CMS NOTES de la SMC

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MESSAGE DE LA PRÉSIDENTE

Christiane Rousseau

(English version on page 15)

La date de tombée pour ce numéro de novembre est le 15 septembre si bien qu'au moment où je vous écris l'année académique vient tout juste de commencer. L'été est la saison des congrès internationaux et l'été 2002 a été marqué par le Congrès International des mathématiciens (ICM2002) qui s'est tenu à Beijing du 20 au 28 août, précédé par l'Assemblée générale de l'Union mathématique internationale (UMI) à Shanghai les 17et 18 août. Les faits marquants de cette assemblée générale ont été l'élection du nouvel exécutif et des membres des commissions de l'UMI. John Ball (Royaume-Uni) est le président élu et il succèdera à Jacob Palis le 1er janvier prochain. Les vice-présidents sont Jean-Michel Bismut (France) et Masaki Kashiwara (Japon), tandis que Philip Griffiths (États-Unis) reste au poste de secrétaire. Les membres élus sont Andrey Bolibrukh (Russie), Martin Grotschel (Allemagne), Zhi-Ming Ma (Chine), Ragni Piene (Norvège), première femme à siéger au comité exécutif, et Madabusi S. Raghunathan (Inde). Bernard Hodgson, notre vice-président Québec, a été réélu au poste de secrétaire général de la Commission internationale sur l'enseignement mathématique (ICMI). L'assemblée générale a également décidé du lieu du prochain congrès international des mathématiciens de 2006, lequel se tiendra à Madrid, précédé de l'assemblée générale de l'UMI à Saint-Jacques de Compostelle. Les membres de la délégation norvégienne ont décrit les règles d'attribution du premier prix Abel en 2003. En cette première ronde tout mathématicien peut faire une nomination. La date limite est le 1er novembre 2002. Le comité d'attribution du prix comprendra un norvégien, un membre nommé par la Société mathématique européenne et 3 membres nommés par l'Union mathématique internationale. En utilisant les surplus du Congrès international des mathématiciens de Berlin de 1998, l'Union mathématique allemande (DMV) l'Union mathématique internationale ont créé un nouveau prix, le Prix Gauss,

(*continued on page 16)*

CMS NOTES
NOTES DE LA SMC

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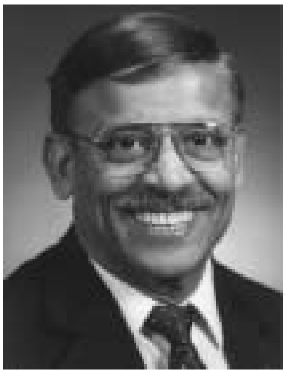
EDITORIAL



S. Swaminathan

As the new year 2003 approaches I ponder over the centenary of the extraordinary fertility in the new mathematical ideas that characterized the years from about 1900 to 1905. Hilbert's *Festschrift* on the foundations of geometry, which appeared in 1899, provided an impetus for mathematicians to consider postulates for different mathematical systems. In 1903 appeared the great paper of I. Fredholm on integral equations which became the focus of subsequent research for many mathematicians. This movement led E. H. Moore toward his general analysis and the consideration of abstract spaces by M. Frôechet. Lebesgue's first expositions of a new theory of integration appeared in this period. Einstein's theory of relativity, though a paper in physics, had profound mathematical consequences. Ricci and Levi-Civita introduced absolute differential calculus in a seminal paper in 1901 which laid the foundations of modern differential geometry.

We may also trace to the first few years of the last century some beginnings of modern topology, significant developments in the theory of groups and new interest in boundary value problems. Finally this was also the period when the great *Encyclopadie der mathematischen Wissenschaften* was launched.

We should give some serious thought to the best way of celebrating the centenary of these remarkable achievements. Please let us know your views.

* * * * *

À l'aube de l'année 2003, mes réflexions se portent sur le centenaire de certaines idées mathématiques, qui ont été extraordinairement nombreuses autour des années 1900 à 1905. Par son ouvrage intitulé *Festschrift* sur les fondements de la géométrie, paru en 1899, Hilbert a amené les mathématiciens à envisager l'emploi des postulats dans divers systèmes mathématiques. En 1903 paraissait la grande oeuvre de Fredholm sur les équations intégrales, autour de laquelle s'est ensuite recentrée la recherche de nombreux mathématiciens. C'est ce brassage d'idées qui a amené E. H. Moore vers son analyse générale, et Maurice Fŕechet vers l'étude des espaces abstraits. C'est aussi pendant cette période que Lebesuge a exposé pour la première fois sa nouvelle théorie de l'intégration. Bien qu'appartenant au domaine de la physique, la théorie de la relativité d'Einstein a également eu de grandes répercussions mathématiques. Ricci et Levi-Civita ont en outre abordé pour la première fois le calcul différentiel absolu dans un article fondamental en 1901, qui a établi les fondements de la géométrie différentielle moderne.

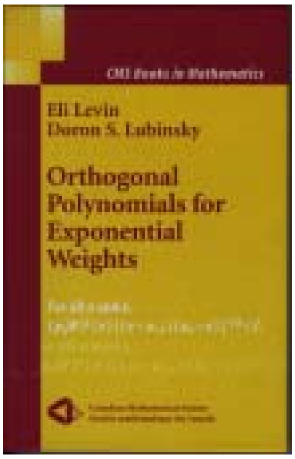
Les premières années du siècle dernier ont aussi vu les premiers balbutiements de la topologie moderne, des progrès importants dans la théorie des groupes et un nouvel intért pour les problèmes de valeur au bord. Enfin, c'est également pendant cette période qu'est née la grande *Encyclopédie des sciences mathématiques pures et appliquées*.

Nous devrions songer sérieusement à la meilleure façon de célébrer le centenaire de ces réalisations remarquables. Faites-nous part de vos idées.

Strong Research Monograph Misses Opportunity

Book Review by Martin Muldoon, York University

Orthogonal Polynomials for Exponential Weights
by Eli Levin and Doron S. Lubinsky
CMS Books in Mathematics, Vol 4
Springer-Verlag, New York, 2001
xi + 476 pp



With each of a large class of positive measures μ on the real line it is possible to associate a sequence $\{p_n(x)\}$ of *orthogonal polynomials* with the property that

$$\int_{-\infty}^{\infty} p_m(x)p_n(x)d\mu(x) = \begin{cases} 0, & m \neq n, \\ 1, & m = n. \end{cases} \quad (1)$$

Such a sequence satisfies a three term recurrence relation

$$xp_n(x) = a_nP_{n+1}(x)+b_nP_n(x)+a_{n-1}P_{n-1}(x), n = 1, 2, \ldots. \quad (2)$$

Conversely, for suitable starting values and coefficient sequences $\{a_n\},\ \{b_n\}$, the recurrence relation (2) generates a sequence of polynomials satisfying (1) for some measure μ. The polynomials have their zeros within the interval of support of the measure.

Examples date from the 19th century. The Jacobi polynomials $P_n^{(\alpha,\beta)}(x)$ are orthogonal with respect to μ with support $[-1, 1]$, where $d\mu = (1-x)^{\alpha+1}(1+x)^{\beta+1}\ dx,\ \ \alpha, \beta > -1$. The Laguerre polynomials are orthogonal with respect to the weight $w(x) = x^\alpha e^{-x}$ with support on $(0, \infty)$ while the Hermite polynomials are orthogonal on $(-\infty, \infty)$ with $w(x) = e^{-x^2}dx$. Special cases were known earlier or singled out for special discussion later. So, for example, we have the Legendre polynomials as the special case $\alpha = \beta = 0$, and the Chebyshev polynomials as the special case $\alpha = \beta = \pm\frac{1}{2}$ of the Jacobi polynomials.

Some of these polynomials arise when we use separation of variables in partial differential equations of mathematical physics. They arise also in numerical quadrature; the formula

$$\int_a^b f(x)dx \approx \sum_{k=1}^{n} a_nf(x_n)$$

is most accurate when the x_n are the zeros of an appropriate orthogonal polynomial. Classes of orthogonal polynomials are connected intimately with continued fractions, with birth and death processes, random matrices, Padé approximation,and a host of other areas of mathematics and its applications.

The books [2], [3], [8] offer somewhat different approaches to orthogonal polynomials. For an introduction, the reader can consult the appropriate chapters in, e.g., [1] or [9]. Among attempts to unify their study of special orthogonal polynomials, is the noteworthy Askey scheme (see, e.g., [4]), in which specific sequences of orthogonal polynomials are seen as special or limiting cases of orthogonal polynomials of "hypergeometric type".

But this is rather far from the subject matter of the book under review, which is concerned with the orthogonal polynomials corresponding to very general measures, in particular the problem of inferring information about the polynomials or their zeros directly from the measure μ in (1). Exponential weights refer to the situation where $d\mu(x) = w(x)dx$ and $w = W^2 = \exp(-2Q)$ on $(-\infty, \infty)$. This area of study owes much to the impetus of G. Freud (see [7]). Important new methods have been introduced in recent decades, for example techniques of potential theory by Rakhmanov and by Mhaskar and Saff in the 1980s and the Riemann-Hilbert techniques by Deift, Kriecherbauer, McLaughlin and others in the 1990s. The authors of the present monograph are well positioned to report on the explosive activity in this area of research. Lubinsky, in particular, has made many outstanding contributed to the field frequent major speaker at conferences on this and related aspects of approximation theory. The book is clearly the product of prodigious effort —"the fruit of some 18 years of collaboration between the authors", according to the Acknowledgments.

Although the measure determines the polynomials completely, it is by no means easy to extract useful information about them. Often, we are interested in asymptotic (large n) information about the polynomials and their zeros. Progress might include a broadening of the class of weights for which a particular result is known or obtaining more satisfactory asymptotic information for a given class of weights. "Strong asymptotics" refers to the asymptotics as $n \to \infty$ of $p_n(z)$. But sometimes we have to be satisfied with the less informative "nth root asymptotics", i.e., the asymptotics of $p_n^{1/n}$ or the intermediate "ratio asymptotics" involving $\lim p_{n+1}/p_n$. Often, it is desirable to have results as inequalities, rather than in asymptotic form.

The authors define six classes of weights each containing the previous one, together with some subclasses. They are defined on an interval $I = (c, d)$ where $c < 0 < d$ and c, d may be finite or infinite. It takes over half a page to describe the hypotheses on Q or W for the smallest of these classes. For many of these classes, there exists an interval $[a_{-n}, a_n]$ on which the polynomials $p_n(W^2, x)$ corresponding to the weight $W^2 = e^{-2Q}$ behaves much as some classical polynomials do on the finite interval of support of their measures. One of the main results of the book asserts that under certain very general conditions on W,

$$\sup_{x\in I} |p_n(W^2, x)|W(x)[|x - a_n||x - a_{-n}|]^{1/4} \sim 1,$$

uniformly for $n \geq 1$.

On page 5, having described some previous work, the authors ask the rhetorical question: "Is it possible to provide a unified treatment of all these cases - finite and infinite intervals, Q of whatever convex rate of growth? Is is possible to avoid the severe restriction of evenness? The conclusion of this paper (sic) is yes!". In some ways the book has the look of a research paper which grew to book size. The emphasis is on results and their sharpness rather than on motivation or connections. It is a work of extraordinary typographical and logistical complexity in which great care is taken to leave no technical lemma unproved, and no credit or inspiration unacknowledged. There seem to be few typos; I noticed only "swopped" for "swapped" on page 43. The authors even record some typographical errors in earlier works, their own as well as those of others. A useful section called "Notes" is somewhat hidden at pp. 447–453, the Notes on Chapter 1 providing a guide to the bibliography of 193 items. The Subject Index is rather short and there are no page references from the bibliography to the main text. On the other hand, there is a rather complete list of symbols, longer than the index, including the information that I stands for the "basic interval $[c, d]$" and is encountered first in equation (1.14) on p. 6. On the other hand, "Maria's theorem" is mentioned a few times (p. 35, ff.) but is not in the index. But these are small criticisms. As a research monograph, this outstanding book will be a landmark in the field for many years to come.

According to the back cover "The book will be of interest to researchers in approximation theory, harmonic analysis, numerical analysis, potential theory and all those that apply orthogonal polynomials". In the reviewer's opinion, only those who work in the area will have the fortitude to study it in detail. The book will not be of much interest to the general mathematical reader. In part this is because of the nature of the subject matter. The object is to find the weakest possible hypotheses on Q which will give interesting results. Since a mixture of methods are used the hypotheses end up looking somewhat complicated and inelegant. Lubinsky is acknowledged as a skillful expositor who has a knack of making complicated topics accessible to the nonexpert, but this is more evident in some of his other work (see, e.g., [5], [6]) than it is here. The work's appearance in a major book series guarantee it a wider exposure than would be the case for other formats; the authors have missed an opportunity to make the earlier part of the book more reader-friendly. The unrelenting technicality and completeness which make the book strong as a research monograph makes it difficult for the general mathematical reader to gain a foothold and provide an example, in microcosm, of what makes most presentations of mathematics so uninviting to the general reader.

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Report of the Steering Committee for Pure and Applied Mathematics

The CMS Notes is publishing this report in four instalments, the first two of which appeared in September and October. This instalment contains the balance of Part 3 of the Report ("Report on the Canadian Community"), together with Parts 4 and 5.

