CMS NOTES de la SMC

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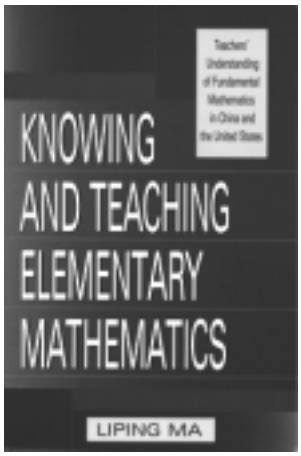
Good Teachers Are at the Core

Book Review by Ed Barbeau, University of Toronto

Knowing and Teaching Elementary Mathematics: Teachers' Understanding of Fundamental Mathematics in China and the United States
By Liping Ma
Lawrence Erlbaum Associates, Inc., Mahwah, NJ 1999
xxv + 166 pages.



Before its appearance as a book, Liping Ma's thesis was an underground publication enthusiastically read and commented upon by several prominent American mathematicians actively interested in school education. Dismayed at the apparent de-emphasis of technical proficiency in educational reform, they found in Liping Ma's work affirmation of their sense that conceptual development and competence can both be accommodated in the curriculum, provided that teachers are up to the job.

Thirty years ago, the author, a middle-school student in Shanghai, was shipped off to the countryside to "learn from the peasants" as part of the notorious Cultural Revolution in China. Within months of her arrival, the village leader asked her to teach at the local elementary school. This set her on a career that saw her become principal of the school, then superintendent of the elementary schools of the county and eventually earn a master's degree at East China Normal University. In 1989, she began studying at Michigan State University, where she participated in a survey of the mathematical understanding of elementary teachers.

She was puzzled at the apparent systemic lack of thorough knowledge of mathematics among American teachers compared to their Chinese counterparts, despite having had a much higher level of formal education. The exploration of this phenomenon constituted the research for her doctoral dissertation under Lee S. Shulman at Stanford University. Her study involved 23 "better than average" teachers participating in professional development or graduate intern programs in

(see REVIEW–page 8)

CMS NOTES
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EDITORIAL

Peter Fillmore

What advances in mathematics does the twenty-first century hold in store? And what uses will be made of them?

A hundred years ago no one could have foreseen the giant strides our subject would take, nor the enormous impact it would have on the lives of all – predominantly for good, but not always and everywhere. From an introspective preoccupation with the foundations of mathematics at the beginning of the century, we have moved to an increasingly intensive search for applications.

A full-page article on John von Neumann in the December 24-25 *Financial Times* of London, headlined "Man of the Century", says that his "contributions to mathematics, the atom bomb and the computer encompass the intellectual brilliance and human savagery that has defined our times". Canadian mathematicians, like those of other countries, put their skills at the service of war. Little seems to have been written about this, but one apparent consequence was the founding in 1945 of the Canadian Mathematical Society. One of the speakers at the founding meeting was von Neumann, and his subject was the electronic computer and its potential uses – though no manuscript seems to have survived. *The Financial Times* points out, as characteristic of the century, "the decisive shift in intellectual pre-eminence from Europe to the US", symbolized by the establishment of the Institute for Advanced Study at Princeton in 1930, which von Neumann joined in 1933.

In Canada, the century which began with little or no significant mathematical activity (the first PhD was granted only in 1915) has ended with the emergence of no fewer than three mathematical research institutes of international stature. This situation, if peculiarly Canadian, can only be seen as a positive indication for the century ahead.

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Quels progrès mathématiques nous réserve le XXIe siècle et qu'en feronsnous?

Qui aurait-pu prédire, il y a cent ans, les progrès mirobolants réalisés dans notre domaine ou l'énorme impact (surtout positif, mais pas toujours) qu'ils auraient sur nos vies et tout autour de nous? Au début du siècle, les préoccupations portaient surtout sur la science ellemême, sur la base des mathématiques, alors qu'aujourd'hui, on assiste à une recherche d'applications de plus en plus intensive.

Dans un article d'une page paru dans *le Financial Times* de Londres en date du 24-25 décembre, portant sur John von Neumann et intitulé «Man of the Century », l'auteur affirmait que «ses contributions aux mathématiques, la bombe atomique et l'ordinateur résument bien le génie intellectuel et la sauvagerie humaine qui ont marqué notre époque». Les mathématiciens canadiens, comme ceux d'autres pays, ont mis leur savoir au service de la guerre, ce qui, même si le sujet semble peu documenté, aurait entraîné la création de la Société mathématique du Canada en 1945. Von Neumann a d'ailleurs pris la parole à l'assemblée de fondation de la SMC. Bien qu'aucun manuscrit de son allocution ne semble avoir survécu, on sait qu'elle portait sur l'ordinateur et ses possibilités d'utilisation. L'article du *Financial Times* indique aussi que le siècle a été

(voir EDITORIAL–page 12)

1999 COXETER-JAMES PRIZE LECTURE

The Inverse Problem for Resonances

Maciej Zworski, University of Toronto and University of California, Berkeley

This is a short account of the author's Coxeter-James Lecture given at the CMS Winter Meeting in Montréal in December 1999.

Maciej Zworski

Resonances which are described by complex numbers constitute a replacement of eigenvalues for problems on non-compact domains. They appear naturally in many branches of mathematics and physics. The real part of a resonance describes the energy (or frequency) of a state and the imaginary part its rate of decay. This constitutes a more realistic model than an eigenvalue which provides energy only and assumes eternal existence of a state. For a light-hearted introduction to the subject (partly reproduced in the talk) we refer to [9].

The question of recovering the object from its spectrum has a long tradition popularized in mathematics by Mark Kac's famous question "Can you hear the shape of the drum?". Since resonances are more general objects, and also in many settings more realistic, we can ask the same question for them.

Some methods from spectral geometry apply but with additional difficulties. For example it is shown in [2] that the ball in R^3 (considered as a scatterer) is determined by its resonances. In all other dimensions however this obvious question is open. In another situation, Zelditch pointed out that his method for planar domains [7] shows how to determine scatterers formed by two bodies placed symmetrically with respect to a line. The non-trivial scattering-theoretical component in these arguments is the Poisson formula for resonances – see (3) below. There are also a few results which are specific to resonances: it is observed in [10] that compactly supported even potentials on the line are (almost always) determined by resonances.

The purpose of the talk was to motivate the study of resonances by using examples from physical chemistry, and to describe the "inverse problem". Very little is known at the moment, but the potentially useful techniques and their simple applications can already be discussed.

The main tools in the study of the relation between resonances and the scatterer are provided by, or at least motivated by, the wave equation. This point of view has been emphasized early by Lax and Phillips [3]. It is now classical that for a non-trapping obstacle in odd dimensions the solutions of the wave equation have long time expansions in terms of resonances: if $X = R^3 \setminus \mathcal{O}$ where $\mathcal{O}$ is non-trapping and

$$(\partial_t^2 - \Delta)u = 0\,,\ \ u|_{t=0}\,,\ \partial_t u|_{t=0}\ \in \mathcal{C}^\infty_{\rm comp}\,.$$

Then for any fixed compact set $K \subset X$,

$$u(t,x) = \sum_{\mathrm{Im}\,\lambda_j < A} e^{it\lambda_j} w_j(x) + \mathcal{O}(e^{-(A-\epsilon)t})\,,\ \ x \in K\,,\ \ t \to \infty\,, \quad (1)$$

where λ_j, $\mathrm{Im}\,\lambda_j > 0$ are the resonances of $P = -\Delta$ with the Dirichlet (or Neumann) boundary condition (we assume no multiplicities are present for simplicity).

The wave equation can then be used to compute the resonances [4]. This creates a potentially useful recovery technique, when instead of starting with numerical solutions to the wave equations, multiple time samples of a real signal are used.

