CMS NOTES de la SMC

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MESSAGE FROM THE VICE-PRESIDENT

Kathryn Hare
University of Waterloo

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NSERC Discovery Grants 2004 Competition

In the *CMS Notes* of last May, I wrote an article discussing my perspective, as a member of the NSERC Grant selection committee GSC 336 – Pure Mathematics, on how NSERC discovery grants in mathematics are determined. I hope that people applying for grants in this year's competition found the article helpful.

In that article, I tried to emphasize that the size of one's Discovery grant should not be taken as the sole basis for measuring the stature of a mathematician. Excellence of the researcher is only one of four criteria that the committee uses in evaluating a grant application, the four criteria being:

- Excellence of the researcher,
- Merit of the proposal,
- Contribution to the training of highly qualified personnel,
- Need for funds.

I also mentioned that the grant selection committee (whether it be GSC 336 or GSC 337 – the Applied Mathematics committee) has no influence on the overall size of the budget NSERC gives them to award. This can have a significant influence on the size of grants awarded in any given competition, as the committee is not allowed to recommend more money be awarded than is available in the NSERC discovery grants budget, regardless of how well the researchers applying satisfy the four criteria.

In this issue, NSERC has made available to the mathematics community statistical information on the discovery grants results of the last three years. NSERC tries to equilibrate the pressures over different competitions, as best as possible, within their limited budget. However, one can see from their data that results do vary somewhat from year to year. In particular, the average grant size and success rates in the 2004 competition were lower than the previous two years. Of course, each year consists of different groups of people, so some variation is to be expected.

As with other government organizations, there are many stresses on the NSERC budget. One pressure on the budget comes from the number of new applicants who are coming into the system. Some mathematics departments are growing. Others are hiring new researchers to replace retiring mathematicians, some of whom continue to remain active in research, train graduate students and post docs, and hold an NSERC grant as they meet the four criteria. Providing beginning faculty members with a grant adequate to establish their research programs is very important, and NSERC is deliberate in ensuring that this happens by allocating a substantial portion of the discovery grants

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EDITORIAL/ÉDITORIAL

Robert J. MacG. Dawson

It's That Time Of Year Again

About the time that this issue of the *CMS Notes* comes out, a significant proportion of Canadian mathematicians (myself included) will just have finished submitting their applications for NSERC discovery grants. This quinquennial ritual is despised by many of us as heartily as filling out our income tax forms, despite the fact that in this case there is a good chance that it will result in the government giving us money, not taking it away or at best returning it after an involuntary interest-free loan.

Moreover, this is not money that we will have to spend on groceries, the mortgage, and getting the car fixed – this is money to be spent on travel, assistants to help with our research, and in general on our common fascination – mathematics!

Given that so many of us react in much the same way to NSERC's Form 101 as we do to Revenue Canada's T1, there are two possible conclusions. One would be that it is not the transfer of funds between us and the government, but its absolute value, that we react to; the other possibility is that it's just the paperwork. As most of us don't like census forms or annual reports either, I'm inclined to go with the second theory.

Ah, well, it doesn't take forever. Most mathematicians don't have to fill out the parts on environmental impact, animal research, hazardous substances, stem cells, or human subjects. And - like the annual report, if not the income tax form - this exercise does have some benefits in the way of a forced moment or two of introspection when we think about what we are doing and why we're doing it.

In closing, then, let me wish the very best of luck to all of you who applied for a grant this year; and let me thank in advance all of our hard-working colleagues who will be refereeing those applications.

La saison des demandes de subvention

Au moment où ce numéro des *Notes de la SMC* paraîtra, bon nombre de mathématiciens canadiens (moi y compris) viendront tout juste d'envoyer au CRSNG leur demande de subvention de découverte. Bien des gens détestent ce rituel quinquennal autant qu'ils détestent remplir leur déclaration de revenu, même s'il est probable qu'ils recevront en retour de l'argent du gouvernement, qu'ils n'auront pas à en payer ou au pire qu'ils devront le retourner après avoir bénéficié involontairement d'un prêt sans intérêts. Sans compter que cet argent ne servira pas à payer l'épicerie, ni l'hypothèque, ni les réparations de la voiture; il sera plutôt dépensé en frais de déplacement, en assistanats de recherche et, en général, pour nourrir notre fascination commune : les mathématiques.

Le fait que nous soyons si nombreux à rechigner autant devant la formule 101 du CRSNG que devant la T1 de Revenue Canada m'amène à deux conclusions possibles : soit que nous réagissons non pas au transfert de fonds qui s'effectue entre nous et le gouvernement, mais à sa valeur absolue, soit que nous n'aimons tout simplement pas la paperasserie. Comme la plupart d'entre nous n'aimons pas tellement non plus les formulaires de recensement ni les rapports annuels, je penche plutôt pour la seconde possibilité.

À vrai dire, cette formule n'est pas si longue à remplir. La plupart des mathématiciens n'ont pas à se préoccuper des sections sur l'incidence environnementale, la recherche sur les animaux, les matières dangereuses, les cellules souches ni les sujets humains. Et tout comme le rapport annuel – et peut-être même la déclaration de revenu – cet exercice s'avère parfois bénéfique puisqu'il nous force à prendre quelques minutes pour réfléchir à ce que nous faisons et aux raisons qui motivent nos choix.

En terminant, je souhaite tout le succès possible à ceux qui ont présenté une demande de subvention cette année, et je remercie à l'avance nos valeureux collègues qui évalueront toutes ces demandes.

MAPPING MAGIC

Sara Robinson

My mother and stepfather, both professors of medicine, are relentlessly curious about the world and often ask me about technology that fascinates them. During one of our weekly phone calls, my mother alluded to my stepfather's fascination with MapQuest, one of the Web sites that will produce a map for just about any U.S. address. My stepfather thinks the mapping function is pretty neat, she said, but what really blows him away are the driving directions.

"It seems to him like there are infinitely many routes you can take, but it somehow figures out the fastest way to get there," she said. "It's like magic."

The topic came up again the next time they visited, and I relished the opportunity to make use of my limited knowledge of computer science-all gleaned from teaching the computer science department's "Algorithms" class as a math graduate student at Berkeley. I gave them my best guess of how MapQuest must work.

"There is this elegant algorithm called Dijkstra," I said. "It finds the shortest path between two points quite quickly."

"How does it do that?" my stepfather asked. "Well," I explained lamely, "it grows a cluster of points of known distances from the starting point by looking at all the points nearby and continually adding the one that's closest." At this point, my stepfather began shaking his head with authority. "Nope," he said. "That's not it."

After more thought, I realized he had a point: A lot of magic was missing from my explanation. MapQuest produces customized maps and driving directions in a few seconds, for tens of millions of users a day. For a graph of V vertices and E edges, Dijkstra runs in time $O(V \log V + E)$, and these are potentially very large graphs. How does MapQuest produce directions so quickly? The software must be using tricks that let it look at only a portion of the graph, such as the shortest path to the closest major highway. And to keep that data available for rapid access, in what form does MapQuest store it?

A nice thing about being a journalist is that when you or your parents have questions like these, there's often an efficient way to answer them. You call up your editor and ask if she'd like a story for SIAM News on the inner workings of MapQuest. If she says yes, you get to call up an engineer at MapQuest's parent company, AOL (a subsidiary of Time Warner), and ask.

After several weeks of back-and-forth with an AOL public-relations person, ("Yes, I really do want to talk to an engineer"), I finally set up an interview with Marc Smith, MapQuest's chief technical developer.

Dijkstra Does Directions

The first thing I learned from Smith was that, despite my stepfather's skepticism, MapQuest really and truly does use a variant of Dijkstra.

For SIAM News readers not familiar with this elegant and simple algorithm, which Edsger Dijkstra developed in 1956 while sipping coffee in a Dutch cafe, this is how it works:

Starting with a graph, directed or undirected, with positively weighted edges (distances) and a source node, Dijkstra computes the distances from the source to all the other nodes in the graph.

The do-loop of the program is quite simple: At any time, there is a cluster of nodes containing the source whose distance from the source is known. The algorithm considers the nodes adjacent to this cluster and computes a tentative shortest-path distance, which is the shortest path containing only nodes within the cluster. The algorithm then takes the node v for which the tentative distance is least and, concluding that this is the real distance, adds the node to the cluster.

To see why this works, suppose that the computed distance is not the real distance to v, but an overestimate. There is then some shortest path from the source to v that contains nodes outside the cluster, and there is a first vertex u outside the cluster on this path. The distance to u through the cluster would have to be less than the tentative distance computed to v — a contradiction.

The magic of Dijkstra is in the running time, which depends wholly on how the data about the graph is stored. The algorithm does best with a data structure called a "heap," which is like an inverted tree with some unfilled leaves at the bottom. Using the heap, the algorithm can continually pick the node with the shortest tentative distance, without having to sift through all the nodes each time. Instead, it updates the heap simply by following a path from top to bottom that has length logarithmic in the number of leaves. (A "Fibonacci heap" can be updated in constant time, amortized over all queries, but is apparently very difficult to program and is thus not often used in practice.)

Smith acknowledged that MapQuest uses a "double Dijkstra" algorithm for its driving directions, working backward from both the starting and ending points at once. "It's like the golden spike mentality," he said, in a reference to the building of the first transcontinental railroad in the U.S. from both coasts at once. Smith also conceded that the algorithm uses heuristic tricks to minimize the size of the graph that must be searched.

For edge weights, Smith said, the algorithm uses estimated driving times, rather than distances, based on classifications of the different types of roads. The MapQuest software also takes into account such factors as left-turns and long-term construction, and the newest version even incorporates weather conditions and time of day.

"Over time, we have done such radical things to the algorithm that it totally disresembles the original algorithm," Smith said.

MapQuest gets all its road data from about 30 different vendors, each of which concentrates on a certain region. These vendors hire people to drive around and explore new subdivisions and ongoing road construction projects to keep the data up to date.

(See ***http://www.fastcompany.com/magazine/76/mapquest.html***.)

The site also has a user-feedback feature for identifying problems with vendor data. The software, which runs on about three dozen Sun servers, is maintained and continually improved by a team of about 20 programmers.

Corporate Obfuscation

Delighted with the answers I was getting, I rubbed my palms together, anticipating a definitive article that would lay it all out for my stepfather. But when I asked about the crucial issues — how MapQuest stores its data and optimizes its algorithm — I began to run into problems.

"Please describe the heuristics you use," I said. "Also, how do you splice together the map data? How do you store it?"

"Unfortunately," Smith replied, "the way we store the data is what makes MapQuest MapQuest." I got the hint.

Sara Robinson is a freelance writer based in Pasadena, California.

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MESSAGE FROM THE VICE-PRESIDENT *(continued)*

budget to new applicants.

Further pressure comes from the significant number of experienced people entering the NSERC competition for the first time, mathematicians with strong research programs and a high level of activity, who have been attracted to Canada by opportunities such as the Canada Research Chairs.

Of course, many projects and disciplines compete for NSERC funds and mathematicians must continue to argue the case for supporting mathematical research. In the last grant reallocation process mathematics did well and, as a result, received more new funds ($1075K) than were withdrawn for the reallocation ($979K). We refer the reader to the NSERC site ***http://www.nserc.ca/programs/real2000-e.htm*** or Richard Kane's article on the CMS web site at ***http://www.cms.math.ca/Research/reallocations.e*** for full details.

