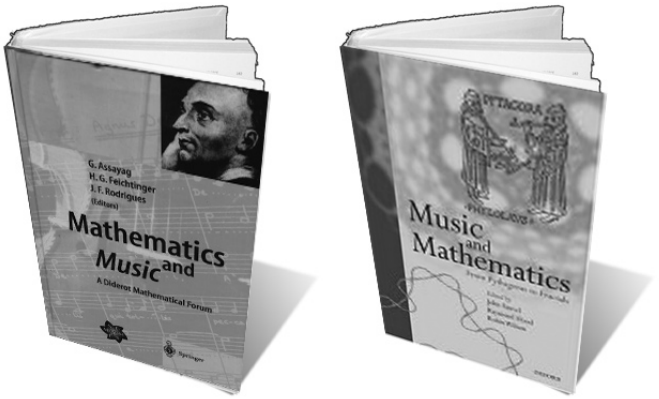
Edited by G. Assayag, H.G. Feichtinger, and J.F. Rodrigues

Springer-Verlag 2002 xviii+288 pages

Music and Mathematics

Edited by John Fauvel, Raymond Flood, and Robin Wilson

Oxford University Press 2003 250 pages



It is often said that there is a close link between mathematics and music. At a superficial level, this relationship can be perceived by any mathematician with some knowledge of music, or by any musician having had exposure to mathematics. Music is indeed an abstract form of artistic expression, in which rhythmic patterns and harmonic structure come together to produce a work of art that stimulates one's feelings and emotions. Many of the major musical compositions of Western classical music are full of complex rhythmic and harmonic structures, whose unraveling requires a great deal of analytical skill. This can be attested by anyone who has tried to study the score of one of the operas by Richard Strauss, not to mention some of the most complex compositions of Pierre Boulez and Yannis Xenakis.

Any attempt to go beyond these superficial observations, aiming for a deeper understanding of the relationship between mathematics and music is a perilous task, in which the extensive formal analysis of patterns in musical compositions can easily become a bit of an empty exercise. A more fundamental difficulty lies in the fact that the written word is by necessity incomplete for the description of music. One wants to hear a piece of music, and not simply read about it. This means that in spite of their undeniable qualities, the books under review would have benefitted from having a companion CD.

The ordering of the topics as they appear in the titles of these books ("Mathematics and Music" vs. "Music and Mathematics") reflects a real difference in spirit and emphasis. The volume edited by Assayag et al. is the proceedings of the Fourth Diderot Mathematical Forum, which took place simultaneously in Lisbon, Paris and Vienna under the umbrella of the European Mathematical Society. While the meeting in Lisbon was devoted to the historical aspects of the relationship of mathematics to music, the meetings in Paris and Vienna were more sophisticated in their mathematical content, dealing respectively with mathematical logic and music in the XXth century, and mathematical and computational methods in music. Thus, besides some of the fine scholarly contributions one would expect to see on the problem of the construction of a scale with equal temperament, or on the relation between combinatorics and music, one finds in this volume some highly sophisticated papers in which topos theory and formal logic are proposed are frameworks for the analysis of musical structure and perception. I remain quite skeptical as to the long-term viability of these highly formalized approaches, unless ways are found to tie them in with the very interesting work which is currently being carried out on musical perception in the cognitive science community. There is no evidence presented in the book that such a dialogue is taking place. The papers on the computational aspects of music, particularly on the problem of the production of sounds via computers, are probably the ones that would have benefitted the most from the presence of a companion CD. In spite of the presence of a number of excellent articles, this book suffers from a lack of consistency in the breadth and depth of the topics that it covers, and can only be viewed as a mitigated success.

The volume edited by Fauvel et al., while in some sense more elementary than the preceding one, is more satisfying in many regards. It is divided into four parts; "Music and mathematics through history", "The mathematics of musical sound", "Mathematical structure in music" and "The composer speaks". The first part does a superb job of summarizing in thirty-four pages the main issues related to the problem of tuning according to a tempered scale, and the fascinating work of Kepler on musical cosmology. The second part is a very clear presentation of the mathematical and physical aspects of musical sound, culminating with the profound work of Helmholtz on combinational tones and consonance. It also contains a very nice paper by Ian Stewart on the mathematics underlying the placement of frets on a stringed instrument. Part three is concerned with the geometric and combinatorial aspects of musical compositions and contains a wealth of musical illustrations (unfortunately only through printed excerpts from musical scores). The fourth part is quite interesting in that it lets composers who are using mathematical tools such as finite projective planes and fractals in their work speak about their experience with mathematics. I would certainly recommend this volume to any mathematician interested in music, or any musician having an interest in mathematics.

BRIEF BOOK REVIEWS

Peter A. Fillmore
Dalhousie University, Halifax, NS

Gödel's Theorem: An Incomplete Guide to Its Use and Abuse

by Torkel Franzén

A K Peters 2005 x + 172 pages

This book is directed at a general audience, and in writing it Franzén has a two-fold aim: to explain Gödel's Theorem from a mathematical point of view, and to comment on some of its many invocations outside of mathematics.

Few theorems have aroused as much interest among non-mathematicians, and among its supposed consequences we find, for example, "it is not possible to prove that an objective reality exists", "nothing can be known for sure", and even, from the realm of theology, "no finite system, even one as vast as the universe, can ultimately satisfy the questions it raises". Franzén discusses these and other claims in some detail, pointing out that at best any connection with Gödel's Theorem is by way of analogy, and he expresses the hope that his book will give readers a basis for judging such claims.

An introductory chapter sets forth the author's goals, and includes a brief essay on Gödel's life and work. The next two chapters are devoted to a gentle introduction to the first and second incompleteness theorems and the mathematical ideas needed to gain a proper appreciation of what they say—and what they don't say. Certain more abstract matters, such as how much arithmetic a formal system needs for the first theorem to be applicable, are relegated to an appendix. The next chapters – Incompleteness Everywhere; Skepticism and Confidence; Gödel, Minds, and Computers—deal with attempts to apply the theorem in philsophy and theology. Gödel's Completeness Theorem (about first order logic), which has been mentioned several times earlier in the book as a possible source of confusion, is carefully explained in the following chapter. The final chapter—Incompleteness, Complexity, and Infinity—includes a discussion of Gregory Chaitin's Incompleteness Theorem and his claims for it.

As with all books that honestly attempt to explain serious mathematics to the general reader, there is some tough sledding here. The maxim "no pain, no gain" needs to be kept in mind. But this is an excellent book, carefully considered and well-written. It will be read by layman and expert alike with pleasure and profit.

The Book of Presidents 1865-1965

Edited by Susan Oakes, Alan Pears, and Adrian Rice

London Mathematical Society 2005 ix+157 pages

The Canadian Mathematical Society, starting in 1945 from modest beginnings, has played a key role in the development of mathematics in Canada. In Britain the primary learned society for mathematics is (despite its local-sounding name) the London Mathematical Society. Since 1865 it has fostered mathematics there, and in fact, as one of the oldest mathematical societies in the world (perhaps only the Netherlands and Russia can claim older ones), its influence has spread far beyond Britain—for example through its extensive publication program. So this delightful little book will be of interest to mathematicians, and historians of mathematics, everywhere.

The core of the book is a two-page spread for each of the fifty-one presidents during the first hundred years of the LMS, a full-page photo on the left and a biographical sketch on the right. Many of these names will be familiar, starting with people like De Morgan, Sylvester and Cayley, going on to Hardy (twice), Whitehead, and the first woman president Mary Cartwright, and in more recent times to Higman, Atiyah, and Hitchin. Presidents who served after 1965 are given briefer entries (two to a page). The sketches contain, in addition to the usual biographical details, descriptions of research interests and contributions.

The book contains a wealth of other information, most notably a brief (17 pages) history of the LMS by Adrian Rice.

There are also a chronology of the LMS, a bibliography of published presidential addresses, biographical sketches of the De Morgan medallists (the premier award of the LMS), and a list of the more than one hundred individuals elected to honorary membership over the years.

Mathematics in Service to the Community

Edited by Charles R. Hadlock

MAA Notes #66 MAA 2005 xiv+264 pages

This book has the sub-title "Concepts and models for service-learning in the mathematical sciences", and in the introductory chapter the concept of "service-learning" is defined as any set of activities that "enhance either the delivery or the impact of curricular material, and take place within a service framework where additional experience with civic engagement or social contribution will be obtained". The underlying idea is that both the student's interest in the material he is studying and his social conscience will be stimulated. The editor conducted surveys to find out what was actually being done in the way of service-learning projects, and from these selected a representative sample for inclusion in the book. The projects generally fall into three categories: mathematical modelling, statistics, and education-related. The bulk of the book is divided correspondingly into three chapters, each examining a number of projects in some detail (about ten pages to each project). The following chapter looks at ways in which the service-learning concept might be extended to subject matter and courses where it isn't commonly found, and the last chapter is a "how-to" guide for starting a service-learning project.

Fixing Frege

by John P. Burgess

Princeton Monographs in Philosophy

Princeton 2005 257 pages

In 1879 the logician Gottlob Frege published the first volume in a grand program to provide a logical foundation for mathematics. But in 1903, as the program was nearing completion, Bertrand Russell discovered a contradiction in Frege's system. This was the famous Russell paradox. Thereafter mathematicians and logicians, beginning with Russell himself (culminating in his three-volume work with Whitehead, Principia Mathematica), turned in other directions seeking such a framework. But in recent decades logicians and philosophers have begun to discover that much more can be salvaged from Frege's system than had been assumed. In its first third, this book sets the stage for these developments, and goes on from there to describe and evaluate some of these systems.

CMS NOTES / Notes de la SMC

NOTES de la SMC

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by Ed Barbeau
University of Toronto

MATHEMATICS AND BIOLOGY

Until recently, applied mathematics at most universities concerned those areas closely related to physics, particularly differential equations. Physical axioms can be formulated at a very basic level and lead to mathematical artifacts that are very specific and yield a high level of predicability. To be sure, there were periodic attempts, some going back decades, to apply mathematics in other areas, but these were not so much geared to scientific exactness as much as finding a means to untangle the different aspects of the situation and gain at least a qualitative sense of what is going on. The book, *The Limits of Growth*, published more than thirty years ago by the Club of Rome, was a controversial example, in which various models were used to project the effects of such factors as pollution and population growth on the future of our planet. There was no hope of finding a mathematical formulation such as Newton had available for gravitation that were based on fundamental postulates closely mirroring the real situation and the models had to be based on more ad hoc functions and equations that roughly reflected reality.

Since then, new developments in both mathematics and science have forced us to reevaluate what constitutes a suitable mathematical training for graduates who will be called upon to use mathematics not only in all sorts of settings but with different levels of expectation as to what the mathematics will deliver. Probably no field illustrates the breadth of mathematical application as much as biology, and a recent book published by the Mathematical Association of America provides a report on how much this has impinged upon university programs already and what directions we might take in the future.

Math & Bio 2010: Linking Undergraduate Disciplines

Lynn Arthur Steen (ed.)

The Mathematical Association of America, 2005, xiii+161 pages

ISBN 0-88385-818-5, US$41.95 (member US$33.95)

Catalogue code: MAB www.maa.org 1-800-331-1622

Lynn Arthur Steen, in his review of mathematical biology, makes clear that quantitative consideration of biological questions has a long pedigree, dating back to 1798 with *An essay on the principle of population* by John Malthus. In 1865, Mendel published his work on genetics and even G.H. Hardy, that quintessence of pure mathematics, published a paper on *Mendelian proportions in a mixed population* in *Science* in 1908. In his 1917 book, *On growth and form*, D'Arcy Thompson looked to mathematics and mechanics to explain how different fauna took on their shapes; "his larger contribution was to break down the unstated assumption of the time that living things and inanimate objects occupied different scientific realms and were subject to different laws. For Thompson, both obeyed the laws of mathematics." An important publication of the period was the 1924 book, *Elements of physical biology* by Alfred J. Lotka who, independently, with his contemporary Vito Volterra created a mathematical model for predator-prey systems. In 1874, Francis Galton and H.W. Watson used stochastic techniques to study extinction.

But it was not until the explosive intrusion of mathematics into many areas of biology that the designers of university programs had to sit up and take notice. Genetics, cardiac behaviour, evolution, morphogenesis, taxonomy, blood flow, population dynamics, epidemics, computed axial tomography (CAT), brain models, for example, are now on the scene and practitioners in these areas need to be familiar with some pretty sophisticated mathematics - difference-differential equations, fractals, functional analysis, statistics, computation, coding, data mining, computer visualization.