From the practical point of view (for instance, in a recovery process of a real object) trapping situations are much more interesting. In the extreme trapping case of waves on a compact manifold, the solutions of the wave equation are obviously expressed by the right hand side of (1) with λ's being eigenvalues (the convergence is rather strong since we assume smooth data; in the non-trapping case the convergence is guaranteed by the decay caused by the imaginary parts of λ's). A naïve "interpolation" argument between the compact case and the non-trapping scattering case, suggests that expansions hold in general.

Despite the presence of trapping, expansions can be obtained in some examples of scattering on hyperbolic surfaces [1] and surfaces of revolution. The general case is far from clear and not much is known. It was recently shown [6] that the expansion (1) is valid for general "black box" perturbations when we sum over resonances satisfying $\mathrm{Im}\,\lambda_j \le |\lambda_j|^{-M}$, M sufficiently large, and when we replace the error by $\mathcal{O}(t^{-N})$ for any N. The result is at the moment

(see LECTURE–page 11)

Opération Métro 2000

The first phase of the math poster campaign “Opération Métro 2000” took place in the Montreal metro during the period January 4-31, 2000. A second phase will occur in September 2000 if funds are available. During the month of January, 500 posters were exhibited inside the metro cars and suburb trains (one poster every two cars). Also 40 large posters were exhibited in 17 stations (there are 52 metro stations in Montreal), mainly the “school” stations, so that the young could be reached by this campaign.

Three of the small posters were taken from the projects of Stépane Durand, researcher at the Centre de Recherches Mathématiques and winner of the EMS posters contest: they deal with mathematics in nature.

The fourth was drawn by Dominic Rochon, a Ph.D. student in mathematics: it deals with the “tetrabrot”, an object that he created in his research.

The very large poster in stations (see top left) was designed by Christiane Rousseau and deals with applications of mathematics in technology: aeronautics, medical imaging and optimization in transport.

The posters can be translated, modified and adapted to other formats.

You can see them on the WMY2000 server
(http://wmy2000.math.jussieu.fr,
click on “Posters available”).
More explanations should soon be found at:
http://www.crm.umontreal.ca/math2000

The poster campaign was organized by Christiane Rousseau from the Université de Montréal as part of the WMY2000 activities of the Canadian Mathematical Society (CMS). In this project the CMS has been associated with the Association Mathématique du Québec (AMQ), the Centre de Recherches Mathématiques (CRM) and the Institut des Sciences Mathématiques (ISM). The advertising in the Montreal metro is done by Metromedia Plus, a firm independent of the Montreal public transport system. Therefore the budget for the “Opération Métro 2000” had to be found from other sources. The sponsors of the project were numerous. They include the four organizations cited above, together with the four Montreal universities, the Montreal research centers involved with mathematics, several colleges and the Pratt & Whitney company. A total amount of $28,000 US was collected for the January phase of the project.

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AWARD / PRIX

Order of Canada

Robert Moody

Professor Robert V. Moody of the University of Alberta has been named an Officer of the Order of Canada.

Robert Vaughan Moody is a world class mathematician whose work for the most part can be said to revolve around questions of symmetry. He is best known for his contributions in the theory of infinite dimensional Lie algebras and the class of much studied Kac-Moody algebras that were discovered independently by V. Kac and himself. These algebras have had applications in many fields of mathematics and mathematical physics, including systems of partial differential equations, combinatorics, modular functions, as well as in conformal and quantum field theories. Since 1990 Robert has been studying the mathematics of long-range aperiodic order, a newly discovered form of symmetry that has connections with quasicrystals, aperiodic tilings, and self-similarity.

Inevitably his early years were spent following his parents around. Born in England, his first real memories are of running around the beaches of Deep River, Ontario where his father worked as a scientist. After a short two year return to England he spent his high school years in Ottawa. It was here that, blessed with some excellent teachers, he found his great love of mathematics, a passion that has not faded in the least with time. From his parents he learned the true measure of human life. His relationship with them has blossomed into one of continuing friendship, love, and respect.

In 1966 he moved with his wife to Saskatoon, taking up his first academic position at the University of Saskatchewan, where he had been an undergraduate and where his father, before him, had been a professor (of Electrical Engineering). Saskatoon provided the perfect environment for nurturing a young family, and those are years that he looks back at with fondness. He joined the Department of Mathematical Sciences at the University of Alberta in 1989. He presently lives in Edmonton with his wife of 35 years, Marian, who has given him unfailing devotion, support, and encouragement, and whose common interest in music has provided them with many hours of enjoyment together. He has three children, all married, whose professions cover the areas of music, computer science, and environmental consulting in the forestry sector.

In addition to these there are a special few, whose friendship has continued to sustain his sense of wonder and joy.

He has a love for black and white photography, which he pursues avidly with the kind forbearance of both family and friends.

Reason is but an item in the mystery.
Behind the proudest consciousness that ever reigned
reason and wonder blushed face to face.
The inevitable stales, while hope and doubt are sisters.
Not unfortunately the universe is wild,
game-flavoured as a hawk’s wing.
Nature is mystery all:
The same returns not, save to be different.

(from Lin Yu Tang)

EDUCATION NOTES

Ed Barbeau, Column Editor

British Columbia Colleges
High School Mathematics Contest

This report was given at the Education Session of the 1999 Summer Meeting of the Canadian Mathematical Society held in St. John's.

Before 1965, there were only four post–secondary academic institutions in BC: UBC, a satellite college in Victoria (now University of Victoria), a small private college (Trinity Western), and Notre Dame University (a tiny facility in the Kootenays). This left most of the province with no local post-secondary academic opportunities. Because post-secondary education required most students in the interior and up-island to relocate, it was quite costly, and many students simply stopped after high school. The political response to this was to create the Community College system wherein university transfer programmes, career/technical programmes, and vocational training were melded under one umbrella.

As a result more students began to proceed to post-secondary education. There was a credibility issue, however, a perception that the colleges were inferior to the universities. And while more students now entered university transfer programmes, many simply stopped once they had gone as far as they could locally, for the same reasons cited above. Thus for many students the "solution" had simply "moved the bar".

"Why another math contest?" I hear you ask. Let me list just a few reasons, in no particular order. There was the credibility issue of the Community Colleges: we needed to make students aware of our existence, and that we were a viable alternative to the universities; in order to do this we needed to establish stronger liaisons with the regional high school math teachers. Simply promoting mathematics was another reason: more interest in mathematics equals more students in college math courses. There was a nucleus of faculty interested in doing the necessary work. And many other math contests were too difficult for the majority of students as these contests were attempting to identify the "cream of the cream".

In 1972 at Cariboo College in Kamloops a local contest was created for first year college students, but it proved unsuccessful at that level. The next year began the Cariboo College High School Math Contest (in Kamloops region), and in 1977 a similar contest started independently at the College of New Caledonia in Prince George. In 1989 three provincial colleges received University College status (currently there are 5 such), enabling them to offer undergraduate degrees. Of course, this change introduced a whole new credibility issue. In 1990 Okanagan University College (Kelowna) started its regional high school math contest. At this time we had three different colleges each running regional math contests independently. Since all three had small departments, the risk of burn-out was very real. In 1995 the three decided to amalgamate their resources and put out the same contest at the same time in each of their regions. They also decided to offer it to any other college in the province, hoping that eventually many of those colleges would have faculty interested in sharing the workload. In 1999 there were 9 of 18 provincial colleges and university colleges participating.

The current format is to have a preliminary multiple choice round held and marked in the high schools in mid-March. Each school then sends its top 4-6 students to the regional College (or University College) for the final round. The final round has (typically) 10 multiple choice and 5 full answer problems in a 2 hour period. The regional College then typically hosts these students and sponsor teachers for the rest of the day to talks and meals, ending with a prize presentation. The details are left up to the local College. There is no cost to the student or high school to participate.