Some people have wondered how there can be less budget money available for discovery grants this past year given that mathematics did well in the reallocation process. Part of the answer is that $270K of the reallocated funds were directed to a special project put forward by the Mathematics steering committee - Leadership support: additional funds to promote structured initiatives by recognized leaders. The results of this project can be found on the NSERC web site at ***http://www.nserc.gc.ca/programs/lsi_results_e.htm***.

A second project - Funding for new applicants – received the remainder of the reallocated funds ($805K). The mathematics steering committee had also proposed a third project – Additional funds for emerging leaders – but this was not funded by NSERC. This proposal had asked for additional research funding for sixty early to mid-career mathematicians who have distinguished research records and growing financial needs, particularly with respect to the training of highly qualified personnel.

We are fortunate that through NSERC there is a good system for supporting basic research at Canadian universities. As a community we must continue to work with NSERC to ensure that the importance, strengths and needs of mathematical research in Canada are well understood and that the work is adequately funded.

NSERC Results of the 2004 competition

Grant Selection Committees Pure and Applied Mathematics A and B (GSC 336, GSC 337)

In February 2004, NSERC's Grant Selection Committees reviewed 2,986 applications (of this number, 971 came from first-time applicants). They recommended 75 per cent for funding (which represent 666 grants for first-time applicants and 1,581 grants for returning applicants).

The two Grant Selection Committees in Mathematics reviewed 184 applications (99 in GSC 336 and 85 in GSC 337). The budget amount for the 2004 competition was $1,214,069 for GSC 336 and $1,127,931 for GSC 337 for a total of $2,342,000. This year was marked by a noticeable increase of 14% in the number of applicants compared to 2003.

The outcome of the 2004 Discovery Grants competition for Mathematics as of April 2004, were as follows :

Table 1: 2004 Discovery Grant results for Mathematics per applicant status

GSC 336 & 337 combined	FN	FA	FNA	RUN	RU	RF$	R$
#applicants	30	24	5	1	9	27	88
#grantees	25	17	3	0	3	27	82
s.r. (%)	83	71	60	0	33	100	93
ave grant ($)	10,600	17,676	17,333	-	22,667	13,741	15,634
GSC 336	**FN**	**FA**	**FNA**	**RUN**	**RU**	**RF$**	**R$**
#applicants	13	14	3	1	5	15	48
#grantees	11	12	2	0	2	15	44
s.r. (%)	85	86	67	0	40	100	92
ave grant ($)	9,091	17,208	19,500	-	24,000	13,400	13,932
Stdev	7,331	7,388	11,158	-	25,456	9,261	8,323
median ($)	11,000	12,000	8,000	-	24,000	11,000	11,500
GSC 337	**FN**	**FA**	**FNA**	**RUN**	**RU**	**RF$**	**R$**
#applicants	17	10	2	0	4	12	40
#grantees	14	5	1	0	1	12	38
s.r. (%)	82	50	50	0	25	100	95
ave grant ($)	11,786	18,800	13,000	-	20,000	14,167	17,605
Stdev	5,229	13,914	-	-	-	4,108	9,600
median ($)	12,000	14,000	-	-	-	14,000	15,000

FN - First-time applicant with two years of experience or less
FA - First-time applicant with previous academic experience
FNA - First-time with non-academic experience
RUN – Returning unsuccessful new
RU - Returning unsuccessful
RF$ - First renewal
R$ - Renewal

Table 2 presents competition results for the past three years in GSC 336 and GSC 337. Comparison is to be made keeping in mind that each year is a different group of applications and outcomes will vary.

Table 2: Discovery Grant results for Mathematics over time

	GSC 336			GSC 337		
	2002	2003	2004	2002	2003	2004
# First-time appl.	26	31	30	26	26	29
Success rate (%)	96	94	83	92	92	69
Average grant ($)	16,520	15,546	13,820	15,583	16,602	13,600
# Returning appl.	61	58	69	53	46	56
Success rate (%)	93	93	88	93	89	91
Average grant ($)	19,395	17,207	14,131	17,755	18,440	16,843
Total # of applicants	87	89	99	79	72	85
Success rate (%)	94	93	87	92	90	84
Average grants ($)	18,518	16,595	14,041	17,041	17,761	15,930

McMASTER UNIVERSITY
Post-Doctoral Fellowship In Mathematics

Applications are invited for post-doctoral fellowship positions in the Department of Mathematics & Statistics. These fellowships provide an opportunity to spend up to two years engaged in research, with a limited amount of teaching, and are particularly suitable for talented young mathematicians who have recently completed the Ph.D. degree.

We will begin considering applications in January 2005.

The Fellowships are open to candidates of any nationality and selection will be based upon the candidate's research potential. McMaster is committed to Employment Equity and encourages applications from all qualified candidates, including aboriginal peoples, persons with disabilities, members of visible minorities and women.

Starting July 1, 2005, the stipend will be $40,000 plus a $2,000 grant for research expenses.

Applications and **three letters of reference**, and the AMS Standard Cover Sheet indicating Primary and Secondary Interest Codes, should be sent by **January 7, 2005** to:

Dr. M. Valeriote, Chair
Mathematics & Statistics
McMaster University
Hamilton, ON L8S 4K1
CANADA

We appreciate all replies to this advertisement, but only those applicants selected for our short list will be contacted.

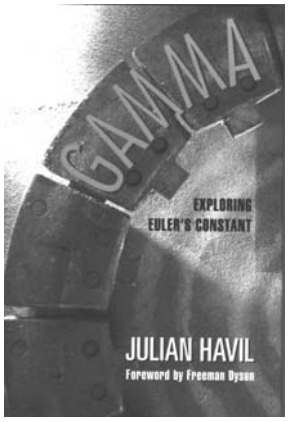
MEANDERING IN EULER'S NEIGHBOURHOOD

Book review by David Borwein, University of Western Ontario

GAMMA: EXPLORING EULER'S CONSTANT

by Julian Havil

Princeton 2003 xxiii + 266 pages



The Gamma of the title is Euler's constant

$$\gamma := \lim_{n\to\infty}\left(1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n} - \ln n\right),$$

and the author describes his book as being an exploration of this constant and inescapably also an exploration of logarithms and the harmonic series. He expresses the hope that: "the material will appeal to a variety of people who have a little probability and statistics and a good calculus course behind them, and before that a rigorous course in algebra, if such a thing still exists: the motivated senior secondary student, who may well be seeing some of the ideas for the first time, the college student for whom the text may put flesh on what can sometimes be bare bones, the teacher for whom it might be a convenient synthesis of some nice ideas (and maybe the makings of a talk or two), and also for those who may have left mathematics behind and who wish to remind themselves why they used to find it so fascinating."

The book starts with a detailed description of Napier's invention of logarithms - historically interesting but not very illuminating mathematically. It continues with many mathematical items interlaced with historical snapshots. Much of the material is connected with Euler's voluminous contributions. Apart from logarithms and the harmonic series, topics visited are: harmonic series of primes, Madelung's constants, the Riemann Zeta function $\zeta(x)$, the Gamma function $\Gamma(x)$, continued fractions, Pell's equation, Euler-Maclaurin summation, Shannon's uncertainty measure, the Prime Number Theorem, the Riemann Hypothesis, and lots more. Some of the topics are dealt with in great detail, while others are only touched on.

Among the gems exhibited is Euler's formula

$$\zeta(2) = \sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6},$$

which he magically derived in 1735 (without bothering with rigor) by equating coefficients of $x3$ in the identity

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots = x\left(1 - \frac{x^2}{\pi^2}\right)\left(1 - \frac{x^2}{2^2\pi^2}\right)\left(1 - \frac{x^2}{3^2\pi^2}\right)\cdots.$$

Euler subsequently showed that

$$\zeta(2n) = (-1)^{n-1}\frac{(2\pi)^{2n}}{2(2n)!}B_{2n}, \quad n = 1, 2, 3, \ldots,$$

where the B_{2n} are the Bernoulli numbers defined by

$$\frac{x}{e^x - 1} + \frac{x}{2} = \sum_{n=0}^{\infty} B_{2n}\frac{x^{2n}}{(2n)!}.$$

Another of Euler's formulas highlighted and proved in the book is the one linking the Riemann Zeta function with the increasing sequence of primes (p_n) with $p_1 = 2$, namely

$$\zeta(x) = \prod_{n=1}^{\infty} \frac{1}{1 - p_n^{-x}}, \quad x > 1,$$

which the author rightly describes as being the link through which analytic number theory came into being.

The Euler-Maclaurin summation formula was developed independently circa 1736 by the two mathematicians in the name. One of its general forms is stated in the book as:

$$\sum_{k=1}^{n} f(k) = \int_1^n f(x)dx + \frac{f(1)+f(n)}{2} + \sum_{k=1}^{m} B_{2k}\frac{f^{(2k-1)}(n) - f^{(2k-1)}(1)}{(2k)!} + R_n(f,m),$$

where the remainder $R_n(f,m)$ is less in magnitude than

$$\frac{2}{(2\pi)^{2m}}\int_1^n |f^{(2m+1)}(x)|\,dx,$$

provided the derivative of order $2m+1$ of the function f exists and is continuous on $[1,n]$. In fact, a valid sharper bound for the remainder is

$$\frac{4}{(2\pi)^{2m+1}}\int_1^n |f^{(2m+1)}(x)|\,dx.$$

It is shown in the book how applying the summation formula to $f(x)=1/x$ yields

$$\sum_{k=1}^{n} \frac{1}{k} - \ln n - \frac{1}{2n} + \frac{1}{2} \sum_{k=1}^{m} \frac{B_{2k}}{kn^{2k}}$$

as an approximation to γ. Euler used this formula with $n=10,\ m=7$ to compute

$$\gamma = 0.5772156649015325 \ldots,$$

of which the first 15 decimal places are correct, but the 16th is not - as can easily be checked in a flash by means of a symbolic computation product such as Maple. To this day it is not known whether γ is rational or not. Modern computational number theorists have shown that if gamma is rational it must have a denominator with many millions of digits.

Though γ is not as familiar a constant as e, π, or i, it creeps surreptitiously into many places in mathematics, as is shown in the book. For example, in the Weierstrass infinite product expansion of the gamma function,

$$\frac{1}{\Gamma(x)} = xe^{\gamma x} \prod_{r=1}^{\infty} \left(1 + \frac{x}{r}\right) e^{-x/r},$$

from which it follows that $\Gamma'(1) = -\gamma$. Other appearances of γ noted in the book are:

$$\mathrm{Li}(x) := \int_2^x \frac{1}{\ln u}\, du = \gamma + \ln(\ln x) + \sum_{r=1}^{\infty} \frac{\ln^r x}{rr!},$$

$$\mathrm{Ci}(x) := \int_x^{\infty} \frac{\cos u}{u}\, du = -\gamma - \ln x + \sum_{r=1}^{\infty} \frac{(-x2)^r}{2r(2r)!},$$

$$\int_0^1 \ln\left(\ln \frac{1}{u}\right) du = -\gamma, \quad \int_0^{\infty} e^{-u} \ln^2 u\, du = \frac{\pi^2}{6} + \gamma^2,$$

$$\sum_{r=2}^{\infty} \frac{\zeta(r)-1}{r} = 1 - \gamma,$$

and there are many more.