Wendy Katkin and Gayle Reznik of the Reinvention Center at the State University of New York, Stony Brook, recently conducted a survey of undergraduate programs in mathematics and biology at North American research universities. Surveys were sent to undergraduate directors in biology, mathematics, applied mathematics and computer science; this was followed by interviews with individuals who were either collaborating in cross-disciplinary research or designing undergraduate courses that connect biology and the quantitative sciences. They heard from sixty-eight institutions and spoke with 34 faculty members. It turns out that there is a great deal going on. Strengthening quantitative skills of students is addressed in almost every basic biology course, and three types of new courses have been created: (1) introductory level general biology courses for life science students in place of standard calculus courses; (2) introductory life science courses with a significant quantitative component; (3) advanced interdisciplinary courses that can be taken by major of mathematics, computer science or biology. For example, at the University of Toronto. about 100 students per year enrol in a first year "Biology, Models and Mathematics" course taught by a mathematician and two or three biologists and using a biology course as a corequisite. The mathematics covered includes linear regression, logarithms, power functions, logarithmic graph paper, exponential and logistic growth, elementary probability, derivatives, integration, dynamical programming, differential equations, Markov chains and introductory chaos theory, each motivated from a biological problem presented to the students. These new courses have been accompanied by pedagogical innovations making greater use of inquiry, problem solving, technology, hands-on-experience and team work. There is a natural tendency to team teach courses. What are the problems encountered? The modern mathematics department has many priorities, of which biology is but one. So it runs into problems of scheduling and staffing special courses; the lecturers who give such courses find that designing and running them can be extremely time-consuming. Even with the best will in the world, there are cultural differences between biologists and mathematicians that have to be moderated. For example, a mathematician wishing to create an example reported, "if I needed something, I'd just make it up, whereas the biologists are rather horrified by that. They are concerned with the sanctity

of real data, from actual experience, from actual observations of real life." Those mathematicians and biologists whose collaboration evolves into a research program report on difficulties of getting work published that is too biological for mathematics journals and too mathematical for biological journals.

A Canadian contribution to the volume is by Leah Edelstein-Keshet of the University of British Columbia. Thanks to the pathfinding work of Colin W. Clark on ecology forty years ago and the foundation of the Institute of Applied Mathematics, this university has had a long presence in the field of mathematical biology. Dr. Edelstein-Keshet addresses the issues in establishing courses and programs, provides a list of essential mathematical topics for the modern biologist, challenges and strategies to meet them. She points to the need for more supportive material, noting that "at present, efforts to create effective biological and mathematical programs and interdisciplinary courses are in great abundance, albeit at formative stages. [Communities undertaking the challenge] need the support of teaching related material such as

- short, well-designed modules that can be used in biological or mathematical courses to increase their interdisciplinary content;
- clearinghouses for these modules with simple effective and descriptive summaries;
- reviews of what works and what fails; discussions of experiences and experiments in teaching;
- simple modeling software that runs on personal computers."

Sidebars include a description of the introductory courses Mathematics 102/103 at UBC (**www.ugrad.math.ubc.ca/coursedoc/math102/, ibid/math103**). Of particular interest is *Science One*, an interdisciplinary first year program at UBC that is team taught by four faculty members, one each from mathematics, physics, chemistry and biology, that attracts about seventy students and is a "greenhouse for talented students". (**www.science.ubc.ca/science1/**). There is a modified version of this, *Coordinated Science Program*, that reaches more than twice as many additional students (**ibid/~csp**) field of mathematical biology.

Additional essays in the volume treat visualization techniques (Maria E. Alvarez, El Paso Community College), building the renaissance team (Carol A. Brewer, Montana and Daniel Maki, Indiana), bioinformatics and genomics (Julius H. Jackson, Michigan State University), and computer science and bioinformatics (Paul Tymann, Rochester Institute of Technology). Debra Hydorn, Stokes Baker and Jeffe Boats provide profiles of seventeen initiatives collected by Project Kaleidoscope from two- and four-year colleges and comprehensive universities in the US. Of value is a bibliography that runs for about fourteen pages, a list of NSF-supported projects along with their websites and a website directory for undergraduate programs and courses, teaching resources, software, professional development and societies, institutes, portals. A site that should be added in the last category is that of the Centre for Mathematical Biology at the University of Alberta (**www.math.ualberta.ca/~mathbio/**). Finally, there are a number of modules produced by the Consortium for Mathematics and its Applications (COMAP) that are described at **www.comap.com**. These treat some topics as optimal foraging theory, the Hardy-Weinberg equilibrium, the Lotka-Volterra predator-prey model, and a graphical analysis of some difference equations in biology.

THE FIFTEENTH INTERNATIONAL WORKSHOP ON MATRICES AND STATISTICS.

www.bt.slu.se/iwms2006/iwms06.html

The Fifteenth International Workshop on Matrices and Statistics will be held in Uppsala, from Thuesday, June 13 through Saturday, June 17, 2006.

"The purpose of the workshop is to stimulate research, in an informal setting, and to foster the interaction of researchers in the interface between matrix theory and statistics. Additional emphasis will be put on related numerical linear algebra issues and numerical solution methods, relevant to problems arising in statistics. The workshop will include both invited and contributed talks."

Among the participants we have the following key note speakers.

Theodore Anderson, Stanford University, USA; Gene Golub, Stanford University, USA; David Harville, IBM Thomas J. Watson Research Center, USA; Sabine Van Huffel, Katholieke Universiteit Leuven, Belgium; Ingram Olkin, Stanford University, USA; Friedrich Pukelsheim, University of Augsburg, Germany; Yousef Saad, University of Minnesota, USA; Muni Srivastava, University of Toronto, Canada.

COMPTE-RENDU DU 48e CONGRÈS DE L'AMQ

Vincent Papillon
Collège Jean-de-Brébeuf, Montréal, QC

Compte-rendu du congrès de l'AMQ tenu au Collège Jean-de-Brébeuf de Montréal, le 15 octobre 2005.

Cette année le congrès annuel de l'Association Mathématique du Québec renouait avec une formule adoptée en 1993, c'est-à-dire un congrès sur une seule journée avec un thème développé par des spécialistes. À l'époque, Benoît Mandelbrot était venu appuyer une équipe de l'École Polytechnique de Montréal sur le thème *Chaos et fractales*. Cette année le thème *Mathématiques et technologies à l'aube du XXIe siècle* a connu un franc succès avec environ 150 participants, majoritairement des professeurs et des étudiants des niveaux collégial et universitaire. Durant la matinée les congressistes pouvaient choisir deux parmi les quatre conférences offertes : *Les mathématiques au service de l'imagerie du cerveau en action* (Jean-Marc Lina, CRM, ETS), *Le positionnement sur la Terre ou dans l'espace* (Christiane Rousseau, U de M), *Codes correcteurs d'erreurs* (Bernard Courteau, Université de Sherbrooke) et *Pourquoi choisissez-vous Google*? (Yvan Saint-Aubin, U de M).

Le président de l'Association, Jean-Marie de Koninck (Université Laval), a profité de l'assemblée générale du dîner pour faire le bilan des actions de l'AMQ et pour rappeler l'importance de telles associations pour notre profession. Dans l'après-midi les participants ont pu choisir deux parmi une douzaine d'ateliers portant sur des thèmes généraux, allant de *Visualisation colorée des fonctions d'une variable complexe* (Gilbert Labelle, UQAM) à *Dans le passé il y avait plus de futur que maintenant* (Fernand Beaudet, CEGEP de Ste-Hyacinthe). Dans le contexte de l'année mondiale de la physique il était naturel d'inviter Stéphane Durand (CRM), auteur du célèbre livre de vulgarisation *La relativité animée : comprendre Einstein en animant soi-même l'espace-temps* (Belin, Paris, 2003) et gagnant, entre autre, du premier prix du concours international d'affiches organisé par la Société Mathématique Européenne dans le cadre de l'année mondiale mathématique (2000). Il nous a livré une conférence très réussie qui s'intitulait: *100 ans de relativité : de la 4e dimension au GPS*. La journée s'est terminée par le traditionnel cocktail de la remise des prix dans la magnifique grande chapelle du Collège Brébeuf . Ce fut l'occasion de remercier Jean Dionne (Université Laval), président sortant de l'AMQ, pour l'immense tâche accomplie avec patience, compétence et générosité.

Le prochain congrès de l'AMQ aura lieu à l'Université de Sherbrooke les 31 mai et 1 juin 2006 en concertation avec le congrès international *Espace mathématique francophone* (EMF2006, du 27 au 31 mai 2006) et la 33e session de perfectionnement du Groupe des responsables en mathématiques au secondaire (GRMS, du 31 mai au 2 juin 2006). Les congrès EMF - le premier a eu lieu à Grenoble en France en 2000 et le second à Tunis en Tunisie en 2003 - visent à favoriser le développement d'une francophonie mathématique centrée sur l'enseignement. Le 31 mai sera une journée commune aux trois congrès et se terminera par une conférence multimédia de Jean-Marie De Koninck, président de l'AMQ, à laquelle le grand public sera invité. Près de mille personnes sont attendues à cet événement exceptionnel. Le thème de ce 49e congrès de l'AMQ est *Mathématiques et diversité culturelle*.

ings without interruptions while getting your meals served and room cleaned daily.

Two summers ago I met with two co-authors from the eastern U.S. and Israel to carry out a large project on which we had been working pairwise for too many years. A lot of mathematics gets done when there are no other distractions and in addition to completing the first project we were able to also initiate a new ongoing program with a participant of an overlapping and related 5-day workshop. FRG's are similar but involve up to 8 participants for a period of 1 to 2 weeks. My colleague, Ander Holroyd, participated in one in 2003 and enjoyed it so much, he is co-organizing another in 2006. To quote Yuval Peres, Dept. of Statistics U. California Berkeley, recipient of the Loeve Prize and one of the participants, "The two weeks I spent at BIRS have motivated much of my work in the 18 months since I visited there. ... I would say BIRS is now the most inspiring and well equipped venue for mathematical meetings I am aware of." The schedules are fluid and time is again spent largely on doing mathematics whether it be in a meeting room or on a hiking trail.

In response to the scientific review of BIRS, there have been a few recent changes in the guidelines for its second funding cycle which will have an impact on the application process. The number of weeks of operation which was 40 per year in its first three years, was increased to 44 in 2006 and then 48 after 2007. Competition was getting stiffer as researchers throughout the world discovered the venue and this was a simple response to the demand. The requirement that each workshop have both a Canadian and American co-organizer has been dropped leading to greater international participation and perhaps a broader scientific scope. As we are the proverbial mouse living next to the elephant, there is a danger that fewer Canadian scientists will be involved in the meetings at BIRS. It is clearly important that the Canadian mathematical science community maintain its keen interest in organizing and participating in BIRS activities. Please keep applying. In many cases excellent applications have been turned down initially due to stiff competition or a similar concurrent meeting, but are then funded upon resubmission in the following year. Geographical and scientific balance among organizers are listed as criteria for evaluation, although scientific excellence of the meeting is of course the primary yardstick used by the Scientific Advisory Board and Programme Committee. So there are perhaps some checks and balances still in effect. The Scientific Advisory Board is a large and scientifically broad group whose members (currently 32 of them) comment electronically on submissions in their area of expertise. The 10-member Program Committee, a subset of the SAB which is chaired by the BIRS Scientific Director, meets annually to review all the submissions and makes decisions based on the input from the entire SAB and their own deliberations.

The participation of Mexico makes BIRS a truly North American enterprise. This is reflected not only through the funding pledge from CONACYT and participation on the Executive Committee of Directors from all three countries, but also by funding committed by the Universidad Nacional Autonoma de Mexico (UNAM) to support Mexican participants at BIRS events. Increased cooperation between the Canadian and Mexican mathematics communities is also being pursued by our respective Mathematical Societies. The Oct. 2005 meeting of the Mexican Mathematical Society included a special joint CMS-MMS session including lectures by Tom Salisbury (York U. and incoming CMS President), Gordon Slade (UBC) and Alejandro Adem (UBC, Deputy Director of PIMS). Representatives of the Societies met to discuss a possible joint meeting of the Societies.

What is the connection between the Canadian Mathematics Institutes and PIMS in particular, and BIRS? The PIMS Board is the body that oversees the finances and takes fiscal responsibility for the operation of BIRS. For example there is a multi-million dollar contract with the Banff Centre which runs the housing complex and dining facilities which are used by BIRS participants. The contract is signed by the PIMS Director. The Directors of PIMS and MSRI sit on the Executive Committee along with the Directors of MITACS (also a contributor to BIRS) and UNAM, and the BIRS Scientific Director. This is the Committee that oversees the management of BIRS. On the other hand the scientific decision-making at BIRS is independent of any Institute. No Institute Directors are members of the SAB. The PIMS and MSRI Boards will no longer recommend particular workshops to the Program Committee. All events will go through the same adjudication process. It is truly an international resource, and one which is in our own backyard.

BIRS is winding up its third successful year having hosted more that 200 events involving over 4600 scientists in Mathematics; Statistics; Computer Science; Physics; Engineering and many other disciplines, has just secured funding for 2006-2010 from the Alberta and US governments, and has initiated a new agreement with Mexican government. What then is the reason for the concern at this time? In fact these concerns involve not only BIRS, but also a major investment of the entire mathematical community in the last two reallocation exercises. NSERC funding for BIRS for its first three years has come from the Major Facilities Access (MFA) Program. This is a program designed for large experimental facilities charging user fees to recover partial costs and even NSERC officials admitted "the MFA program is only a partial fit". At the time of BIRS' inception NSERC's leadership showed considerable ingenuity in quickly moving to set up a suitable peer review process within this program to evaluate and eventually fund a unique institution with international and provincial funding. For the 2006-2010 funding cycle, the hope was that NSERC would follow the lead of the US, Alberta and Mexican governments and provide longer term funding for BIRS in response to its January 2005 MFA application and ensuing positive scientific review. NSERC is in the process of restructuring many of its programs including those to which all Institutes would apply, including BIRS (now in 2006), all the Canadian Mathematics Institutes (in 2007), and at least two new emerging Institutes in Physics and Astronomy (probably in 2006) but there may of course be others in 2007 and ensuing years. At the time of this writing it is not clear what new resources are being brought to

this envelope. As much of the Institute funding arose out of the last two reallocations exercises, an argument could me made that these funds reside with the Mathematics GSC's and should remain with the discipline. A Mathematical Science/NSERC liaison panel was struck in response to the community's concerns. We were again fortunate that Richard Kane has agreed to act as Chair. For BIRS, it is just not clear at present if the old guidelines or some new guidelines will be used to evaluate its 2005 application and site visit in April 2006. Changing the evaluation criteria after the application is submitted and having an accompanying one-year old site visit report, is probably not the fairest process. In the past NSERC has responded to community concerns and NSERC leadership has often pointed to BIRS' scientific accomplishments and its international and provincial funding as one of its success stories, so there is certainly still room for optimism. At the very least, however, we all should be paying close attention to this situation and consider making our views known to the Liaison Committee.