Applied and Industrial Mathematics

(a) Biological and Medical Mathematics: Just as the 20th century witnessed a revolution in physics, the 21st is destined to be the Century of Biology. The sequencing of the human genome is expected to lead to major advances in the areas of health, heredity, and the treatment of genetic diseases. The success of the human genome project relied on mathematical and computational ideas, on sophisticated computational algorithms, and on enormous computing power. The major question now is how to extract useful information from these sequences. The identification of the regulatory processes built upon the genome is the next step, defining the emerging area of functional genomics. Canadian mathematicians involved in this task include D. Sankoff (Montreal; CIAR Fellow, Evolutionary Biology Program 1992-2002, FRSC, Killam), D. Bryant (McGill), M. Li (Waterloo), P. Kearney (Waterloo), V. King (Victoria), T. Wareham (Memorial), A. Bergeron (UQAM), N. El-Mabrouk (Montreal; CIAR Scholar, Evolutionary Biology Program), and A. Bonner (Toronto).

The genome project is part of a global effort that includes research in physiology, cell biology, development, structural chemistry, and genetics to cure or ameliorate disease. Canada has a long established tradition in mathematical physiology and mathematical population dynamics, and these areas continue to make major research contributions.

The Centre for Nonlinear Dynamics in Physiology and Medicine (CNDPM) at McGill is a striking example of such structured interdisciplinary research in Canada. M.C. Mackey (FRSC; Joseph Morley Drake Professor) and L. Glass (McGill; FRSC, Isadore Rosenfeld Chair in Cardiology) made the conceptual breakthrough in 1977 that popularized the field now known as Dynamical Diseases. Mathematics members of the CNDPM include J. Belair (Montreal), who uses delay-differential and functional differential equations to model complex biological rhythms (neuromuscular control, cell population, neural networks, and controlled drug delivery), and S.A. Campbell (Waterloo), who uses nonlinear dynamical systems and differential delay equations to study regulatory feedback systems in mechanics and physiology. In collaboration with Engineering and Industry (Cardianove), M. Delfour (Montreal) is involved in a joint CRM-CERCA NCM_2 project on the design and control of medical devices (e.g. endoprotheses in cardiac surgery). UBC also has a strong tradition in mathematical biology, with prominent pioneers such as C. Clark and D. Ludwig (management of natural resources, ecology), R. Miura (neurophysiology) and younger rising researchers, such as L. Edelstein-Keshet (development, pattern formation), Y-X. Li (neurophysiology), and M. Doebeli (ecology). R. Miura (FRSC, Guggenheim), co-founder of the theory of solitons, is a leading figure in mathematical properties of excitable media and has analyzed bursting electrical behavior in pancreatic cells and electrical properties of cortical neurons. In Victoria, mathematical biology is centered on P. van den Driessche (population dynamics, epidemic models) and R. Edwards (neural networks, neuromotor control). J. Wu (York; CRC) and A. Longtin (Ottawa) work on modelling in the nervous system, the bifurcation behavior for delay-differential equation models, and especially the role of stochastic processes in signal recognition and transduction. Alberta, under the influence of H. Freedman, has also been establishing strong leadership through the recruitment of rising stars such as M. Lewis (CRC) in ecology and G. de Vries in physiology. Alberta researchers M. Y. Li*, J. Muldowney, G. de Vries, and D. Wiens work on a MITACS project concerning mathematical modelling in pharmaceutical development.

Canadian leadership has been very visible at the international level through Canadian involvement in the international Society for Mathematical Biology (SMB), the most mathematicized organization in this area. M. Mackey was the first SMB president, L. Glass and L. Edelstein are past presidents, and M. Lewis is the current president.

(b) Applied Mathematics and Modelling: Many problems in the physical sciences and biological sciences can be formulated in terms of partial and ordinary differential equations. The analysis of these equations and their solutions (e.g. regularity, bifurcation and asymptotic behavior, numerical approximations, optimization) can often provide insight into not only mathematical issues but also the physical phenomena under consideration, thereby having a substantial impact on industrial applications. Through the hiring of young talented researchers, there has been a growing trend towards this type of interdisciplinary research in Canada.

In the field of continuum mechanics, J. Heywood (UBC), with Rannacher, provided the first full convergence analysis of finite element schemes for the Navier-Stokes equations. These theoretical advances are the basis of an acclaimed CFD solver. Key results of R. Illner (Victoria) include a global existence and uniqueness result for the Boltzmann equation. T.B. Moodie (Alberta) was the first to introduce strain energy concepts into cardiovascular research. He solved a 50-year old problem by providing a frame invariant form of the constitutive equations of thermo-elasticity. Many talented younger researchers are working in emerging areas of applied mathematics. M. Ward (UBC; Steacie, ICIAM) has made important contributions to metastable phenomena in reaction-diffusion equations with applications to materials science. Jointly with condensed matter physicists, S. Alama (McMaster) and L. Bronsard (McMaster) are working on SO(5) models of superconductivity. Dendritic and crystal growth has been studied by J.J. Xu (McGill) with NASA funding. A. Pierce (UBC) has made key contributions to the computational analysis of problems in rock and fracture mechanics and has research ties to Schlumberger. W. Langford (Guelph) is a leading expert in bifurcation theory, and has studied such diverse topics as the transition to turbulence in the famous Taylor-Couette experiment in fluid mechanics, resonance phenomena for flow-induced vibrations, chaotic mode interactions, and instabilities in biological systems. A. Lewis (SFU) has provided, with J. Borwein (SFU; Chauvenet Prize), key convergence results for maximum entropy methods.

The newly founded Applied and Industrial Mathematical Sciences (AIMS) lab at McMaster, with W. Craig as director, is concentrating on the applications of analysis and scientific computing to applied, engineering, and industrial problem-solving. The core members of the group belong to the newly revitalized applied mathematics group at McMaster, which is comprised of S. Alama, L. Bronsard, and G. Wolkowicz, plus 3 recent hirings (D. Earn*, N. Kevlahan*, and D. Pelinovsky*) and 6 PDFs. Other centres promoting industrial mathematics are the Applied Mathematics Institute (AMI) at Alberta and the Institute of Industrial Mathematical Science (IIMS) at Manitoba.

(c) Financial Mathematics: During the past decade, financial mathematics has become a major area of focus in Canada. U. Haussmann (UBC) is a leading figure in optimal control for stochastic differential equations with applications to math finance. The Clark-Haussmann formula in stochastic calculus is one of the fundamental tools used in the pricing of derivatives. Graduate programs have been established at a number of universities and the Fields Institute has made financial mathematics a priority of its outreach program. The Mathematics Finance Laboratory at Calgary, Risklab at Toronto, and the Mathematics Finance Laboratory (PhiMAC) at McMaster are applying the theory of PDEs to the study of market and credit risk. Two MITACS projects, under the direction of U. Haussmann (UBC) and T. Hurd (McMaster), are investigating financial risk management.

Computational Mathematics

Computing has now become an integral aspect of science and engineering, playing a role as crucial as theory and experiment have done in the past. This is an area where Canadian mathematics, both pure and applied, has displayed considerable innovation. Leadership has been demonstrated in numerical modelling, computational number theory, cryptography and symbolic analysis. Number theory with its major ties to algorithms, cryptography, error correction, and computing, is a major theme in much of the work which we detail.

(a) Numerical Modelling M. Fortin (Laval; FRSC) is a leading figure in mixed finite element methods and an original contributor to computational fluid and solid Mechanics. He has established a long standing and effective cooperation with Engineering and Industry (e.g., Bombardier, ADS Composites, Prevost Cars) and with medicine through interdisciplinary projects like SKALPEL-ICT (simulation kernel applied to the planning and evaluation of image-guided cryo-therapy), and tackled large scale industrial problems (PIGE-ISP, Pratt Whitney, ALCAN). A. Fortin (Laval) is involved in the forming of polymeric materials and the development of iterative solvers for fluid flow problems (Peugeot and Elf). He is currently working on mixed methods for large deformation of hyperelastic materials with Michelin.

Giref (Groupe Interdisciplinaire de Recherche en Elements Finis) at Laval University under the direction of A. Fortin, promotes and develops mathematical techniques for engineering sciences, particularly through joint development of software. Industrial contracts include Bombardier, ALCAN, and Pratt Whitney Canada. Giref has a budget of $230K, and organizes the very successful annual Journée des Éléments finis.

The Mathematical Modelling and Scientific Computation group is part of the MITACS NCE and consists of R. Choksi* (SFU), H. Huang (York), M.C. Kropinski (SFU), R. Miura (formerly UBC), A. Peirce (UBC), K. Promislow (SFU), R. Russell (SFU), S. Ruuth (SFU), B. Seymour (SFU), M. Ward (UBC), B. Wetton (UBC) and R. Westbrook (Calgary). They have an on-going project with Ballard Power Systems, with whom they are modelling multi-dimensional heat and mass transfer with phase change in fuel cell electrodes. The group of M. Best, L. Tuncel, and H. Wolkowicz in Waterloo is specialized in continuous optimization, semidefinite relaxations for computationally hard problems, quadratic programming, and optimization, and interior-point methods. Other labs for computational mathematics are the Numerical Analysis Research Laboratory at Ottawa and the Combinatorial Computing Center at Memorial.

(*continued on page 23)*

The ICM 2002: A Personal Account

by A. C. Thompson, Dalhousie University

If participants at the first ICM in Zurich in 1897 could have been present in Beijing at this 24th such gathering they would have been astonished at the changes in mathematics in the intervening years.

First of all, mathematics and mathematicians have rarely (ever?) been accorded the recognition and official stamp of approval that they were given in Beijing. The Opening Ceremony took place in the Great Hall of the People on Tiananmen Square (China's closest analogy to the Houses of Parliament). It was attended by the President of China, Jiang Zemin, one of the Vice Premiers and the Mayor of Beijing (a city with a population nearly half that of Canada). To transfer the delegates from the Conference Centre on the 4th ring road to the city centre a fleet of about 90 buses was used. These were given a police escort and whisked through the traffic non-stop in the middle of the day. Taxi drivers were not happy. The Congress was given prominent display in the daily papers for at least a week. Ordinary citizens – shopkeepers, taxi drivers, train conductors – that I met in rural Hunan the following week were aware of the conference and of the reported "not-quite-top-level" performance of Chinese mathematicians. The newsworthiness was enhanced by some celebrities: Stephen Hawking gave a public lecture on the Sunday before the Congress and John Nash Jr. gave one on the Wednesday evening.

Secondly, there were the prizes. Since the first Nobel prizes were not awarded until 1901, our time travellers might be surprised to see the conferring of three prestigious awards (two Fields medals and one Nevanlinna prize). These went to Laurent Lafforgue, Vladimir Voevodsky and Madhu Sudan. The areas of the first two would not surprise the visitors. Lafforgue was honoured for his major advance in the Langlands programme providing new connections between number theory and analysis; Voevodsky for his work in algebraic geometry and number theory. Sudan's work on a wide variety of topics within theoretical computer science contributes to the ever expanding domain of mathematics. One might insert here that prizes always generate controversy. Why only two Fields medals at this congress? If, as rumour suggests, it is lack of adequate endowment for the prizes, then the Federal Government is missing a wonderful opportunity. We need to do more lobbying. Why both prizes in such traditional (and somewhat related) fields? Next is the breadth of the programme.

(Photo Courtesy of Judi Borwein)

The 20 plenary talks ranged from Lafforgue explaining very clearly what Mumford described as one of the "tremendous Himalayan peaks of arithmetic algebraic geometry" to the new applications of mathematics exemplified by Shafi Goldwasser's beautiful presentation (using Powerpoint) of: "The mathematical foundations of modern cryptography, a complexity perspective". Incidentally, Lafforgue was the only presenter I saw to provide a Chinese translation—to assuage his dislike of presenting his talk in English. There were 19 parallel sessions of Invited and Contributed talks. These roughly followed the order of subjects in Math Reviews and went from Logic to Applications of Mathematics in the Sciences, Mathematics Education and Popularization, and History of Mathematics. The Short Communications offered a bewildering range of topics. Here are a few titles from the programme: Relativization in non-standard set theory; 2 x 2 matrices as sums of cubes; affinely convex ovals; polynomial knots; Toeplitz operators on semisimple Lie groups; graph polynomials for the game of Go; Geometric Fourier analysis and image processing; the fractal dimension and predictions of a chaotic time series from Shanghai stock market; the poetry of mathematics; logical reasoning in ancient Chinese mathematics.My own intake of talks was very mixed. "The poetry of mathematics" turned out to be a delightful 15 minutes listening to Anne Hughes read poems (mostly her own) on mathematics and mathematicians. I spent an interesting afternoon in the History section listening to a series of talks on medieval Islamic mathematics. The two short talks that seemed closest to my own interests were both disappointing; one did not show up and the other was a strong candidate for the worst presentation I have ever been at. The most productive time was spent at plenary and invited talks. In addition to the two mentioned above, David Mumford gave a brilliant talk on the mathematics of perception once more stressing the stochastic nature of the problem. By concentrating on the particular example of the Monge- Ampère equation, Luis Cafarelli made non-linear elliptic equations seem accessible (even to me). For the first time I saw a structure to the problems. Douglas Arnold unified a broad range of mathematics in a very surprising way by linking exact sequences to numerical analysis. On Saturday afternoon, I spent an interesting time listening to combinatorics. Günter Ziegler, talking about face numbers of 3-spheres and 4-polytopes, gave the impression of being close to characterizing these f-vectors. This was followed by Gerard Cornuejols outlining a proof of the perfect graph conjecture. Many of the invited talks presented very new results; here so new that he admitted not all the proofs had been written out. The conference was brilliantly organized and ran smoothly. The only glitches had to do with computers. There was always a wait to get access to the machines handling e-mails and very few of the Powerpoint presentations ran without interruption. Particularly troublesome in this respect was the hold up in the expositions of the work of the medallists. Nevertheless, Mao may have turned in his mausoleum to see such abstract mathematics publicly displayed in the Great Hall. Particularly noteworthy to the organization was the band of volunteers (about 200) from Beijing University (mostly math undergraduates) who were always on hand to answer questions and help. They first made their presence felt by making the transition from airport to hotel particularly easy. Registration was fast and easy. No-one I spoke to had any complaints about the organization. The main complaint was of the air quality in Beijing. It was unpleasant to wake up every morning to a yellowish brown haze limiting visibility. It was made more difficult to bear by the sticky heat outside and the dust from a great deal of construction going on for the Olympics.