Chapters 15 and 16, the final two chapters in the book, are devoted to a discussion of the Prime Number Theorem that

$$\pi(x) := \sum_{p_n < x} 1 \sim \frac{x}{\ln x} \qquad \text{as } x \to \infty$$

and the Riemann Hypothesis that all the non-trivial zeros of $\zeta(z)$ lie on the line $z = 1/2$ in the complex plane. No proof of the theorem is offered in the book, and, of course, the famous hypothesis remains as one of the pre-eminent open problems in mathematics today. The Prime Number Theorem is one of the most fundamental and beautiful results in number theory. It was originally proved in 1896 by Hadamard and de la Vallée Poissin, independently, using properties of the complex zeros of $\zeta(z)$. Their proofs were lengthy and complicated. In 1980 Donald J. Newman developed a very simple and elegant Tauberian argument needed for an analytic proof of the theorem. Based on Newman's approach, a completely self-contained, yet concise analytic proof of the Prime Number Theorem was published by Don Zagier in *The American Mathematical Monthly* (October 1997, pages 705-708). It is a masterpiece of excellent mathematical exposition and is accessible to anyone with a minimum background in complex analysis. For this article Zagier was awarded the Chauvenet prize by the Mathematical Association of America.

The author mentions that Alte Selberg gave the first so-called "elementary" proof (i.e.,avoiding complex variable theory) in 1949, but fails to mention that Paul Erdös independently produced such a proof at about the same time.

The author's writing style is pleasing and clear. The material is reasonably free of typos – though there are some and also a few easily correctable logical flaws. A less obvious error is the author's assertion that the 3-dimensional Madelung constant associated with the crystallographic structure of NaCl is given by the sum of the series

$$\sum_{n=1}^{\infty} (-1)^n \frac{r_3(n)}{\sqrt{n}}$$

where $r_3(n)$ is the number of ways of writing n as the sum of three squares. It is known, however, that the n-th term of this series does not tend to zero, so that the series is divergent, whereas its 2-dimensional counterpart is convergent and does measure the 2-dimensional Madelung constant. Figures 3.1 and 3.2 certainly confirm this dichotomy.

There are many other diagrams in the book – some helpful in understanding the mathematics, and some (to me) confusing. There are appendices containing some basic real and complex function theory to help the reader who is either vague about or has never known the parts needed to follow the mathematical ideas in the text. An aspect of the book I enjoyed *inter alia* was that it prodded me into revisiting the Euler-Maclaurin summation formula and to understanding for the first time the real nature of the remainder term therein.

To sum up, the book contains a wealth of interesting material, both mathematical and historical. It is not a book that one would normally read from cover to cover, but anyone with curiosity and some basic mathematical knowledge could browse through it and pick parts which would be fascinating and instructive. The book would make a nice gift for anyone mathematically inclined.v

WELCOME BOOK INSIGHTFUL AND UP-TO-DATE

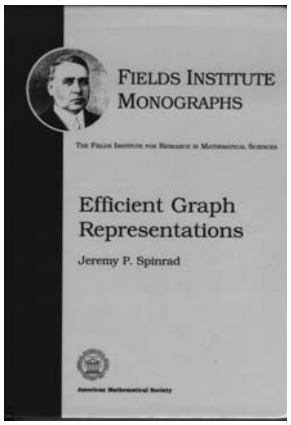
Book review Pavol Hell, Simon Fraser University

EFFICIENT GRAPH REPRESENTATIONS

by Jeremy P. Spinrad

Fields Institute Monographs 19

AMS 2003 viii + 342 pages



Well-structured graphs are a popular research topic. A well-known example is given by the interval graphs whose vertices can be represented by intervals on the real line so that two vertices are adjacent if and only if their corresponding intervals intersect. Similar definitions by intersections (or containments, or overlaps) of the sets representing the vertices, give rise to circular arc graphs, circle graphs, chordal graphs, and so on. Other well-structured graphs include comparability graphs (of partial orders), series-parallel graphs, and cographs. These graphs arise naturally in many applications, and often admit efficient algorithms solving problems that are in general intractable.

Most of these graph classes are hereditary, in the sense of being closed under taking induced subgraphs. Many are also perfect, which in the case of a hereditary class simply means that the graphs have their chromatic number equal to the maximum clique size.

The standard textbook on this general topic, due to M. Golumbic, was written some 25 years ago. (A new edition has just been published.) There are also textbooks focusing on more specialized graph classes, such as interval graphs and orders (Fishburn 1985), tolerance graphs and orders (Golumbic and Trenk 2003), intersection graphs (McKee and McMorris 1999), threshold graphs (Mahadev and Peled 1995), as well as a general survey monograph on graph classes by the present author and Brandstadt and Le (1999).

This latest word on the subject highlights efficient representations. The question of representation is, of course, at the core of the subject; indeed, the definitions of many graph classes depend on such representations. The objects representing the vertices (not necessarily sets) are encoded as strings, over some finite alphabet. For instance, if G is an interval graph, the intervals representing the vertices of G can be described by pairs of integers between 1 and $2n$, where n is the number of vertices of G. Encoded as (say, binary) strings, this represents G in space proportional to $n \log n$. Note that this representation allows easy testing for adjacency, by comparisons of the respective integers.

Representations, where a graph on n vertices is represented in space proportional to $\log n$ bits per vertex, and there are easy adjacency tests based on the local information, are called implicit representations. They are known, for instance, for circular arc graphs, circle graphs, permutation graphs, cographs, line graphs, graphs of bounded treewidth, and planar graphs.

On the other hand, for chordal graphs, there is no implicit representation, since there are at least $2^{f(n)}$ chordal graphs where f is asymptotically of order n^2. This means that chordal graphs cannot be represented in space $o(n^2)$, and hence the standard adjacency matrix representation is asymptotically space optimal. In fact, the argument applies to the smaller class of split graphs, included in class of chordal graphs.

A similar argument can also be made for the class of bipartite graphs (and hence the class of comparability graphs in which it is contained). In fact, it was proved by Alekseev that a hereditary graph class has $2^{f(n)}$ members, where $f(n)$ is of order at least n^2, if and only if it contains the class of bipartite graphs, the class of the complements of bipartite graphs, or the class of split graphs. As for hereditary graph classes with $2^{O(n \log n)}$ graphs on n vertices, there is a conjecture of Kannan, Naor, and Rudich which asserts that they always admit an implicit representation.

A nice concrete open problem arises for the intersection graphs of disks in the plane. A theorem of Warren implies that that there are $2^{O(n \log n)}$ such graphs on n vertices, yet no implicit representation is known.

The second key point highlighted in the book concerns robust algorithms. This issue is also close to the core of the study of algorithms for special graphs. Suppose we have an efficient algorithm to solve a computational problem P on a class C of graphs. Given a graph G we should first test if G belongs to C, and then apply the efficient algorithm to solve P. Thus the efficiency of the overall algorithm also depends on the efficiency of the membership test for the class C.

If there is no comparably efficient membership test, we may be satisfied instead with a robust algorithm, i.e., an efficient algorithm that, on input G, either solves P or finds that G is not in C. (Note that the algorithm may solve P even for some G which are not in C, thus cannot be used as a membership test for C.) This is not an uncommon scenario.

Consider, for instance, finding minimum dominating sets in strongly chordal graphs. While there is a well-known linear time algorithm to solve this problem for a strongly chordal graph G, the algorithm needs a certain enumeration of the vertices of G, only possible for strongly chordal graphs. Unfortunately, the best available algorithms to find such an enumeration (or declaring G not strongly chordal) require quadratic time, in the worst case. However, there is a linear-time robust algorithm for the minimum dominating set in a strongly chordal graph G, which works as follows.

First test if G is dually chordal (membership in this larger class can be tested in linear time); if not, then G is not strongly chordal either. If G is dually chordal, then apply a linear time algorithm available for finding the minimum dominating set in dually chordal graphs. This reduces the quadratic time obtained by using the standard algorithms to linear time. The advantage is even more pronounced if the membership problem for C is NP-complete, while there is a robust polynomial time algorithm.

In addition to these novel viewpoints, the book covers the standard graph classes, and contains much valuable information. In particular, the recognition algorithms (membership tests) are discussed in detail, offering much more up-to-date and insightful information than other texts. The author has managed to include a discussion of the new Strong Perfect Graph Theorem, although the polynomial membership test for perfect graphs was discovered too late to be included in the book.

The book is written in a conversational and entertaining style. At times, this makes it difficult to navigate. Nevertheless, the wealth of information, the carefully thought-out exercises and open problems, and the intuitive insights offered, make this book a welcome contribution that will play an important role.

CALL FOR SESSIONS
CMS WINTER MEETING 2005

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 10 - 12, 2005) at the Victoria Conference Centre. Proposals should include a brief description of the focus and purpose of the session, the number and expected length of the talks, 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.

Deadline: December 15, 2004

In addition to various plenary and prize lectures, the following sessions will be taking place:

1. **Operator Algebras**
   Org: Marcelo Laca, John Phillips (Victoria)
2. **Applied Partial Differential Equations**
   Org: Anne Bourlioux (Montreal), Reinhard Illner, Boualem Khouider, (Victoria)
3. **Probability**
   Org: Martin Barlow, Edwin Pekins (UBC)
4. **Matrix Analysis**
   Org: Man-Duen Choi (Toronto), Douglas Farenick (Regina)
5. **Variational Analysis and Optimization**
   Org: Jane Ye (Victoria)
6. **Ergodic Theory**
   Org: Christopher Bose (Victoria), Andres del Junco (Toronto)

Meeting Director: Ahmed Ramzi Sourour
CMS Winter Meeting
Department of Mathematics & Statistics
University of Victoria
PO Box 3045 STN CSC
Victoria, BC, V8W 3P4
sourour@math.uvic.ca

APPEL DE PROPOSITIONS DE SESSIONS
RÉUNION D'HIVER 2005 DE LA SMC

Les sessions complémentaires autonomes jouent un rôle important dans le succès de nos Réunions. La SMC vous invitent à proposer des sessions autonomes pour son congrès qui se tiendra à Victoria Conference Centre (du 10 au 12 décembre 2005). Toute proposition doit inclure une brève description de l'orientation et des objectifs de la session, le nombre de communications prévues et leur durée 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.

Date limite : 15 décembre, 2004

Aux différentes conférences plénières et de prix s'ajouteront les sessions suivantes:

1. **Algèbres d'opérateurs**
   Org: Marcelo Laca, John Phillips (Victoria)
2. **Équations différentielles appliquées**
   Org: Anne Bourlioux (Montreal), Reinhard Illner, Boualem Khouider, (Victoria)
3. **Probabilité**
   Org: Martin Barlow, Edwin Pekins (UBC)
4. **Analyse matricielle**
   Org: Man-Duen Choi (Toronto), Douglas Farenick (Regina)
5. **Analyse variationnelle et optimisation**
   Org: Jane Ye (Victoria)
6. **Théorie ergodique**
   Org: Christopher Bose (Victoria), Andres del Junco (Toronto)

Directeur de réunion : Ahmed Ramzi Sourour
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BRIEF BOOK REVIEWS

S. Swaminathan, Dalhousie University

MATHEMATICAL DELIGHTS

by Ross Honsberger

Dolciani Mathematical Expositions No.28

MAA, Washington, DC, 2004, x + 252 pp.

Many interesting articles on elementary topics appear from time to time in mathematical periodicals like *The College Mathematical Journal, Mathematics Magazine*, *Quantum* etc.