There is a very long list of people who deserve our thanks for the creation and continued support of BIRS from the university administrators at U. Alberta and U. Calgary who helped in convincing the Alberta government to support the project, to the leadership at NSERC, NSF and ASRA who saw the potential value of the proposal and arranged for the appropriate review mechanisms. However, there are two leading members of the Canadian mathematics community who, more than anyone else, are responsible for BIRS' success. Nassif Ghoussoub was the driving force behind the concept and its tri-government funding formula. Robert Moody as its founding

NEW CMS PRIZE

CALL FOR NOMINATIONS
2006 David Borwein Distinguished Career Award

The David Borwein Distinguished career award recognizes mathematicians who have made exceptional, broad, and continued contribution to Canadian mathematics.

A complete nomination dossier consists of:

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

A nomination can be updated and will remain active for three years. Six copies of the complete nomination dossier must arrive at the CMS Executive Office no later than **March 31, 2006.**

NOUVEAU PRIX DE LA SMC

APPEL DE MISES EN CANDIDATURE
Prix David-Borwein de mathématicien émérite pour l'ensemble d'une carrière 2006

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

Le dossier de candidature comprendra les éléments suivants :

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

Toute mise en candidature est modifiable et demeurera active pendant trois ans. Le dossier complet, en six exemplaires, doit parvenir au bureau administratif de SMC au plus tard le **31 mars 2006**.

Selection Committee / Comité de sélection
David Borwein Distinguished Career Award
Prix David Borwein pour carrière distinguée
Canadian Mathematical Society / Société mathématique du Canada
577 King Edward, Ottawa, Ontario K1N 6N5

Its is hoped to present the first award at the Summer 2006 meeting in Calgary.

Nous esperons présenter le premier prix à la réunion d'été 2006 de la SMC à Calgary.

CALL FOR NOMINATIONS - 2006 DOCTORAL PRIZE
APPEL DE MISES EN CANDIDATURE - PRIX DE DOCTORAT 2006

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

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

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

Candidatures
Les candidats doivent être nommés par leur université; la personne qui propose un candidat doit se charger de regrouper les documents décrits aux paragraphes suivants et de faire parvenir la candidature à l'adresse ci-dessous. Aucune université ne peut nommer plus d'un candidat. Les candidatures doivent parvenir à la SMC au plus tard le **31 janvier 2006**.

Le dossier sera constitué des documents suivants :

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

The CMS Doctoral Prize recognizes outstanding performance by a doctoral student. The prize is awarded to the person who received a Ph.D. from a Canadian university in the preceding year (January 1st to December 31st) and whose overall performance in graduate school is judged to be the most outstanding. Although the dissertation will be the most important criterion (the impact of the results, the creativity of the work, the quality of exposition, etc.) it will not be the only one. Other publications, activities in support of students and other accomplishments will also be considered.

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

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

Nominations
Candidates must be nominated by their university and the nominator is responsible for preparing the documentation described below, and submitting the nomination to the address below. No university may nominate more than one candidate and the deadline for the receipt of nominations is **January 31, 2006**.

The documentation shall consist of:

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

Président du Comité de sélection du Prix de doctorat
Chair, Doctoral Prize Selection Committee
Société mathématique du Canada / Canadian Mathematical Society
577 King Edward
Ottawa, Ontario Canada K1N 6N5

WANTED: Books for Review

RECHERCHÉS : Livres pour critiques littéraires

Have you written a book lately? Would you like to see it reviewed in the CMS Notes? If so, please arrange to have a review copy sent to our Book Review Editor.

Vous avez récemment écrit un livre? Vous aimeriez une critiques littéraires de celui-ci dans les Notes de la SMC? Si oui, veuillez faire parvenir une copie au rédacteur des critiques littéraires

Peter Fillmore
Department of Mathematics and Statistics
Dalhousie University
Halifax NS B3H 3J5

Call for Sessions - Propositions de sessions

Additional self-supported sessions play an important role in the success of our meetings. The CMS welcomes and invites proposals for self-supported sessions for this meeting (December 9-11, 2006) at the Sheraton Centre, Toronto. Proposals should include a brief description of the focus and purpose of the session, a tentative list of speakers, as well as the organizer's name, complete address, telephone number, e-mail address, etc. These additional sessions will be incorporated with the other sessions in time blocks allocated by the Meeting Director. All sessions will be advertised in the *CMS Notes*, on the web sites and, if possible, in the Notices of the AMS and in publications of other societies. Speakers in these additional sessions will be requested to submit abstracts which will be published on the web site and in the meeting programme. Those wishing to organize a session should send a proposal to the Meeting Director by the deadline below.

Les sessions complémentaires autonomes jouent un rôle important dans le succès de nos Réunions. La SMC vous invite à proposer des sessions autonomes pour son congrès qui se tiendra au Sheraton Centre, Toronto (du 9 au 11 décembre 2006). Toute proposition doit inclure une brève description de l'orientation et des objectifs de la session, une liste des conférenciers possibles ainsi que le nom, l'adresse complète, le numéro de téléphone, le courriel et autres coordonnées de l'organisateur. Ces sessions complémentaires seront intégrées aux autres sessions du programme, dans des cases horaires prévues à cet effet par le directeur de la Réunion. Toutes les sessions seront annoncées dans les *Notes de la SMC*, sur le site web et, si possible, dans le bulletin de l'AMS et les publications d'autres sociétés. Les conférenciers de ces sessions complémentaires devront présenter un résumé qui sera publié sur le site web et dans le programme de la Réunion. Toute personne qui souhaiterait organiser une session est priée de faire parvenir une proposition au directeur de la Réunion avant la date limite ci-dessous.

In addition to various plenary and prize lectures, the following sessions will be taking place:
Aux différentes conférences plénières et de prix s'ajouteront les sessions suivantes:

Calabi-Yau Varieties and Mirror Symmetry
Variétés de Calabi-Yau et symétrie miroir
Org: James Lewis (Alberta), Noriko Yui (Queen's)

Commutative Algebra and Algebraic Geometry
Algèbre commutative et géométrie algébrique
Org: Ragnar Buchweitz (Toronto), Graham Lueschke (Syracuse), Greg Smith (Queen's)

Complexity and Computability in Analysis, Geometry, and Dynamics
Complexité et calculabilité en analyse, géométrie et dynamique
Org: Alex Nabutovsky, Michael Yampolsky (Toronto)

Differentiable Dynamics and Smooth Ergodic Theory
Dynamique différentiable et théorie ergodique lisse
Org: Giovanni Forni, Konstantin Khanin (Toronto)

Nonlinear Schrödinger Equations
Équations de Schrödinger non linéaires
Org: James Colliander, Robert Jerrard (Toronto)

Poisson Geometry and Mathematical Physics
Géométrie de Poisson et physique mathématique
Org: Eckhard Meinrenken (Toronto)

Probability Theory and Operator Algebras
Théorie des probabilités et algèbres d'opérateurs
Org: Matthias Neufang (Carleton), Balint Virag (Toronto)

Deadline: **December 21, 2005**
Date limite : **21 décembre 2005**

Meeting Director / Directeur de la réunion:
Ian Graham
CMS Winter 2006 Meeting
Department of Mathematics - University of Toronto
40 St. George Street, Toronto, ON M5S 2E4
graham@math.toronto.edu

CMS Summer 2006 Meeting	CMS Winter 2006 Meeting	CMS/MITACS Summer 2007 Meeting	CMS Winter 2007 Meeting
Host: University of Calgary June 3 - 5, 2006 Westin Hotel, Calgary	Host: University of Toronto December 9 - 11, 2006 Sheraton Centre Toronto	Host: University of Manitoba June 2007 Winnipeg, Manitoba	Host: University of Western Ontario December 8 - 10, 2007 London, Ontario

CANADA WIDE SCIENCE FAIR

MATE BEZDEK (CMS - JUNIOR AWARD)

St.Brigid School, Calgary, Grade 8

PLANETS GUARDED BY SATELLITES

PROJECT DESCRIPTION

Background and purpose:
Hadwiger's satellite conjecture was phrased in 1960: 'Prove that every convex 3D planet can be guarded by 8 satellites'. This conjecture is a known open problem in geometry that remains unsolved to this day.

Major results :

(1) I studied the planet guarding problem in the plane with the goal of extending these results to space later on. I managed to generalize Hadwiger's question in two different ways. First, I found the smallest possible number of satellites that can guard an arbitrary system of n disjoint circular 2D planets in the plane. Second, I answered Hadwiger's question for some nonconvex 2D planets, namely for those 2D planets that are unions of sufficiently close unit circles.

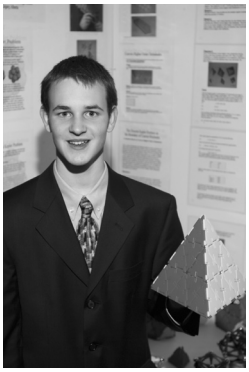
(2) The extension of the planar results to space is not immediate. First, I solved the simultaneous guarding problem of n disjoint unit sphere planets up to 3 planets and based on these results, I have a method that might lead to the solution of this problem for any n. Second, I was able to answer Hadwiger's question for some nonconvex 3D planets; namely for those 3D planets that are unions of sufficiently close unit spheres.

(3) I solved Hadwiger's satellite conjecture for 3D planets that are sufficiently "fat".

Awards at the Canada Wide Science Fair 2005:
- Gold Medal – Physical Mathematical Sciences (Junior)
- Canadian Mathematical Society Award (Junior)
- The University of Western Ontario Scholarships

Mate was born on November 4, 1991 in Budapest, Hungary and moved to Canada (Calgary) in the summer of 2003. He loves problem solving in science (including of course, mathematics) and piano playing as well as a great variety of sports, in particular basketball and volleyball.

DANIEL BEZDEK (CMS - INTERMEDIATE AWARD)



Father Lacombe High School, Calgary, Grade 10

KEPLER'S QUEST

PROJECT DESCRIPTION

Kepler asked the following question in 1611:
How should one arrange non-overlapping unit spheres in 3 dimensional space such that they occupy the largest possible fraction of space. In fact, Kepler proposed that the packing of unit spheres whose centres are in the grid points of the tetrahedral lattice of edge length 2 with density of 74.048% is the densest possible sphere packing.

(This packing shows up in real life quite often, think of oranges, apples and spherical shape fruits that are stored this way.)

This problem of Kepler is strongly connected to the following finite version of it which is often called the Discrete Kepler Problem: Let n be a given positive integer. Then take all possible packings of n unit spheres in 3 dimensional space. Now find the packing of n unit spheres which has the largest possible contact number that is the largest possible number of touching pairs of unit spheres.

The major results of my project can be summerized as follows.

(1) I solved the Discrete Kepler Problem for all n between 2 and 7, and I found a way of solving it for the class of packings of unit spheres when all the spheres are in convex position. (Here "convex position" means that the spheres can be put in a rubber balloon that in its minimal position will touch all the spheres.)

(2) In the solution of (1) I introduce a new class of convex polyhedra which I call convex higher order deltahedra. This new class of convex polyhedra turns out to be a generalization of the well-known convex deltahedra that have been

studied intensively in the 1940s. (Here convex polyhedron means a convex solid bounded convex polygons. Well-known examples of convex higher order deltahedra include the tetrahdron, the octahedron, and the icosahedron just to mention a few.) In short, convex higher order deltahedra are convex polyhedra whose faces are built from regular triangles of the same size. In this part of my project I propose a classification of all convex higher order deltahedra.

(3) The protein folding problem is one of the major unsolved problems in computational biology. For this reason, simplified models have been introduced, which have become a major tool for investigating general properties of protein folding. In this last part of my project I propose a new model, which I call the folded triangular lattice model for studying the protein folding problem.

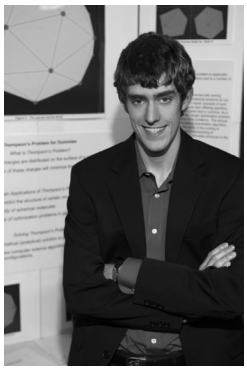
Awards at the Canada Wide Science Fair 2005:

-Genome Canada Award (Intermediate First Place)
-Silver Medal-Physical and Mathematical Sciences
-Canadian Mathematical Society Award (Intermediate)
-Discovery Channel Math Award
-The University of Western Ontario Scholarships

Daniel was born on February 11, 1990 in Budapest, Hungary and moved to Canada (Calgary) in the summer of 2003. Besides biology, chemistry, mathematics, and physics he loves reading, drawing and always seem to find some time for soccer as well as basketball.