What have we accomplished? Local students are aware of the regional College and the credibility issue is disappearing. Strong liaisons have been established with regional high school teachers. Good math students from many different schools get together to discuss math and are beginning to believe it is acceptable to be good in mathematics. College mathematics faculty are now cooperating for the betterment of mathematics, instead of feeling they are in competition for a limited supply of students.

The future? Some would like to see a further round of competition where the top students from each region come together for a provincial contest, but that is still far off. To stimulate more interest in mathematics among its students, the Kamloops School District has asked the University College of the Cariboo to post monthly or weekly problems in the high schools. We also need to remember our origins: one of our reasons for having this contest was the feeling that national and international math contest problems were too difficult for most of our students; yet we keep making our contests harder. This is not planned, but it is one of the aspects of designing a contest by committee that just happens. Everyone comes with one or two good (which usually means more challenging) problems, and it is difficult to remember that a good contest needs interesting problems at all levels of difficulty.

If anyone has suggestions to help us out, they would be received most gratefully.

Jim Totten, University College of the Cariboo

Reflets sur la réunion d'hiver 1999

Benoit Charbonneau, MIT

À la demande des redacteurs, j'écris ces quelques lignes pour vous donner mes impressions sur la dernière réunion de la Société mathématique du Canada. J'irai ainsi: une mise en situation, quelques fleurs, puis quelques critiques et un bravo final.

Ma relation avec la Société est un peu spéciale, je fus un des premiers représentants étudiants sur le conseil d'administration de la Société avec Daniel Piché. Ma présence aux dernières réunions est donc due à des obligations administratives. Malgré cela, j'ai toujours profité de l'occasion de participer aux autres activités. Je ne sais pas cependant si je me serais deplacé seulement pour le volet scientifique. Étant donné que je ne suis pas encore un chercheur actif, que je ne suis qu'un étudiant qui ne fait que commencer son doctorat, j'aurais eu bien de la peine à justifier le déplacement en pleine fin de session.

La réunion de Montréal, ma quatrième réunion, marque la fin de mon mandat au conseil d'administration de la Société. Je croyais en me rendant à Montréal être libre de toutes responsabilités dès la réunion du CA terminée, je me trompais. Cette réunion marque donc aussi le début de mon mandat au sein du comité étudiant né en septembre 1999 et ma nomination comme représentant substitut de Daniel Piché au conseil d'administration. Pour ceux et celles qui s'interroge sur les activités du Comité étudiant, vous pourrez bientôt consulter notre page web via Camel. D'ici là, vous pouvez vous renseigner sur le prochain CUMC (Canadian Undergraduate Mathematics Conference) au site *http://cumc.math.ca*.

Jon Borwein, Président –élu du SMC et Jennifer Chayes

Outre le magnifique exposé de François Lalonde, exposé d'ouverture de la sessions pour étudiants gradués, je ne suis allé qu'aux exposés d'histoire des maths. Qu'il y ait autant de session a au moins l'avantage qu'on ne s'ennuie pas... mais malheureusement on ne peut être à deux endroits à la fois. J'ai ainsi manqué l'exposé de Mark Haiman *"The McKay correspondance and the* $n!$ *conjecture"* dans la session de combinatoire algébrique parce que je l'avais oublié et que j'étais justement dans la salle d'histoire des maths. Domage, il s'agissait d'un exposé historique: la première conférence au Canada présentant la preuve de la conjecture $n!$. Ceci dit, j'ai trouvé la session d'histoire des maths fort intéressante.

J'espère bien un jour enseigner. C'est un peu pour ça que je me suis interessé à la session d'histoire des maths, parce que je trouvais que c'était la session qui serait la plus profitable à ma formation d'enseignant. Dans cette même veine, j'étais très heureux d'écouter l'exposé plénier de David Lay *"Recent advances in teaching linear algebra"*.

Voici tout de même une critique. Je ne crois pas que la conférence grand public par Jennifer Chayes était vraiment destinée au grand public. Je ne vois pas comment mes parents auraient pu apprécier cette conférence. C'est tout de même fort domage que la communauté mathématique arrive si peu à expliquer son travail et ses merveilles à la population. Il serait important d'y parvenir et je vous invite tous à y refléchir. Ceci dit, Chayes a tout de même réussi à donner un exposé susbstantiel qui aura permis aux matheux d'en retirer quelque chose.

Sabin Lessard au banquet

Je ressens le besoin de faire une seconde critique. J'ai eu la chance lors de l'exposé de Chayes de m'assoeir dans une des premières rangées. Il est malheureux cependant que même si près, je ne pouvais pas voir tellement bien. Cette salle n'était vraiment pas idéale pour une conférence. J'ai toujours trouvé étrange de faire les réunions d'hiver dans les hôtels, les salles ne sont tellement pas appropriées. L'avantage des hôtels est l'abondance de fauteuils et d'endroits sympathiques pour s'asseoir et travailler avec des collègues. Il y a en fait

(voir REFLETS–page 12)

(REVIEW–continued from page 1)

the USA and a sample of 72 teachers from five elementary schools of varying reputation in China. The American teachers reported themselves to be comfortable with mathematics, while the Chinese teachers were more broadly representative.

The teachers were given four scenarios to discuss mathematically and pedagogically:

(1) teaching subtraction of two-digit numbers with regrouping;

(2) dealing with the erroneous multiplication:

$$\begin{array}{rr} & 123 \\ \times & 645 \\ \hline & 615 \\ & 492 \\ & 738 \\ \hline & 1845 \end{array}$$

(3) determining $1\frac{3}{4} \div \frac{1}{2}$ and creating a story or model for which this division is pertinent;

(4) responding to the student who asserts that, because a 4×4 rectangle has perimeter 16 and area 16 while a 4×8 rectangle has perimeter 24 and area 32, the area of a closed figure increases as the perimeter increases.

The first four chapters analyze the responses of the teachers to these situations, and the last two deal with *Profound Understanding of Elementary Mathematics* or *PUFM*: what it is, how one determines whether teachers have it, and how it can be attained. A short conclusion and a substantial bibliography wrap up the monograph.

What were the findings that so excited our mathematical colleagues? On the whole, the Chinese teachers saw the items as part of *knowledge packages* that had to be strategically presented to pupils in order for them to grasp the fundamental principles. While American teachers tended to appeal to a rote borrowing rule in subtraction, Chinese teachers were more likely to refer to the decomposition of higher place values and to ground the algorithm in basic subtraction of numbers less than 10 and less than 20. Many American teachers treated the erroneous multiplication as a procedural mishap, while most of the Chinese teachers sought to diagnose the mistake and give an explanation that focussed on the properties of the place value system. Here, for example, is the comment of Teacher Wong:

" We need to deepen students' understanding of place value. Their concept of place value used to be pretty straightforward. The basic unit of a number is always the one at the ones place. When they saw a number 492, it always meant 492 ones. When they saw a number 738, it always meant 738 ones. But now the place value of the basic unit is no longer a unique one. It changes according to the context. For example, the place value of the 4 in the problem is ten. When we multiply 123 by the 4, we regard it as 4 tens. The tens becomes the place value of the product 492. It is not 492 ones, like it is in the students' work, but 492 tens. That is why we put the 2 at the tens place. The same happens when we multiply 123 by the 6, which we regard as 6 hundreds. [$\cdots$] To correct the students' mistake we should expand their understanding of place value, to help them to think of the concept in a flexible way." (p. 43)