The conference was truly global in its scope. There were participants from well over 100 countries, naturally a large contingent from China and more than 50% from Asia. During the Congress there was a two day Juvenile Mathematics Forum for school children from China. Some of these appeared briefly in the Convention centre and appeared to be both extremely bright and very keen to practice English skills.

While in Beijing, many of us enjoyed the exquisite landscaping and buildings of the old Summer Palace. It was shortly after the first ICM that this park was looted and destroyed by a consortium of western powers. Much has changed. Will the world and the world of mathematics change as much before the first ICM of the next century? The most likely answer is "yes". Certainly one has a lot of faith in the bright young mathematicians at this Congress (and the volunteers and the participants in the Juvenile Forum) who are likely to advance our subject in unforeseen ways before then.

EDUCATION NOTES

Ed Barbeau and Harry White, Column Editors

VERMONT MATH INITIATIVE

The *Vermont Math Initiative* (VMI) is a three-year professional development program for elementary teachers offered at the University of Vermont. At the end of the program, graduating teachers receive a master's degree in education with a specialty in K-6 mathematics education. Since its inception in 1999, the program has enrolled 105 teachers from 76 schools; within three years, it is planned to boost the number of graduates to 300, roughly ten per cent of the corps of elementary teachers in the state. This band of Gideon (cf. Judges 7) will then serve as catalysts for other teachers in reshaping mathematics instruction in Vermont.

According to the director, Dr. Kenneth Gross, professor of mathematics and education at UV, the philosophy of the program is to "train teachers to think like mathematians" and to teach them college mathematics in a way that they can assimilate it. Participants take two courses lasting a fortnight each summer and two lasting three weekends during each academic year; the University of Vermont and other colleges in the state provide instructors. The syllabus includes arithmetic, probability, statistics, algebra, trigonometry, and calculus. An early course, entitled *Math as a second language*, brings together arithmetic, algebra, and geometry to show that they are different approaches to the same subject.

Principals of participating teachers must sign their applications and provide a statement outlining how the training can be applied in their schools. After the first year of the program, teachers and principals attend a three-day workshop on implementing VMI-based instruction.

This is indeed an impressive initiative that has earned plaudits from those in the program, and is well worth following on this side of the border as we struggle with raising the mathematical level of comfort of our own elementary teachers. More details can be gleaned from an ariticle by Ellen R. Delisio in *Education World*, an electronic site for school issues at *http://www.education-world.com/a_issues/issues266.shtml/*. The URL for the webpage of Professor Gross is

http://www.emba.uvm.edu/˜ gross.

ACHIEVE, Inc.

In the wake of the 1996 National Education Summit in the United States, a group of state governors and chief executive officers set up *Achieve, Inc.*, an independent, bipartisan organization whose mandate is to address concerns about educational quality in U.S. schools. It fosters an increased emphasis on standards and accountability.

In February, 2002, the *Mathematics Achievement Partnership*, a subgroup examining middle school performance, produced a consultation draft of a report entitled *Foundations for success – mathematics expectations for the middle grades*. The group of authors consisted of fifteen mathematics educators, some of whose names, such as Lynn Steen, may be familiar to readers of these *Notes*. Noting that American students lose ground with respect to their peers in other countries in the middle school grades, the report makes a number of recommendations about what students need to know by the end of the eighth grade in order to access mathematics comfortably for personal needs, understand what they read in the press and be in a position to address public policy. This draft can be found on the website *www.achieve.org.* I located it by searching "Foundations for success", clicking on the button beside the name of the report and then clicking on the cover of the book. The report is quite long, but I found it useful, particularly in its provision of a large number of sample questions sorted among the four strands, *Number*, *Data*, *Geometry*, *Algebra*. In view of the types of review questions posted on the web for students planning to enter university, it would seem that such students would be fairly well off if they knew what the ideal grade eight student described in the report is supposed to know.

The questions on numbers involved such topics as manipulations with fractions, greatest common divisor and proportionality. Pupils are even expected to do a little proving: *Show that the product of any two rationals is rational.* The data section includes questions of conversion of units, error of measurement and the usual material involving graphical representation of data. Over twenty geometrical questions deal with angles, properties of plane and solid figures, visualization, mensuration, transformation. For example, pupils are asked what per cent of the can is filled by three tennis balls packed snugly into a cylindrical container. The algebra section treats formulae, patterns, graphical and analytical solutions of linear equations. Pupils are asked to show that the sum of two odd integers is even, to use a geometric diagram to justify the difference of squares factorization, and to complete the square for a quadratic polynomial.

To prepare for the suggested syllabus, students should come into Grade 6 with fluency in manual computations and mental estimation, experience visualizing and drawing geometric objects,

continued on page 26

AMS Centennial Fellowship for 2003-2004
Invitation for Applications

DEADLINE DECEMBER 1, 2002

The AMS Centennial Research Fellowship Program makes awards annually to outstanding mathematicians to help further their careers in research. From 1997-2001, the fellowship program was aimed at recent PhDs. Recently, the AMS Council approved changes in the rules for the fellowships. The eligibility rules are as follows.

The primary selection criterion for the Centennial Fellowship is the excellence of the candidate's research. Preference will be given to candidates who have not had extensive fellowship support in the past. Recipients may not hold the Centennial Fellowship concurrently with another research fellowship such as a Sloan or NSF Postdoctoral fellowship. Under normal circumstances, the fellowship cannot be deferred. A recipient of the fellowship shall have held his or her doctoral degree for at least three years and not more than twelve years at the inception of the award. Applications will be accepted from those currently holding a tenured, tenure track, post-doctoral, or comparable (at the discretion of the selection committee) position at an institution in North America.

The stipend for fellowships awarded for 2003-2004 is expected to be approximately $57,000, with an additional expense allowance of about $1,600. Acceptance of the fellowship cannot be postponed. The number of fellowships to be awarded is small and depends on the amount of money contributed to the program. The Trustees have arranged a matching program from general funds in such a way that funds for at least one fellowship are guaranteed. Due to a change in eligibility criteria and an increase in the stipend beginning last year, it is expected that two fellowships will be awarded. A list of previous fellowship winners can be found at **http://www.ams.org/secretary/prizes.html.**

Applications should include a cogent plan indicating how the fellowship will be used. The plan should include travel to at least one other institution and should demonstrate that the fellowship will be used for more than reduction of teaching at the candidate's home institution. The selection committee will consider the plan in addition to the quality of the candidate's research, and will try to award the fellowship to those for whom the award would make a real difference in the development of their research careers. Work in all areas of mathematics, including interdisciplinary work, is eligible.

The deadline for receipt of applications is **December 1, 2002.** Awards will be announced in February 2003 or earlier if possible.

Application forms can be printed from from the AMS website located at **www.ams.org**

Reference forms can also be printed from html or pdf versions.

If you would like application and reference forms sent to you by US mail, contact the

Professional Services Department
American Mathematical Society
201 Charles Street
Providence, RI 02904-2294
prof-serv@ams.org
401-455-4107

Completed application and reference forms should be sent to the AMS at the address given above.

New Research Unit at the University of Saskatchewan

A Research Unit "Algebra & Logic" has been established in the College of Arts Science at the University of Saskatchewan; see the web site http://math.usask.ca/fvk/algg.htm for more details. The founding members are F.-V. Kuhlmann, S. Kuhlmann, and M. Marshall. In addition to the founding members, the unit consists of graduate students, post-doctoral fellows and visiting scholars.

The research interests of the unit include: valuation theory, model theory, ordered algebraic structures, algebraic geometry and real algebraic geometry. The goals of the unit are to encourage and support collaboration with other researchers in Canada and internationally and to provide a vibrant research environment for young researchers through the organization of conferences, workshops, summer schools and seminars. The group has created the Valuation Theory Homepage as a forum for researchers in the area: http://math.usask.ca/fvk/Valth.html

The unit evolved from the earlier Algebra & Logic Group created in 1997. Past (and current) activities include: a lively research seminar with a large number of visitors. An Annual Colloquiumfest. The group hosted the International Conference Workshop on Valuation Theory (Saskatoon, Summer 1999), and edited the volume proceedings of that conference, the first volume of which has just appeared.

The 43rd International Mathematical Olympiad Leader's Report

by Arthur Baragar

I'm sipping a beer, sitting on the patio of a pub in Dunblane, overlooking the river. The water is stained brown by the peat bogs it drains through. With me are Bill Sands of the University of Calgary, and Graham Wright, Executive Director of the CMS. We are in Scotland for the International Mathematical Olympiad - I am leader of the Canadian team, Bill is observing, and Graham came over for a couple of days to Chair the meeting of the APMO (the Asian Pacific Mathematics Olympiad, which is currently being run by Canada).

Over the past few days, the International Jury (the leaders of the 84 competing countries) selected the six challenging problems that would make up the 43rd International Mathematical Olympiad. When we first arrived in Scotland, we were given a short list of twenty-seven problems and twenty-four hours to solve them, a daunting task when one thinks of it. After all, the students are given nine hours over two days to do six questions - and they are quite often better problem solvers than we are! On the second day, we were given the official solutions and we began our selection process. The meetings took place in English, though motions were translated into the four other official languages of the IMO - French, German, Russian, and Spanish. Once the exam was set, it was translated into the five official languages, and then the appropriate leaders translated the exam into the language of their students. In a matter of hours, the exam was translated into over forty languages! That we were finished with our task is a testament to the skills of this year's Chair, Adam McBride. Our schedule had been rushed, but not overly so, and we were enjoying a well deserved night of fresh air.

The topic of conversation turns to the prospects of the Canadian team. I am optimistic, but cautious. The training went well and the students are well prepared, but ... well, there are 'buts.'

Our team training took place over two weeks in St. John's, Newfoundland. The location was ideal. Our hosts, Nabil Shalaby, and his colleagues from Memorial University, were excellent. The weather and setting was quite pleasant, and the distractions were minimal. We worked hard, but still found the time for a little recreation, including a hike up Signal Hill and a whale and bird watching tour. The latter was a highlight that I'll never forget.

Back in Dunblane, we finished our beers and treked back up the hill to our hotel - a grand old building built on the location of a natural spring. We enter the haze of the lobby, a harsh reminder that the rest of the world smokes, but also a reminder that the rest of the world is here. It is quite incredible to be in the company of representatives of 84 countries.

The Competition

The competition is held in two parts over two days. Each day, the students have four and a half hours to solve three problems. This is, of course, the most exciting time for the students. The Deputy Leaders share the excitement of the students when they leave the exam, but it's not so exciting for the Leaders. We are still sequestered, since we know the contents of the exam. We must wait until late evening before we have any idea of how well our students are doing. That's when we receive the team's scripts from that day.

Excitement builds as I read them. Roger Mong from Don Mills Collegiate Institute in Toronto, solved all three problems from the first day. His solution to Problem 3 follows the clever "Bulgarian solution," which is a prettier solution than the official solution. Roger is an energetic young man who has the ability to divert his teammates from their tasks and still solve the problems assigned him. He was on last year's IMO team, and we have high hopes for him this year. No one else on the team got Problem 3, but that doesn't worry me. It is a tough question and I do not expect many to solve it. The team did well on the other two problems - it looks like eight or nine complete solutions.

On the second day of the exam, the jury's isolation ends. We travel into Glasgow and meet the students as they leave the exam. I anxiously quiz the students about their performance. Roger is disappointed, which worries me, since Roger is not one for understatement. I press for more details and discover that his disappointment is that he didn't solve Problem 6. In contrast, Olena Bormashenko, also from Don Mills Collegiate Institute, is thrilled with her performance. At our summer camp, she sometimes expressed doubts that she belonged there, a suggestion that we pretty much ignored. She now wonders if her performance is good enough for a bronze. I don't commit myself.

Coordination

The grading of the scripts is a procedure called coordination. The coordinators are mathematicians from the host country. The leaders and deputy leaders of each team look over their team's scripts and decide on grades. They bring their scripts before the coordinators and describe what the students have done that deserves the grade they suggest. Between them, a final grade is agreed upon. It is a remarkably workable procedure.

We first coordinate Problem 5, a functional equation problem. Such problems are usually very difficult to grade because students who do not solve them often find relevant identities that get buried amongst endless calculations. Fortunately, four of our students solved this problem, so there is not much scavenging to do. In fact, with respect to this problem, we were quite lucky. Naoki Sato, our Deputy Leader, assigned a problem during the summer camp that was directly relevant to this problem. This was done after I left, so I was unaware of the advantage our students had (and hence, there was no conflict of interest when the problem was selected). But coordination still holds a surprise for us. I expect to get a seven (full marks) for Olena's paper, but one of the coordinators expresses skepticism over a step. I patiently wait for her to figure it out ... but no, she points out a gut wrenching error. It's the type of error that drives professors batty when they see their students make them, and here is Canada's cream making the same mistake (and I didn't catch it!) My heart sinks and I begin to wonder if I can even salvage a five for this paper. I timidly ask for that grade when Naoki asserts his belief that it is worth at least a six, ... and they agree! What a relief.