PETER FORSYTH (CMS - SENIOR AWARD)

St. Johns-Kilmarnock, Waterloo, Grade 12



THE ATTRACTION OF REPULSION

PROJECT DESCRIPTION

Thompson's Problem is a fascinating example of an optimization problem which cannot be solved by analytical methods. The problem is defined as follows: Given N identical point charges constrained to the surface of a unit sphere, what configuration of these charges will minimize the total Coulomb electric potential energy of the system? I wrote an original program to find solutions to Thompson's problem and aid in the analysis of these solutions.

The two most interesting aspects of my project are the ways in which I modified the standard methods for the study of Thompson's Problem. First of all, instead of only testing a system governed by electrostatic repulsion, I varied the repulsion law by which the particles interacted. Thus, I tested systems where the force that particles exerted upon each other was not proportional to the inverse square of the distance between them, but the inverse cube of the distance or the reciprocal of the distance. Second, I interpreted solutions to the problem not as sets of points, but as 3d polyhedrons (or convex hulls) defined by those points. By employing this method of analysis, I was able to obtain some fairly interesting insights.

My most interesting result appeared when I varied the repulsion function for a constant number of particles. I found that though the actual minimum-energy configuration changed, the structure of the convex hull which the configuration defined did not change. I believe that this result could be used to create an algorithm to efficiently solve Thompson's Problem for very complex repulsion functions. The algorithm could begin by finding a solution for a simple repulsion function with the same number of particles. The algorithm would then record the convex hull of this preliminary solution, and use this convex hull as a starting point to solve the more complicated problem.

Awards at the Canada Wide Science Fair 2005:

- Gold Medal-Physical and Mathematical Sciences (Senior)
- CAPTRIUMF World Year of Physics Award
- Canadian Mathematical Society Award (Senior)
- CAP/TRIUMF Physics Prize
- The University of Western Ontario Scholarship
- University of British Columbia Science & Engineering Entrance

A native of Waterloo, Ontario, Peter Forsyth is now in his first year at the University of British Columbia. Peter is enrolled in UBC's Science One program, which he is enjoying despite the workload. Peter spends a lot of time reading, and a few of his favourite authors are Kurt Vonnegut, Douglas Adams and Terry Pratchett. From his appreciation for the written word comes Peter's love of creative writing. Peter hopes to have time to continue to write despite his current focus on science. In mathematics, Peter is interested in optimization and modeling, and these interests have lead him to fields as diverse as biology, physics and economics. In terms of plans for the future, Peter hopes to do wild and amazing things, but he hasn't yet worked out the details.

2005 INTERNATIONAL MATH OLYMPIAD

FIVE MEDALS FOR TEAM CANADA AT THE 2005 IMO

México was the host country for the 46th International Mathematical Olympiad. This year's event took place from July 8th to July 19th in the city of Mérida, capital of the state of Yucatán. Mérida, with a population of over 1 million, is a beautiful and nostalgic colonial city, safe and hospitable, and very rich in Mexican history and culture. The city has been called the "White City" because many of the city's older buildings, dating back to the 17th and 18th century, have graceful white and pastel exteriors. Mérida has been considered the "Paris of the West" and this could be validated by a leisure walk along the elegant and majestic Paseo Montejo, lined with old shade trees, artworks, grand mansions and colonial palaces just a few steps away from the main IMO sites. Mérida is also surrounded by several of the most important Mayan archaeological sites in México like world famous Chichén Itzá and Uxmal and about 300 km away from popular tourist destinations like internationally renowned Cancun and Cozumel.

The Mexican Organizing Committee strictly followed the IMO established regulations and traditions. The IMO is the oldest and most important international mathematics contest for secondary and high school students. The first IMO was held in 1959 in Romania with the participation of only 7 countries and the 45th IMO was held in 2004 in Greece with the participation of 85 countries. All the countries that competed last year in Greece plus a handful of others, mostly from Central and South America, were invited to the 46th IMO. The 513 contestants and 91 participating countries were the highest ever for an IMO. Most of the team leaders and leader observers arrived in Mérida on Friday, July 8th, three days in advance of the rest of the team. The site for the first six days of IMO jury sessions was a very pleasant and conveniently isolated hotel and convention centre some 60 km from the area assigned for the remaining team members. Deputy leaders, deputy observers and contestants arrived on July 11th. As they were dealing in advance with the contest problems, leaders were kept strictly separated from the other team members until the second examination day. Teams were reunited in Mérida in the afternoon of Thursday, July 14th. Deputy leaders, deputy observers and contestants were all housed in three of the finest hotels in Mérida, all within walking distance from each other.

An entertaining programme of non-mathematical events was also provided by the organizers, including excursions to parks, beaches and historical sites for the contestants and a visit to Chichén Itzá for all the participants. Some of these events as well as the closing ceremony had to be hastily modified due to the threats posed by Hurricane Emily, which battered the Yucatán peninsula during the final days of the IMO but could not affect the joyful and relaxed mood that prevailed during the whole event. In general, jury sessions, examinations, coordinations and other IMO related events were well organized and proceeded smoothly. Accommodations, food, recreational facilities, transportation and communication means, meeting facilities and other material resources made available for the IMO participants were all first class. The efficiency, friendliness and exceptional hospitality demonstrated by our Mexican hosts were also remarkable.

Each of the participating countries, other than the host, was invited to submit some original and interesting problems several weeks in advance. The problems are chosen from the general areas of algebra, combinatorics, geometry and number theory. They should require a high degree of ingenuity but have to be formulated and have solutions within the context of high school mathematics. A very knowledgeable Problem Selection Committee, provided by the host country, sorted through all of the problems which had been submitted by 42 of the participating countries and provided a short list of 27 problems; 5 algebra, 8 combinatorics, 7 geometry and 7 number theory.

The IMO examination consists of 6 problems. One of the first and most important responsibilities for the team leaders upon arrival at the jury site was the final selection of the 6 problems. After two or three sessions of intense but well organized jury meetings per day (July 9 and 10) the arduous job of reaching consensus on the 6 problems was completed. The next two days of jury meetings, before the move back to Mérida on July 14th, were used to discuss and approve the official translations of all of the problems and to establish general guidelines for the problem coordinators. The actual contest was held on July 13th and 14th with contestants having four and one-half hours to solve 3 of the selected problems on each day. Contestants' solutions to each of the 6 problems were graded out of 7 marks for a maximum possible score, per contestant, of 42 points.

Following IMO traditions, the 6 selected problems consisted of two that the jury roughly perceived as easy, two medium and two hard. The supposedly easy problems were then placed as problems 1 and 4 and the supposedly hard problems as 3 and 6. The following table shows that the assessments of the IMO jury about the selected problems were generally correct with some exceptions.

	DAY 1			DAY 2		
Problem number:	1	2	3	4	5	6
Maximum score:	7	7	7	7	7	7
Number of contestants:	513	513	513	513	513	513
Average score	2.61	3.05	0.91	3.76	2.17	1.35
Standard deviation:	2.94	2.98	2.26	3.12	2.97	2.30

The relative degrees of difficulty between the problems on Day 1 and between the problems on Day 1 and Day 2 were not as expected.

The host country put together a formidable team of more than 80 Problem Coordinators. They included several well known IMO-problems experts, math professors, former IMO contestants and a large number of very talented and knowledgeable young mathematicians. The high quality, particularly the efficiency and fairness of the coordinators was recognized by many of the participants.

The outstanding work done by our Deputy Leader, Dorette Pronk, and our Deputy Observer, Adrian Tang, was one of the main reasons for the success of the 2005 Canadian Team. They carefully prepared for the meetings with problem coordinators and eloquently presented the Canadian contestants' solutions.

Gold medals were awarded to all contestants with scores from 35 to 42, silver medals to those with scores from 23 to 34 and bronze medals to those with scores from 12 to 22. A total of 42 gold, 79 silver, and 128 bronze medals were awarded at the 2005 IMO.

The following table provides some comparative data for the last five years.

IMO YEAR:	2001	2002	2003	2004	2005
Number of perfect scores:	4	3	3	4	16
Minimum score for a gold medal:	30	29	29	32	35
Minimum score for a medal:	11	14	13	16	12

The relative low minimum score needed for a medal was not too significant. It could be attributed to the addition of many low individual scores that arose by the participation of several new countries with limited IMO expertise. The increases in the number of high scores, at least partially, may be a result of a significant raise of the competitive level of the participants. This trend in the direction of higher scores may continue for the coming years. Several internet math problems clubs, some of them recently created, have greatly contributed to the currently fast growing interest of groups of students toward the IMO. Larger numbers of motivated and sufficiently talented students from more countries can now easily obtain and share enough information and materials to learn and train to an IMO competitive level rarely reached outside the few most experienced and developed IMO participants. Math problems related publications, training camps and trainees have also considerably grown in number and improved in quality. Some of the strongest trainees in our training camps showed remarkably high levels of knowledge and expertise acquired not only through previous camps and math contests but also through the internet and interchanges with other fellow students. Finding good training materials within IMO boundaries, interesting and relatively unknown to some of our best trainees is becoming an increasingly hard and more specialized task. The following table summarize the results of our Canadian teams for the last six years.

CANADIAN IMO TEAM RESULTS (2000-2005)					
YEAR	SCORE	MEDALS			PLACE
		G	S	B	
2005	132	1	2	2	19 / 91
2004	132	1	0	3	21 / 85
2003	119	2	0	3	12 / 82
2002	142	1	3	1	12 / 84
2001	100	1	0	4	24 / 83
2000	112	1	2	1	17 / 82

The six members of the 2005 Canadian team were **Lin Fei**, Don Mills Collegiate Institute, Toronto (Ontario); **Elyot Grant**, Cameron Heights Collegiate Institute, Kitchener (Ontario); **Yang (Richard) Peng**, Vaughan Road Academy, Toronto (Ontario); **Dong Uk (David) Rhee**, McNally High School, Edmonton (Alberta); **Peng Shi**, Sir John A. MacDonald Collegiate Institute, Toronto (Ontario); and **Yufei Zhao**, Don Mills Collegiate Institute, Toronto (Ontario).

The students did extremely well with a Gold Medal awarded to Yufei Zhao, Silver Medals to Yang (Richard) Peng and Peng Shi, and Bronze Medals to Elyot Grant and Dong Uk (David) Rhee.

The 2005 Canadian IMO team extended the sequence of excellent performances from recent years. For the sixth year in a row Canadian contestants achieved gold medals and also for the sixth time in a row our team score was one of the 25 highest in the event. I am very proud of our students' performance at the 46th IMO. They not only succeeded academically but they were also excellent representatives of the Canadian youth at the event. Our students quickly became a truly popular group among their peers in Mérida, always cheerful, united and cooperative. Their relation with the adult members of the team was always very friendly, respectful and courteous. They all worked very hard to succeed, and each of them should be congratulated for their personal achievements and for their contribution to the success of the team.

Although the IMO is an individual competition, the following table provides information on the some of the "team" results for 2005 IMO.

	COUNTRY	SCORE
1	China	235
2	USA	213
3	Russia	212
4	Iran	201
5	South Korea	200
6	Romania	191
5	Taiwan	190
8	Japan	188
9	Hungary	181
9	Ukraine	181
11	Bulgaria	173
12	Germany	163
13	United Kingdom	159
14	Singapore	145
15	Vietnam	143

	COUNTRY	SCORE
16	Czech Republic	139
17	Hong Kong	138
18	Belarus	136
19	Canada	132
20	Slovakia	131
24	Italy	120
25	Australia	117
27	Poland	105
31	México	91
32	France	83
33	Brazil	82
36	India	81
38	New Zealand	77
47	Netherlands	62
61	Sweden	42

The success of the 2005 Canadian IMO team would not be possible without the significant support from the Canadian Mathematical Society; NSERC PromoScience; the Ontario Ministry of Education; Alberta Learning; Nova Scotia Department of Education; the Newfoundland and Labrador Ministry of Education; the Quebec Ministry of Education; the Northwest Territories Ministry of Education; the Saskatchewan Ministry of Education; Sun Life Financial; the Samuel Beatty Fund; Maplesoft; Centre de recherches mathématiques; the Fields Institute; the Pacific Institute for the Mathematical Sciences; the Department of Mathematics and Statistics, University of Calgary; the Department of Mathematics and Statistics, University of New Brunswick at Fredericton; the Department of Mathematics and Statistics, University of Ottawa; le département de mathématiques, Université du Québec à Montréal; the Department of Mathematics, University of Toronto; the Centre for Education in Mathematics and Computing, University of Waterloo; the Department of Mathematics, Wilfrid Laurier University; the Department of Mathematics and Statistics, University of Winnipeg; the Department of Mathematics and Statistics, York University; and the Department of Mathematics and Statistics, Dalhousie University.

I wish to acknowledge the valuable support provided by York University for the Winter 2005 IMO Training Seminar, by the Banff International Research Station for the Summer 2005 IMO Training Seminar and by many colleagues like Ed Barbeau, Ed Wang, Andy Liu, Neal Madras, Igor Poliakov, Elena Braverman and Paul Ottaway for the team's training session. I also wish to recognize the excellent guidance and leadership provided by Bill Sands (Chair – IMO Committee) and Graham Wright (CMS Executive Director). Thanks to their effectiveness and seemingly infinite reserves of enthusiasm, energy and patience, our IMO 2005 experience was not only successful but also smooth and enjoyable.

The 47th International Mathematical Olympiad will take place in Ljubljana, Slovenia, from July 6 to 18, 2006.