The differences between the national groups were more striking in the fraction example. All 72 Chinese teachers gave the correct answer; of the US teachers, eleven had the correct algorithm but two did not give a complete answer, and the reaction of the remainder varied between uncertainty and incomprehension. The Chinese teachers elaborated on the validity of the invert-and-multiply rule. Only one of the 23 American teachers generated a correct representation for the meaning of the equation, while 65 of the Chinese teachers created among them more than 80 problems, picking up different themes, such as the measurement and the partitive models of division, and the determination of a factor that when multiplied by $\frac{1}{2}$ will give $1\frac{3}{4}$. Ms. D., for example, said,

"The division $1\frac{3}{4} \div \frac{1}{2}$ can be represented from different perspectives. For instance, we can say, here is $1\frac{3}{4}$ kg sugar and we want to wrap it into packs of $\frac{1}{2}$ kg each. How many packs can we wrap? Also, we can say that here we have two packs of sugar, one of white sugar and the other of brown sugar. The white sugar is $1\frac{3}{4}$ kg and the brown sugar is $\frac{1}{2}$ kg. How many times is the weight of white sugar of that of brown sugar? Still, we can say that here is some sugar on the table that weighs $1\frac{3}{4}$ kg; it is $\frac{1}{2}$ of the sugar we now have at home, so how much sugar do we have at home? All three stories are about sugar, and all of them represent $1\frac{3}{4} \div \frac{1}{2}$. But the numerical models they illustrate are not the same. I would put the three stories on the board and invite my students to compare the different meanings they represent. After discussion I would ask them to try to make up their own story problems to represent the different models of division by fractions." (p. 80)

Ma notes that American and Chinese teachers seem to operate from different concepts of fractions. While the US teachers generally deal with "real" and "concrete" wholes and their fractions, Chinese teachers go beyond this. Teaching operations with fractions, they tend to use "abstract" and "invisible" wholes, such as the length of a particular stretch of road or the length of time taken to complete a task. Similar differences were manifest in the perimeter-area scenario. While the American teachers tried to engage the student in exploring the conjecture, their own lack of appreciation of the issues did not allow this to happen in more than a superficial way; two accepted the student's statement and only one investigated the matter thoroughly enough to reach a sound conclusion. The Chinese teachers started out similarly uncertain, but then approached the situation more systemat-

ically. Their responses ranged from simply providing a counterexample to analyzing under what circumstances the conjecture might hold and indicating where a counter-example might be found. About one fifth of the Chinese teachers failed to produce a fine enough analysis to get a correct solution.

For each of the four scenarios, the author provides a conceptual map involving related topics and techniques that provides a solid critical foundation for discussing the teachers' approaches. As for the teachers themselves, she comes to this conclusion:

"Considered as a whole, the knowledge of the Chinese teachers seemed clearly coherent while that of the US teachers was clearly fragmented. Although the four topics in this study are located at various levels and subareas of elementary mathematics, while interviewing the Chinese teachers I could perceive interconnections among their discussions of each topic. From the US teachers' responses, however, one can hardly see any connection among the four topics. Intriguingly, the fragmentation of the US teachers' mathematical knowledge coincides with the fragmentation of mathematics curriculum and teaching in the US found by other researchers as major explanations for unsatisfactory mathematics learning in the United States. [$\cdots$] From my perspective, however, this fragmentation and coherence are effects, not causes. Curricula, teaching, and teachers' knowledge reflect the terrains of elementary mathematics in the United States and in China. What caused the coherence of the Chinese' knowledge, in fact, is the mathematical substance of their knowledge." (pp. 107-108)

Even though the American teachers, unlike the Chinese ones, had a college education that included some advanced mathematics, it is not to such courses and exposure to abstract structures that we look to provide this substance. The cause is much more subtle, and a major strength of Ma's book is her ability to put a finger on it. The better Chinese teachers exhibited *Profound Understanding of Fundamental Mathematics*; "profound" here carries the triple connotation of *deep*, *vast* and *thorough*. This has four characteristics. The first is a sense of the connectedness of mathematics; the teachers have knowledge packages with a central core linked to ancillary topics. Those with *PUFM* entertain multiple perspectives, can analyze their advantages and disadvantages, and lead students to a flexible understanding. Thirdly, there is an awareness of the importance of simple but powerful ideas, which are especially stressed and developed. Finally, their teaching exhibits longitudinal coherence, with a sense of the elementary curriculum as a whole, so they can exploit what students have studied already and lay the foundations for what is to follow.

When and how is *PUFM* achieved? To answer this question, Ma interviewed two additional groups in China, 26 preservice teachers and 20 ninth-grade students "from a mediocre school in Shanghai". While both groups were equally competent algorithmically, the students were more divergent but less sound, and the prospective teachers seemed to grasp the concepts more firmly. Both groups performed better than the American teachers on the third and fourth scenarios. However, they lacked the maturity of the Chinese teachers, and Ma interviewed three of the latter to find out why there was a difference. They pointed to the value of teaching a spectrum of grades over their careers, studying intently teaching materials, particularly the textbook and the government curriculum, interacting with colleagues, solving problems on their own, and being willing to learn from their students. The better Chinese teachers are products of a virtuous circle that begins with a solid school education and continues with their preparation for teaching and the substantial mathematics they pass on to *their* students. In the United States, elementary mathematics seems to be undervalued and teachers have less to build on; the positive feedback does not occur.

To remedy the North American situation, Ma would recognize the interdependence of improving the school curriculum and teacher knowledge, working on both *simultaneously*. She would enhance the interaction between teachers' study of school mathematics and how to teach it; she would like to have college programs more pertinent to the mastery of the elementary curriculum. She concludes the book with some pithy observations on the reform movement, pointing out that while Chinese teachers may not look as they were being very modern, their students may still often be actively engaged in enquiry, problem solving and making critical judgments.

As this is a qualitative investigation that involves only a limited number of teachers, it would be wrong to interpret it as a general investigation of the knowledge of teachers in either China or the United States. Also, this is certainly not the first time on this continent that researchers have concerned themselves with what teachers know and feel about mathematics; Ma's work fits into a much broader pattern of American investigation, particularly that carried out by Deborah Ball. (See Roger Howe's review in the September 1999 *Notices of the AMS* for more discussion of this point.) But Ma's purpose was not to make national comparisons or just record different perceptions of elementary teachers, but to understand more fully where they were and what was possible; for this, it was useful to go outside the American cultural setting for a referent. As a result, we have a work that can serve as a powerful guide to some of the factors that we should be examining in addressing what should be done in North American mathematical education. The so–called "math wars" in the United States have left people in opposing hostile camps despite the attempts of many prominent educators and mathematicians to find a common ground. Ma's book helps

to define that ground. Those who are strong proponents of solid mastery will be reassured that this need not be neglected in successful teaching, while those who see salvation in the active engagement of students in formulating concepts, investigations and problem solving will see that these too are key. Improvement of mathematical education will not come from hopeful purple prose in curriculum documents and threats of hellfire on teachers and schools whose students do not measure up in some way, but only through a corps of knowledgable, reflective and meticulous teachers with the time and environment that supports continuous professional growth.

Our best teachers often toil in isolation, not well supported by their principals or superintendents; teachers-in-training might have taken innovative and strong courses either as undergraduates or as teachers-in-training, but are not given the mentoring in the field to incorporate these into their own coherent vision. The temptation is to respond to a crisis in education by spending money on new texts, testing and technology. Ma's book reminds us how good teachers must be at the core of a solid mathematics education.

Every prospective elementary teacher, university library, board and ministry of education in the country should have a copy of this fine, clearly argued monograph.