By evening, we have coordinated three problems and I know approximately what to expect on the other three. I send an email to Graham Wright (who had returned to Canada a few days earlier) to let him know that I expect a gold, a silver, and three bronze medals. Naoki and I decide to make the trip out to the students' residence to congratulate them.

The students' residences are quite comfortable. They all have individual rooms and share a kitchen, lounge, and washroom. We find the students in good spirits. Olena asks again whether she'll win a bronze. Grinning, I avoid the question. I think she'll get a silver, but don't want to be proved wrong.

This is our first meeting with the students since coordination began. We've taken a good look at the scripts, and have a few questions for some of them. Ralph Furmaniak has a partial solution to Problem 6 that is worth at least two points, but he introduces an idea that might make it worth more. I want to know what he was thinking. Ralph hails from London, Ontario, where he attends the John Paul II Secondary School. He thinks better on his feet (literally) and I even once warned him, in jest, that he would have to write the Olympiad sitting down. He nervously shifts his weight from one foot to the other, trying to explain his ideas on Problem 6, but I don't see anything useful.

By noon of the next day, our six perfect scores for Problem 4 are posted and some of the leaders begin to notice our strong showing, though I am still a bit nervous. Hans-Dietrich Gronau, the Leader of the German team, offers his congratulations and asks me what I expect our final score to be. Around 140, I reply, and I ask him how the German team is doing. One hundred and forty four. I am floored. We're up there with Germany! I was proud of how well our team was doing, but until then, I had no idea just how well. I held in my hands the scripts for Problem 6. With renewed energy (could we actually catch up with Germany?) I looked them over one more time, and suddenly, I understood what Ralph was trying to tell me. I went into coordination looking to get a three for his script, and I did.

The Results

The scores of each country are slowly filling up, organized by country and not in any way that helps me with the big picture. I seek out Gordon Lessells of the Irish team and Michael Albert of the New Zealand team. (Some of you might remember Michael - he was on the very successful Waterloo Putnam team from the early '80's.) Gordon is organizing the data into a sensible fashion and they both offer their analysis. By evening, Gordon is confident we will be twelfth, and places medal cutoffs to within a couple of points. It is now clear that our team will get a gold medal, and at least three silver medals and a bronze medal. Our team includes two students at the lower end of Gordon's estimates. If we are lucky, then Ralph might also get a bronze medal, and Robert Barrington-Leigh might get a silver instead of a bronze medal. Robert attends Old Scona Academic High School (my old high school) in Edmonton, Alberta, and will be eligible for next year's team.

At the Awards Ceremony, Roger Mong is awarded a gold medal that is presented to him by the Princess Royal. He is tied for 12th overall (there are three perfect scores and 4th place is a mere two points higher than Roger's score). Olena Bormashenko, Alex Fink, and Tianyi (David) Han won silver medals. Alex is from Calgary, where he attended Queen Elizabeth High School. Though he is the youngest member of the team, his ambitions to attend university this year will make him ineligible for next year's team. David is from Toronto, where he has graduated from Woburn Collegiate Institute. Robert Barrington-Leigh won a bronze medal with a score that is one point shy of the cutoff for a silver medal. Ralph Furmaniak received an honourable mention for his perfect score on Problem 4, and has a score that is one point out of the medals. A total of 479 students competed and just under half (232) get medals. Of those, approximately a third win silver medals and a sixth win gold medals.

Our 'unofficial' team score is 142 (this is an individual competition, not a team competition). We are tied with Hungary for twelfth place, one point behind Iran, and two points behind Germany. It is Canada's best showing ever!*[1] The first nine countries are China (212 points), Russia (204), USA (171), Bulgaria (167), Vietnam (166), Korea (163), Taiwan (161), Romania (157), and India (156). We handily beat the teams we usually compare ourselves with: Japan (tied for 16th with 133 points), France (19th, 127), Australia (26th, 117), the United Kingdom (27th, 116), and New Zealand (tied 35th, 82).

I want to again congratulate the team for doing so well, and thank them for representing Canada with distinction. It was a pleasure working with them, and I look forward to hearing of their future successes.

[1] This claim deserves an asterisk. In 1981, Canada placed 7th out of 36 nations; in 1988, we were 10th out of 49; and in 1990 we were 11th out of 54.

Electronic Information in the IMU — an Update

Introduction. As previously noted, I sit on the IMU Executive's advisory *Committee on Electronic Information and Communication.* I now take over as chair. This is both both exciting and daunting. The CEIC (www.ceic.math.ca), founded in 1998, continues to make progress on its mandate: on issues of digital publishing, metadata (my spell-checker does not know this word and usefully suggests 'megadeath' as a replacement!), copyright and intellectual property. All are designed to offer the world mathematical community the greatest possible access to its own intellectual fruit.

CEIC at the ICM. We met informally in Beijing after providing a written and verbal report to the General Assembly (GA) in Shanghai (August 15–17). The 32 page report was very well received and is available in HTML or as either a Word or PDF booklet at www.ceic.math.ca/index.php?topic=Bestpractices. On August 26th a very fruitful afternoon session on *Electronic Information* was held at the ICM, the presentations from which will be available on the CEIC website soon.

The Next Four Years. A continuing focus is development of the world-wide *MathNet*'s collection of tools that allow one to obtain high quality information about mathematicians and mathematics. There are now over 160 such departmental pages world wide — about 15% of the target. The two primary steps are the installation of "secondary home pages" (institutional, departmental, and personal—more about these will be described in a later note) and the integration of preprint and other literature harvesting services such as http://euler.zblmath.fiz-karlsruhe.de/MPRESS/. About 50% of Canadian departments now have such a page and I urge your department to add one if it has not.
You can tell at www.math-net.org/navigator/ and at www.cms.math.ca/bulletins/Math-Net-Recommendation.html.
My own secondary pages can be viewed at www.cecm.sfu.ca/althome.html(SFU/CECM) and www.cecm.sfu.ca/jalthome.html(personal).
A web interface for installation lives at www.math-net.de/project/tools/pagecreator/index.en.html.

Another focus is to expand and enhance our *Best Practice Statements* as described in the report to the GA. We intend to add and update detail to each recommendation (as we have with copyright) and to add sparingly a few new ones (e.g., one on refereeing and editing).

An enormous new task is to assist with the creation of the:

Digital Mathematics Library. The 'DML' project proposes over the next decade to put on line (scanned images) the entire printed corpus of Mathematics and to make it generally available. It is estimated that between five and ten percent is already available though hard to find or access! A good idea of some of the progress already made can be gathered at the European Math Society's website (http://elib.uni-osnabrueck.de/EMIS/). As was clear from a meeting I attended at NSF in late July, the project has significant support from NSF and from its German counterpart. Our NRC was also present, and seems likely to assist in digitizing our own content.

It is generally agreed that the greatest obstacle to success is not financial[2] or technical but lies in the incredibly complicated intellectual property issues that will have to be addressed. For example, in some settings one may have to request permission from the estate of authors deceased as much as 70 years ago, as they certainly never anticipated such a use of their work.[3] More surely, while Springer-Verlag is already 'on-board', we shall have to come to some 'modus vivendi' with other large publishers such as Elsvier.

That said success would represent an epochal event in cultural history. The material will, with caveats, be assured for posterity, it will be searchable (eventually the mathematics as well as the text) and we (mathematicians and others) will discover many things we do not know that we know.

Membership. The membership of CEIC for 2002-20 06 is Peter Michor (Austria, past-Chair), Jonathan Borwein (Canada, Chair), John Ewing (USA), Martin Groetschel (Germany, IMU Executive Member), Alejandro Jofre (Chile), David Morrison (USA), Alf van der Poorten (Australia), and David Mumford (USA, DML liaison).

An Invitation. If some subset of the issues confronting us interest you, I invite you to join the *CEIC Advisory Group* (CAG) by emailing me (jborwein@cecm.sfu.ca). This group will interact by email and act as a sounding board for the Committee as it weaves its uncertain way. Michael Doob will be serving as one of the CAG Moderators.

Jonathan Borwein
CMS Past President 2002-2003 and Chair CEIC

[2] Though the cost is likely to be somewhere between \$100 and \$200 million US.
[3] A recent US Supreme Court ruling told the New York Times that it had to pay free-lancers again when it put pre-digital material on its website.

From the President's Desk

by Christiane Rousseau

The deadline for the November issue is actually September 15, so I am writing these words just as the new academic is getting under way. Summertime is conference time, and the summer of 2002 saw two major international events: the International Congress of Mathematicians in Beijing on August 20-28, preceded by the General Assembly of the International Mathematical Union (IMU) in Shanghai on August 17-18.

At IMU General Assembly, a new executive and new commission members were elected. John Ball (UK) is the President-Elect and will replace Jacob Palis in January 2003. Vice-presidents are Jean-Michel Bismut (France) and Masaki Kashiwara (Japan), while Philip Griffiths (US) remains Secretary. Elected members are Andrey Bolibrukh (Russia), Martin Grotschel (Germany), Zhi-Ming Ma (China), Ragni Piene (Norway) (the first woman to serve on the Executive Committee), and Madabusi S. Raghunathan (India). Bernard Hodgson, our Quebec Vice-President, was re-elected Secretary of the International Commission of Mathematics Instruction (ICMI). The General Assembly also decided that the next International Congress of Mathematicians in 2006 will take place in Madrid, preceded by the IMU General Assembly in Saint-Jacques de Compostelle. The members of the Norwegian delegation presented the regulations for awarding the first Abel Prize in 2003. In the first round, any mathematician can submit a name for consideration; the deadline is November 1, 2002. The selection committee will include one Norwegian, one member nominated by the European Mathematical Society and three members nominated by the International Mathematical Union. The German Mathematical Union (DMV) and the International Mathematical Union have used the surplus from the 1998 International Congress of Mathematicians in Berlin to create a new prize, the Gauss Prize, to be awarded to a scientist whose mathematical research has had an impact outside mathematics-in technology, in business or simply in people's everyday lives. The prize will be awarded every four years at the International Congress of Mathematicians by a jury appointed by the International Mathematical Union, with the first award to be made at the 2006 congress in Madrid. The presentation of the Committee on Electronic Information and Communication was particularly well received at the Assembly. Jonathan Borwein, who is a member of this committee, will keep us informed of its work. In the meantime, visit the IMU's web site (www.mathunion.org) to read the document prepared by the committee entitled "Best Current Practices: Recommendations on Electronic Information Communication." (*See the September issue of the Notes for a summary - Ed.*) The General Assembly voted to increase the contributions of member countries by 10costs and the fact that the last increase dates back to 1994. The IMU provides funds for congresses and for the activities of its various commissions: the Committee on Electronic Information and Communication (CEIC), the International Commission of Mathematical Instruction (ICMI), the Commission on Development and Exchange (CDE), and the International Commission on the History of Mathematics (ICHM). For more information on the IMU, please visit its web site (www.mathunion.org).

The International Congress attracted more than 4000 participants. All attendees were extremely impressed by the efficient organization. Every detail had been looked after, line-ups were non-existent, and everywhere cheerful volunteers were on hand to guide participants. The Congress began with an opening ceremony in the Great Hall of the People, presided over by Zhi-Ming Ma, President of the Chinese Mathematical Society, with the presence of Jiang Zemin, Chairman of the People's Republic of China, as well as many other high-ranking Chinese dignitaries. Following the opening ceremonies, Jacob Palis announced the names of the two Fields Medal recipients for 2002: Laurent Lafforgue (IHES, France) and Vladimir Voevodsky (IAS, US). Jiang Zemin himself presented the medals. Next, the recipient of the 2002 Nevanlinna prize was announced: Mahdu Sudan (MIT, US). Last April, the Fields Institute and the Canadian Mathematical Society petitioned the Prime Minister's Office to request that Canada make a significant contribution to the Fields Medal Foundation, which is currently experiencing a funding shortfall. Hoping to promote our cause to the Canadian authorities, we asked the International Mathematical Union and Zhi-Ming Ma to invite the Canadian ambassador to the opening reception.

With Ambassador Joseph Caron on sick leave, Gordon Houlden, the Canadian Embassy's Minister of Political and Public Affairs, accepted the invitation. Mr. Houlden expressed his surprise and admiration at the level of support accorded by the Chinese government to science and mathematics. Not only did some of the highest-ranking officials of the People's Republic of China make it a point to attend the Congress's opening ceremonies, but the Chinese government contributed the unheard-of sum of $1.2 million US to underwrite the Congress.

The Canadian Mathematical Society, the Centre de recherches mathmatiques, the Fields Institute, and the Pacific Institute of Mathematical Science jointly organized a reception at the Canadian Embassy on August 21 to honour the Fields medallists and the recipient of the Nevanlinna Prize. Mr. Houlden, speaking in French, English and Chinese, recalled the role played by Charles Fields, the organizer of the 1924 International Congress in Toronto, in creating the Fields Medals.

The Canadian Mathematical Society has had some preliminary discussions with the International Mathematical Union to gauge whether it would favourably view a bid by Canada to host the 2010 International Congress of Mathematicians in Montreal. The IMU has indicated that Montreal would be an acceptable venue, and so we will work closely with the National Research Council of Canada over the next two years to assess the feasibility of this proposal.

Now that you are up to date on international news, we would like to remind you to sign up for our next meeting at the University of Ottawa, if you haven't already done so. And don't forget to invite your students!