"I remember IMO 2005 not only for its mathematics, but more importantly, for the wonderful social experience. We will never forget the intense battles with other teams on the foosball table, the frequent abduction of our team mascot Can-Moo, and the late-night reading of the new Harry Potter book during the evening of the hurricane (with a copy apparently "borrowed" from the Icelandic team). We met many students from around the world with incredible talents; there were polyglots, pianists, and a few masters of martial arts – definitely defying the "math nerd" stereotype. We overcame our culture differences, and we shared stories, played games, and made lasting friendships. For me, perhaps the most difficult part of the trip was leaving it at the end. Tears almost dropped from my eyes as I stepped into the departure gate of the Mérida airport. The medal I received is for others to see, but memory of the experience is for me to cherish."

Yufei Zhao, Winner of a Gold Medal at the 2005 IMO

REPORT ON THE 2005 INTERNATIONAL MATHEMATICAL OLYMPIAD IN MÉRIDA, MEXICO

by Elyot Grant, Samuel Beatty Contestant to the 2005 IMO

Attending the 46th annual International Mathematical Olympiad in Mérida Mexico has been one of the most unique and memorable experiences of my life. Not only was I able to take part in a prestigious international competition, but I was also given the opportunity to connect with other mathematics students from around the world while experiencing the Mexican culture first hand. In this report, I hope to share some of these remarkable experiences from the perspective of a contest participant.

The International Mathematical Olympiad (IMO) is one of a family of annual academic olympiads for high school students (the others are in biology, physics, chemistry, computer science, and astronomy). Each country may send up to six participants, who must be of age 19 or less and attending high school. This year there were about 90 countries participating. The contest itself consists of two papers written on two consecutive days, each with three difficult mathematical problems and a time limit of 4.5 hours. The questions demand creativity and ingenuity in their solutions and require detailed justification and complete explanation for full credit. The competition takes place during mid-July annually and each year, the contest takes place in a different city somewhere around the world.

Canada offers a wide variety of contests available for students at various grade levels. The top-scoring students can be invited to a series of training camps, which help prepare students for the tougher math competitions. A handful of the top students in Canada are given an invitation to write the Canadian Mathematical Olympiad--Canada's toughest contest--and some of the top contenders write the USA and Asian-Pacific Olympiads as well. The scores and rankings from these contests are tabulated and evaluated by the team selection committee, and Canada's six students for the IMO are chosen.

In June, we flew out to Banff, Alberta for a two week IMO training camp, which consisted of daily lectures, problem solving sessions, and mock Olympiad papers. The training sessions were instrumental in helping the team learn various advanced problem solving techniques (which we actually used when writing the IMO paper). They also provided a little bit of a confidence boost. For once, I could actually see myself solving problems of IMO difficulty. The training camp was perfect preparation for the IMO.

We left Banff after training feeling optimistic and ready for the competition. A few flights later, we were in Mérida, all set for the contest. The first evening and second day had few activities planned, but were instead set aside to give the teams a chance to lose their jetlag and mentally prepare for the contest papers. We met up with some other teams, played games, and really just chilled in our hotels for a day. We were bussed to an old Mexican theatre during the second night, and opening ceremonies were held. After a few welcoming speeches given in Spanish (a language that only our team leader, Dr. Felix Recio, could understand), each team was given a chance to walk on the stage and receive a few seconds of applause. Some teams goofed around on stage, others threw out pins and gifts, and many simply walked across the stage. It was a nice way to start the contest.

Although the IMO is about nine days long, the contest is always written early during the week to allow enough time for the papers to be marked and coordinated. Days three and four were contest days. Each contest started at 9:00 in the morning and finished at 1:30 in the afternoon, so we had to wake up quite early to get ready. The paper itself was written in three large rooms of a convention centre, with two members of each team being seated in each room. Each contestant was given a large desk to work on, an enormous stack of answer paper to write on, a boxed lunch to munch on during the contest, and large signs that we could hold up to request a bathroom break or a water bottle. The four and a half hours really seemed to just flash by, as solving Olympiad-level problems can get quite intense.

The problems for the IMO are chosen in a very complicated selection process. Potential problems for the IMO are submitted by different countries and assembled into a long list, and from them, a shortlist of about thirty problems is selected by the IMO committee. After this, the problems are voted on until the final six are chosen for the olympiad paper. The problems are designed to be of varying difficulty level and from many different branches of mathematics (including algebra, geometry, and such). I'll give a brief description of each of the six problems, so the uninterested can skip the next few paragraphs.

Question one was an interesting problem in that it was selected to be the easiest problem on the paper, but turned out to be very difficult to solve for many contestants. It was a standard geometry problem involving a few triangles, and it had a very simple, elegant solution using vectors that many students failed to see. There were many other complicated solutions using geometric transformations, spiral similarities, and trigonometry, but these were quite difficult to obtain and often required several pages of arguments. Although the vector solution was simple and almost obvious, it was overlooked by a number of participants, probably because vectors are not commonly used in the solution of olympiad-level geometry problems (most of our training materials had us solving problems using much more complicated techniques). Fortunately, most of the Canadian team solved this problem somehow, although a few of us lost points because of messy or incomplete solutions.

The second problem was definitely the easiest of the first day, and was a simple sequence problem that could be solved using deductive arguments. There was really only one solution to this problem, and it was a simple, step-by-step analysis of given facts. Most of our team did quite well on this one.

The third problem was the toughest challenge of the entire olympiad, as few contestants were able to solve it completely. It demanded the proof of a cyclic, three-variable inequality. I was actually surprised that this question was even selected for the IMO, as such problems usually can be solved in an hour or so without much ingenuity using a technique known as Muirhead-Bashing (named after the algebraic formula--the Muirhead Inequality--which is used). Muirhead-Bashing is a form of what us Canadians like to call "grunging", which means solving a problem in an ugly, tedious, long, and inelegant way, but still getting the job done (Americans refer to this technique as "dumb-assing"). Another form of grunging is the use of messy coordinates or complex numbers to solve geometry problems. Muirhead-Bashing has recently gained a lot of popularity (especially on the Internet) as a technique used to solve cyclic 3-variable inequalities. The Muirhead solution worked perfectly on this problem, as long as the student writing up the proof made no errors in the multiple pages of algebra that needed to be worked out. I actually know of students who have invented their own notation to help make Muirhead-Bashing less messy. A few members of our team who were experienced in this technique gave it a try, and two solved the question (although one lost some marks because of an error). The rest of us didn't do so well. There were, in fact, some very elegant solutions to this problem using other well-known inequalities, but few students managed to find them.

Problem four was an interesting number theory problem that had only one solution that was very easy to understand and explain, but relied on one small but crucial observation that was not so easy to see. This was one of those questions where you either see it, or you don't. Most of the scores on this problem were either perfect, or close to zero.

Question five was a geometry problem that was much tougher than the geometry problem of the previous day. Given a quadrilateral with a few known properties and moveable line on it, we had to prove that a certain family of circles all passed through a common point. This problem didn't appear to be very difficult at first glance, but it turns out that the biggest challenge of this problem is determining exactly where this common point lies. A variety of solutions to this problem were given, and most of them weren't too complicated, but this problem was indeed quite tough. A few members of our team did quite well on this one, but a lot of us got zero.

The sixth problem was a combinatorics problem that had a tough, complicated, and long solution. Given an unspecified number of students writing a contest of six questions and a statement about how many times each pair of problems was solved, we had to prove that more than one student solved five problems. The strangest part about this problem was that the statements given in the problem were seemingly unconnected to the result that we had to prove. It was easy to make discoveries about the problem from the given information, but one never knows whether such discoveries will actually lead to a solution. Many contestants wrote over ten pages of solution for this problem, sometimes receiving very few, if any, marks for their work. The official solution involved a bit of modular arithmetic, and the proof itself could be either worked out combinatorially or solved algebraically using linear systems.

For those interested, a much more detailed analysis of each problem and its solution can be found online at many websites such as **www.mathlinks.ro** and **www.artofproblemsolving.com**.

After each day of contest writing, we would each sit down with our deputy leader Dorette Pronk and observer Adrian Tang and discuss our solutions to the day's problems, so that they could prepare to defend our solutions when confronted by the coordinators that evaluate us. The next few days of the olympiad were quite stressful for many of the contestants, as we eagerly awaited to find out how many points our solutions would receive. Even after we knew the scores, we still couldn't relax, because we didn't know what the cutoff scores would be for gold, silver, and bronze medals (which are given in a ratio of approximately 1:2:3, with about half of all participants receiving medals).

After the contest days, the Olympiad is really over for the contestants, so we had a lot of time to relax and hang out with olympians from other countries. We went on many tourism excursions to the Mexican pyramids and beaches, which were quite a lot of fun. We also played a lot of games like soccer, table tennis, and foosball. We even played card games like poker, mafia, and mao to pass the time. Of course, many contestants were eagerly discussing the problems and their solutions, and many new friendships were made.

The most unusual aspect of this year's IMO was the hurricane that struck Mérida late in the second week. Hurricane Emily forced us to cut our travel time short, pack up all of our belongings, and stay in the basement of the hotel for a day until it passed. The hotel staff taped up all of the windows and tied all of the cabinets shut. We actually had a lot of fun at what became known as the "hurricane slumber party". Most people stayed up all night playing cards and games and just chilling with the other IMO people. Fortunately, the worst part of the hurricane went north of Mérida, and our hotel rooms stayed in good shape.

Fortunately, we were still able to have our closing ceremonies, which involved a few farewell speeches and the presentation of the medals. Canada received one gold, two silver, and two bronze medals, and we ranked 19th overall. The final evening was of course a huge party, and quite sad in a way, because many of us had to say goodbye to our new friends from faraway countries.

Overall, the IMO was amazing. I would definitely do this again, even if I wasn't competing. Of course, a huge thanks goes out to the Canadian Math Society and all of their sponsors, namely: the **Samuel Beatty Fund**; the provincial governments; SunLife Finacial; the research institutes and the schools and teachers who make this possible, as well as the many profs and students who work to train Canadian students for the competition. It's a remarkable, unforgettable experience that has left me with many fond memories and lasting friendships. It truly has been an honour to have been selected to attend such a fantastic event.

EMPLOYMENT OPPORTUNITY

UNIVERSITY OF OTTAWA DEPARTMENT OF MATHEMATICS AND STATISTICS

The Department of Mathematics and Statistics of the University of Ottawa invites applications from recent Ph.D.s for one Postdoctoral fellowship.

Applications in all areas of mathematics and statistics will be considered but preference will be given to applications in areas represented in the department. Information about the department can be found at **http://www.science.uottawa.ca/mathstat**

This fellowship is open to candidates of any nationality. The selection will be based on the candidate's potential for research and teaching.

This fellowship is for one year, with a possible renewal for a second year. The annual salary is $40,000. Duties include research and the teaching of two one-semester courses. Applicants should send a curriculum vitae, a research plan, and arrange for three confidential letters of recommendation, with one addressing teaching, to be sent to Professor Mayer Alvo, Chairman, Department of Mathematics and Statistics, University of Ottawa, Ottawa, ON Canada, K1N 6N5 by **January 15, 2006**. Applicants are also encouraged to include up to three copies of their most significant publications.

Employment equity is University policy and the University strongly encourages applications from women.

Le Département de mathématiques et de statistique de l'Université d'Ottawa met au concours un poste de chercheur postdoctoral.

Ce poste de recherche et d'enseignement de deux cours (un par session) sont pour une période d'une année avec possibilité d'un renouvellement pour une autre année. Le salaire annuel est de 40,000$.

Ce poste est ouvert aux candidates et candidats de toutes nationalités. Les candidates et candidats de tout domaine des mathématiques ou de la statistique seront considérés mais la préférence ira aux domaines représentés au département. La sélection se fera selon la qualité du dossier.

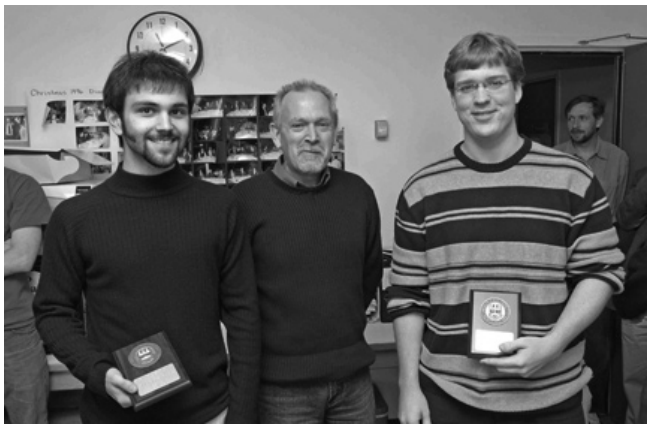
Les candidates et candidats doivent avoir obtenu récemment un doctorat en mathématiques ou en statistique et doivent faire parvenir leur dossier de candidature au directeur du département, le Professeur Mayer Alvo, Département de mathématiques et de statistique, Université d'Ottawa, Ottawa ON, Canada, K1N 6N5, au plus tard le **15 janvier 2006.** Ceux-ci doivent comprendre un curriculum vitae, un projet de recherche et trois lettres confidentielles de recommandation dont une concernant l'enseignement. Nous encourageons les candidates et candidats à joindre à leur dossier trois tirés à part de leurs contributions les plus importantes.

Pour obtenir des informations supplémentaires sur le département, vous pouvez consulter: **http://www.science.uottawa.ca/mathstat**

L'Université a une politique d'équité en matière d'emploi. Les femmes sont fortement encouragées à poser leur candidature.