UPCOMING CONFERENCES

International Conference on "Mathematics for Living"

Jordan, November 18-22, 2000

The Jordan 2000 Conference is organised by the Mathematics Education into the 21st Century Project - an international educational initiative whose coordinators are Dr. Alan Rogerson (Australia) and Professor Fayez Mina (Egypt). Since its inception in 1986, the Mathematics Education into the 21st Century Project has received support and funding from educational bodies and institutions throughout the world including UNESCO and numerous universities. The Mathematics Education into the 21st Century Project is dedicated to the improvement of mathematics education world-wide through the publication and dissemination of innovative ideas. The Canadian national representative for the Project is Pamela Hagen <pamelahagen@telus.net>.

The Jordan 2000 Conference arose out of the very successful initial conference in Cairo, Egypt in November 1999. That conference represented the culmination of some thirteen years of dedicated work by the contributors to the Mathematics Education into the 21st Century Project and provided a unique opportunity for us to look back and evaluate, and to look forwards and plan for the future. For further information on the history of the Project, the Egypt 1999 Conference or the Jordan 2000 conference, please consult http://www.vsg.edu.au/egypt99/.

Accommodation venue, costs and other details will be confirmed soon in the First Announcement. The registration and participation fee will be of the order of US $250-300 for participants from outside Jordan. This will cover all lunches, coffee breaks, conference documents, welcome reception, gala dinner, and any excursions.

Local Organising Committee Coordinator: Dr. Hanan Innabi. Program and Publication Chair: Dr. Alan Rogerson.

Those wishing to present a paper should send an abstract ASAP indicating the area of mathematics education their topic falls under and in what specific way their paper will relate to the theme of the conference.

Please indicate your interest in the conference by replying to the e-mail address above.

COLLOQUIUMFEST

in honour of the 60th Birthday of Murray Marshall
University of Saskatchewan, March 24-25, 2000

We are celebrating Murray Marshall's 60th birthday on Friday March 24th and Saturday March 25th at the Department of Mathematics and Statistics in Saskatoon. In addition to talks on Saturday morning, we are very pleased and honoured to have the following two colloquiumfest talks on Friday:

Professor Konrad Schmüdgen (Universität Leipzig, Germany): The Classical Multidimensional Moment Problem

Professor Albrecht Pfister (Universität Mainz, Germany): On the Milnor Conjectures: History, Influence, Applications

Professor Schmüdgen will visit our department for two weeks, from March 17th to 31st; and Professor Pfister for one week (probably from March 22nd to March 29th).

For further information:
fvk@snoopy.usask.ca or skuhlman@snoopy.usask.ca.
Franz-Viktor and Salma Kuhlmann
University of Saskatchewan

OBITUARY / AVIS DE DÉCÈS

Jessica Lei
(1981 - 1999)

On December 25, 1999, Jessie Lei was involved in a car accident near Los Angeles, leading to her death in the early hours of January 1, 2000.

Jessie was born in 1981 in Wu Han, China. When she was fourteen, she moved to Windsor, Ontario. She graduated from Vincent Massey Secondary School in June 1999, and during the following months, studied Engineering Science at the University of Toronto. She was an extraordinary student. She had achieved the highest mark of all graduating students in Ontario, and was furthermore recognised nationally in the fields of computer programming, mathematics, and the sciences. Twice she was selected to represent Canada as member of the Canadian International Mathematical Olympiads team. In the first semester of university, her marks ranked with the top students. She had much potential, never to be fully realised because of this tragedy.

Jessie was not merely an academic. She was a person, warm and loving, with a smile always on her face. Her laughter was contagious. If you wanted to talk, she would be glad to listen. If you seemed down, she would try to cheer you up. She always succeeded in bringing a smile to your face. She was a true friend.

Jessie touched the hearts of many people in her life. She will be dearly missed by all who knew her.

A rising sun too soon eclipsed, but still shining in the memories of those who had the privilege to know you.

Jimmy Chui, 1999 IMO team member

(LECTURE–continued from page 3)

conditional and the following generically reasonable yet unverifiable assumption has to be made:

$$|\lambda_l - \lambda_k| > \frac{1}{C}(\max\{|\lambda_l|, |\lambda_k|\})^{-L}\,, \qquad (2)$$

for some fixed $L > 0$.

The Poisson formula for resonances formally follows from the expansions of the wave group by taking the trace and summing over all resonances – that is how one obtains the usual trace formula for eigenvalues. Fortunately, it can be obtained by different methods and is now known in great generality following the initial work of Bardos-Guillot-Ralston and Melrose – see [5] and [8] and references given there. If $-\Delta$ is the free Laplacian on R^n and P an operator differing from $-\Delta$ on a compact set (as in (1)) then

$$\mathrm{tr}\ (\cos t\sqrt{P} - \cos t\sqrt{-\Delta}) =$$

$$\frac{1}{2}\sum_{|\,\mathrm{Im}\,\lambda_j|<|\,\mathrm{Re}\,\lambda_j|/C} e^{i\lambda_j t} + \begin{cases} \mathcal{O}(e^{-Kt}) & \text{n } odd \\ \mathcal{O}(t^{-n+2}) & \text{n } even \end{cases}, \quad t \neq 0\,, \quad (3)$$

where the equality is in the sense of distributions on $R \setminus \{0\}$ and the error terms are smooth functions of t. When n is odd we can sum over all resonances and we do not have an error term. It is clear that the results of spectral geometry which are based on the analysis of the trace at non-zero times, such as [7] apply with easy modifications. The situation at $t = 0$ is more complicated and more delicate methods have to be used – see [2] for a very simple case.

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[5] J. Sjöstrand, *A trace formula and review of some estimates for resonances*, in *Microlocal analysis and spectral theory (Lucca, 1996)*, 377–437, NATO Adv. Sci. Inst. Ser. C Math. Phys. Sci., 490, Kluwer Acad. Publ., Dordrecht, 1997.

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[9] M. Zworski, *Resonances in Physics and Geometry,* Notices of the AMS, **46** no.3, March, 1999.

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FROM THE INSTITUTES

PIMS SUMMER SCHOOL: ALGEBRA 2000

University of Alberta, Edmonton

This consists of 3 separate Summer Schools/Workshops running in the period June 19 through July 14, 2000. Please note that there are special opportunities for financial assistance for graduate students, post-docs and advanced undergraduates; for details check the web-pages given below.

LIE THEORY: June 19-30, 2000.
Week 1: (June 19-23) Instructional Component (2 mini courses):
A. Pianzola, University of Alberta, Lie algebras S. Donkin, Queen Mary College, Algebraic groups.
Week 2: (June 26-30) Conference Component: Confirmed speakers:
G. Benkart, N. Bergeron, S. Berman, Y. Billig, A. Broer, C. Dong, S. Donkin, Y. Gao, M. Gaberdiel, T. Gannon, Y.-Z. Huang, O. Mathieu, K.-H. Neeb, E. Neher, C. Schweigert, O. Smirnov.
There are possibilities for contributed talks. Participants are welcome for either or both weeks.
Organizers: A. Pianzola and B. Allison
http://wren.pims.ubc.ca/algebra2000/

GROUP THEORY: June 26- July 7, 2000.
Week 1: (June 26-30) Instructional Component (4 mini courses):
Michel Broue, Representations of groups of Lie type; Peter Kropholler, Cohomological methods; Dan Segal, Residually finite groups; Aner Shalev, Profinite and p-adic analytic groups.
Week 2: (July 3-7) Conference Component: Confirmed speakers:
Michel Broue, Steve Gersten, Rod Gow, Peter Kropholler, T. Muller, A. Yu. Ol'shanskii, Geoffrey Robinson, Dan Segal, Aner Shalev, Alex Turull.
There are possibilities for contributed talks. Participants are welcome for either or both weeks.
Organizer: A. Rhemtulla
http://wren.pims.ubc.ca/algebra2000/

MATHEMATICS OF APERIODIC ORDER: July 3-14, 2000.
Week 1: (July 3-7) Instuctional Component (3 mini courses):
M.Baake, Introduction to aperiodic order, tilings, and diffraction; J. Lagarias, Discrete geometry and aperiodic point sets; B. Solomyak, Dynamical systems and aperiodic order.
Week 2: (July 10-14) Conference Component: Confirmed speakers:
Jean-Paul Allouche, Michael Baake, David Damanik, Jean-Pierre Gazeau, Uwe Grimm, Petra Gummelt, Jeffrey Lagarias, Boris Solomyak.
There are possibilities for contributed talks. Participants are welcome for either or both weeks.
Organizer: Robert Moody
http://wren.pims.ubc.ca/algebra2000/

(EDITORIAL–continué de page 2)

marqué par «une migration décisive de l'éminence intellectuelle de l'Europe vers les États-Unis», symbolisée par la création, en 1930, de l'Institute for Advanced Study de l'Université Princeton, auquel s'est joint von Neumann en 1933.