(At the Canadian Embassy in Beijing are(from left to right): Jonathan Borwein (CMS Past-President), David Eisenbud (MSRI Director and AMS President),Christiane Rousseau, (CMS President) and Jacob Palis (IMU President) (PhotoCourtesy of Judi Borwein)

(Message de la présidente–continued from page 1)

pour honorer des scientifiques dont la recherche mathématique a un impact en dehors des mathématiques, que ce soit en technologie, affaires ou simplement dans la vie de tous les jours. Le prix sera attribué tous les quatre ans lors du Congrès international des mathématiciens par un jury nommé par l'Union mathématique internationale. Le premier prix sera attribué lors du congrès de 2006 à Madrid. L'assemblée a particulièrement apprécié la présentation de la Commission sur l'information et les communications électroniques (CEIC). Jonathan Borwein fait partie de cette commission et nous tiendra informés de ses travaux. En attendant je vous invite à aller consulter sur le site de l'UMI (www.mathunion.org) le document produite par cette commission : ≪ Best Current Practices : Recommendations on Electronic Information Communication ≫. L'assemblée générale a voté une hausse des contributions des pays membres de 10%, justifiée par une hausse des coûts et par le fait que la dernière augmentation date de 1994. L'UMI finance des congrès ainsi que les activités de ses différentes commissions : la Commission sur l'information et les communications électroniques (CEIC), la Commission internationale sur l'enseignement mathématique (ICMI), la Commission sur le développement et les échanges (CDE) et la Commission Internationale sur l'histoire des mathématiques (ICHM). Vous pouvez aller consulter le site de l'UMI (www.mathunion.org) pour connaître plus en détails ses activités. Le congrès international a accueilli plus de 4000 participants. Tous les participants ont été émerveillés de l'efficacité de l'organisation : chaque détail avait été pensé, il n'y avait aucune queue nulle part et partout des volontaires souriants guidaient les participants. Le congrès a débuté par la cérémonie d'ouverture dans le Grand Hall du Peuple, présidée par Zhi-Ming Ma, président de la Société mathématique chinoise, en présence de Jiang Zemin, président de la République populaire de Chine, ainsi que de plusieurs hauts dignitaires chinois. Jacob Palis a ensuite dévoilé les noms des récipiendaires des deux médaillés Fields de 2002 : Laurent Lafforgue (IHES, France) et Vladimir Voevodsky (IAS, États-Unis), lesquels ont reçu leur médaille de la main de Zhang Zemin. Le récipiendaire du prix Nevanlinna 2002, Mahdu Sudan (MIT, États-Unis) a ensuite été dévoilé. L'Institut Fields et la Société mathématique du Canada ont déposé en avril dernier auprès du bureau du premier ministre une requête à l'effet que le Canada contribue significativement à la fondation de la médaille Fields laquelle est présentement sous-financée. Nous avions donc demandé à l'Union mathématique internationale et à Zhi-ming Ma que l'Ambassadeur du Canada soit invité à la réception d'ouverture du congrès, espérant par ce fait faire avancer le dossier auprès des autorités canadiennes. L'Ambassadeur M. Joseph Caron étant en congé de maladie, il a été remplacé par M. Gordon Houlden, Ministre de la section des affaires politiques et publiques à l'Ambassade canadienne. Ce dernier nous a témoigné de sa surprise et de son admiration lorsqu'il a découvert l'importance que le gouvernement chinois accorde au soutien de la science et des mathématiques. Non seulement les plus hauts politiciens de la République populaire de Chine se sont déplacés pour l'ouverture du Congrès, mais le gouvernement chinois a consenti un montant de 1,2 million US$ pour la tenue du congrès, une somme jamais égalée dans le passé.

La société mathématique du Canada, le Centre de recherches mathématiques, l'Institut Fields et le Pacific Institute of Mathematical Science ont organisé conjointement une réception à l'Ambassade du Canada à Beijing le 21 août, pour célébrer les médaillés Fields et le récipiendaire du prix Nevanlinna. M. Houlden s'est adressé aux invités en français, en anglais et en chinois et il a rappelé le rôle de Charles Fields, organisateur du Congrès international de 1924 à Toronto, dans la création de la médaille Fields.

La Société mathématique a entamé des discussions préliminaires avec l'Union mathématique internationale pour savoir si celle-ci verrait d'un bon oeil que le Canada, en l'occurrence Montréal, se porte candidat pour accueillir le Congrès international des mathématiciens de 2010. L'union mathématique internationale nous a indiqué que la candidature de Montréal semblait recevable et nous nous pencherons dans les deux prochaines années avec le Conseil de recherches du Canada sur la faisabilité du projet.

Après ce bain de nouvelles internationales c'est le moment, si ce n'est déjà fait, de penser à vous inscrire à notre prochaine réunion à l'Université d'Ottawa. Et n'oubliez pas d'amener vos étudiants!

Can You Spare Books?

Some of you may be sitting on books, or some of your books may be sitting on shelves, although you may not need them anymore: these books collect dust. At the same time, many universities in developing countries are in dire need of scientific literature - from undergraduate and graduate texts to journals.

The Committee for Developing Countries (CDC) of the European Mathematical Society considers the collecting of books from you and their shipment to various universities in developing countries as one of its central activities. Moreover, although being a committee of the EMS, the CDC turns not only to European colleagues, but takes this opportunity to call upon colleagues in any developed country, to join us in our efforts. We are looking mainly for scientific literature published in English or French, including undergraduate texts.

As experience has shown, the problem is not to find books for donations to such universities, nor the identification of universities in developing countries that are interested in receiving such donations. The problem lies in the shipping expenses and in the logistics. With some cooperation by the various players in this (truly international) action, the CDC will be in a position to fulfill this task.

The CDC hopes to combine its efforts with the International Centre for Theoretical Physics (ICTP) at Trieste, Italy, which has long-standing experience in matters relating to developing countries, to organise a book donation scheme. We shall try to identify recipients for donated books and journals. By way of example, we know that the University of Zimbabwe not only would gladly accept such donations (as it has done in the past in a different framework, and as would many other African universities), but that it is also prepared to act as a centre for distribution of donated books to universities in the SADC region, which comprises countries as diverse as South Africa, Zambia, Malawi, Tanzania, Angola and Mozambique, among others.

In order to take care of the shipping of donations to the respective places, CDC will apply to the Book Donation Scheme which the ICTP runs, to pay for the transport subject to their regulations. We, or the donors, respectively, might also try various National Commissions for UNESCO to help with shipping costs. A minimum of 40-50 books constitutes a reasonable consignment.

We hope that some of you will not only give away some of your own books, but will involve yourselves actively in collecting books/journals from other colleagues in your respective department. Maybe you know of some colleagues in the USA who would be prepared to donate books within this scheme. And maybe, you can get your university to pay for the transportation costs of the books you collected. Again, experience in a different framework has shown that some universities (or maybe private donors) may have funds available for such purposes.

Prof. Gert Sabidussi of the Université de Montréal has agreed to act as a "clearing house" for this project in Canada. So, if you have books or journals (in mathematics or related disciplines, such as computer science or mathematical physics) that you wish to donate to a developing country, please contact him at

sab@dms.umontreal.ca

He will discuss with you the modalities of shipment.

Tsou Sheung Tsun and Herbert Fleischner
(EMS Committee for Developing Countries)

ICM 2002 Medallists

Laurent Lafforgue

Laurent Lafforgue has made an enormous advance in the so-called Langlands Program by proving the global Langlands correspondence for function fields. His work is characterized by formidable technical power, deep insight, and a tenacious, systematic approach.

The Langlands Program, formulated by Robert P. Langlands for the first time in a famous letter to Andre Weil in 1967, is a set of far-reaching conjectures that make precise predictions about how certain disparate areas of mathematics might be connected. The influence of the Langlands Program has grown over the years, with each new advance hailed as an important achievement.

One of the most spectacular confirmations of the Langlands Program came in the 1990s, when Andrew Wiles's proof of Fermat's Last Theorem, together with work by others, led to the solution of the Taniyama-Shimura-Weil Conjecture. This conjecture states that elliptic curves, which are geometric objects with deep arithmetic properties, have a close relationship to modular forms, which are highly periodic functions that originally emerged in a completely different context in mathematical analysis. The Langlands Program proposes a web of such relationships connecting Galois representations, which arise in number theory, and automorphic forms, which arise in analysis.

The roots of the Langlands program are found in one of the deepest results in number theory, the Law of Quadratic Reciprocity, which goes back to the time of Fermat in the 17th century and was first proved by Carl Friedrich Gauss in 1801. An important question that often arises in number theory is whether, upon dividing two prime numbers, the remainder is a perfect square. The Law of Quadratic Reciprocity reveals a remarkable connection between two seemingly unrelated questions involving prime numbers p and q: "Is the remainder of p divided by q a perfect square?" and "Is the remainder of q divided by p a perfect square?" Despite many proofs of this law (Gauss himself produced six different proofs), it remains one of the most mysterious facts in number theory. Other reciprocity laws that apply in more general situations were discovered by Teiji Takagi and by Emil Artin in the 1920s. One of the original motivations behind the Langlands Program was to provide a complete understanding of reciprocity laws that apply in even more general situations.

The global Langlands correspondence proved by Lafforgue provides this complete understanding in the setting not of the ordinary numbers but of more abstract objects called function fields. One can think of a function field as consisting of quotients of polynomials; these quotients can be added, subtracted, multiplied, and divided just like the rational numbers. Lafforgue established, for any given function field, a precise link between the representations of its Galois groups and the automorphic forms associated with the field. He built on work of 1990 Fields Medalist Vladimir Drinfeld, who proved a special case of the Langlands correspondence in the 1970s. Lafforgue was the first to see how Drinfeld's work could be expanded to provide a complete picture of the Langlands correspondence in the function field case.

In the course of this work Lafforgue invented a new geometric construction that may prove to be important in the future. The influence of these developments is being felt across all of mathematics.

Laurent Lafforgue was born on 6 November 1966 in Antony, France. He graduated from the Ecole Normale Superieure in Paris (1986). He became an attache de recherche of the Centre National de la Recherche Scientifique (1990) and worked in the Arithmetic and Algebraic Geometry team at the Universite de Paris-Sud, where he received his doctorate (1994). In 2000 he was made a permanent professor of mathematics at the Institut des Hautes Etudes Scientifiques in Bures-sur-Yvette, France.

The following is an article about the work of Lafforgue: "Fermat's Last Theorem's First Cousin," by Dana Mackenzie. Science, Volume 287, Number 5454, 4 February 2000, pages 792-793.

Vladimir Voevodsky

Vladimir Voevodsky made one of the most outstanding advances in algebraic geometry in the past few decades by developing new cohomology theories for algebraic varieties. His work is characterized by an ability to handle highly abstract ideas with ease and flexibility and to deploy those ideas in solving quite concrete mathematical problems.

Voevodsky's achievement has its roots in the work of 1966 Fields Medalist Alexandre Grothendieck, a profound and original mathematician who could perceive the deep abstract structures that unite mathematics. Grothendieck realized that there should be objects, which he called "motives," that are at the root of the unity between two branches of mathematics, number theory and geometry. Grothendieck's ideas have had widespread influence in mathematics and provided inspiration for Voevodsky's work.

The notion of cohomology first arose in topology, which can be loosely described as "the science of shapes." Examples of shapes studied are the sphere, the surface of a doughnut, and their higher-dimensional analogues. Topology investigates fundamental properties that do not change when such objects are deformed (but not torn). On a very basic level, cohomology theory provides a way to cut a topological object into easier-to-understand pieces. Cohomology groups encode how the pieces fit together to form the object. There are various ways of making this precise, one of which is called singular cohomology. Generalized cohomology theories extract data about properties of topological objects and encode that information in the language of groups. One of the most important of the generalized cohomology theories, topological K-theory, was developed chiefly by another 1966 Fields Medalist, Michael Atiyah. One remarkable result revealed a strong connection between singular cohomology and topological K-theory.

In algebraic geometry, the main objects of study are algebraic varieties, which are the common solution sets of polynomial equations. Algebraic varieties can be represented by geometric objects like curves or surfaces, but they are far more "rigid" than the malleable objects of topology, so the cohomology theories developed in the topological setting do not apply here. For about forty years, mathematicians worked hard to develop good cohomology theories for algebraic varieties; the best understood of these was the algebraic version of K-theory. A major advance came when Voevodsky, building on a little-understood idea proposed by Andrei Suslin, created a theory of "motivic cohomology." In analogy with the topological setting, there is a strong connection between motivic cohomology and algebraic K-theory. In addition, Voevodsky provided a framework for describing many new cohomology theories for algebraic varieties. His work constitutes a major step toward fulfilling Grothendieck's vision of the unity of mathematics.

One consequence of Voevodsky's work, and one of his most celebrated achievements, is the solution of the Milnor Conjecture, which for three decades was the main outstanding problem in algebraic K-theory. This result has striking consequences in several areas, including Galois cohomology, quadratic forms, and the cohomology of complex algebraic varieties. Voevodsky's work may have a large impact on mathematics in the future by allowing powerful machinery developed in topology to be used for investigating algebraic varieties.

Vladmir Voevodsky was born on 4 June 1966 in Russia. He received his B.S. in mathematics from Moscow State University (1989) and his Ph.D. in mathematics from Harvard University (1992). He held visiting positions at the Institute for Advanced Study, Harvard University, and the Max-Planck-Institut fuer Mathematik before joining the faculty of Northwestern University in 1996. In 2002 he was named a permanent professor in the School of Mathematics at the Institute for Advanced Study in Princeton, New Jersey.

Madhu Sudan

Madhu Sudan has made important contributions to several areas of theoretical computer science, including probabilistically checkable proofs, non-approximability of optimization problems, and error-correcting codes. His work is characterized by brilliant insights and wide-ranging interests.