APICS

Memorial's student mathematicians have scored again at an Atlantic competition. Memorial finished first in the **Atlantic Provinces Council on the Sciences** (APICS) competition out of a field of 22 teams. The team of Andrew Critch and Neil McKay were in a league of their own, scoring 55 marks (out of a possible 80). The second place team had 40.



The APICS math competition is a mathematical problem solving team competition written at the annual APICS Mathematics and Statistics meeting, held this year at Acadia University Oct. 21-23.

MATH IN MOSCOW - MATH À MOSCOU

WINNERS OF THE FALL 2005 COMPETITION

We are happy to announce that the winners of the NSERC-CMS Math in Moscow scholarships for the Fall 2005 competition are **Nithum Thain** from Queen's University and **Daniel Fiorilli** from Université de Montréal. They will attend the Winter semester 2006 at the Moscow Independent University.

Nous avons le plaisir d'annoncer que les récipiendaires des bourses CRSNG-SMC du concours de l'automne 2005 sont **Nithum Thain** de Queen's University et **Daniel Fiorilli** de l'Université de Montréal. Ils passeront le trimestre d'hiver 2006 à l'Université Indépendante de Moscou.

Christiane Rousseau, Université de Montréal

MESSAGE DU DIRECTEUR ADMINISTRATIF

Graham P. Wright

NOUVELLES ORIENTATIONS

À la Réunion d'hiver 2005, à Victoria, le conseil d'administration et le comité des publications discuteront d'une nouvelle structure de prix pour nos périodiques, qui entrerait en vigueur en 2007 ou en 2008. Les recettes d'abonnement aux périodiques de la SMC représentent de loin la plus grande source de revenus annuels de la SMC, et tout changement aux prix des périodiques doit se faire avec une extrême prudence et en tenant compte des répercussions possibles de ces changements sur les revenus.

La structure proposée regrouperait le JCM, le BCM, le *CRUX with MAYHEM* et les *Notes de la SMC* à un prix très concurrentiel. Pour les abonnés actuels du JCM et du BCM, le prix pour les quatre périodiques serait *inférieur* au prix actuel du JCM et du BCM. Les bibliothèques abonnées seulement au BCM auraient deux options : payer un peu plus pour recevoir beaucoup plus, à la fois en format *électronique et papier*; ou payer un peu plus que le prix actuel du BCM, mais obtenir *l'accès électronique aux quatre périodiques*. Les personnes qui sont abonnées au *CRUX with MAYHEM* seulement auraient toujours cette option, mais pourraient aussi s'abonner aux quatre périodiques en même temps.

En adoptant cette structure, semblable à celle d'autres sociétés et maisons d'édition, la Société augmenterait la visibilité du BCM et du *CRUX with MAYHEM*, et, dans une moindre mesure, celle du JCM.

De plus, nous pourrions organiser une grande campagne d'information auprès des bibliothèques, des départements de mathématiques et des agents d'adhésion pour les informer du changement et des avantages de la nouvelle structure. La SMC serait ainsi en mesure d'offrir de meilleurs services à tous ses abonnés.

Le modèle proposé sera publié sur le site de la SMC dès que le conseil d'administration et le comité des publications auront eu l'occasion de l'étudier. Pour toute question ou tout commentaire à ce sujet, veuillez écrire à **directeur@smc.math.ca.**

Depuis quelques années, la participation aux Réunions d'été et d'hiver de la Société augmente constamment. Plusieurs réunions conjointes sont également prévues au cours des années à venir.

Des représentants de la SMC et de la Société mexicaine de mathématiques (SMM) se sont rencontrés à Mexico le 24 octobre dernier pour aborder la possibilité de tenir des réunions conjointes. Ce fut une rencontre très productive, et l'on s'attend à ce que les réunions conjointes SMC/SMM s'ajoutent aux Réunions ordinaires d'été et d'hiver de la SMC. Moyennant leur approbation par le conseil d'administration, la première réunion conjointe se tiendrait en septembre 2006, au Mexique, et la seconde, à l'automne 2009, probablement à Toronto ou à Vancouver.

La Réunion d'été 2007 de Winnipeg sera une réunion conjointe SMC-MITACS. La Réunion d'été 2008 sera le deuxième congrès Canada-France et se tiendra du 2 au 6 juin à Montréal. Elle sera organisée conjointement par la SMC, la Société canadienne de mathématiques appliquées et industrielles, le Réseau MITACS, la Société mathématique de France et la Société de mathématiques appliquées et industrielles de France. La Société statistique du Canada et la Société française de statistique se réuniront à Ottawa juste avant la réunion conjointe à Montréal.

La SMC envisage aussi de tenir une réunion conjointe avec l'AMS, une autre avec les sociétés mathématiques d'Australie et de Nouvelle-Zélande, ainsi qu'une autre, peut-être, avec l'Inde.

Comme nous l'avons écrit dans le dernier numéro des *Notes de la SMC*, la Société entreprend une grande campagne de financement, sous la direction du président, H.E.A. (Eddy) Campbell (Memorial), avec l'aide d'un partenaire spécialiste, les Advancement External Services (Queen's), et du personnel du bureau administratif d'Ottawa. La SMC nommera en outre un coordonnateur ou une coordonnatrice du développement, qui aura pour principales tâches d'élaborer du matériel pertinent, d'organiser des visites pour les donateurs potentiels et de coordonner tous les aspects de la campagne.

Nous avons déjà communiqué avec plusieurs membres pour dresser une liste de commanditaires potentiels et, dans la mesure du possible, des personnes sensibles aux objectifs et aux besoins de la SMC. L'appui des membres étant un élément essentiel de toute campagne de financement réussie, nous communiquerons avec eux en 2006 pour leur demander d'aider leur société.

L'année 2005 a été très productive. Comme vous l'avez sans doute déjà constaté, nos nouveaux projets nous permettront de présenter, tant à nos membres qu'à nos abonnés, des services et des activités mathématiques de haut niveau.

MESSAGE DU VICE-PRÉSIDENT - provinces de l'ouest

Ed Perkins
Université de la Colombie-Britannique

Le 21 mars 2005, une équipe internationale d'experts a évalué la Station de recherche internationale de Banff (SRIB) au nom de quatre gouvernements et de leurs agences scientifiques. Une imposante délégation internationale de mathématiciens, dont les directeurs de l'AARMS, du CRM, de l'Institut Fields et du PIMS, le président de l'Institut Clay, le directeur scientifique du réseau MITACS, ainsi que les présidents de la SMC et de la Société statistique du Canada, s'est réunie pour défendre la cause de la SRIB. Toute personne qui a déjà participé à une activité de la SRIB ne sera pas étonnée d'apprendre que l'évaluation a été positive à tous points de vue. À la suite de cet exercice, la SRIB a obtenu :

i) le plein financement accru de la NSF, qui passera à 2,64 millions ($US) par année [à vérifier absolument] pendant cinq ans à compter de 2006;
ii) une hausse de financement de l'Alberta Science and Research Authority (ASRA), pour un total de 3,42 millions de dollars sur cinq ans;
iii) une promesse de financement du Conseil national des sciences et de la technologie du Mexique (CONACYT) de 0,55 million sur cinq ans;
iv) une prolongation de la Subvention d'accès aux installations majeures du CRSNG – 0,5 million sur un an jusqu'en 2007.

Un tel apport de fonds étrangers aux mathématiques canadiennes est une première. La SRIB est une ressource très précieuse pour les mathématiques au Canada, et elle pourrait avoir besoin de notre appui à une étape de son développement qui semble déterminante.

Pourquoi cet appui enthousiaste? Parce que l'expérience mathématique que procure la SRIB est stimulante et passionnante. J'ai eu la chance d'organiser avec des collègues un atelier de cinq jours à la SRIB en 2003, l'année de son ouverture. Les démarches nécessaires à l'organisation d'une telle activité sont assez simples : il suffit de présenter une description brève et convaincante de l'atelier et de son contenu, et d'obtenir un engagement préliminaire de quelques participants clés. Selon mon expérience – qui semble généralisée –, il est facile de convaincre des candidats de choix de participer à une activité mathématique dans les Rocheuses canadiennes. La configuration des lieux limite la participation à une quarantaine de personnes, ce qui permet à tout le monde de se connaître. Durant l'activité comme telle, le personnel de la Station est si efficace que les organisateurs peuvent même participer à leur propre atelier ou colloque et en profiter pleinement. La date limite pour présenter un projet d'atelier de cinq jours et le 14 octobre; au moment où vous lirez ces lignes, vous aurez donc dix mois pour préparer une demande pour 2008. Par contre, il est aussi possible d'organiser des activités d'une fin de semaine, des groupes de recherche ciblée et des visites d'équipes de recherche; pour ces types d'activités, les demandes sont acceptées en tout temps. Il est préférable de réserver au moins six mois à l'avance, mais si vous avez du jeu dans les dates, quatre mois d'avance peuvent suffire. Il est certain que les universités albertaines sont avantagées pour les colloques d'une fin de semaine, mais c'est un avantage qui leur revient sans doute puisque le gouvernement de cette province fournit le tiers du budget de fonctionnement de la Station. J'hésite un peu à vous donner beaucoup plus d'information sur les groupes de recherche ciblée et les visites d'équipes, car trop de publicité pourrait en réduire l'accessibilité, et ce serait dommage, car ce sont des occasions extraordinaires. Les visites se déroulent comme suit : un petit groupe de deux à 4 chercheurs se réunit pendant une ou deux semaines pour travailler sur un problème précis, dans un lieu enchanteur, sans interruptions, hébergement et repas compris. Il y a deux ans, j'y suis allé en été avec deux collaborateurs de l'Est des États-Unis et d'Israël. Nous avons travaillé à un projet auquel nous travaillions deux par deux depuis trop longtemps. On accomplit beaucoup à l'abri de toute distraction : nous avons non seulement terminé notre premier projet, mais nous avons aussi réussi à lancer un nouveau programme (toujours en cours) avec une personne qui participait à un autre atelier de cinq jours durant notre séjour. La formule des groupes de recherche ciblée est semblable, sauf qu'elle réunit jusqu'à huit participants pendant une ou deux semaines. Mon collègue Ander Holroyd a participé à un tel groupe en 2003; il a tellement aimé l'expérience qu'il en organise un autre en 2006. Je me permets de citer Yuval Peres du département de statistique de l'Université de la Californie à Berkeley, lauréat du prix Loeve et l'un des participants de ce groupe : « Mes deux semaines à la SRIB ont donné l'élan à une bonne partie du travail que j'ai accompli dans les 18 mois qui ont suivi. À mon avis, la SRIB est l'endroit le mieux organisé et le plus inspirant que je connaisse pour tenir des rencontres à caractère mathématique. » La souplesse des horaires permet aux chercheurs de se concentrer sur les mathématiques, que ce soit dans une salle de réunion ou un sentier de randonnée.

À la suite de l'évaluation scientifique de la SRIB, quelques changements ont été apportés dernièrement aux lignes directrices, pour le second cycle de financement, et ces changements auront une incidence sur la façon de présenter des demandes à la SRIB. Le nombre de semaines de fonctionnement de la Station, fixé à 40 par année les trois premières années, passera à 44 en 2006, puis à 48 après 2007. La concurrence se faisant de plus en plus vive à mesure que les chercheurs du monde entier découvrent l'endroit, c'était une simple réponse à la demande. Il n'est plus obligatoire non plus que chaque atelier soit organisé par au moins un canadien et un américain, ce qui a pour effet d'accroître la participation internationale et peut-être aussi d'élargir la portée scientifique de la Station. Faisant figure de souris à côté de l'éléphant américain, nous craignons que la participation canadienne aux activités de la SRIB ne diminue. De toute évidence, il est important que la communauté mathématique canadienne continue d'organiser des activités à la SRIB et d'y participer avec le même enthousiasme. Je vous incite donc à continuer de présenter des demandes. Il arrive souvent que d'excellents projets soient refusés en raison de la concurrence élevée ou de la tenue d'une autre rencontre semblable en même temps, mais que ces projets soient financés l'année suivante. L'équilibre géographique et scientifique entre les organisateurs est au nombre des critères d'évaluation, même si la qualité scientifique de l'activité demeure évidemment le critère principal du conseil consultatif scientifique et du comité du programme de la SIRB. Il reste donc peut-être quelques moyens d'équilibrer les choses. Le conseil consultatif scientifique est un grand groupe (32 personnes

pour l'instant), et sa portée scientifique est large. Ses membres commentent par voie électronique les demandes dans leur domaine de spécialité. Le comité du programme (un sous-comité du conseil consultatif comptant 10 membres) est présidé par le directeur scientifique et se réunit une fois l'an pour étudier les demandes et prendre des décisions basées sur les commentaires de tous les membres du conseil et leurs propres délibérations.

La participation du Mexique à la SRIB en fait une entreprise véritablement nord-américaine, non seulement de par l'engagement financier du Conseil national des sciences et de la technologie du Mexique et la participation d'administrateurs des trois pays au comité exécutif, mais aussi de par le soutien financier de l'Université nationale autonome du Mexique (UNAM) aux Mexicains qui participent aux activités de la SRIB. Les sociétés mathématiques du Canada et du Mexique s'efforcent en outre d'intensifier la collaboration entre les communautés mathématiques des deux pays. Le congrès de la Société mexicaine de mathématiques (SMM) d'octobre dernier présentait une séance conjointe SMC-SMM donnée par Tom Salisbury (Université York et président élu de la SMC), Gordon Slade (UBC) et Alejandro Adem (UBC, directeur adjoint du PIMS). Les représentants des deux sociétés se sont rencontrés pour discuter d'une éventuelle réunion conjointe.