Au Canada, le siècle s'est ouvert sur une quasi absence d'activité mathématique importante (le premier doctorat a été décernée en 1915) et s'est fermé sur l'émergence de trois instituts de recherche mathématique d'envergure internationale. Cette situation, si canadienne qu'elle soit, ne peut être que de bon augure pour le siècle à venir.

(REFLETS–continué de page 7)

tout un luxe et une propreté qu'on ne retrouve pas dans une université. Cet avantage est tout de même la marque d'un inconvénient car l'absence de poussière de craie signale aussitôt l'absence des bons vieux tableaux noirs, médium si précieux pour le mathématicien. Je crois que je serai partisan de réunions dans les hôtels que le jour où nous aurons accès à de véritables tableaux et à de véritables auditoriums pour les exposés pléniers.

J'ai tout de même un dernier commentaire positif. J'aimerais féliciter Sabin Lessard, directeur du département de mathématiques de l'Université de Montréal pour la qualité de ses discours. Adrien Pouliot Jr a aussi fait un excellent discours qui fut très agréable à écouter. Ils ont réussi à transformer la période habituellement pénible des discours lors du banquet en un agréable moment.

Report of the Committee on Electronic Information and Communication of the IMU

Jonathan Borwein, Simon Fraser University

This is a report on the meeting of the Committee on Electronic Information and Communication (CEIC) of the IMU in Berkeley, December 5, 1999, MSRI, during and after the conference 'The Future of Mathematical Communication' Berkeley, Dec. 1-5, 1999, see: *http://msri.org/activities/events/9900/fmc99/index.html* for the full record of the conference including overheads and streaming video. The conference was very successful. It was jointly sponsored by the three Canadian research Institutes (CRM, Fields and Pims) and by MSRI, with additional support from the IMU, AMS, CMS, Springer, Cambridge University Press, Mathematica and Maple. Their support is gratefully acknowledged.

There were roughly 100 participants and 35 speakers from more than a dozen countries representing mathematicians, computer scientists, physicists, educators, librarians, software developers, publishers and many other perspectives. One highlight was a stimulating public symposium held on December 4th. This symposium — as much of the rest of the meeting — helped emphasize that we are a small part of a much larger world. In particular, there are three parts to the mathematical literature: commercial journals, freely accessible parts (see below), and all the rest.

The CEIC is a standing committee of the IMU which held its first meeting in Berlin in November 1998 and its second meeting on December 5th, 1999 at Berkeley. It will meet next fall in Vienna. As described in below. The CEIC has an ambitious mandate and is now quite advanced in its activity. Some details of the December 5 meeting follow. They give a good sense of the CEIC's preoccupations and of topics discussed at the conference.

The December 5 1999 CEIC Meeting

The morning was a session of the CEIC, open to the general public, with the following lectures:

- Peter Michor, Martin Grötschel: Presentation of CEIC, its members, and its subcommittees
- Wolfram Sperber: The Idea of Secondary Home Pages in MathNet
- Roland Schwänzl: Metadata — a Tool for Indexing and Linking Mathematical Preprints Globally
- Wilfrid Hodges: What do you want from your publisher? (Copyright issues)
- Peter Michor: Electronic services offered by the European Mathematical Society
- Jonas Gomes: MathNet in Brazil
- Kapil Paranjape: The Situation in India
- Open Discussion of the Prospects for MathNet and Similar Activities

The afternoon was a closed session of CEIC. *Present*: Jonathan Borwein (Deputy Chair, CA), John Ewing (US), Jonas Gomes (Brazil), Wilfrid Hodges (UK), Martin Grötschel (D), Kapil Paranjape (India), Peter Michor (Chair, A), David Morrison (US), Alf van der Poorten (AUS), Alexei Zhizhchenco (RU), *Absent*: Qin Zhou (China)

1. The MathNet initiative which was started in Germany will be developed as a worldwide system of access to electronic information and communication. It is based on the use of machine readable metadata for preprints, institutions, persons, etc., which are developed within the frameweork of the 'Dublin core metadata initiative'. Contacts are being preserved with the Santa Fe initiative on metadata for preprint servers. See *http://www.mathnet.de/* for an entry point into the existing system. A charter for the organizational infrastructure was discussed and will be available on the MathNet site soon. Many thanks are owed to our German colleagues who have been developing MathNet for several years.

   It is anticipated that the CEIC will have a robust web site by April and will make a general call for the establishment of secondary home pages and for development of harvestable preprint servers. Prototypes are presently being checked in Vancouver, Rio de Janeiro and elsewhere.

2. A checklist devoted to copyright issues for authors of mathematical literature is in preparation. This will be continued as an open source initiative, lead by Wilfrid Hodges. See *http://www.maths.qmw.ac.uk/ wilfrid/copyrightdoc.pdf*.

3. The CEIC discussed whether bundling of small and independent journals should be considered so that they could compete with the large electronic libraries of Elsevier, Springer-Verlag, and Academic Press in consortia negotiations. The European Mathematical Society EMIS (*http://www.emis.de*) is addressing this already, in freely accessible fashion. The work of EMIS is commended and encouraged by CEIC.

What will happen to the electronic material in the electronic libraries of the commercial publishers? Will the publishers archive this material permanently? Should there be an independent archiving facility somewhere?

4. The arXiv (*http://www.arXiv.org*) is a very reliable and technically very competent server for primary physical and mathematical literature, growing out of the Los Alamos preprint server. It is willing to consider reliable archiving for the indefinite future. The work of the arXiv is also commended and applauded by the CEIC.

The CEIC's Terms of Refererence

Building on the enabling resolution passed by the General Assembly (GA) in Dresden on August 16, 1998, the Executive Committee of the International Mathematical Union establishes a *Committee on Electronic Information and Communication (CEIC)* of the International Mathematical Union (IMU).

a) The CEIC shall be a standing committee of the Executive Committee (EC) of the IMU, to be reviewed every four years by the EC at its meeting preceding that of the GA. Members will be appointed for four year terms by procedures similar to those for Commissions of the IMU. The Executive Committee will appoint one of its members to serve on the CEIC.

b) The CEIC may meet as necessary in each four year period, review the development of Electronic Information and Communication as it impacts the international mathematical community and submit a report to the EC.

c) The CEIC may organize or sponsor international meetings or forums to bring together representatives of all interested parties, including societies, publishers, libraries, and researchers, publish and otherwise disseminate proceedings, reviews of recent developments, and technical surveys for the use of the mathematical community.

d) The CEIC may recommend international standards on issues related to electronic communication. Such recommendations should be reviewed by the EC and, if approved, may be published and promoted in the name of the IMU.

e) During its first 4 year term, the CEIC is specifically asked to address the coordination of world-wide efforts to establish web-based servers for mathematical papers, preprints, journals, and books. This includes issues of uniformizing metadata, document identifiers and supported formats, promoting mirroring and the development of search engines for mathematical material and coordination of existing servers. It should publish its findings with the goal of making the use of these servers universally understood and usable by the whole mathematical community. It is also asked to consider transferring the World Directory of Mathematicians to an electronic freely accessible form.