Sudan has been a main contributor to the development of the theory of probabilistically checkable proofs. Given a proof of a mathematical statement, the theory provides a way to recast the proof in a form where its fundamental logic is encoded as a sequence of bits that can be stored in a computer. A "verifier" can, by checking only some of the bits, determine with high probability whether the proof is correct. What is extremely surprising, and quite counterintuitive, is that the number of bits the verifier needs to examine can be made extremely small. The theory was developed in papers by Sudan, S. Arora, U. Feige, S. Goldwasser, C. Lund, L. Lovasz, R. Motwani, S. Safra, and M. Szegedy. For this work, these authors jointly received the 2001 Goedel Prize of the Association for Computing Machinery.

Also together with other researchers, Sudan has made fundamental contributions to understanding the non-approximability of solutions to certain problems. This work connects to the fundamental outstanding question in theoretical computer science: Does P equal NP? Roughly, P consists of problems that are "easy" to solve with current computing methods, while NP is thought to contain problems that are fundamentally harder. The term "easy" has a technical meaning related to the efficiency of computer algorithms for solving problems. A fundamentally hard problem in NP has the property that a proposed solution is easily checked but that no algorithm is known that will easily produce a solution from scratch. Some NP hard problems require finding an optimal solution to a combinatorial problem such as the following: Given a finite collection of finite sets, what is the largest size of a subcollection such that every two sets in the subcollection are disjoint? What Sudan and others showed is that, for many such problems, approximating an optimal solution is just as hard as finding an optimal solution. This result is closely related to the work on probabilistically checkable proofs. Because the problems in question are closely related to many everyday problems in science and technology, this result is of immense practical as well as theoretical significance.

The third area in which Sudan made important contributions is error-correcting codes. These codes play an enormous role in securing the reliability and quality of all kinds of information transmission, from music recorded on CDs to communications over the Internet to satellite transmissions. In any communication channel, there is a certain amount of noise that can introduce errors into the messages being sent. Redundancy is used to eliminate errors due to noise by encoding the message into a larger message. Provided the coded message does not suffer too many errors in transmission, the recipient can recover the original message. Redundancy adds to the cost of transmitting messages, and the art and science of error-correcting codes is to balance redundancy with efficiency. A class of widely used codes is the Reed-Solomon codes (and their variants), which were invented in the 1960s. For 40 years it was assumed that the codes could correct only a certain number of errors. By creating a new decoding algorithm, Sudan demonstrated that the Reed-Solomon codes could correct many more errors than previously thought possible.

Madhu Sudan was born on 12 September 1966, in Madras (now Chennai), India. He received his B. Tech. degree in computer science from the Indian Institute of Technology in New Delhi (1987) and his Ph.D. in computer science at the University of California at Berkeley (1992). He was a research staff member at the IBM Thomas J. Watson Research Center in Yorktown Heights, New York (1992-1997). He is currently an associate professor in the Department of Electrical Engineering and Computer Science at the Massachusetts Institute of Technology.

Here are two articles about the work of Sudan: "The easy way to check hard maths," by Arturo Sangalli. New Scientist, 8 May 1993, pages 24-28; and "Coding theory meets theoretical computer science," by Sara Robinson. SIAM News, 34(10):216–217, December 2001 (also available online).

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En Guise d'Introduction Présidentielle

Bernard R. Hodgson, Université Laval
CMS Vice President (Québec)

Lors du banquet du congrès d'été de la Société mathématique du Canada, tenu le 16 juin 2002 au Musée du Québec, on m'a invité à dire quelques mots afin d'introduire Christiane Rousseau et Jonathan Borwein, respectivement nouvelle présidente et président sortant de la Société, pour la présentation des prix de la SMC. C'est également à l'occasion de ce banquet qu'a eu lieu la cérémonie de remise par l'Université Laval d'un doctorat honorifique au professeur Robert Langlands. Le texte qui suit reprend le contenu de mon allocution.

Monsieur le recteur François Tavenas, Monsieur le professeur Robert Langlands, Distingués dignitaires de l'Université Laval, Chers amis de la Société mathématique du Canada, de l'Université Laval et d'ailleurs,

I was asked to introduce the last part of this banquet leading to the presentation of prizes given by the Canadian Mathematical Society to some of its members in order to recognize their outstanding merits and contributions to mathematics. But prior to that I was charged by my colleagues of the Executive Committee of CMS of an extremely important, but daunting, task.

Mais permettez que je dise tout d'abord combien je suis heureux d'être content, et même content d'être heureux, de me retrouver ici ce soir pour vous saluer à l'occasion de ces sympathiques agapes. Je dois cependant vous dire tout de go que mes collègues de l'Exécutif de la SMC m'ont chargé d'une mission quasi impossible. As a matter of fact I should rather say : I am charged with a doubly impossible mission. And in opposition to a double negation which, some would classically and non-intuitionistically argue, amounts to an affirmation, it unfortunately does not appear that a double impossibility would lead to a possible task.

Pourquoi ma mission est-elle doublement impossible? D'une part parce qu'on m'a demandé de vous entretenir d'un sujet d'une extrême subtilité. And on the other hand because it is already quite late in the evening after a hard day of congress work, une impressionnante et émouvante cérémonie de remise d'un doctorat honoris causa, and a hearty meal accompanied with good wine. Now some may claim wine is surely no problem here, as so many mathematicians appear to be tempted to repeat almost anywhere and anytime ≪ How I want a drink, alcoholic of course ≫ Et certains poursuivraient même ≪ After the heavy chapters involving quantum mechanics ! ≫

Comme plusieurs d'entre le savent fort bien, le passage d'une langue à une autre est souvent une aventure de haut risque. À preuve, comment certains de nos collègues germanophones réagissent-ils à l'assertion précédente? En s'exclamant dans un élan teutonique: ≪ Dir, o Held, o alter Philosoph, du Riesen-Genie ! ≫ And what about francophones, you may wonder. Well, their view of the underlying matter may be seen as a bit more delicate than for their English or German counterparts, révèlant à la fois l'élégance, le bon goût et même une certaine poésie que recèle l'≪ esprit français ≫ : ≪ Que j'aime à faire apprendre un nombre utile aux sages ≫ N'est-ce pas joli? And it goes on even more : ≪ Immortel Archimède. artiste ingénieur Qui de ton jugement peut priser la valeur Pour moi ton problème eut de pareils avantages. ≫

Que tout cela est donc si p-ttoresque... mais m'éloigne quand même un peu du sujet des plus subtils que je dois traiter avec vous. Et que fait le mathématicien devant un problème complexe? Eh non, il ne s'agit surtout pas d'en faire un problème réel. Rappelez-vous à cet égard la devise du grand mathématicien français Jacques Hadamard : La voie la plus courte et le meilleure entre deux vérités du domaine réel passe souvent par le domaine imaginaire. Le domaine du complexe peut servir à résoudre des questions du réel, mais pas à l'inverse. No, the approach all mathematicians would favor when facing a comple problem is to transform it into a simplex problem - I'm sorry, I meant the other way around : to transform a complex situation into a simple one.

I have thus tried to look for good models, good approaches for the extremely subtle topic I was asked to introduce to you. A possible solution I have thoroughly investigated is thus to transfer my problem into more suitable realms. For instance, si j'eus été philosophe, j'eusse pu, tout comme Aristote, distinguer entre l'être en puissance et l'être en acte.

As a side remark to the casual user of French, I would like to stress the elegant turn of phrase I have just used : si j'eus été philosophe, j'eusse pu... One recognizes here a not too surprising passé antérieur : si j'eus été, accompanied by a funny-looking j'eusse pu, a so-called ≪ conditionnel passé 2e forme ≫. Something, I should insist, all true French speakers have to use at least five times a day in order to keep mentally in good shape. Now this verb tense, as you may know, is quite similar to the wonderful ≪ plus-que-parfait du subjonctif ≫, which then in turn reminds us of the ≪ imparfait du subjonctif ≫ allowing for extremely deep assertions, such as the lady complaining to the doctor that her husband is in very poor health : Docteur, mon mari est cloué au lit. Je souhaiterais que vous l'y vissiez. Or else, the mother reprimanding her children who have eaten too much cake : À force de manger trop de gâteau, je crains que vous n'en pâtissiez. These sentences allow to express much more interesting facts than the simple-minded, if not ridiculous, constructions possible with the mere past tense, le ≪ passé simple ≫ : Lorsque nous nous vîmes, nous nous plûmes. Mais quand vous me parlâtes, vous m'épatâtes. (If any of you had been wondering whether and why Québec IS different, maybe you have a better clue for it now.)

Donc si j'eus été philosophe, j'eusse pu, tout comme Aristote, distinguer entre l'être en puissance et l'être en acte pour étayer mon thème à élucider. Mais je ne suis pas philosophe. Ou si peu. Et de plus Aristote ne nous dit rien sur ce qui arrive après l'acte. Est-ce le néant? Ou est-ce l'être? Jean-Paul Sartre n'a pas pu trancher, et moi non plus.

A specialist of the Bible may have suggested the following trichotomy to express the subtle continuum I am trying to convey : first, an antediluvian situation, followed by the deluge itself, and then a postdiluvian resolution. Mais il aurait fallu que j'accepte de me mouiller diablement pour cela, et je n'ai pu m'y résoudre.

Comment aurait réagi un historien devant mon dilemme? Peut-être en distinguant une période archaïque, puis une période classique, et enfin une période de décadence? Non, cela n'est pas très heureux comme image. Or maybe an historian would have identified a BC period, I mean by that a period before Christiane - désolé, je voulais dire avant le Christ -, then a Christian period, and finally a post Christian period (commonly abbreviated to PC).

Parfois j'étais tenté de vous expliquez mon sujet qui, ne l'oublions pas, est très dense et profond, en recourant à la musique, par exemple au monde de l'opéra. Ainsi Georges Bizet, dans un opéra que tous, je le sais, connaissent par coeur, Carmen, nous parle joliment, dans la scène 2 du 1er acte, du changement de la garde, avec la garde montante remplaçant la garde descendante : Avec la garde montante Nous arrivons, nous voilà Sonne, trompette éclatante Ta ra ta ta, ta ra ta ta (ce sont les petits enfants qui parlent.) Mais il n'est alors pas vraiment question de la garde en place. Conséquemment cela me laisse un brin pantois pour tenter d'exprimer les trois phases caractéristiques de la situation que je dois vous aider à appréhender. Et de plus le risque était trop grand que je me mette ici à chanter illico, et pas forcément in petto.

Another possibility to solve my intense dilemma of clarifying this deep and intense notion I need to introduce to this august audience was to wear the hat of a physicist, trying to use the notion of the 4 dimensions of space and time to express the multiple aspects of the situation I have to deal with. And for a while I was happy. I thought that this would help me capture the idea of two individuals located in two different space setting and being timely-distant by a three-hour lag. But then I got all mixed up : was it a plus 3 or a minus 3? Could it happen that two different people, one being in Vancouver (or more precisely in Burnaby) and one in Montréal, would be sitting simultaneously on the same seat in my space-time framework - not an ideal situation - or still worse, that no one would occupy the captain seat for a while, possibly leading to a catastrophe for our community?

Au diable donc l'approche du physicien. Non, à tout prendre, il m'a semblé que c'est en agissant tout bonnement selon notre nature de simples mathématiciens -remarquez que je ne dis pas de mathématiciens simples - que nous pouvons le mieux saisir tout le sens de la tripolarité dont je cherche à vous faire part. On peut voir le tout comme une structure numérique à la fois simple et riche : un-deux-un, one-two-one. One time-unit before, two time-units during and one time-unit after. A pre-thing, an in-thing (of double size) and a post-thing.

Seriously - or almost - we all must be grateful to the wisdom of our predecessors inside the Canadian Mathematical Society, who have conceived this very clever 1-2-1 scheme for the high governance of our society, with all the stability it generates and the possibility for incoming and outgoing officers to concretely collaborate on an extended basis. This is why we have such identifications as: - année 1 : président élu - années 2 et 3 : président en titre - année 4 : président sortant. Consequently our society always has two people legally entitled to call themselves ≪ president ≫ being active on the Executive Committee at a given time, some years a president elect learning the job alongside a president in full power, and other years a newly upgraded president taking the relay from a president slowly tranforming him or herself into a president in decompression — not to be confused with a president in decomposition. (One might even be tempted here to speak of ≪ ghosts of departed presidents ≫, sorry again, I meant ≪ quantities ≫, as in Berkeley's criticisms of the foundations of the differential calculus as developed by Newton.) Thus those of you who have paid close attention have seen over the last days Jonathan and Christiane, and at other times Christiane and Jonathan, act in the quality of the President the Canadian Mathematical Society. The fact is that they both are!

Après avoir rendu de façon aussi transparente, me semble-t-il, à défaut d'être brève, ce concept à la fois riche, profond et fructueux de président à trois volets (le président montant, le président en place et le président descendant, pour reprendre les mots de Bizet), il me fait grandement plaisir d'inviter maintenant nos deux présidents, à savoir tout d'abord la nouvelle présidente en titre de la Société mathématique du Canada, Christiane Rousseau, en poste depuis tout juste quelques heures, accompagnée un peu plus tard du nouveau président sortant de la SMC, Jonathan Borwein, à faire la présentation des prix de la SMC remis à l'occasion de la réunion d'été 2002. Christiane, à toi la parole!

(Steering Committee Report–continued from page 6)

(b) Discrete Scientific Computing

(i) Symbolic Computation:

In Canada, symbolic computation has been considerably advanced through the work of J. Borwein (SFU; FRSC, Chauvenet Prize), most notably through his role as director of the Centre for Experimental and Constructive Mathematics (CECM) at SFU.