Making a judicious selection from these and other sources Ross Honsberger presents in the 18 sections of this book a miscellaneous collection of topics mostly concerning algebra, geometry, combinatorics and number theory. The sections contain surprising results, brilliant ideas and beautiful arguments in mathematics. As said in the Preface, "just as one can hardly fail to pick up something from wandering through an art gallery, there might be some things to be learned from these essays." The topics are independent and can be read by a college sophomore in any order. At the end of the essays is a set of exercises (with solutions) which contains some remarkable results. Among the many delights one will find in this volume a lovely safe-cracking problem, a brief discussion of Archimedes circles in the arbelos, a characterization of Euler's congruent numbers, a formula for Einstein triples, an essay on Cipolla's pseudoprimes and two characterizations of twin primes. The final chapter, called Challenges, contains brain-teasers and problems with full solutions.

Sample: (A mind-boggler; factorial ten million is a BIG number).

Clearly there are 10 million 7-digit nonnegative integers when the ones with fewer digits are padded on the left with 0's: 0000000, 0000001, 0000002, …, 9999999. Suppose these are concatenated in any order to form a 70-million digit number *N*. Prove that each of these 10000000! gigantic numbers *N* is divisible by 239. Please see hint page 14.

INVARIANT THEORY IN ALL CHARACTERISTICS

edited by H. E. A. Campbell and David L. Wehlau

CRM Proceedings and Lecture Notes, Volume 35

AMS 2004, xiv + 287 pp.

This is the proceedings volume of a workshop on Invariant Theory held at Queen's University, Kingston, ON in April 2002 as part of the theme year on "Groups and Geometry", under the auspices of the *Centre de recherches mathématiques* in Montreal. All articles in the volumes are refereed papers. The participants of the workshop consisted of those working in characteristic 0 and those working in positive characteristic. The volume contains both research and expository papers. A paper of Wehlau presents summaries of research problems posed during the workshop.

GALOIS THEORY, HOPF ALGEBRAS AND SEMIABELIAN CATEGORIES

edited by George Janelidze, Bodo Pareigis and Walter Tholen

Fields Institute Communications 43, AMS 2004, ix + 570 pp.

Hopf algebras arrived in the Galois theory of rings as early as the 1960s, independently of, but in fact similarly to, the way in which algebraic group schemes were introduced to the theory of étale coverings in algebraic geometry. Galois theory was in turn extended to elementary toposes and was then formulated in purely categorical contexts. Eventually it became general enough to even include abstractions of the theory of extensions, to mention only one of the various fairly recent developments. Finally, semiabelian categories have very recently emerged as a suitable environment to pursue not only basic modern algebra but also homological algebra of groups and other non-abelian structures categorically.

This volume is based on talks (which should give the reader a good idea about the current connections among the themes of the title) that were given at a workshop on categorical structures for Descent and Galois Theory, Hopf Algebras and Semiabelian Categories held in September 2002 at the Fields Institute, Toronto. It consists of independent articles on selected topics in algebra, topology and pure category theory that should seriously contribute to the categorical unification of the subjects in question. There are survey articles also. The editors have provided a 'rough general "map" of the topics/articles presented,' with solid lines representing links explicitly discussed in this volume and dotted lines indicating other known links.

HIGH PRIMES AND MISDEMEANOURS: LECTURES IN HONOUR OF THE 60TH BIRTHDAY OF HUGH COWIE WILLIAMS

edited by Alf van der Poorten and Andreas Stein

Fields Institute Communications 41, AMS 2004, xiv + 392 pp.

This volume consists of a selection of papers largely based on presentations made at the international conference in Number Theory in honour of Hugh Williams on his 60th birthday, held at Banff in May 2003.The papers address topics in the areas of computational and explicit number theory and its applications. Some noteworthy papers: Commentary on Lucas' Test by John Brillhart; Number Field Cryptography by J. Buchmann, T. Takagi and U. Vollmer; On a conjecture of Feit and Thompson by Karl Dilcher and Joshua Knauer; On the research contributions of Hugh Williams by Andrew Granville; The Cunningham Project by Samuel Wagstaff, Jr. The editors include a useful appendix containing guidelines for the referees of submissions to the volume.

BRIEF BOOK REVIEWS *(continued)*

COMPLEX ANALYSIS: THE GEOMETRIC VIEWPOINT

by Steven G. Krantz
Second Edition, The Carus Mathematical Monographs, 25,
MAA,Washington, DC, xvii + 219 pp.

The modern geometric point of view in complex function theory began in 1938 when Lars Ahlfors demonstrated, in his classic paper in the Transactions of AMS, that the Schwarz lemma can be viewed as an inequality of certain differential geometric quantities on the disc. This view, that substantive analytic facts can be interpreted in the language of Riemannian geometry, has developed considerably in the last sixty-five years, providing new insights and new proofs of many classical results in complex analysis.

In this monograph Steven Krantz presents a one semester course on complex analysis without assuming any geometric background. Chapter 0 gives a glimpse of the classical complex function theory. Chapter 1 is on basic notions of differential geometry. Chapter 2 is about Curvature and applications. Chapter 3 deals with invariant metric of Carathéodory and Kobayashi metrics.

Chapter 4 gives an introduction to Bergman theory. Chapter 5 gives a glimpse of several complex variables.

DIFFERENCE AND DIFFERENTIAL EQUATION

edited by Saber Elaydi, Gerry Ladas, Jianhong Wu and Xinfu Zou
Fields Institute Communications 42, AMS 2004, x + 438 pp.

This volume constitutes the proceedings of the seventh International Conference on Difference Equations and Applications held in August 2002 at Hunan University, Changsa, China, a satellite conference of ICM2002, Beijing. Peer-reviewed papers are classified and presented in three categories: survey papers, research papers and open problems and conjectures. They cover a wide range of topics such as stability, oscillation, chaos, symmetries, boundary value problems and bifurcations for discrete dynamical systems, difference-dynamical equations, and discretization of continuous systems.

NUMBER THEORY

Canadian Number Theory Association VII, Montreal, May 2002
edited by Hershy Kisilevsky and Eyal Z. Goren, CRM Proceedings and Lecture Notes, Volume 36, AMS 2004, xxiii + 303 pp.

This volume contains a collection of articles from the meeting of the Canadian Number Theory Association held at CRM, Montréal. Research and expository papers in the volume deal with algebraic number theory, analytic number theory, arithmetic algebraic geometry, computational number theory, and Diophantine analysis and approximation.

EDUCATION NOTES

Ed Barbeau, University of Toronto

This month, we have two contributions from members of the Society. The first is from Peter Taylor of Queen's University, who is soliciting your participation in the education session at the June, 2005 meeting of the Society. The second is by Jim Timourian of the University of Alberta about an innovative mathematics fair in his city that is now seven years old.

Call for Speakers

Bare ruined choirs, where late the sweet birds sang.

I am the organizer of the Education Session at the June, 2005 meeting of the *CMS* in Waterloo. I have chosen the title *Exploratory classroom problems in calculus*. In order to attract a good set of speakers, let me say something about what I have in mind.

Twenty years ago, George Bluman of UBC produced a book *Problems in calculus* which I found to be a valuable classroom resource. This was just before the calculus reform movement of the late 80s and 90s that produced a set of textbooks with new kinds of problems, some of which could be found in some form in George's book. The calculus reform movement embodied several different kinds of changes. One was a move away from the standard physics/engineering context of classical calculus towards application in the life and social sciences. Another was a new emphasis on graphical and numerical ways of thinking and interpretation. Still another, the most subtle and difficult of the three, was a move towards problems which were more investigative or exploratory, which did not rely so heavily on special tricks or techniques (and calculus has formidable techniques!) but yielded to persistent questioning and some understanding of a few basic principles of the subject. It is this aspect of the reform movement that, for years, I have been trying to advance in my own teaching, not only advance but raise to a new plane. In a word, it is to raise the level of sophistication of the work.

Here is where I am coming from. I co-teach a course called *Mathematics and Poetry* with an English profesor, **Maggie Berg**. She spends half the time working with a poem and I take the other half and work with a mathematics problem. Now, I watch her carefully, paying particular attention, first to the quality of the material she works with, and secondly to the character of the discussion and the dialogue that this material engenders in the classroom. And my objective as a mathematics professor (in all my courses!) is to find material of comparable sophistication that sparks a discussion of comparable quality.

The poems used are of many types from many periods. Some are modern, and some, like this sonnet, are classics.

Sonnet 73

That time of year thou mayst in me behold
When yellow leaves, or none, or few, do hang
Upon these boughs which shake against the cold,
Bare ruin'd choirs, where late the sweet birds sang.
In me thou seest the twilight of such day
As after sunset fadeth in the west,
Which by and by black night doth take away,
Death's second self, that seals up all in rest.
In me thou see'st the glowing of such fire
That on the ashes of his youth doth lie,
As the death-bed whereon it must expire
Consumed with that which it was nourish'd by.
This thou perceivest, which makes thy love more strong,
To love that well which thou must leave ere long.

William Shakespeare

This poem is a work of art. First, it is beautiful – beautiful in many ways, in construction, in meaning, and even in simple sound when read aloud. Secondly, it is powerful. It has a purpose, a message, and it delivers it with great force. Thirdly, it is sophisticated, both technically and conceptually. Indeed, as a work, it is substantially beyond the technical and creative capacities of both student and teacher.

Yet it works wonderfully in the classroom. We get a lively discussion from what is most definitely an eclectic class, and a number of ideas, some off the wall, some insightful, but which eventually, with a steady hand from the front of the class, lead into the heart of the poem. At the end of the class, we have certainly advanced the general objectives of the course, knowledge, understanding and technical skill, a sense of community with fellow students, and increased self-confidence and readiness to tackle the writing of their own poetry.

My challenge, in the math and poetry course, is to come up with material that is the equal of this sonnet. In principle this should be possible: history, ancient and modern, has given us some extraordinary mathematicians and the subject itself has a beauty and power that would rival sonnet 73.

But mathematics is not quite the same as poetry; although the analogy between them has been a great source of insight and inspiration to me, it only goes so far. Cutting edge mathematics is not accessible to our students in the same way that cutting edge poetry is, and most of my students have little beyond high school mathematics. Mathematics appears to have greater prerequisite requirements than literature. The tragedy is that this remark has been used to justify the bare ruin'd choirs of our current high school and introductory university mathematics curriculum.

To find 12 elementary works of mathematical art (one class per week for 12 weeks), which are not only beautiful and powerful but which will spark an inventive and lively classroom discussion, I have to stretch. The problems that I work with have been discovered and developed over a 20-year period and the student enthusiasm tells me they are still working well. My objective is to find a similar collection of problems for my calculus class. I have some but I want more.

EDUCATION NOTES *(continued)*

So that's what the education session is aimed at - a coming together to share ideas for such problems.

They should be beautiful, powerful and sophisticated. In some ways they will be beyond the technical and conceptual capability of the student and thus they represent a real stretch. But most importantly they must be discussion oriented. I want students to put forward conjectures, to try things out, to share insights with a partner or with the class as a whole. And at the end of the class, or the week, though they won't have, and perhaps never will, fully come to grps with the problem, they will have glimpsed eternity.

If you have something to say in such a session, send me an email. My own course is a service course, and I am primarily interested in problems that can be used with majors in other disciplines (though I hope these problems might serve as a powerful recruiting tool). But more theoretical problems for the honours course are also welcome.

Peter Taylor (***taylorp@post.queensu.ca***)

Reference

George W. Bluman, *Problem book for first year calculus*. (Problems books in mathematics.) Springer, New York, 1984. ISBN 3-540-90920-6/0-387-90920-6.