f) Membership:

- Peter Michor (Chair), University of Vienna, Vienna, Austria; Peter.Michor@esi.ac.at
- Jonathan Borwein (Deputy Chair), Simon Fraser University, Burnaby, Canada; jborwein@cecm.sfu.ca
- John Ewing, American Mathematical Society, Providence, USA; jhe@ams.org
- Jonas Gomes, IMPA, Rio de Janeiro, Brazil; jonas@impa.br
- Martin Groetschel (EC member) Konrad-Zuse-Zentrum, Berlin, Germany; groetschel@zib.de
- Wilfrid Hodges, Queen Mary & Westfield College, London, UK; w.hodges$q$@mw.ac.uk
- David Morrison, Duke University, Durham, USA; drm@math.duke.edu
- Kapil Paranjape, Institute of Mathematical Sciences, Chennai, India; kapil@imsc.ernet.in
- Alfred J. (Alf) van der Poorten, Macquarie University, Sydney, Australia; alf@math.mq.edu.au
- Alexei Zhizhchenko, Russian Academy of Sciences, Moscow, Russia; abz@ipsun.ras.ru
- Qing Zhou, East China Normal University, Shanghai,China; qzhou@math.ecnu.edu.cn

CALL FOR NOMINATIONS / APPEL DE CANDIDATURES

Editors-in-Chief - Canadian Journal of Mathematics

Rédacteurs-en-chef - Journal canadien de mathématiques

The term of office of the present Editors-in-Chief of the Canadian Journal of Mathematics will end June 30, 2001. The Publications Committee of the CMS now invites nominations for the next Editors-in-Chief to serve a five year term.

Applications should consist of a formal letter of application and include the following:

- A curriculum vitae
- An expression of views of the publication indicating if any changes in direction or policy are contemplated
- Since editorial responsibilities often necessitate a lessening of responsabilities in an individual's normal

work, applicants should indicate that they have the support of their university department and, in particular, of their head of department.

The Publications Committee will communicate its recommendation to the Executive Committee of the CMS in October 2000. Any input from the mathematical community concerning this important selection process is welcome.

Applications (with supporting material) and/or comments should be sent to the address below. The deadline for the receipt of applications is **April 15, 2000**.

****

Le mandat des rédacteurs-en-chef actuels du Journal canadien de mathématiques prendra fin le 30 juin 2001. Le Comité des publications de la SMC sollicite des mises en candidatures pour les prochains rédacteurs-en-chef pour un mandat de cinq ans.

Les mises en candidature doivent inclure une lettre formelle et les éléments suivants:

- Un curriculum vitae
- L'expression de votre opinion sur la publication indiquant si des changements de directions ou de politiques sont envisagés
- Puisque les responsabilités de rédaction nécessitent souvent une réduction dans la charge normale de travail, les candidats devraient indiquer qu'ils(elles) ont l'appui de leur département et en particulier, de leur chef de département.

Le Comité des publications transmettra ses recommandations au Comité exécutif de la SMC en octobre 2000. Les commentaires de la communauté mathématique au sujet de cette importante sélection sont bienvenus.

Les mises en candiatures (avec matérial à l'appui) et/ou commentaires devraient être acheminés à l'adresse ci-dessous. L'échéance pour la réception des mises en candidature est le **15 avril 2000.**

Associate Editors - CJM and CMB / Rédacteurs associés - JCM et BCM

The Publications Committee of the CMS solicits nominations for two Associate Editors for the Canadian Journal of Mathematics (CJM) and the Canadian Mathematical Bulletin (CMB). The appointment will be for five years beginning January 1, 2001. The continuing members (with their end of term) are below.

Le comité des publications de la SMC sollicite des mises en candidatures pour deux postes de rédacteur associé du Journal canadien de mathématiques (JCM) et Bulletin canadien de mathématiques (BCM). Le mandat sera de cinq ans et débutera le 1 janvier 2001. Les membres qui continuent suivent.

CJM Editors-in-Chief / Rédacteurs-en-chef du JCM :
J. Carrell and / et N. Ghoussoub (UBC) (2001)

CMB Editors-in-Chief / Rédacteurs-en-chef du BCM :
A.J. Nicas and / et M. Min-oo (McMaster) (2000)

Associate Editors / Rédacteurs associés :
M. Barlow (UBC)(2004); J. Bland (Toronto) (2002); P. Borwein (SFU) (2004); J. Friedlander (Toronto) (2001); M. Goresky (Northeastern) (2001); N. Higson (Penn. State) (2000); J.F. Jardine (Western) (2000); F. Lalonde (UQAM) (2003); J. Lipman (Purdue) (2001); J. Millson (Maryland) (2003); N. Pippenger (UBC) (2004); and / et C. Sulem (Toronto) (2003).

The deadline for the submission of nominations is **April 15, 2000**. Nominations, containing a curriculum vitae and the candidate's agreement to serve should be sent to the address below.

L'échéance pour proposer des candidats est **le 15 avril 2000**. Les mises en candidature, accompagnés d'un curriculum vitae ainsi que du consentement du candidat(e), devrait être envoyées à l'adresse ci-dessous.

James A. Mingo
Chair–CMS Publications Committee / Président–Comité des publications
Department of Mathematics and Statistics
Queen's University
Kingston, Ontario K7L 3N6

2000 Adrien Pouliot Award /Prix Adrien-Pouliot 2000

Nominations of individuals or teams of individuals who have made significant and sustained contributions to mathematics education in Canada are solicited. Such contributions are to be interpreted in the broadest possible sense and might include: community outreach programmes, the development of a new program in either an academic or industrial setting, publicizing mathematics so as to make mathematics accessible to the general public, developing mathematics displays, establishing and supporting mathematics conferences and competitions for students, etc.

Nominations must be submitted on the "Nomination Form" available from the CMS office. To assure uniformity in the selection process, please follow the instructions precisely. Documentation exceeding the prescribed limits will not be considered by the Selection Committee. Individuals who made a nomination in 1998 can renew this nomination by simply indicating their wish to do so by the deadline date. Only materials updating the 1999 Nomination need be provided as the original has been retained.

Nominations must be received by the CMS Office no later **April 30, 2000**. Please send six copies of each nomination to the following address:

Nous sollicitons la candidature de personnes ou de groupe de personnes ayant contribué de façon importante et soutenue à des activités mathématiques éducatives au Canada. Le terme "contributions" s'emploie ici au sens large; les candidats pourront être associés à une activité de sensibilisation, un nouveau programme adapté au milieu scolaire ou à l'industrie, des activités promotionnelles de vulgarisation des mathématiques, des initiatives, spéciales, des conférences ou des concours à l'intention des étudiants, etc.

Les candidatures doivent nous être transmises via le "Formulaire de mise en candidature" disponible du bureau de la direction de la SMC. Pour garantir l'uniformité du processus de sélection, veuillez suivre les instructions à la lettre. Toute documentation excédant les limites prescrites ne sera pas considérée par le comité de sélection. 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.

Les mises en candidature doivent parvenir au bureau de la SMC avant **le 30 avril 2000**. Veuillez faire parvenir vos mises en candidature en six exemplaires à l'adresse suivante:

The Adrien Pouliot Award / Le Prix Adrien-Pouliot
Canadian Mathematical Society / Société mathématique du Canada
577 King Edward, Suite 109
P.O. Box 450, Station A / C.P. 450, Succ. A
Ottawa, Ontario K1N 6N5

Coxeter-James / Jeffery-Williams / Krieger-Nelson Prize Lectureships
Prix de conférence Coxeter-James / Jeffery-Williams / Krieger-Nelson

The CMS Research Committee is inviting nominations for three prize lectureships.