Quel est le lien entre les instituts mathématiques du Canada, et le PIMS en particulier, et la SRIB? Le conseil d'administration du PIMS gère les finances de la SRIB et assume les responsabilités financières associées à son fonctionnement. Par exemple, un contrat de plusieurs millions de dollars a été conclu entre la SRIB et le Banff Centre, qui gère le complexe d'hébergement et de restauration qui accueille les participants aux activités de la SRIB. Ce contrat est signé par le directeur du PIMS. Les directeurs du PIMS et du MSRI siègent au comité exécutif aux côtés des directeurs du Réseau MITACS (qui finance aussi la SRIB) et de l'UNAM, et du directeur scientifique de la SRIB. C'est ce comité qui supervise la gestion de la SRIB. Par contre, la SRIB prend toutes ses décisions scientifiques indépendamment de tout autre établissement. Aucun directeur d'un institut n'est membre du conseil consultatif. Les conseils d'administration du PIMS et du MSRI ne font plus de recommandations particulières au comité du programme, et toutes les activités seront choisies de la même façon. C'est une ressource véritablement internationale, que nous avons la chance d'avoir tout près de chez nous.

La SRIB achève sa troisième année, sous le signe de la réussite : elle a accueilli plus de 200 activités auxquelles ont participé plus de 4 600 mathématiciens, statisticiens, informaticiens, physiciens, ingénieurs et spécialistes de nombreuses autres disciplines; elle vient de voir confirmer son financement pour 2006-2010 par les gouvernements de l'Alberta et des États-Unis, et elle vient de conclure une nouvelle entente avec le gouvernement mexicain. Mais alors, pourquoi cette inquiétude? En fait, ces préoccupations ne s'appliquent pas qu'à la SRIB, mais aussi à un investissement considérable de toute la communauté mathématique au cours des deux derniers exercices de réaffectation. Le financement accordé par le CRSNG à la SRIB pour ses trois premières années venait de la Subvention d'accès aux installations majeures (AIM). Ce programme est surtout destiné aux grands laboratoires qui facturent les utilisateurs pour récupérer une partie de leurs frais. Même le personnel du CRSNG admettait volontiers que ce n'était pas le programme idéal. À la création de la SRIB, les dirigeants du CRSNG ont déployé des trésors d'ingéniosité pour monter rapidement un mécanisme acceptable d'évaluation par les pairs dans le cadre de ce programme afin d'évaluer et de financer un jour un établissement unique en son genre avec des fonds internationaux et provinciaux. Pour la période 2006-2010, on espérait que le CRSNG emboîterait le pas aux gouvernements américain, albertain et mexicain, et accorderait un financement à plus long terme à la SRIB en réponse à sa demande de janvier 2005 au programme d'AIM et à l'excellente évaluation scientifique qui a suivi. Or, le CRSNG procède en ce moment à la restructuration d'un grand nombre de ses programmes, y compris ceux auxquels tous instituts font leurs demandes de financement, notamment la SRIB (pour 2006), tous les instituts mathématiques canadiens (en 2007) et au moins deux nouveaux instituts, l'un de physique, l'autre d'astronomie (probablement en 2006, mais d'autres pourraient s'ajouter en 2007 et au cours des années suivantes). Au moment d'écrire ces lignes, nous ne savons pas exactement quelles ressources seront versées dans cette enveloppe. Comme une bonne partie du financement des instituts provient des deux derniers exercices de réaffectation, on pourrait supposer que ces fonds appartiennent aux Comités de sélection des subventions de mathématiques et qu'ils devraient rester dans cette discipline. Un comité de liaison mathématiques/CRSNG a été créé pour donner suite aux inquiétudes du milieu. Encore une fois, nous avons la chance que Richard Kane en ait accepté la présidence. Pour la SRIB, il n'est pas clair en ce moment si ce sont les anciennes directives ou de nouvelles qui s'appliqueront à sa demande et à la visite de l'établissement en avril 2006. Il n'est sans doute pas très équitable de modifier les critères d'évaluation une fois la demande présentée et d'accompagner la demande d'un rapport de visite datant d'un an. Jusqu'à maintenant, le CRSNG a tenu compte des inquiétudes de la communauté mathématique, et ses dirigeants ont souvent cité la SRIB comme l'une de ses grandes réussites en faisant valoir ses réalisations scientifiques et son financement international et provincial. Nous croyons donc qu'il y a tout lieu d'être optimistes. Nous devons à tout le moins surveiller la situation avec grand intérêt et songer à faire connaître notre opinion au comité de liaison.

La liste de personnes à remercier pour la création et l'appui continu à la SRIB est très longue. J'aimerais mentionner en particulier les administrateurs de l'Université de l'Alberta et de l'Université de Calgary, qui ont convaincu le gouvernement albertain de financer le projet, et les dirigeants du CRSNG, de la NSF et de l'ASRA, qui ont compris le potentiel du projet et ont su trouver des mécanismes d'évaluation acceptables. Toutefois, la réussite de la SRIB repose en très grande partie sur deux membres de la communauté mathématique canadienne : Nassif Ghoussoub et Robert Moody. Le premier est à l'origine du concept et de la formule de financement « tri-gouvernementale », et le second veille à la bonne marche de la Station et à l'excellence de son programme scientifique depuis sa création, en tant que directeur scientifique fondateur. Pour leur dévouement inlassable à la réussite du projet, ils méritent nos remerciements les plus sincères.

CMS SUMMER 2006 MEETING

Host: University of Calgary
June 3-5
Westin Hotel, Calgary, AB
Meeting Director - Claude Laflamme (Calgary)
Local Arrangements - Tony Ware (Calgary)

PRIZES

Krieger-Nelson

Penny Haxell (University of Waterloo)

Excellence in Teaching

To be determined

PLENARY LECTURERS

Charalambos Aliprantis (Purdue University)
Steve Awodey (Carnegie Mellon University)
John Conway (Princeton University)
Nicole El Karoui (Ecole Polytechnique, Paris, France)
Alexander S. Kechris (California Institute of Technology)
Dave Marker (University of Illinois at Chicago)

SESSIONS

Category Theory
Org: Robin Cockett (Calgary)

Differential Equations and Dynamical Systems
Org: Elena Braverman (Calgary), Michael Y. Li (Alberta)

Discrete and Convex Geometry
Org: Karoly Bezdek (Calgary), Jozsef Solymosi (UBC)

Education Session, in conjunction with the Canadian Mathematics Education Study Group (CMESG)
Org: Peter Taylor (Queen's)

Game Theory / Number Theory in honour of Richard Guy's 90th birthday
Org: Richard Nowakowski (Dalhousie), Bill Sands, Hugh Williams, Robert Woodrow (Calgary)

L-functions, Automorphic Forms and Representation Theory
Org: Amir Akbary (Lethbridge), C. Cunningham (Calgary)

Mathematical Finance
Org: Len Bos, Anatoliy Swishchuk (Calgary)

Model Theory
Org: Patrick Speissegger (McMaster)

Positivity in Functional Analysis and Applications
Org: Charalambos Aliprantis (Purdue), Vladimir Troitsky (Alberta)

Recent Work in History of Mathematics
Org: Tom Archibald (SFU)

Set Theory and Infinitary Combinatorics
Org: Stevo Todorcevic (Toronto)

Symmetry in Geometry
Org: Ted Bisztriczky (Calgary), Ferenc Fodor (Szeged, Hungary; Calgary), Richard K. Guy (Calgary), Asia Weiss (York)

Contributed Papers
Org: To be determined

www.cms.math.ca/Events/summer06

RÉUNION D'ÉTÉ 2006 de la SMC

Hôte: Université de Calgary
du 3 au 5 juin
Westin Hotel, Calgary, AB
Directeur de réunion - Claude Laflamme (Calgary)
Logistique - Tony Ware (Calgary)

PRIX

Krieger-Nelson

Penny Haxell (Université de Waterloo)

Excellence in Teaching

à déterminer

CONFÉRENCIERS PLÉNIERS

Charalambos Aliprantis (Purdue University)
Steve Awodey (Carnegie Mellon University)
John Conway (Princeton University)
Nicole El Karoui (Ecole Polytechnique, Paris, France)
Alexander S. Kechris (California Institute of Technology)
Dave Marker (University of Illinois at Chicago)

SESSIONS

Théorie des catégories
Org: Robin Cockett (Calgary)

Équations différentielles et systèmes dynamiques
Org: Elena Braverman (Calgary), Michael Y. Li (Alberta)

Géométrie discrète et convexe
Org: Karoly Bezdek (Calgary), Jozsef Solymosi (UBC)

Session d'éducation, conjointement avec le GCEDM
Org: Peter Taylor (Queen's)

Théorie des jeux et des nombres en l'honneur du 90e anniversaire de Richard Guy
Org: Richard Nowakowski (Dalhousie), Bill Sands, Hugh Williams, Robert Woodrow (Calgary)

Fonctions L, formes automorphes et théorie de la représentation
Org: Amir Akbary (Lethbridge), C. Cunningham (Calgary)

Finance mathématique
Org: Len Bos, Anatoliy Swishchuk (Calgary)

Théorie des modèles
Org: Patrick Speissegger (McMaster)

Positivité an analyse fonctionnelle et applications
Org: Charalambos Aliprantis (Purdue), Vladimir Troitsky (Alberta)

Travaux récents en histoire des mathématiques
Org: Tom Archibald (SFU)

Théorie des ensembles et combinatoire infinie
Org: Stevo Todorcevic (Toronto)

Symétrie en géométrie
Org: Ted Bisztriczky (Calgary), Ferenc Fodor (Szeged, Hungary; Calgary), Richard K. Guy (Calgary), Asia Weiss (York)

Communications libres
Org: à déterminer

www.cms.math.ca/Events/summer06

CAIMS-MITACS 2006 JOINT ANNUAL CONFERENCE

York University, Toronto, ON, June 15-20, 2006

The 2006 joint Annual Conference of CAIMS*SCMAI and MITACS will be held at York University in Toronto, Canada from June 15-20, 2006. This conference will be a showcase of Canadian industrial and applied mathematics and the broad range of exciting collaborative research activities conducted by Canadian mathematical scientists.

INVITED SESSIONS: The meeting features a number of invited scientific sessions in the areas of Bioinformatics, Communication and Security in Ad Hoc Networks, Data Mining (joint with the Statistical Society of Canada), Fluid Dynamics (the 17th Canadian Symposium on Fluid Dynamics), Image Processing and Inverse Problems, Industrial Mathematics, Financial Mathematics, Nonlinear Dynamics in the Health Sciences, Operations Research and Optimization, Scientific Computing, Symbolic Computation and Visual Mathematics. For more information, visit: http://www.mitacs.ca/AC06

CALL FOR CONTRIBUTED PAPERS: The conference will also have a number of sessions of contributed papers in any area of applied or industrial mathematics, for which abstracts are invited. Interested speakers should submit a title and short (100 word) abstract to ac06@mitacs.ca by December 15, 2005 in order to be considered.

POSTER SESSION: In addition, a poster session will be held concurrently with the meeting. All conference participants are strongly encouraged to present posters. Information about submitting a poster will be available on the conference web site shortly. Prizes will be awarded to the top posters presented by students or postdocs.

SPONSORS: This conference is sponsored le Centre de recherches mathématiques Fields Institute for Research in Mathematical Sciences, Pacific Institute for the Mathematical Sciences and York University.

CONTACT: Any questions or requests for more information should be addressed by e-mail to ac06@mitacs.ca.

CAIMS SCMAI

MITACS

CONFÉRENCE ANNUELLE CONJOINTE SCMAI-MITACS

Université York, Toronto, ON, du 15 au 20 juin 2006

La conférence annuelle conjointe 2006 de la SCMAI*CAIMS et de MITACS aura lieu à l'Université York, à Toronto, Canada, du 15 au 20 juin 2006. Cette conférence mettra en vedette les mathématiques industrielles et appliquées au Canada ainsi qu'une vaste gamme de stimulantes activités de recherche coopérative menées par des scientifiques mathématiciens du Canada.

SÉANCES : La rencontre comprendra un nombre de séances scientifiques animées par des présentateurs invités dans les domaines suivants : Bioinformatique, Communication et sécurité dans les réseaux ad hoc, Exploration de données (conjointement avec la Société statistique du Canada), Dynamique des fluides (17e Symposium canadien sur la dynamique des fluides), Traitement des images et problèmes inverses, Mathématiques industrielles, Mathématiques financières, Dynamique non linéaire dans les sciences de la santé, Recherche et optimisation dans le domaine des opérations, Informatique scientifique, Informatique symbolique et Mathématiques visuelles. Pour plus d'information, visitez http://www.mitacs.ca/AC06

APPEL DE COMMUNICATIONS : La conférence comprendra également un nombre de séances de communications dans n'importe quel domaine des mathématiques appliquées ou industrielles. Les présentateurs intéressés sont priés d'envoyer un bref résumé (100 mots, avec titre) à l'adresse ac06@mitacs.ca au plus tard le 15 décembre 2005 aux fins de considération.

SÉANCE D'AFFICHES : De plus, une séance d'affiches se déroulera en concomitance avec la rencontre. Nous encourageons tous les participants à la conférence à présenter des affiches. Nous diffuserons sous peu des renseignements sur la soumission d'affiches dans le site Web de la conférence. Des prix seront décernés pour les meilleures affiches créées par des étudiants ou par des chercheurs de niveau postdoctoral.