CECM researchers explore and promote the interplay of conventional mathematics and modern computation. The CECM pioneered this area in Canadian mathematics and remains a driving force. It supports research projects connected with symbolic computation, numerical computation, complexity, collaborative network technology, digital information and visualization. CECM projects involve many industrial partners, including MathResources, Waterloo Maple, SmartTech, SynchroPoint, and Packeteer.

A MITACS project on Symbolic Analysis headed by P. Borwein (SFU; Chauvenet Prize) is an outgrowth of CECM innovations. The project, with Maple as a corporate partner, is exploring the use of symbolic analysis in mathematical analysis and includes the active participation of grantees from a variety of disciplines, notably S. Watt, funded by Computing Science, and R. Corless, funded by Mechanical Engineering, both at Western Ontario.

(ii) Computational Number Theory: The growing reliance of theory upon computation is a striking trend in current number theory. There has been ongoing development of algorithms and conjectures based on computation. P. Borwein (SFU; Chauvenet Prize), in part with J. Borwein (SFU; Chauvenet Prize), has made striking advances in algorithms for number theory, notably with an amazing and efficient way of computing specific digits of polylogarithms (including pi). The study of L-functions is one area that has greatly profited from the use of computational techniques. D. Boyd (UBC) has provided computational insights into the special values of L-functions and their relation to Mahler measures, plus explored a whole range of other computational issues: sphere packings, Pisot and Salem numbers, and invariants of hyperbolic manifolds. M. Bennett* (UBC) and G. Martin* (UBC) have developed special purpose algorithms in their respective studies of diophantine equations and zeros of L-functions.

(iii) Cryptography: Cryptography has a major presence in Canada. Number theory and algebraic geometry have formed the basis for the very successful public cryptosystem developed by the Waterloo mathematicians R. Mullin and S. Vanstone. Their company, CertiCOM, even after the market turndown, employs approximately 200 people, including 20 mathematical and engineering PhDs; Revenue Canada, IBM, Motorola, and various banks are among its customers. The number theorist, K. Murty (Toronto; FRSC, Steacie), has commercialized an encryption system based on algebraic varieties. His company, Karthika, established in 1999, now employs 15 people. MITACS projects, with Murty and A. Menezes (Waterloo) as leaders, are also dedicated to cryptography. H. Williams (Calgary; Killam) has made a number of advances in primality testing and public key cryptography, and is head of the iCORE Centre for Cryptography at Calgary.

CACR (Center for Applied Cryptographic Research) at Waterloo, founded in 1998, has quickly grown to become one of the largest cryptographic research centres in the world. Between 1998 and 2001, CACR received over $1M in research funding from private industry (including Certicom, MasterCard, and Pitney Bowes) which was matched by NSERC, MITACS, ORDCF and CITO. In 4 years, CACR has organized 7 international research conferences and 9 one-day information security workshops for its industrial partners.

Other labs devoted to computer mathematics are the Laborative de Combinatoire et d'Informatique Mathématique (LACIM) at UQAM and the Applied Computer Lab at Saint Francis Xavier.

Part 4: Mathematical Institutes

The Canadian Institutes for the Mathematical Sciences are pivotal forces that shape and promote the new reality for Canadian mathematics (as described in Part 1). The 3 Institutes have provided innovative leadership at the international level by organizing an amazing variety of scientific activities with an emphasis on emerging areas, areas at the interface of different branches of mathematics, and areas that cross traditional discipline boundaries. They have been particularly effective in the promotion of interdisciplinary research, and have systematically built partnerships among the mathematical sciences, other disciplines, and the business/industrial sector. As well, the Institutes represent the principal mechanism for outreach by the mathematics community to both industrial and educational sectors. Finally, there has been a significant commitment to comprehensive training of HQP, both at graduate and postdoctoral levels, with a particular focus on the types of significant and innovative research described above. The cumulative effect of the Institutes on Canadian mathematical life and on the role of mathematics in Canadian science has been profound.

Canada's Mathematical Institutes have evolved a unique capacity to function simultaneously as both a national network and as 3 distinct regional presences. The Institutes provide significant benefits to Canadian mathematics at both levels, and major initiatives have been created both by a single Institute (NCM_2, BIRS) and by the Institutes as a whole (MITACS). The Institutes regional base has enabled each to leverage resources and to multiply opportunities at a remarkable rate. Currently, federal funding for the 3 Institutes is being leveraged by almost $4M per year from provincial governments and universities and by almost $3M per year from the private sector. A regional presence also ensures maximal leveraging of human resources. Research institutes have a major impact and a major reliance upon scientific activity in their home region. Furthermore, regional presences have been crucial to effective outreach, which is primarily focused upon local business and industry. At the national level, there is significant collaboration between the Institutes with the objective of creating research opportunities in all of Canada's regions. MITACS (to be discussed in Part 5) is their largest and most successful joint venture. The Institutes also fund and coordinate their National Program Committee, which provides support for the Atlantic Association for Research in the Mathematical Sciences (AARMS) and for 3 major professional Canadian mathematical societies. One recent initiative of the 3 Institutes has been the partnering with several Atlantic Canadian universities and AARMS to develop mathematics in Eastern Canada. The goal is to develop a series of graduate activities and workshops to foster mathematics in a region with many smaller universities.

The Institutes not only collaborate, but also compete in appropriate spheres. We view such competition as healthy and proper, as it is part of a striving for excellence and is clearly contributing to the ongoing innovation displayed by the Institutes and to their considerable impact on the Canadian and international mathematical scene. In summary, the Institutes are thriving, and are much appreciated by Canadian mathematicians. The 3 Institutes play a central and essential role in Canadian mathematics and their impact will continue to grow in the coming period. The main contributions of each Institute since the last Reallocation Exercise will be outlined in the Appendix at the end of this document.

Part 5: New Initiatives in Infrastructure

Interdisciplinary activity is now a major force shaping both Canadian mathematical research and graduate training. Most of this interdisciplinary thrust is attributable to a new level of infrastructure created over the past decade. The mathematical institutes, both in their own right and through a number of major initiatives, have displayed major leadership in this area. This section begins with 3 of their most comprehensive interdisciplinary initiatives. **MITACS**: The highly successful national network Mathematics of Information Technology and Complex Systems (MITACS) is a joint initiative of the 3 Institutes. MITACS has fostered a broad range of collaborative partnerships involving the mathematical sciences and industry/business. It currently funds 25 projects, with more than 75 corporate sponsors. Over 40 grantees from GSC 336/337 have participated in 15 different MITACS projects that have involved 150 scientists and 50 corporations or companies. GSC 336/337 has provided project leaders or co-leaders for 9 of these projects, which are investigating such diverse phenomena as seismic imaging, symbolic analysis, pattern storage retrieval and recognition, cryptography, material science, signal processing, and financial risk management. The projects currently receive $825K from MITACS and $300K from other sources. **BIRS**: The Banff International Research Station (BIRS) is a new research facility located in Alberta's Banff Centre. BIRS is based on the highly successful Oberwolfach/Luminy model (comparable to the Boston-based Gordon Research Conferences). Beginning in 2003, BIRS will host 40 international 5-day research-intensive workshops each year, covering all pure and applied mathematics, statistics, mathematical biology, mathematical physics, theoretical computer science, industrial and financial mathematics, and promote training of young, talented researchers. BIRS is a joint Canada-US collaborative venture of PIMS and the MSRI (Berkeley). In addition to PIMS support, 4 years funding has been secured from the NSF, NSERC (MFA), and the Alberta Science Research Authority. The Call for Proposals for 2003 had an enthusiastic response, with 108 quality proposals for workshops, each having a Canadian and an American co-organizer. The initiative is the first joint NSERC/NSF venture of this scale. **NCM_2**: The Network for Computing and Mathematical Modelling (NCM_2) is an alliance of 8 research and transfer centres in the Montreal area; CRM is the lead partner. NCM_2's 5-year, $3M NSERC research partnerships program grant, with an equivalent contribution in industrial funds, currently supports 20 projects in areas such as optimization, finance, risk management, imaging, and data-mining. NCM_2 has established large-scale laboratories with some major partners. These include a $12M laboratory on electronic commerce and multi-media research, launched jointly with Bell in 1998, and, most recently, the Laboratoire Universitaire sur le Temps Extrême (LUTE), which has annual contributions of $300K cash, 5 full time researchers, and up to $1M in computing time from Environment Canada. In addition, there are two large (>$1M) Valorisation Recherche Québec projects, in e-commerce and risk management New Labs and Centres: Another confirmation of the trend towards interaction is the evolution over the past decade of a striking number of new labs or centres dedicated to interdisciplinary activity and industrial mathematics. These labs and centres have base funding, are typically university-based, and reflect the emergence of new research and training priorities at the university level. Ten years ago there were only a few such labs or centres; today, there are at least 20. All of these new labs and centres involve extensive participation by researchers funded by GSC 336/337. A number of these labs and centres were discussed in Part 3. There are also at least 20 additional, less structured, groups, distributed over 10 universities and mathematics departments. These groups pursue interdisciplinary research on topics such as dynamical systems, mathematical modelling, mathematical biology, mathematical physics, numerical analysis, scientific computing, and telecommunications algorithms. These groups have had a number of CRC chairs assigned to them. The primary need of these groups is significant long term funding, particularly to expand their training capabilities.

CALL FOR NOMINATIONS / APPEL DE CANDIDATURES

2003 Canadian Mathematical Society Doctoral Prize
Le Prix de doctorat 2003 de la Société mathématique du Canada

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.

Individuals who made a nomination last year can renew this nomination by simply indicating their wish to do so by the deadline date. Only materials updating the 2001 nomination need be provided as the original has been retained.

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, 2003**.

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.

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

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

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 2003**.

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 fera aussi l'affaire). Le comité n'acceptera pas plus de trois lettres de recommandation.

Chair/Président
Doctoral Prize Selection Committee/Comité de sélection du Prix de doctorat
CMS Executive Office/Bureau administratif de la SMC
577 King Edward, Suite 109
P.O. Box 450, Station A/C.P. 450, Succursale A
Ottawa, Ontario Canada
K1N 6N5

McMASTER UNIVERSITY–HAMILTON, ONTARIO DEPARTMENT OF MATHEMATICS AND STATISTICS

SHARCNET Chair in Scientific Computation

The Department of Mathematics Statistics, McMaster University, invites applications for a SHARCNET Chair in Scientific Computation. This Chair is funded by SHARCNET, which has developed a network of high-performance computer clusters spanning seven universities and colleges in Southern Ontario. The McMaster site has a 112-node cluster and a 16-node shared memory machine (please see **http://www.sharcnet.ca** for more information).

Candidates should have a Ph.D., have the potential to become an international leader in numerical analysis and/or scientific computation, and have demonstrated interest and ability in teaching. The successful candidate will have a particular interest in parallel algorithms, as well as a strong scientific background in applied mathematics or mathematical physics.

The salary and rank will be based on qualifications and experience. Normally the appointment will be made at the tenure-track assistant or associate professor level, but tenure may be offered in exceptional circumstances.

All qualified candidates are encouraged to apply; however, Canadian citizens and permanent residents will be considered first for this position. McMaster University is strongly committed to employment equity within its community, and to recruiting a diverse faculty and staff. The University encourages applications from all qualified candidates, including women, members of visible minorities, Aboriginal persons, members of sexual minorities, and persons with disabilities.

Applicants should also arrange for at least three letters of recommendation to be sent to the Chair. These letters should address the applicant's research accomplishments and supply evidence that the applicant can communicate articulately and teach effectively.

Applications will be considered until the position has been filled.

Applications, including a curriculum vitae and a letter of application should be sent to the following address:

M. Valeriote, Chair
Mathematics & Statistics
McMaster University
Hamilton, Ontario Canada L8S 4K1

(Education Notes–continued from page 10)
practice in formulating mathematical questions from a given context, and background in explaining and analyzing mathematical thinking and use mathematics methods to solve problems. Two appendices list topics that should be covered in Grades 1-5 and in Grades 9-11. An interesting feature of the report is a concluding section on "explanation of mathematical subtleties".

This report represents an excellent point from which to engage a discussion about what should be happening in the intermediate level of Canadian schools, and I would welcome comments from the readers of these *Notes* on the proposed program and the suggested problems.

SNIPPETS

An article in the Tuesday, May 14, 2002 issue of the *Christian Science Monitor*, describes a new book by Ron Ritchart with the title *Intellectual character: what it is, why it matters and how to get it*. Ritchart holds that intelligence is not ability-centred as commonly believed, but lies in a set of dispositions or patterns of behaviour. He is a research assistant with the Harvard Graduate School of Education's *Project Zero*, which studies how to promote critical and creative thinking. There are six dispositions that are central to intelligence: curiosity, open-mindedness, reflectiveness, strategic thinking, skepticism, and hunger for truth and understanding. When cognitive ability is a set of behaviours rather than the result of innate talent, then teachers can foster it by emphasizing that the process of learning and asking of questions are as important as the answers.

The Manchester, NH, *Union Leader* published an article on Saturday, February 9, 2002 about Louis P. Benezet, Manchester's Superintendent of Public Education from 1924 to 1938. He advocated, and implemented in some schools, the abolition of formal, ritualized mathematics until the seventh grade. He wanted to relieve younger children of a lot of the mindless drill and rote learning that they were subjected to, which he felt tended to "dull and almost chloroform the child's reasoning abilities".

Both these articles put into question a lot of what is occurring in even modern reformed classrooms. Is there an argument to be made for a "Just-in-Time" approach to learning facts and techniques, while spending more effort doing what is necessary to provide student with a global picture of learning that allows for rapid acquisition of syllabus when the occasion demands? What do you think?