Mathematics Fair in Edmonton

Alberta elementary school teachers found that the familiar standard "science fair" concept (at least for elementary school children) was not working. The children did not understand their projects; there were jealousies and parental interference; judges' decisions produced animosities. For many children and teachers, a science fair was not a wonderful experience, and as a result there was little enthusiasm and participation. Our colleagues in Edmonton have been in the vanguard of creating what appears to be a successful and valuable alternative. In 1997, *SNAP* Math Fair was inaugurated by Andy Liu of the University of Alberta and elementary school teacher Micheal Dumanski in the common area of a shopping mall. Attractively decorated tables were set up in a large rectangular ring and elementary school children in teams of two and three stood behind them, ready to interact with any passersby. Each table featured a logical puzzle or mathematical problem that visitors were challenged to solve. While most adults easily understood them, they were not standard textbook problems and the adults needed to think hard about how to solve them; the children sympathetically offered hints and encouragement.

In the seven years that have since passed, math fairs have spread to many countries and many schools, and have been held in shopping malls, gymnasia, classsrooms, school hallways and on college campuses. The SNAP Mathematics Foundation was created to promote the Math Fair concept, to help teachers wanting to organize one, and to evaluate their effects. While our concept is flexible, there are essential features that contribute to the successs of the model.

First, SNAP Math Fairs are **S** student-oriented. The students solve the problems and prepare the booths on their own with little or no input from parents and teachers. Second, they are **N** noncompetitive. With no winners and losers, there is 100% enthusiastic participation; the children do not judge their chances of winning and tailor their efforts accordingly. Third, they are **A** all-inclusive, so that every child can take part and contribute. Finally, the Math Fairs are **P** problem-based.

In a Math Fair, the students are frequently better at problem-solving than their teachers. The characteristics of the mathematics and elementary logic involved mean that they can truly understand the problems and their solutions.

Occasionally, I have seen children such as music or chess prodigies interact with adults on an adult level. Children in a SNAP Math Fair have the same experience. Since they know more about the solution to the problem than visitors to their booth, their efforts in encouraging a correct solution have them playing the role of a teacher.

It is easy to see the positive effects of a child's participation in a SNAP Math Fair. Anecdotal information from teachers points to a new enthusiasm and appreciation for mathematics in their classes. The children clearly love to participate in them. One would hope that logical thinking and skill at solving problems are enhanced, although we have not attempted any formal evaluations of these effects. Such research is part of our agenda.

There are other potential effects having nothing to do with mathematics or logical thinking. Children gain experience in team work. Performing before an audience of peers and adults develops poise. They gain confidence through teaching a problem and its solution to someone else. They have the thrill of knowing what it means to understand something well. The discovery of a talent, such as an ability to teach or explain, that might not have been recognized before.

The SNAP Mathematics Foundation has a website (***www.mathfair.com***) with more information on what constitutes a Math Fair and how people have adapted the concept to their situations. We offer a booklet (*The Math Fair Booklet*) to help with creating and running a Math Fair - what works, finding problems, how much time to allot, costs (very low) and other organizational details.

There is another version of the SNAP Math Fair specifically aimed at undergraduates interested in elementary education. In this version, future teachers put on a Math Fair for children. Further details are on the website.

For more information or to order a copy of the Math Fair Booklet, email Dr. Ted Lewis at ***tlewis@math.ualberta.ca***.

Jim Timourian

EDUCATION NOTES *(continued)*

Technology's impact on teaching

An article in the *Chronicle of Higher Education* on August 4, 2004, described a survey of 4374 freshmen and seniors at 13 US colleges by the Educause Center for Applied Research. It found that 48.5% or respondents felt that the major benefit of classroom technology was convenience, such as being able to check grades on line. Only 12.7% said the improved learning was the greatest benefit.

How much information technology should professors use in class? 41.2% wanted moderate use; 31% wanted extensive use and 22.7% preferred limited use. Only 2.2% wanted courses entirely online and 2.9% preferred having no technology at all.

Interviews with 132 students unearthed frustration at poor use of technology in the classroom. However, when technology is used for onlines quizzes and other interactive features, there was a benefit for learning.

The final report is available for sale on the website ***www.educause.edu/ecar***.

QUEEN'S UNIVERSITY
Department of Mathematics and Statistics

The Department seeks applications for a position in Engineering Mathematics to commence July 1, 2005; the deadline for applications is December 15, 2004.

The Department of Mathematics and Statistics invites applications for a position in Mathematics and Engineering, an interdisciplinary applied mathematics program in the Engineering Faculty. The Department has strong research groups in communications and information theory, and in control, dynamics and mechanics, and we plan to expand the faculty complement in these areas. The Department also has interests in other areas including partial or applied differential equations, large scale scientific computation, computer security, and statistical data analysis. Candidates must have a strong research record and the ability to develop an independent research programme.

The appointment will be at the Assistant Professor level, but exceptional candidates may be appointed at the rank of Associate Professor. Salary will be commensurate with qualifications. The appointment shall commence July 1, 2005.

Candidates must have a Ph.D. in applied mathematics, electrical, mechanical or chemical engineering, computer science, statistics or a closely related field. Membership or eligibility for membership in a Canadian professional engineering association is required, which normally requires an undergraduate engineering degree. Candidates should offer evidence of ability to teach a range of applied mathematics or statistics courses to some of the most talented engineering students at Queen's, and supervise graduate students. To quickly establish the research programme, the Department normally offers teaching release in the first year of the appointment.

Interested candidates should send a curriculum vitae, descriptions of teaching and research interests, at least four letters of recommendation, and copies of their three most significant publications, to the address below, before December 15, 2004. At least one letter should comment on the candidate's teaching. More details are available at ***http://www.mast.queensu.ca/positions/***.

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fax: (613) 533-2964

position@mast.queensu.ca ***http://www.mast.queensu.ca***

All qualified candidates are encouraged to apply; however Canadians and permanent residents will be given priority. The University invites applications from all qualified individuals. Queen's is committed to employment equity and diversity in the workplace and welcomes applications from women, visible minorities, aboriginal people, persons with disabilities and persons of any sexual orientation or gender identity. Academic staff at Queen's University are governed by a collective agreement, the details of which are posted at ***http://www.queensu.ca/qufa/.***

from page 10
BRIEF BOOK REVIEWS *Mathematical Delights*

Hint: 10^7 is congruent to 1 (mod 239).

MESSAGE DE LA VICE-PRÉSIDENTE

Kathryn Hare, University of Waterloo

Concours 2004 de subventions à la découverte du CRSNG

Dans les Notes de la SMC de mai dernier, je vous ai donné mon point de vue, en tant que membre du Comité de sélection des subventions (CSS) du CRSNG 336 – Mathématiques pures, sur la façon dont les subventions à la découverte du CRSNG en mathématiques sont attribuées. J'espère que les personnes qui ont présenté une demande de subvention au concours de cette année y auront trouvé des renseignements utiles.

Dans cet article, j'ai souligné que l'ampleur d'une subvention à la découverte ne devrait pas être le seul critère pour évaluer l'excellence d'un mathématicien. L'excellence n'est en fait qu'un des quatre critères évalué par le comité :

- Excellence du chercheur
- Qualité de la demande
- Contribution à la formation de personnel de haut niveau
- Besoins financiers

J'ai aussi mentionné que le Comité de sélection des subventions (tant le CSS 336 que le CSS 337 – mathématiques appliquées) n'avait rien à dire sur la taille de l'enveloppe totale que le CRSNG lui donne à répartir. Cela peut avoir une incidence considérable sur la taille des subventions accordées dans le cadre d'un concours donné, puisque le comité ne peut recommander plus de subventions que ne peut en financer le budget des subventions à la découverte du CRSNG, quelle que soit la qualité des demandes.

Dans ce numéro nous vous présentons des statistiques que le CRSNG a procurées à la communauté mathématique sur les résultats des concours de subventions à la découverte des trois dernières années. Le CRSNG fait de son mieux pour équilibrer les pressions sur plusieurs concours, dans les limites de son budget. Toutefois, on verra d'après les données fournies que les résultats varient tout de même d'une année à l'autre. On remarquera en particulier que la valeur moyenne des subventions et les taux d'acceptation étaient plus bas en 2004 qu'au cours des deux années précédentes. Évidemment, il ne faut pas oublier que chaque année porte sur un groupe différent de candidats; une certaine variation est donc naturelle.

À l'instar de celui d'autres organismes gouvernementaux, le budget du CRSNG subit de nombreuses pressions. L'une d'entre elles est le nombre de nouveaux candidats qui présentent une demande. Certains départements de mathématiques sont en croissance. D'autres embauchent de nouveaux chercheurs pour remplacer des professeurs qui prennent leur retraite, dont certains continuent à faire de la recherche, à former des étudiants aux cycles supérieurs et des boursiers postdoctoraux, et reçoivent une subvention du CRSNG puisqu'ils répondent aux quatre critères. Il est très important d'offrir aux nouveaux professeurs des subventions qui leur permettront d'établir leurs programmes de recherche; le CRSNG prend des mesures dans ce sens en attribuant une proportion considérable des subventions à la découverte à des nouveaux candidats.

Des pressions découlent également du grand nombre de chercheurs d'expérience qui se présentent au concours du CRSNG pour la première fois, souvent des mathématiciens d'expérience très actifs qui ont des programmes de recherche bien établis, et qui ont été attirés au Canada par des possibilités intéressantes comme les Chaires de recherche du Canada.

Évidemment, les projets et disciplines qui se disputent les fonds du CRSNG sont nombreux, et les mathématiciens doivent continuer de défendre l'appui à la recherche mathématique. Au dernier exercice de réaffectation, les mathématiques ont fait assez bonne figure et, par conséquent, ont reçu plus de nouvelles subventions (1075K $) qu'il ne leur en a été retiré (979K $). Pour de plus amples renseignements à ce sujet, passez sur le site du CRSNG au ***http://www.nserc.ca/programs/real2000-f.htm***, ou lisez l'article de Richard Kane sur le site de la SMC au : ***http://www.cms.math.ca/Research/reallocations.e (en anglais).***

Quelques personnes m'ont demandé comment il se pouvait que le budget des subventions à la découverte ait été réduit la dernière année étant donné que les mathématiques avaient fait bonne figure à l'exercice de réaffectation. Cela tient en partie au fait que les 270K $ des fonds réaffectés sont allés à un projet spécial du Comité de direction en mathématiques pures et appliquées, l'Initiative d'appui au leadership, qui procure du financement supplémentaire aux projets structurés de chefs de file reconnus. Les résultats de ce projet sont publiés sur le site du CRSNG au : ***http://www.nserc.gc.ca/programs/lsi_results_e.htm***.

Un deuxième projet, Fonds destinés aux nouveaux candidats, a reçu le reste des fonds réaffectés (805K $). Le Comité de direction en mathématiques avait aussi proposé un troisième projet (fonds destinés aux leaders en émergence), mais ce dernier n'a pas été financé par le CRSNG. Ce projet demandait des fonds de recherche supplémentaires pour soixante mathématiciens en début de carrière ou à mi-carrière qui ont un dossier de recherche exceptionnel et des besoins financiers croissants, particulièrement pour la formation de personnel de haut niveau.

Nous sommes choyés que le CRSNG offre un bon système d'appui à la recherche de base dans les universités canadiennes. En tant que communauté, nous devons continuer de travailler avec le CRSNG à faire en sorte que l'importance, les forces et les besoins de la recherche mathématique au Canada soient bien compris et que le travail soit suffisamment financé.