COMMANDITAIRES : Cette conférence est commanditée par les organisations suivantes : Le Centre de recherches mathématiques, Fields Institute for Research in Mathematical Sciences, Pacific Institute for the Mathematical Sciences et Université York.

POUR NOUS JOINDRE : Si vous avez des questions ou si vous souhaitez obtenir plus de renseignements, veuillez écrire à ac06@mitacs.ca.

"Journal of Homotopy and Related Structures" (JHRS)

"Journal of Homotopy and Related Structures" (JHRS) is a fully refereed international journal dealing with homotopy and related structures of mathematical and physical sciences. JHRS intends to publish papers on homotopy in the broad sense, including works in established areas such as homological and homotopical algebra, K-theory, stable homotopy theory and cyclic homology, as well as in emerging areas such as noncommutative geometry and motivic cohomology. "Call for papers": We invite authors of significant and original research papers within the scope of the journal to submit papers for publication. Authors are also invited to visit the Web site of the journal for a longer list of journal interest areas, submission instructions, and copyright and subscription information.

"Journal of Homotopy and Related Structures" is located at A.Razmadze Mathematical Institute (`http://www.rmi.acnet.ge`) (M.Alexidze Str.1, Tbilisi 0193, Georgia) and is directed by its Editor-in-Chief (`hvedri@rmi.acnet.ge`). The journal is on the internet at URL: `http://jhrs.rmi.acnet.ge`

UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA

www.careers.ualberta.ca

NSERC University Faculty Award

The Department of Mathematical and Statistical Sciences, at the University of Alberta, is actively seeking to nominate a candidate for an NSERC University Faculty Award in the Fall 2006 competition.

The University Faculty Award was created by NSERC to encourage Canadian universities to appoint outstanding women and aboriginal researchers to tenure-track positions in science and engineering. Further information on the program can be found at the following web page: http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=c7

The nominee will have an excellent record of research and publication. We are particularly interested in candidates who work in a field related to an area of existing or emerging strength in the Department, although other areas will be considered. Some areas of research excellence, recently highlighted by the Faculty of Science, include algebra, functional analysis, fluid dynamics, statistics, mathematical biology, and scientific computing. The candidate will also have a strong commitment to and aptitude for teaching undergraduate students, and will be expected to supervise graduate theses.

This tenure-track appointment is scheduled to begin on or near July 1, 2007.

The closing date for applications is March 1, 2006. Early applications are encouraged. According to NSERC regulations, applicants must be Canadian citizens or permanent residents of Canada.

Ordinary Differential Equations

The Department of Mathematical and Statistical Sciences at the University of Alberta invites applications for a tenure track position at the Assistant Professor level, starting in July 2006, in the area of qualitative theory of differential equations and dynamical systems. The candidate should have a PhD in pure or applied mathematics, a strong record, excellent communication and teaching skills and leadership potential. The successful candidate must have a strong commitment to excellence in undergraduate and graduate education.

Preference will be given to applicants whose research expertise would complement and strengthen those of the differential equations and dynamical systems group in our Department. Areas of particular interest are qualitative theory of ordinary/delay/partial differential equations, control theory, mathematical biology, stochastic differential equations and random dynamical systems.

The closing date for application is January 15, 2006, or until a suitable candidate is found. Early applications are encouraged. For more information about the Department and the University of Alberta, please see the Department's web page: http://www.math.ualberta.ca

Algebraic Geometry

The Department of Mathematical and Statistical Sciences, at the University of Alberta, invites applications for a tenure-track position at the Assistant Professor level in Algebraic Geometry. We are looking for a person with a PhD, strong research record, excellent communication and teaching skills and leadership potential. The successful candidate must also have a strong commitment to excellence in undergraduate and graduate education.

All areas of Algebraic Geometry will be seriously considered. Current interest within the Department includes Hodge Theory, Algebraic K-Theory and Cohomological Methods.

The closing date for application is January 15, 2006, or until a suitable candidate is found. Early applications are encouraged. For more information about the Department and the University of Alberta, please see the Department's web page: http://www.math.ualberta.ca

Algebraic Groups and Applications

The Department of Mathematical and Statistical Sciences, at the University of Alberta, invites applications for a tenure-track position at the Assistant Professor level in Algebraic Groups and Applications. We are looking for a person with a PhD, strong research record and leadership potential as well as excellent communication and teaching skills. The successful candidate must also have a strong commitment to excellence in undergraduate and graduate education.

All aspects of Algebraic Groups and their applications will be seriously considered. Current interests within the Department include Brauer groups, Quadratic forms, Galois cohomology and Lie theory.

The closing date for applications is January 15, 2006, or until a suitable candidate is found. Early applications are encouraged. For more information about the Department and the University of Alberta, please see the Department's web page: http://www.math.ualberta.ca

Applicants should submit a curriculum vitae, research and teaching profiles outlining experience and/or interests, and at least three confidential letters of reference to:

Anthony To-Ming Lau
Chair,
Department of Mathematical and Statistical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1

Please Note: Applicants being considered will generally be contacted within 3-4 weeks of the deadline date. Those not contacted are thanked for their interest and encouraged to apply for future positions advertised by the University.

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. If suitable Canadian citizens and permanent residents cannot be found, other individuals will be considered. The University of Alberta hires on the basis of merit. We are committed to the principle of equity in employment. We welcome diversity and encourage applications from all qualified women and men, including persons with disabilities, members of visible minorities, and Aboriginal persons.

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

DECEMBER 2005 DÉCEMBRE

10-12 **CMS Winter 2005 Meeting / Réunion d'hiver 2005 de la SMC (Victoria Conference Centre)** www.cms.math.ca/Events

12-15 Second International Conference on Technology, Knowledge and Society (Hyderabad, India) www.technology-conference.com

12-16 Atelier sur l'intersection arithmetique de cycles et formes modulaires, Workshop on Arithmetic Intersection of Cycles and Modular Forms (Centre de recherches mathematiques, Montréal, Québec) www.crm.umontreal.ca/Intersection05

14-18 First Joint International Meeting between AMS and the Taiwanese Mathematical Society, Tung-Hai University (Taichung, Taiwan) www.ams.org/amsmtgs/internmtgs.html

16-18 8th WSEAS Conference on Applied Mathematics (Tenerife, Spain) www.wseas.org/

JANUARY 2006 JANVIER

3-7 Moduli spaces of knots - AIM Research Conference Center (Palo Alto, CA) www.aimath.org/ARCC/workshops/spaceofknots.html

5-9 Partially Hyperbolic Dynamics, Laminations, & Teichmuller Flow (Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/05-06/

9-11 Distinguished Lecture Series: Gregory Margulis (Yale) (Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/05-06/

13-15 2006 Workshop on Combinatorial Inverse Systems www.fields.utoronto.ca/programs/scientific/05-06/coinvariants/

12-15 Joint Mathematical Meetings, AMS, AWM. SIAM etc, Henry B. Gonzalez Center (San Antonio, Texas) www.ams.org/amsmtgs/sectional.html

20-21 Atlantic Analysis Days (Dalhousie University, Halifax, NS) dll@cs.dal.ca, www.arms.math.ca

22-24 ACM-SIAM Symposium on Discrete Algorithms (Miami, Florida) www.siam.org/meetings/calendar.php

30-Feb.3 Mathematics-in-Study Group 2005 (Massey University, Auckland, New Zealand) http://misg2006.massey.ac.nz/

30-Feb.3 The Cacetta-Haggkvist conjecture in Graph Theory - AIM Research Conference Center (Palo Alto, CA) www.aimath.org/ARCC/workshops/cacetta.html

FEBRUARY 2006 FÉVRIER

13-18 L-functions and Related Themes (CRM, Montreal, Quebec) www.crm.umontreal.ca/Number2005/

20-24 p-Adic Representations, Modularity, and beyond AIM Research Conference Center (Palo Alto, CA) www.aimath.org/ARCC/workshops/padicmodularity.html

MARCH 2006 MARS

7-11 Holomorphic Dynamics, in Celebration of John Milnor's 75th Birthday (Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/05-06/

13-17 Anatomy of Integers (CRM, Montreal, Quebec) www.crm.umontreal.ca/Number2005/

MARCH 2006 MARS

13-17 International Congress on the Applications of Mathematics (in co-operation with SIAM) (Santiago, Chile) www.siam.org/meetings/calendar.php

21-24 Workshop on Valuation Theory and Applications – in memoriam Otto Endler, State University of Campinas (UNICAMP) (Campinas, Brazil) www.ime.unicamp.br/~wvlapp

29 **Canadian Mathematical Olympiad** www.cms.math.ca/Competitions/CMO/

APRIL 2006 AVRIL

3-7 Workshop on Number Theory and Polynomials, Heilbronn Institute for Mathematical Research (University of Bristol, UK) www.maths.bris.ac.uk/heilbronn/heilbronn.html

6-12 Additive Combinatorics (CRM, Montreal, Quebec) www.crm.montreal.ca/Number 2005/

MAY 2006 MAI

3-27 Hyperbolic Geometry Workshop (Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/05-06/holodynamics/

5-10 Combinatorial and Geometric Group Theory (Vanderbilt University, Nashville, TN) www.math.vanderbilt.ed/~msapir/cggt/cggt.html

10-12 Workshop on Numerical, Mathematical and Modeling Analysis related to Fluid Dynamics in Hydrogen Fuel Cells (University of Ottawa) Supported by MITACS www.fields.utoronto.ca/programs/scientific/05-06/fuelcells/

13-18 Analytical Methods for Diophantine Equations (Banff International Research Station, Banff, AB) paradis@crm.umontreal.ca

14-20 44th International Symposium on Functional Equations (University of Louisville, Louisville, KY 40292) romanger@us.edu.pl, thomas.riedel@louisville.edu, sahoo@louisville.edu

15-17 Workshop on Probabilistic Symmetries and their Applications (University of Ottawa) www.mathstat.uottawa.ca/%7Egivanoff/workshop.htm

17-21 ASL Annual Meeting (Montreal, Quebec) asl@vassar.edu

Coxeter Lecture Series: Yair Minsky (Yale) (Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/05-06/ *date to be determined / date à déterminer*

23-27 Hyperbolic Geometry (Fields Institute, Toronto) www.fields.utoronto.ca/programs/scientific/05-06/

24-27 MFPS XXII Twenty-second Conference on the Mathematical Foundations of Programming Semantics (University of Genoa, Italy) www.math.tulane.edu/~mfps/mfps22.htm, mfps@math.tulane.edu.

JUNE 2006 JUIN

3-5 **CMS Summer 2006 Meeting - Réunion d'été 2006 de la SMC Westin Hotel, Calgary AB** www.cms.math.ca/events

17 The fifteenth International Workshop on Matrices and Statistics www.bt.slu.se/iwms2006.html

25-28 2006 SIAM Conference on Discrete Mathematics (Victoria, B.C.) www.siam.org/meetings/calendar.php

24-Jul1 CT'06, International Conference on Category Theory (White Point Beach Resort, Nova Scotia) ct06@mathstat.dal.ca

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

JUNE	2006	JUIN

27-Jul 3 International Commission on Mathematical Instruction: Challenging Mathematics in and beyond the Classroom (Trondheim, Norway) `www.amt.canberra.edu/icmis16.html/` `barbeau@math.utoronto.ca`

JULY	2006	JUILLET

2-22 Valuation Theory and Integral Closures in Commutative Algebra Summer School and Conference (University of Ottawa) `www.mathstat.dal.ca/~faridi/integral-closure.html`

8-19 **47th International Mathematical Olympiad, Slovenia** `http://imo2006.dmfa.si/`

10-14 SIAM Annual Meeting (Boston, MA) `www.siam.org/meetings/calendar.php`

AUGUST	2006	AOÛT

2-6 Eighth IMS North American New Researchers Conference (Minneapolis,Minnesota) `galin@stat.umn.edu`

12-20 Methods of Integrable Systems in Geometry: An LMS Durham Research Symposium, Satellite to ICM 2006 (University of Durham, UK) `www.icm2006.org`

AUGUST	2006	AOÛT

13-19 10th Prague Topological Symposium, International Conference on General Topology and its Relations to Modern Analysis and Algebra (Prague, Czech Republic) `topology-news@atlas-conferences.com`

16-19 Trends and Challenges in Calculus of Variations and its Applications, Satellite to ICM 2006 (UCLM, Toledo, Spain) `www.icm2006.org`

16-19 Algebraic Geometry, Satellite to ICM 2006 (Segovia, Spain) `www.icm2006.org`

22-30 **International Congress of Mathematicians (Madrid, Spain)** `www.icm2006.org`

SEPTEMBER	2006	SEPTEMBER

14-17 Conference On Routing And Location 2006 (CORAL 2006), Satellite to ICM 2006 (Puerto de la Cruz, Tenerife) `www.icm2006.org`

18-20 Algebraic curves in cryptography. The 10th Workshop on Elliptic Curve Cryptography (ECC 2006) (the Fields Institute,Toronto) `www.fields.utoronto.ca/programs/scientific/06-07/crypto/`

DECEMBER	2006	DÉCEMBRE

9-11 **CMS Winter 2006 Meeting / Réunion d'hiver 2006 de la SMC Toronto, ON** `www.cms.math.ca/events, meetings@cms.math.ca`

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December / décembre	October 16 / le 16 octobre

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1/4 page	95.00	175.00	235.00
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