UNIVERSITY OF TORONTO–TORONTO, ONTARIO DEPARTMENT OF MATHEMATICS AND STATISTICS

Canada Research Chair in Mathematics and Statistics at UTSC

The University of Toronto at Scarborough solicits applications for a tenured or tenure-track position in the Department of Mathematical Sciences, to begin July 1, 2003. The graduate appointment will be jointly to the Department of Mathematics and the Department of Statistics at the University of Toronto. Rank and salary will be commensurate with qualifications. The main areas of research interest are Mathematical Statistics, Mathematical Finance, or Probability; however, exceptional candidates in other areas relevant to both Mathematics and Statistics are encouraged to apply.

It is intended that the successful applicants will be nominated for a junior Canada Research Chair (Tier II). Accordingly, candidates are expected to be outstanding researchers, whose scholarship and teaching will make major contributions to the quality and stature of the university.

Applicants should send their complete C.V. including a list of publications, a short statement describing their research programme, and all appropriate material about their teaching. They should also arrange to have at least four letters of reference sent directly to:

Search Committee UTSC
Department of Mathematics
University of Toronto
100 St. George Street, Room 4072
Toronto, Ontario Canada M5S 3G3

Additional information is available at the Web page: **www.math.toronto.edu/jobs.**

Priority will be given to applications received by **December 31, 2002.** Applications after this date will be considered until the position has been filled.

The University of Toronto is strongly committed to diversity within its community and especially welcomes applications 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.

Any inquiries about the application should be sent to **ida@math.toronto.edu** or **laura@utstat.toronto.edu**

UNIVERSITY OF TORONTO–TORONTO, ONTARIO DEPARTMENT OF MATHEMATICS AND STATISTICS

Tenure-track Appointments in Mathematics at UT-Mississauga

The University of Toronto solicits applications for two tenure-track appointments in Mathematics. Preference will be given to researchers in the areas: (i) Algebra, Number Theory and Cryptography, and (ii) Applied PDE's such as Mathematical Modelling, Mathematical Finance or Pattern Recognition. However, exceptional candidates in any field of pure or applied mathematics are encouraged to apply.

The appointments are at the University of Toronto at Mississauga, at the rank of Assistant Professor, to begin July 1, 2003. Salary commensurate with experience. Candidates are expected to have demonstrated excellence in both teaching and research after the Ph.D.; in particular, a candidate's research record should show clearly the ability to make significant original and independent contributions to Mathematics.

Applicants should send a complete C.V. including a list of publications, a short statement describing their research programme, all appropriate material about their teaching, and the AMS Standard Cover Sheet. They should also arrange to have at least four letters of reference sent directly to :

Search Committee
Department of Mathematics
University of Toronto
100 St. George Street, Room 4072
Toronto, Ontario Canada M5S 3G3

At least one letter should be primarily concerned with the candidate's teaching.

Additional information is available at our Web page: **http://www.math.toronto.edu/jobs.**

Priority will be given to applications received by **November 15, 2002.** Applications after this date will be considered until the positions have been filled.

The University of Toronto is strongly committed to diversity within its community and especially welcomes applications 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.

Any enquiries about the application should be sent to **ida@math.toronto.edu.**

UNIVERSITY OF VICTORIA–VICTORIA, BRITISH COLUMBIA DEPARTMENT OF MATHEMATICS AND STATISTICS

Assistant Professor Position

The Department of Mathematics and Statistics at the University of Victoria invites applications for a tenure-track position at the Assistant Professor level to commence on July 1, 2003. Applicants for the position should have a Ph.D. in Mathematics and their main research area should be operator algebras or other closely related areas, especially dynamical systems. The successful applicant should be able to interact with our strong groups in operator algebras and analysis, and is expected to participate in the activities of the Pacific Institute for the Mathematical Sciences (PIMS) and the Banff International Research Station (BIRS). A demonstrated record of excellence in research is expected from all applicants, and a strong commitment to undergraduate and graduate teaching is essential.

Information about the department, including descriptions of courses offered, can be found at its website:
http://www.math.uvic.ca/

Applicants should submit a curriculum vitae and a teaching dossier (or equivalent documentation) that outlines their teaching experience, philosophy and effectiveness. They should also request three letters of reference be sent. Applications and reference letters should be directed to:

Dr. John Phillips, Chair
Department of Mathematics and Statistics
University of Victoria
PO Box 3045 STN CSC
Victoria BC V8W 3P4 CANADA
Telephone: (250) 721-7436
FAX: (250) 721-8962
E-mail: acme@math.uvic.ca

The CLOSING DATE for applications is **December 31, 2002**.

The University of Victoria is an equity employer and encourages applications from women, persons with disabilities, visible minorities, aboriginal peoples, people of all sexual orientations and genders, and others who may contribute to the further diversification of the University.

In accordance with Canadian Immigration requirements, this advertisement is directed in the first instance to Canadian citizens and permanent residents. All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority.

YORK UNIVERSITY–TORONTO, ONTARIO
DEPARTMENT OF MATHEMATICS AND STATISTICS

Assistant Professor, Applied Mathematics

Applications are invited for an NSERC University Faculty Award, at the Assistant Professor level in the Department of Mathematics and Statistics to commence July 1, 2003. Applications in the areas of Applied or Computational Mathematics will be considered. The successful candidate must have a PhD and is expected to have a proven record of research excellence, and superior teaching. The position is subject to budgetary approval and the selection process will begin immediately. Applicants should send resumes and arrange for three letters of recommendation (one of which should address teaching) to be sent directly to:

UFA Search Committee
Department of Mathematics and Statistics
York University
4700 Keele Street
Toronto, Ontario Canada M3J 1P3
Fax: 416-736-5757
Email: ufa.recruit@mathstat.yorku.ca
www.math.yorku.ca/Hiring

The UFA program is directed to women and aboriginal peoples. York University also has an Affirmative Action Program with respect to its faculty and librarian appointments. The designated groups are: women, racial/visible minorities, persons with disabilities and aboriginal peoples. Persons in these groups must self-identify in order to participate in the Affirmative Action Program. The Department of Mathematics and Statistics welcomes applications from persons in these groups. The Affirmative Action Program can be found on York's website at **www.yorku.ca/acadjobs/** or a copy can be obtained by calling the affirmative action office at 416-736-5713. The UFA program is restricted to Canadian citizens and permanent residents.

QUEEN'S UNIVERSITY–KINGSTON, ONTARIO
DEPARTMENT OF MATHEMATICS AND STATISTICS

Faculty Positions

The Department of Mathematics and Statistics invites applications for a tenure-track appointment at the Assistant Professor level to begin July 2003, and a Tier II Canada Research Chair in Pure Mathematics. Successful applicants for the tenure track position must have a strong research record and the ability to develop an independent research programme; applicants for the Canada Research Chair must have international stature. All candidates must have the ability to teach a range of mathematics or statistics courses and supervise graduate students. Salary will be commensurate with qualifications and experience.

Candidates should have a Ph.D. in pure or applied mathematics, statistics, or a related area and will have begun an active research program in algebra and number theory, analysis, dynamical systems, or probability and statistics.

Interested candidates should arrange for a curriculum vitae, a description of research interests, up to five publications or preprints, a statement on teaching or a teaching dossier, and at least four letters of reference, one of which should comment on the candidate's teaching, to be sent to the address below by **December 1, 2002.** Applications will be considered until the position is filled. More details are available at **http://www.mast.queensu.ca/jobs/**

James A. Mingo, Associate Head
Department of Mathematics and Statistics
Queen's University,
Kingston Ontario K7L 3N6
fax: (613)533-2964
e-mail: position@mast.queensu.ca
http://www.mast.queensu.ca

Canadian citizens and permanent residents will be considered first for this position. Queen's University is committed to employment equity and welcomes applications from all qualified women and men, including visible minorities, aboriginal people, persons with disabilities, gay men and lesbians.

UNIVERSITY OF WATERLOO–WATERLOO, ONTARIO
DEPARTMENT OF COMBINATORICS AND OPTIMIZATION

Faculty Positions in Computational Mathematics

Applications are being invited for one or more tenure-track faculty positions in computational mathematics. Applicants should have as their primary interest the development, analysis, and implementation of algorithms for the effective solution of problems in any of the Department's research areas: algebraic combinatorics, combinatorial optimization, continuous optimization, cryptography, graph theory, and quantum computing. Successful candidates will participate in a major initiative of the Faculty of Mathematics in the area of computational mathematics including a research centre, a new undergraduate program, and an expanded graduate program. While the intention is to make appointments at the rank of Assistant Professor, applications for more senior positions will be considered. Outstanding junior candidates will be considered for a Tier 2 Canada Research Chair. A Ph.D. and significant evidence of excellence in research and the potential for effective teaching are required. Responsibilities will include the supervision of graduate students, as well as teaching at the undergraduate and graduate levels. Salary will depend on the candidate's qualifications. Effective date of appointment: July 1, 2003. These appointments are subject to the availability of funds. All qualified candidates are encouraged to apply; however Canadian and permanent residents will be given priority. The University of Waterloo encourages applications from all qualified individuals, including women, members of visible minorities, native peoples, and persons with disabilities.

Interested individuals should send curriculum vitae, selected reprints/preprints and the names of three references to:

Prof. W.H. Cunningham, Chair
Department of Combinatorics and Optimization
Faculty of Mathematics
University of Waterloo
Waterloo, Ontario, Canada N2L 3G1
e-mail: combopt@math.uwaterloo.ca
phone: (519) 888-4567 x3482
fax: (519) 725-5441
http://www.math.uwaterloo.ca/CandO_Dept/index.shtml

Closing date for receipt of applications is **December 10, 2002.**

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

NOVEMBER 2002 NOVEMBRE 2002

2–3 PIMS Cascade Topology Conference (University of British Columbia, Vancouver, BC)

25–28 Fifth International Conference on Monte Carlo and QuasiCarlo methods in Scientific Computing (MCQMC) (Singapore, Republic of Singapore) *www.mcqmc2002.math.nus.edu.sg*

DECEMBER 2002 DÉCEMBRE 2002

8–10 CMS Winter Meeting / Réunion d'hiver de la SMC (Marriott Hotel, Ottawa, Ontario) *www.cms.math.ca/Events/winter02/index.html*

9–13 Elliptic Cohomology and Chromatic Phenomena (EuroWorkshop, Newton Institute, Cambridge, U.K.) *t.andrew@newton.cam.ac.uk, www:newton.cam.ac.uk/programs/NST/nstw04.html*

16–20 Higher Chromatic Phenomena (EuroWorkshop, Newton Institute, Cambridge, U.K.) *t.andrew@newton.cam.ac.uk, www:newton.cam.ac.uk/programs/NST/nstw04.html*

JANUARY 2003 JANVIER 2003

Jan – Aug Thematic Program on Automorphic Forms, (The Fields Institute for Research in Mathematical Sciences, Toronto) *Automorphic@fields.utoronto.ca*

6-19 Pan-American Summer Institute(PASI) on PDE, Inverse Problems and Non-linear Analysis, Centro de Modalamiento Matemático(CMM), Universidad de Chile. *sandy@pims.math.ca*

FEBRUARY 2003 FÉVRIER 2003

10–15 Mathématiques Appliquées et Applications des Mathématiques (Nice, France) *www.acm.emath.fr/amam/*

MAY 2003 MAI 2003

11–16 International Conference on General Control Problems and Applications (GCP2003) : Dedicated to the 100th anniversary of A. N. Kolmogorov (Tambov Sate University, Tambov, Russia) *www.opu2003.narod.ru/*

JUNE 2003 JUIN 2003

14–16 CMS Summer Meeting / Réunion d'été de la SMC (University of Alberta, Edmonton, Alberta)
www.cms.math.ca/Events/summer03/index.e

17–21 Fourth Butler Memorial Conference (University of Alberta, Edmonton, Alberta, Canada) *//conley.math.ualberta.ca/butler.html*

18–21 First Joint Meeting between AMS and Real Sociedad Matematica Espanola (Seville, Spain)
www.us.es/rsme/-ams/

JULY 2003 JUILLET 2003

7–11 Fifth International Congress in Industrial and Applied Mathematics (Sydney, Australia)
www.iciam.org

27 - Aug. 9 Banach algebras and their applications (University of Alberta, Edmonton, AB)
www.math.ualberta.ca/ ba03/

DECEMBER 2003 DÉCEMBRE 2003

6–8 CMS Winter Meeting / Réunion d'hiver de la SMC (Simon Fraser University, Harbour Centre, Vancouver, British Columbia)
Monique Bouchard: meetings@cms.math.ca

SUMMER 2004 ÉTÉ 2004

CMS Summer Meeting / Réunion d'été de la SMC (Dalhousie University, Halifax, Nova Scotia)
Monique Bouchard: meetings@cms.math.ca

JUNE 2004 JUIN 2004

27 June–2 July European Congress of Mathematics, Stockholm

JULY 2004 JUILLET 2004

12–15 Toulouse 2004 Joint Meeting between the CMS, Société Mathématique de France (SMF), Société de Mathématiques Appliquées et Industrielles (SMAI) and the Société Française de Statistiques (SFDS), (Toulouse, France)
www.cms.math.ca/Events/Toulouse2004/
www.cms.math.ca/Reunions/Toulouse2004/

DECEMBER 2004 DÉCEMBRE 2004

CMS Winter Meeting / Réunion d'hiver de la SMC (McGill University, Montréal, Québec)
Monique Bouchard: meetings@cms.math.ca

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