CRSNG : Résultats du concours 2004

Comités de sélection des subventions Mathématiques pures et appliquées A et B (CSS 336 CSS 337)

En février 2004, les comités de sélection des subventions (CSS) du CRSNG ont étudié 2 986 demandes (dont 971 de nouveaux candidats). Ils ont recommandé le financement de 75 % de ces demandes (ce qui représente 666 subventions pour les nouveaux candidats et 1 581 pour les candidats présentant une demande subséquente à un refus).

MESSAGE DE LA VICE-PRÉSIDENTE *(suite)*

Les deux CSS en mathématiques ont étudié 184 demandes (99 pour le CSS 336 et 85 pour le CSS 337). Le financement disponible en 2004 était 1 214 069 $ pour le CSS 336 et 1 127 931 $ pour le CSS 337 pour un total de 2 342 000 $. En 2004, le nombre de demandes a augmenté de 14 % par rapport à l'année précédente.

Voici les résultats du concours 2004 de subventions à la découverte en mathématiques en date d'avril 2004 :

Tableau 1 : Résultats du concours 2004 de subventions à la découverte en mathématiques par type de candidat

CSS 336 et 337 ensemble	NC	NE	NEA	NSR	SR	PR$	R$
nbre demandes	30	24	5	1	9	27	88
demandes acceptées	25	17	3	0	3	27	82
taux d'acceptation (%)	83	71	60	0	33	100	93
subv. moy. ($)	10 600	17 676	17 333	-	22 667	13 741	15 634
CSS 336	**NC**	**NE**	**NEA**	**NSR**	**SR**	**PR$**	**R$**
nbre demandes	13	14	3	1	5	15	48
demandes acceptées	11	12	2	0	2	15	44
taux d'acceptation (%)	85	86	67	0	40	100	92
subv. moy. ($)	9 091	17 208	19 500	-	24 000	13 400	13 932
Stdev	7 331	7 388	11 158	-	25 456	9 261	8 323
médiane ($)	11 000	12 000	8 000	-	24 000	11 000	11 500
CSS 337	**NC**	**NE**	**NEA**	**NSR**	**SR**	**PR$**	**R$**
nbre demandes	17	10	2	0	4	12	40
demandes acceptées	14	5	1	0	1	12	38
taux d'acceptation (%)	82	50	50	0	25	100	95
subv. moy. ($)	11 786	18 800	13 000	-	20 000	14 167	17 605
Stdev	5 229	13 914	-	-	-	4 108	9 600
médiane ($)	12 000	14 000	-	-	-	14 000	15 000

NC - Nouveaux candidats ayant moins de deux ans d'expérience
NE - Nouveaux candidats avec expérience universitaire
NEA - Nouveaux candidats avec expérience autre qu'universitaire
NSR - Nouveaux candidats présentant une demande subséquente à un refus
SR - Candidats présentant une demande subséquente à un refus
PR$ - Premier renouvellement
R$ - Renouvellement

Le tableau 2 présente les résultats des concours des trois dernières années des CSS 336 et CCS 337. Si l'on fait des comparaisons, il ne faut pas oublier que le groupe de demandes diffère chaque année, et que les résultats varient en conséquence.

Tableau 2 : Résultats des concours de subventions à la découverte en mathématique

	CSS 336			CSS 337		
	2002	2003	2004	2002	2003	2004
Première demande	26	31	30	26	26	29
Taux d'acceptation (%)	96	94	83	92	92	69
Subv. moy. ($)	16 520	15 546	13 820	15 583	16 602	13 600
Nbre de dem. subséquentes	61	58	69	53	46	56
Taux d'acceptation (%)	93	93	88	93	89	91
Subv. moy. ($)	19 395	17 207	14 131	17 755	18 440	16 843
Nbre total de demandes	87	89	99	79	72	85
Taux d'acceptation (%)	94	93	87	92	90	84
Subv. moy. ($)	18 518	16 595	14 041	17 041	17 761	15 930

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OBITUARY
Murray Seymour Klamkin (1921-2004)

by Andy Liu, University of Alberta

Let me first make it clear that this is not a eulogy. By my definition, a eulogy is an attempt to make the life of the departed sound much better than it was. In the present case, it is not only unnecessary, it is actually impossible. Murray Seymour Klamkin had a most productive and fulfilling life, divided between industry and academia.

Of the early part of his life, I know little except that he was born in 1921 in Brooklyn, New York, where his father owned a bakery. This apparently induced in him his life-long fondness for bread. I read in his curriculum vitae that his undergraduate degree in Chemical Engineering was obtained in 1942 from Cooper Union's School of Engineering. During the war, he was attached to a chemical warfare unit stationed in Maryland, as his younger sister Mrs. Judith Horn informed me.

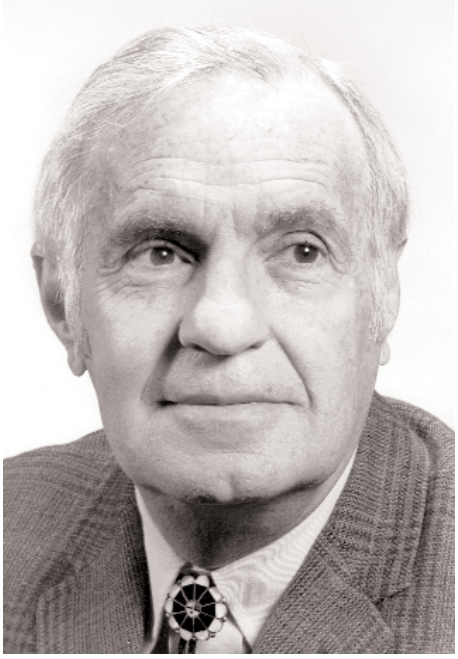
In 1947, Murray obtained a Master of Science degree from the Polytechnic Institute of New York, and taught there until 1957 when he joined AVCO's Research and Advanced Development Division.

In 1962, Murray returned briefly to academia as a professor at SUNY, Buffalo, and then became a visiting professor at the University of Minnesota. In 1965, he felt again the lure of industry and joined Ford Motor Company as the Principal Research Scientist, staying there until 1976.

During all this time, Murray had been extremely active in the field of mathematics problem solving. His main contribution was serving as the editor of the problem section of SIAM Review. He had a close working relation with the Mathematical Association of America, partly arising from his involvement with the William Lowell Putnam Mathematics Competition.

In 1972, the MAA started the USA Mathematical Olympiad, paving the way for the country's entry into the International Mathematical Olympiad in 1974, hosted by what was still East Germany.

Murray was unable to obtain from Ford release time to coach the team. Disappointed, he began to look elsewhere for an alternative career. This



was what brought him to Canada, at first as a Professor of Applied Mathematics at the University of Waterloo.

However, it was not until the offer came from the University of Alberta that made up his mind to leave Ford. I did not know if Murray had been to Banff before, but he must have visited this tourist spot during the negotiation period, fell in love with the place and closed the deal.

As Chair, Murray brought with him a management style from the private sector. Apparently not everyone was happy with that, but he did light some fires under several pairs of pants, and rekindled the research programs of the wearers.

Murray had always been interested in Euclidean Geometry. He often told me about his high school years when he and a friend would challenge each other to perform various Euclidean constructions. Although the Chair had no teaching duties at the time, Murray took on a geometry class himself.

At the same time, Murray began editing the Olympiad Corner in Crux Mathematicorum, a magazine then published privately by Professor Leo Sauve of Ottawa. It is now an official journal of the Canadian Mathematical Society. Murray also introduced the Freshmen and Undergraduate Mathematics Competitions in the Department.

Geometry, mathematics competitions and Crux Mathematicorum were what brought me to Murray's attention. At the time, I was a post-doctoral fellow seeking employment, having just graduated from his Department. Thus I was ready to do anything, and it happened that my interests coincided with those of Murray. I was holding office hours for his geometry class, helping to run the Department's competitions and assisting him in his editorial duty.

I remember being called into his office one day. He had just received a problem proposal for Crux Mathematicorum. "Here is a nice problem," he said, "but the proposer's solution is crappy. Come up with a nice solution, and I need it by Friday afternoon!"

As much as I liked problem-solving, I was not sure that I could produce results by an industrial schedule. Nevertheless, I found that I did respond to challenges, and although I was not able to satisfy him every time, I managed to do much better than if I was left on my own, especially after I had got over the initial culture shock.

The late seventies were hard times for academics, with few openings in post-secondary institutions. I was short-listed for every position offered by the Department, but always came just short. Eventually, I went elsewhere for a year as sabbatical replacement. Murray came over to interview me for a new position, pushed my appointment through the Hiring Committee and brought me back in 1980.

Murray had been the Deputy Leader for the USA National Team in the IMO since 1975. In 1981, USA became the host of the event, held outside Europe for the first time. Sam Greitzer, the usual Leader, became the chief organizer. Murray took over as the Leader, and secured my appointment as his Deputy Leader.

OBITUARY - Murray Seymour Klamkin *(continued)*

I stayed in that position for four year, and in 1982, made my first trip to Europe because the IMO was in Budapest. This was followed by IMO 1983 in Paris, and IMO 1984 in Prague. I was overawed by the international assembly, but found that they in turn were overawed by Murray's presence. He was arguably the most well-known mathematics problem-solver in the whole world.

We both retired from the IMO after 1984, even though I would later return to it. His term as Chair also expired in 1981. Thus our relationship became collegial and personal. He and his wife Irene had no children, but they were very fond of company. I found myself a guest at their place at regular interval, and they visited my humble abode a few times.

It was during this period that I saw a different side of Murray. Before, I found him very businesslike, his immense talent shining through his incisive insight and clinical efficiency.

Now I found him a warm person with many diverse interest, including classical music, ballroom dancing, adventure novels, kung-fu movies and sports, in particular basketball.

Although Murray had been highly successful in everything he attempted, he will probably be remembered the most for his involvement in mathematics problem-solving and competitions. He had authored or edited four problem books, and had left his mark in every major journal which had a problem section. He had received an Honorary Doctorate from the University of Waterloo and was a Fellow of the Royal Society of Belgium. He had won numerous prizes, and had some named after him.

Murray had enjoyed remarkably good health during his long life. It began to deteriorate in September 2000 when he underwent a by-pass operation. After his release from the hospital, he continued to exert himself, walking up to his office on the sixth floor, and skating in the West Edmonton Mall.

His heart valve gave in November, fortunately while he was already in the hospital for physiotherapy. He was in coma for some time. One day, when I visited him, he was bleeding profusely from his aorta. The doctor indicated to me that he did not expect Murray to last through the day.

Somehow, the inner strength of Murray came through, and on my next visit, he was fully conscious. He told me to make arrangement for his eightieth birthday party, stating simply that he would be out of the hospital by that time. It was a good thing that I took his words seriously, for he was out of the hospital by that time, ready to celebrate.

One of the last mathematical commitment he made was to edit the problem section in the MAA's new journal *Math Horizons*. During this difficult time, he asked me to serve with him as joint-editor. Later, he passed the column onto me, but his finger-prints were still all over the pages.

Now I have to try to fill in his shoes without the benefit of his wisdom. His passing marks the end of an era in the world of mathematics competition and problem-solving. He will be deeply missed.