The Coxeter-James Prize Lectureship recognizes outstanding young research mathematicians in Canada. The selected candidate will deliver the prize lecture at the Winter 2000 Meeting in Vancouver, British Columbia. Nomination letters should include at least three names of suggested referees.

The Jeffery-Williams Prize Lectureship recognizes outstanding leaders in mathematics in a Canadian context. The prize lecture will be delivered at the Summer 2001 Meeting in Saskatoon, Saskatchewan. Nomination letters should include three names of suggested referees.

The Krieger-Nelson Prize Lectureship recognizes outstanding female mathematicians. The prize lecture will be delivered at the Summer 2001 Meeting in Saskatoon, Saskatchewan. Nomination letters should include three names of suggested referees.

The deadline for nominations is **September 1, 2000**. Letters of nomination should be sent to (see next page):

Le Comité de recherche de la SMC invite les mises en candidatures pour les trois prix de conférence de la Société, la Conférence Coxeter-James, la Conférence Jeffery-Williams et la Conférence Krieger-Nelson.

Le prix Coxeter-James rend hommage à l'apport exceptionnel des jeunes mathématiciens au Canada. Le candidat choisi présentera sa conférence lors de la réunion d'hiver 2000 à Vancouver (Columbie Britannique). Les lettres de mises en candidatures devraient inclure les noms d'au moins trois répondants possibles.

Le prix Jeffery-Williams rend hommage à l'apport exceptionnel des mathématiciens d'expérience au Canada. La Conférence sera présentée lors de la réunion d'été 2001 au Saskatoon (Saskatchewan). Les lettres de mises en candidature devraient inclure les noms d'au moins trois répondants possibles.

Le prix Krieger-Nelson rend hommage à l'apport exceptionnel des mathématiciennes au Canada. La Conférence sera présentée lors de la réunion d'été 2001 au Saskatoon (Saskatchewan). Les lettres de mises en candidatures devraient inclure les noms d'au moins trois répondants possibles.

La date limite pour les mises en candidatures est **le 1 septembre 2000**. Les lettres de mises en candidatures devraient être envoyées à :

Niky Kamran
CMS Research Committee / Comité de recherche de la SMC
Department of Mathematics and Statistics
McGill University
Montréal, Québec H3A 2K6

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

MARCH 2000 **MARS 2000**

24–25 Colloquiumfest – in honour of the 60th Birthday of Murray Marshall (University of Saskatchewan)
fvk@snoopy.usask.ca or skuhlman@snoopy.usask.ca

MAY 2000 **MAI 2000**

5–7 Unified Congress of Mathematical Associations and Groups of Quebec (Université Laval), a WMY2000 event
pallascio.richard@uqam.ca

JUNE 2000 **JUIN 2000**

Canadian Mathematics Education Study Group Meeting (UQAM, Montreal) *Dates to be announced*

4–7 Annual Meeting of the Statistical Society of Canada (Ottawa, Ontario) *André Dabrowski: adrsg@uottawa.ca*

4–8 Canadian Annual Operator Algebra Symposium (Fields Institute, Toronto, Ontario) *elliott@math.utoronto.ca; choi@math.utoronto.ca*

8–9 Symposium on the Legacy of John Charles Fields
(The Royal Ontario Museum, Toronto); a WMY2000 event
www.fields.utoronto.ca

10–13 MATH 2000 (McMaster University, Hamilton, Ontario – includes the CMS Summer Meeting)
Participating Societies include the Canadian Mathematical Society (CMS), the Canadian Applied and Industrial Mathematics Society (CAIMS), the Canadian Operational Research Society (CORS), the Canadian Symposium on Fluid Dynamics (CSFD), the Canadian Society for the History and Philosophy of Mathematics (CSHPM) and the Canadian Undergraduates Mathematics Conference (CUMC). A WMY2000 event
www.cms.math.ca/Events/math2000

12–15 Integral Methods in Science and Engineering (Banff, Alberta) *Peter.Schiavone@ualberta.ca*

JULY 2000 **JUILLET 2000**

10–14 Third European Congress of Mathematics (Barcelona)
3ecm@iec.es; http://www.iec.es/3ecm/info.htm

11–25 41st International Mathematical Olympiad (Korea)

17-22 XIII International Congress on Mathematical Physics (Imperial College, London) *http://icmp2000.ma.ic.ac.uk*

30-Aug 5 7th International Conference on Radicals - ICOR 2000 (Innsbruck) *Rainer Mlitz mlitz@umbriel.tuwien.ac.at*

31–Aug 7 International Congress on the Teaching of Mathematics (ICME-9)(Tokyo/Makuhara)
http://www.ma.kagu.sut.ac.jp/ icme9/

AUGUST 2000 **AOÛT 2000**

7–12 AMS Meeting (Los Angeles); a WMY2000 event
www.ams.org/meetings/

SEPTEMBER 2000 **SEPTEMBRE 2000**

22–24 American Mathematical Society Central Section Meetings (University of Toronto)
http://www.ams.org/meetings/

NOVEMBER 2000 **NOVEMBRE 2000**

18–22 International Conference on "Mathematics for Living" (Jordan)
http://www.vsg.edu.au/egypt99/

DECEMBER 2000 **DÉCEMBRE 2000**

10–12 CMS Winter Meeting / Réunion d'hiver de la SMC (University of British Columbia, Vancouver, B. C.)
Monique Bouchard: meetings@cms.math.ca

JUNE 2001 **JUIN 2001**

2–4 CMS Summer Meeting / Réunion d'été de la SMC (University of Saskatchewan, Saskatoon, Saskatchewan)
Monique Bouchard: meetings@cms.math.ca

Canadian Mathematics Education Study Group Meeting (University of Alberta, Edmonton)

Annual Meeting of the Statistical Society of Canada (Vancouver, British Columbia)

DECEMBER 2001 **DÉCEMBRE 2001**

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

JUNE 2002 **JUIN 2002**

CMS Summer Meeting / Réunion d'été de la SMC (Université Laval, Québec, Québec)
Monique Bouchard: meetings@cms.math.ca

AUGUST 2002 **AOÛT 2002**

20–28 International Congress of Mathematicians, (Beijing, China)
cms@math08.math.ac.cn; http://icm2002.org.cn/

DECEMBER 2002 **DÉCEMBRE 2002**

CMS Winter Meeting / Réunion d'hiver de la SMC (University of Ottawa / Université d'Ottawa, Ottawa, Ontario)
Monique Bouchard: meetings@cms.math.ca

JUNE 2003 **JUIN 2003**

CMS Summer Meeting / Réunion d'été de la SMC (University of Alberta, Edmonton, Alberta)
Monique Bouchard: meetings@cms.math.ca

DECEMBER 2003 **DÉCEMBRE 2003**

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

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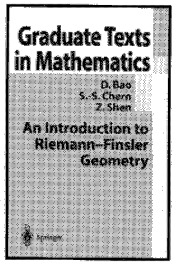

In Riemannian geometry, measurements are made with both yardsticks and protractors. These tools are represented by a family of inner-products. In Riemann-Finsler geometry (or Finsler geometry for short), one is in principle equipped with only a family of Minkowski norms. So yardsticks are assigned but protractors are not. With such a limited tool kit, it is natural to wonder just how much geometry one can uncover and describe.

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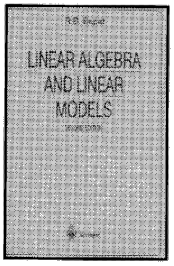

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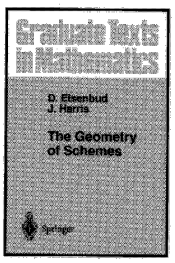

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