CMS WINTER MEETING 2004

Hilton Bonaventure Hotel, Montreal, Quebec - December 11-13, 2004
Host: McGill University

Most activities and all scientific talks will be held at the Hilton Bonaventure Hotel. The activities of the evening of Friday, December 10, will be held at the nearby Best Western Hotel Europa.

The most up-to-date information concerning the programme, including detailed schedules, a list of invited speakers and abstracts, is available at this web site. ***www.cms.math.ca/Events/winter04***

The web site also provides on-line forms for registration and submission of abstracts. Meeting registration forms and hotel accommodation forms appeared in the September 2004 issue of the *CMS Notes.*

RÉUNION D'HIVER 2004 DE LA SMC

Hôtel Hilton Bonaventure, Montréal (Québec) - 11-13 décembre 2004

Hôte: Université McGill

La plupart des activités et toutes celles du programme scientifique se dérouleront à l'Hôtel Hilton Bonaventure. La soirée du vendredi 10 décembre se tiendra au Best Western Europa, à quelques pas de là.

Vous trouverez l'information la plus récente sur les programmes, y compris les horaires, la liste de conférenciers et les résumés de conférences, sur ce site Web. ***www.smc.math.ca/Reunions/hiver04***

Les formulaires électroniques d'inscription et de présentation des résumés seront aussi publiés sur notre site Web. Vous trouverez les formulaires d'inscription et de réservation d'hôtel dans le numéro de septembre 2004 des *Notes de la SMC*.

AWARDS/PRIX

Prix Adrien-Pouliot - Jean-Marie De Koninck (Laval)

Le prix d'éducation mathématique Adrien-Pouliot 2004 de la Société mathématique du Canada (SMC) est accordé à Jean-Marie De Koninck. Le lauréat recevra son prix le 12 décembre, au banquet de la Réunion d'hiver 2004 de la SMC, à l'Hôtel Hilton Bonaventure de Montréal (Québec).

Le prix Adrien-Pouliot rend hommage aux personnes qui ont fait une contribution importante et soutenue à l'éducation mathématique au Canada.

Le prix Adrien-Pouliot 2004 est accordé à Jean-Marie De Koninck (Laval) pour son rôle exceptionnel en tant qu'« ambassadeur des mathématiques » au Canada. Très actif dans son milieu, notamment en tant que fondateur d'Opération Nez rouge, il est régulièrement sollicité par la presse électronique pour commenter des nouvelles scientifiques. Dès que l'occasion se présente, il s'empresse de redorer l'image des mathématiques et des mathématiciens auprès du public. Ce qu'il a d'ailleurs fait avec brio dans les 29 épisodes de la série télévisée *C'est mathématique!*, qui visait à présenter des concepts mathématiques présents dans notre vie de tous les jours. Pour toutes ces raisons et bien d'autres, la Société mathématique du Canada considère Jean-Marie De Koninck comme une figure exemplaire en éducation mathématique.

Jean-Marie De Koninck est professeur au Département de mathématiques et de statistique de l'Université Laval depuis 1972. Il a publié, au cours de sa carrière d'enseignant-chercheur, plus d'une cinquantaine d'articles de recherche en théorie des nombres ainsi que cinq livres, dont deux au cours de la dernière année (1001 problèmes en théorie classique des nombres, Éditions Ellipses, Paris, et Mathématiques de l'ingénieur, Éditions Loze, Montréal, écrits en collaboration respectivement avec Armel Mercier et Norbert Lacroix). Mais c'est principalement par son rôle d'ambassadeur des mathématiques auprès du grand public, et ce, depuis plus de quinze ans, que Jean-Marie De Koninck se démarque nettement et qu'il a fait un apport hors du commun à la promotion et au développement des mathématiques au Canada. Ses contributions s'inscrivent dans des contextes nombreux et variés.

D'abord, sa réputation d'enseignant hors pair lui a valu d'être maintes fois invité à présenter des conférences dans des universités, collèges et écoles secondaires, ainsi qu'à l'occasion de séminaires et de camps mathématiques. De même, il a été à plusieurs reprises conférencier principal lors de congrès d'associations mathématiques provinciales ou canadiennes.

Par ailleurs, grâce à son exceptionnelle implication communautaire - rappelons tout particulièrement qu'il a fondé en 1984 l'Opération Nez rouge, une vaste campagne de sensibilisation au danger de la conduite en état d'ébriété impliquant plus de 45 000 bénévoles au Canada -, le monde des médias a reconnu en lui un excellent communicateur. C'est ainsi qu'il est régulièrement sollicité par la presse électronique pour commenter des nouvelles scientifiques et mathématiques. Conjuguant la notoriété qu'il a acquise sur le plan social (et même sportif, étant depuis de nombreuses années le commentateur attitré des compétitions de natation à la télévision de Radio-Canada) et son expertise scientifique, Jean-Marie De Koninck contribue indéniablement au développement chez le grand public d'une image positive des mathématiques... et des mathématiciens!

Enfin, ses talents d'organisateur l'ont amené à organiser une foule de réunions et colloques scientifiques, tant à l'échelle provinciale, nationale qu'internationale.

Que Jean-Marie De Koninck ait réussi à mener une carrière de mathématicien de haut niveau tout en s'impliquant de façon si marquée dans la société est en soi un exploit. Mais qu'il ait su mettre à profit la visibilité et le respect que lui conférait son implication sociale en vue de la promotion des mathématiques est tout à son honneur en tant que mathématicien. L'ensemble de son oeuvre académique et sociale lui a valu de nombreux prix et distinctions. Il a en particulier été décoré de l'Ordre du Canada en 1994 et de l'Ordre national du Québec en 1999.

Ramanujan Prize

The founding has been announced of the "Ramanujan Prize for Young Mathematicians from Developing Countries" by the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy, in cooperation with IMU, and with support from the Niels Henrik Abel Memorial Fund, Norway. The Prize will be awarded annually for the highest mathematical achievement by young researchers from developing countries, who conduct their research in a developing country. The recipient must be less than 45 years old. Work in any branch of the mathematical sciences is eligible for the prize. The Prize amount will be $10,000. The goal is to make the selection of the first Prize winner in 2005. Further information will appear on the IMU and ICTP websites. (ICTP website: ***http://www.ictp.it/***).

Shaw Prize - Shiing-Shen Chern (Nankai University, China)

The Shaw Prize in Mathematical Sciences 2004 has been awarded to Professor Shiing-Shen Chern of Nankai University (China). Professor Chern has been a leading researcher in global differential geometry for many decades. He is known for such discoveries as Chern classes, the Chern connection, and the Chern-Simons invariants. He was born in China, but spent almost half his life at Berkeley, where he was the founding director of the MSRI.

Call for Nominations for the Abel Prize

The Norwegian Academy of Science and Letters calls for nominations of candidates for the Abel Prize 2005. The Abel Prize, which was awarded for the first time in 2003, amounts to NOK 6 million (EUR 750.000). It is an international prize for outstanding scientific work in the field of mathematics, including mathematical aspects of computer science, mathematical physics, probability, numerical analysis and scientific computing, statistics, and also applications of mathematics in the sciences. For information, see ***http://www.abelprisen.no/en/abelprisen/retningslinjer.html.***

McMASTER UNIVERSITY
Canada Research Chair Post-Doctoral Fellowship In Mathematics

Applications are invited for the Canada Research Chair Post-Doctoral Fellowship in Mathematics at McMaster University. These fellowships provide an opportunity to spend up to two years engaged in research, with a limited amount of teaching, and are particularly suitable for talented young mathematicians who have recently completed the Ph.D. degree. Fellowship holders will work under the supervision of Dr. Walter Craig, a holder of a Canada Research Chair in Mathematics at McMaster University.

The Canada Research Chair Fellowship is open to candidates of any nationality and selection will be based upon the candidate's research potential. Research areas of particular interest include analysis, partial differential equations, Hamiltonian dynamical systems and applied mathematics.

McMaster is committed to Employment Equity and encourages applications from all qualified candidates, including aboriginal peoples, persons with disabilities, members of visible minorities and women.

The Canada Research Chair Fellowship is tenable for a period of **two years beginning July 1, 2005** at a salary of $42,000 per year plus a research grant of $5,000. Duties include research and the teaching of two courses per year.

Applications, **including three letters of reference**, and the AMS Standard Cover Sheet indicating Primary and Secondary Interest Codes, should be received **before January 7, 2005 by**:

Dr. M. Valeriote
Chair
Mathematics & Statistics
McMaster University
Hamilton, ON L8S 4K1
CANADA

OR

Dr. W. Craig, Canada Research Chair in Mathematical Analysis and its Applications
Mathematics & Statistics
McMaster University
Hamilton, ON L8S 4K1 CANADA

We appreciate all replies to this advertisement, but only those applicants selected for our short list will be contacted.

McMASTER UNIVERSITY
Britton Post-Doctoral Fellowship In Mathematics

Applications are invited for the Britton Post-Doctoral Fellowship in Mathematics, named after our former colleague Dr. Ronald F. Britton. These fellowships provide an opportunity to spend up to two years engaged in research, with a limited amount of teaching, and are particularly suitable for talented young mathematicians who have recently completed the Ph.D. degree.

The Britton Fellowship is open to candidates of any nationality and selection will be based upon the candidate's research potential. Research areas of particular interest include Geometry and Topology of Manifolds, Gauge Theory, and Group Actions.

McMaster is committed to Employment Equity and encourages applications from all qualified candidates, including aboriginal peoples, persons with disabilities, members of visible minorities and women.

The Britton Fellowship is tenable for a period of **two years beginning July 1, 2005** at a salary of $42,000 per year plus a research grant of $5,000. Duties include research and the teaching of two courses per year.

Applications, including **three letters of reference**, and the AMS Standard Cover Sheet indicating Primary and Secondary Interest Codes, should be received before **January 7, 2005 by**:

Dr. M. Valeriote
Chair
Mathematics & Statistics
McMaster University
Hamilton, ON L8S 4K1
CANADA

OR

Dr. I. Hambleton
Britton Professor of Mathematics
Mathematics & Statistics
McMaster University
Hamilton, ON L8S 4K1
CANADA

We appreciate all replies to this advertisement, but only those applicants selected for our short list will be contacted.

McMASTER UNIVERSITY
McKay Post-Doctoral Fellowship In Mathematics

Applications are invited for the McKay Post-Doctoral Fellowship in Mathematics, named after Dr. A.C. McKay, a former Dean and Chancellor of McMaster University. These fellowships provide an opportunity to spend up to two years engaged in research, with a limited amount of teaching, and are particularly suitable for talented young mathematicians who have recently completed the Ph.D. degree.

The McKay Fellowship is open to candidates of any nationality and selection will be based upon the candidate's research potential. Research areas of particular interest include Harmonic Analysis, Linear and Nonlinear Partial Differential Equations.

McMaster is committed to Employment Equity and encourages applications from all qualified candidates, including aboriginal peoples, persons with disabilities, members of visible minorities and women.

The McKay Fellowship is tenable for a period of **two years beginning July 1, 2005** at a salary of $42,000 per year plus a research grant of $5,000. Duties include research and the teaching of two courses per year.

Applications, including **three letters of reference**, and the AMS Standard Cover Sheet indicating Primary and Secondary Interest Codes, should be received before **January 7, 2005 by**:

Dr. M. Valeriote
Chair
Mathematics & Statistics
McMaster University
Hamilton, ON L8S 4K1
CANADA

OR

Dr. E. Sawyer
McKay Professor of Mathematics
Mathematics & Statistics
McMaster University
Hamilton, ON L8S 4K1
CANADA

We appreciate all replies to this advertisement, but only those applicants selected for our short list will be contacted.

APPEL DE MISES EN CANDIDATURE
PRIX DE DOCTORAT 2005 DE LA SMC

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 considérer 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 2005**.

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.

Président, Comité de sélection du Prix de doctorat
Bureau administratif de la SMC
577 avenue King Edward
Ottawa, Ontario Canada K1N 6N5

CALL FOR NOMINATIONS
2005 CMS DOCTORAL PRIZE

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, 2005**.

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.

Chair, Doctoral Prize Selection Committee
CMS Executive Office
577 King Edward Avenue
Ottawa, Ontario K1N 6N5 Canada

FIFTH COMPETITION FOR THE NSERC-CMS MATH IN MOSCOW SCHOLARSHIP

The fifth competition took place in September 2004. Simon Belzile, studying in mathematics at the Université du Québec à Montréal is the winner of this competition. He will benefit from a $10,000 scholarship to attend the Winter semester 2005 at the Moscow Independent University. We wish him a very interesting and exciting semester.

The next competition is in the Spring and the deadline is March 30 2005. Two scholarships will be awarded.

Please visit the following web site for additional information: ***http://www.cms.math.ca/bulletins/Moscow_web.html***

CINQUIÈME COMPÉTITION POUR LA BOURSE CRSNG-SMC MATH À MOSCOU

La cinquième compétition a eu lieu en septembre 2004. Simon Belzile (baccalauréat en mathématiques) de l'Université du Québec à Montréal en est le gagnant. Il se méritera une bourse de 10 000 $ pour passer le trimestre d'hiver 2005 à l'Université Indépendante de Moscou. Nous lui souhaitons un trimestre intéressant et excitant.

La prochaine compétition aura lieu au printemps avec date d'échéance le 30 mars 2005. Deux bourses seront alors attribuées.

Veuillez visiter notre site web pour de plus amples information: ***http://www.smc.math.ca/bulletins/Moscou_web.html***

THE UNIVERSITY OF TORONTO
Department of Mathematics

The department anticipates having a number of open positions over the next several years, subject to budgetary approval.

- Full professorships (tenured). Successful candidates will be nominated for a Canada Research Chair. Applicants must be outstanding mathematicians who are leaders in their field. (Code: CRC)

- Assistant Professorships (tenure-stream). Applicants must demonstrate excellent accomplishments and outstanding promise in research and strong commitment to graduate and undergraduate teaching. Preference will be given to researchers in areas of Analysis (Code: ANA), Algebra (Code: ALG), and Geometric analysis (Code: GAN). However, exceptional candidates in all fields of pure or applied mathematics are encouraged to apply (Code: OTHER).

- Limited Term Assistant Professorships, for a period of one to three years. Applicants must demonstrate strength in teaching and significant research promise. (Code: CLTA)

- Post-doctoral positions, for a period of one to two years. Applicants must demonstrate strength in teaching and research. Applicants must directly contact faculty members who may support them from their grants. For a list of faculty members and their research interests, see ***http://www.math.toronto.edu/dept/dirfac.html***. (Code: PDF)

Applicants are asked to specify the code of the most relevant positions and to include the standard AMS Cover Sheet. Applicant material must include the candidate's Curriculum Vitae, list of publications, and four letters of recommendation, of which at least one letter primarily addresses the candidate's teaching. All application material should be sent to the Search Committee by Email (text, postscript, or PDF only) to ***mathjobs@math.utoronto.ca***, or by fax to 416-978-4107, or by post to the Department of Mathematics, University of Toronto, 100 St. George Street, Room 4072, Toronto, Ontario, Canada M5S 3G3. Preference will be given to applications received by December 1, 2004.

The University of Toronto offers the opportunity to teach, conduct research, and live in one of the most diverse cities in the world. See ***http://www.toronto.ca*** and ***http://www.toronto.com.***

The University of Toronto is strongly committed to diversity within its community and especially welcomes applicants from visible minority group members, women, Aboriginal persons, persons with disabilities, members of sexual minority groups, and others who may contribute to the further diversification of ideas.

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority.

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

NOVEMBER 2004 NOVEMBRE

14-17 Multiscale Rehological Models for Fluids (Centre de Recherches Mathematiques, Université de Montreal, Montreal, QC) *crm@ere.umontreal.ca*

15-17 Coxeter Lecture Series (Fields Institute, Toronto, ON) *abrand@fields.utoronto.ca*

19-23 Workshop on Mirror Symmetry (The Perimeter Institute, Waterloo, ON) *abrand@fields.utoronto.ca*

DECEMBER 2004 DÉCEMBRE

6-10 III Joint Meeting Japan-Mexico in Topology and its Applications (Oaxaca, Mexico) *jamex@matmor.unam.mx*

6-10 Compact Moduli Spaces and Birational Geometry (AIM Research Conference Center, Palo Alto, CA) *http://aimath.org/ARCC/workshop/birational/*

11-13 **CMS Winter Meeting / Réunion d'hiver de la SMC** (McGill University, Montréal, Québec) *meetings@cms.math.ca*

16-19 International Conference on History and Heritage of Mathematical Sciences (Holkar Science College, Indore, India) *bsyadav@indiashm.com*

JANUARY 2005 JANVIER

5-8 Annual Meeting of American Mathematical Society (Atlanta,GA) *www.ams.org/meetings/*

10-14 Workshop on Topological Strings (Fields Institute, Toronto, ON) *abrand@fields.utoronto.ca*

26-30 Front Propagation and Nonlinear Stochastic PDEs for Combustion and other applications (CRM, Montreal, Quebec) *crm@ere.umontreal.ca*

FEBRUARY 2005 FÉVRIER

7-9 IMA Tutorial/Workshop: Where Mathematics Meets Industry (University of Minnesota, Minneapolis, MN) *visit@ima.umn.edu; www.ima.umn.edu/matter/*

MARCH 2005 MARS

2-5 Representing Unresolved Degrees of Freedom for the Atmosphere and Ocean (CRM, Montreal, Qc) *crm@ere.umontreal.ca*

19-20 28th Annual Texas PDE Conference (University of Texas, Pan American, Edinburgh, TX) *http://www.math.panam.edu/txpde05/*

21-25 Workshop on $N = 1$ Compactifications (Fields Institute, Toronto, ON) *abrand@fields.utoronto.ca*

MARCH 2005 MARS

21-25 Extensions of Hilbert's Tenth Problem, AIM Research Conference Center, Palo Alto, CA) *www.aimath.org/ARCC/workshops/Hilberts10th/*

22-26 Conference on Algebra and its Applications, Ring Theory and its Applications (Ohio University, Athens, OH) *algebraconference@math.ohiou.edu*

28-Apr 1 Workshop on String Phenomenology (The Perimeter Institute, Waterloo, ON) *abrand@fields.utoronto.ca*

APRIL 2005 AVRIL

6-10 Extracting Macroscopic Information from Molecular Dynamics (CRM, Montreal, Quebec) *crm@ere.umontreal.ca*

27-May 1 Multiscale Modelling in Solids (CRM, Montreal, Quebec) *crm@ere.umontreal.ca*

MAY 2005 MAI

2-6 Workshop on Gravitational Aspects of String Theory (Fields Institute, Toronto, ON) *abrand@fields.utoronto.ca*

11-15 Integrative Multiscale Modelling and Simulation in Materials Science, Fluids and Environmental Science (CRM, Montreal, QC)

13-14 6th Mississippi State-UAB Conference on Differential Equations & Computational Simulations; Dedicated to Louis Nirenberg's 80th birthday and Klaus Schmitt's 65th birthday(Mississippi State University, Mississippi State, MS) *http://www.msstate.edu/dept/math/de2005/*

14-15 Conference in honor of Heydar Radjavi's 70th Birthday (Hotel Golf, Bled, Slovenia) *Damjana.Kokol@FMF.Uni-Lj.SI, www.law05.si/hrc/*

15-21 ICMI Study15; The Professional Education and Development of Teachers of Mathematics (Aguas de Lindoia, Sao Paulo, Brazil) *dball@umich.edu*

22-25 ICCS 2005: International Conference on Computational Science, Advancing Science through Computation (Atlanta, GA) *Iccs2005@mathcs.emory.edu*

JUNE 2005 JUIN

1-5 Stochastic Modelling in Financial Mathematics (CRM, Montreal, Quebec) *crm@ere.umontreal.ca*

4-6 **CMS 2005 Summer Meeting / Réunion d'été 2005 de la SMC** (University of Waterloo) *meetings@cms.math.ca*

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

JUNE 2005 JUIN

16-19 Second Joint Meeting of American Math. Soc with the Deutsche Math.-Vereinigung and the Osterreichische Math.Gesellschft (Mainz, Germany) ***www.ams.org/meetings/***

26-29 12th International Linear Algebra Society Conference (Regina, SK) ***www.math.uregina.ca/~ilas2005/***

31-Aug.3 Renaissance Banff: mathematical connections in art, music and science (The Banff Center, Banff, AB). The last day of the conference will be a Coxeter Day. ***www.sckans.edu/~bridges***

AUGUST 2005 AOÛT

3-9 XXIVièmes Journées Arithmétiques, All branches of Number Theory (Marseilles, France) ***www.latp.univ-mrs.fr/ja2005***

31-Aug.3 Renaissance Banff: the 8th Bridges Conference and Coxeter Day, (The Banff Center, Banff, Alberta). ***rmoody@ualberta.ca www.sckans.edu/~bridges, gsarhangi@towson.edu***

22-30 International Congress of Mathematicians (ICM 2006) (Madrid, Spain) ***www.icm2006.org***

Letters to the Editors / Lettres aux Rédacteurs

The Editors of the *CMS 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 de la SMC* 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.*

RATES AND DEADLINES 2005 / TARIFS ET ÉCHÉANCES 2005

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Issue/Numéro	Deadline/Date limite
February / février	December 1 décembre
March / mars	January 15 janvier
April / avril	February 15 février
May / mai	March 15 mars
September / septembre	July 1 juillet
October / octobre	August 15 août
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December / décembre	October 15 octobre

Maximum page size / taille maximum des pages:
Back cover/plat verso: 7.5 x 8.5 in/pouces
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Les *Notes de la SMC* sont postées la première semaine du mois de parution. L'adhésion à la SMC compred l'abonnement aux *Notes de la SMC*. Le tarif d'abonnement pour les non-membres est de 50 $ CAN si l'adresse de l'abonné est au Canada et de 50 $ US autrement.

NEW AND NOTEWORTHY

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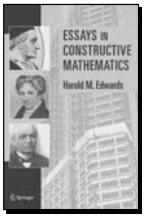
HAROLD M. EDWARDS, New York University, New York, NY



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KEHE ZHU, State University of New York at Albany, NY

The book presents a modern theory of holomorphic function spaces in the open unit ball. Spaces discussed include the Bergman spaces, the Hardy spaces, the Bloch space, BMOA, the Dirichlet space, the Besov spaces, and the Lipschitz spaces. Most proofs in the book are new and simpler than the existing proofs in the literature. The central idea in almost all these proofs is based on integral representations of holomorphic functions and elementary properties of the Bergman kernel, the Bergman metric, and the automorphism group.

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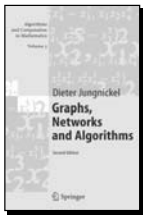

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ANTOINE CHAMBERT-LOIR, Ecole Polytechnique, Palaiseau, France

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