CMS NOTES de la SMC

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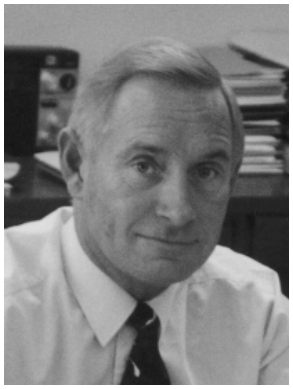
FROM THE EXECUTIVE DIRECTOR'S DESK



Graham Wright

CMS and AMS Approve New Reciprocal Agreement

(voir la page 5 pour la version française)

I am delighted to report that, at the December 1998 meeting of the Board of Directors of the Canadian Mathematical Society and at the January 1999 meeting of the Council of the American Mathematical Society (AMS), a reciprocal agreement between the two societies was approved. This new reciprocal agreement will come into effect for the 2000 membership year.

For many years, reciprocal agreements have existed between the CMS and fifteen other international mathematical societies (*Australian Mathematical Society, Sociedad Brasileira-Matematica, Société mathématique de France, Deutsche Math-Vereinigung, London Mathematical Society, Sociedad Matematica Mexicana, New Zealand Mathematical Society, Polish Mathematical Society, Hong Kong Mathematical Society, Union Matematica Italiana, Allahabad Mathematical Society, Union-Bulgarian Mathematicians, Calcutta Mathematical Society, Indian Mathematical Society & GAMM*). Under the terms of these reciprocal agreements, members of these societies who reside outside Canada can be members of the CMS at one half of the appropriate membership rate. Also, CMS members can belong to any of these societies at one half of the applicable rate and each society's publications are available to members at considerable savings.

Now that the AMS and the CMS have adopted a similar reciprocal agreement, for the year 2000, members of the AMS (who reside outside Canada) will be able to be members of the CMS at 50% of the appropriate rate. As an example, an individual member of the AMS (not resident in Canada) will be able to save up to $58.00 (US) on their CMS membership fee and, as a CMS member, receive

- the CMS Notes - at no cost,
- the CMS Membership Directory and binder - at no cost,
- access to the members' area on the CMS web site (www.cms.math.ca)

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CMS NOTES
NOTES DE LA SMC

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EDITORIAL

P. Fillmore

We have now turned the final corner on the way to the year 2000, and the frequency of references to the millenium in the public press and elsewhere increases apace. Many organizations are taking this opportunity to review their mandates and set new goals, or simply to celebrate. Mathematics is certainly no exception.

In its 1992 "Declaration of Rio", the International Mathematical Union declared a World Mathematical Year for 2000 (WMY2000) with three focal points: the great challenges of the 21st century, mathematics as a key for development, and the image of mathematics. In support of these the IMU will publish a volume, entitled *Mathematics Tomorrow*, of essays by distinguished mathematicians, it will support a number of international conferences, and through a series of newsletters it is encouraging national societies to plan WMY2000 activities of their own (visit www.math.jussieu.fr/jarraud/wmy2000/ma2000.html for details). The CMS has taken up the cause, establishing an ad hoc WMY2000 committee chaired by Bernard Hodgson. In the February issue of the *CMS Notes* President Richard Kane has described some of their initiatives.

Here at the *Notes*, we too have been preparing for the millenium. Besides our "new look", recently we welcomed Noriko Yui and James D. Lewis as our Research Editors and Ed Barbeau as our Education Editor. We have instituted regular columns by the President and the Executive Director, as well as an editorial in every issue. A book review department is off to a modest but we hope promising start. In the near future we plan to add regular reports from the three institutes and from such sister societies as CAIMS and CORS. These initiatives will help, but to reach our full potential we must have more help from you, our readers. Please let us know how we're doing and how we can be more useful or interesting. And if you fancy the idea of writing something, an article or a book review or whatever, please let us hear from you.

Nous voilà maintenant dans le dernier droit avant l'an 2000, et la fréquence des références au nouveau millénaire, dans la presse et un peu partout, s'accroît rapidement. Bon nombre d'organisations profitent de l'occasion pour revoir leur mandat et se fixer de nouveaux objectifs, ou simplement pour célébrer. Le domaine des mathématiques ne fait certes pas exception.

À Rio, en 1992, l'Union mathématique internationale (UMI) déclarait que l'an 2000 serait l'année internationale des mathématiques et que l'on mettrait l'accent sur trois aspects : les grands défis du 21e siècle, les mathématiques à la base du développement et l'image des mathématiques. Dans cette optique, l'UMI publiera un ouvrage intitulé *Mathematics Tomorrow*, constitué d'essais de mathématiciens de renom. Elle appuiera également un certain nombre de conférences internationales et, par l'entremise d'une série de bulletins, elle encourage les sociétés nationales à organiser leurs propres activités dans le cadre de cette année internationale (pour plus de détails, visitez le site suivant : www.math.jussieu.fr/ jarraud/wmy2000/ma2000.html). La SMC a suivi ce conseil : elle a formé le Comité spécial des activités pour l'an

2000, dont la présidence est assurée par Bernard Hodgson. Dans le numéro de février des *CMS Notes*, le président Richard Kane décrit certaines des initiatives proposées.

Du côté des *Notes*, nous nous préparons également au nouveau millénaire. Nouveau «look» mis à part, nous avons récemment accueilli Noriko Yui et James D. Lewis dans notre équipe, en tant que rédacteurs responsables de la recherche, et Ed Barbeau, rédacteur chargé du dossier de l'éducation. Le président et le directeur administratif nous livreront des chroniques qui paraîtront à intervalles réguliers, et chaque numéro comprendra désormais un éditorial. Une critique de livres fait aussi son apparition de façon très modeste, mais nous croyons qu'elle est vouée à un avenir prometteur. Nous avons l'intention, dans un avenir très rapproché, d'ajouter régulièrement des rapports des trois instituts et de sociétés soeurs comme la Société canadienne de mathématiques appliquées et industrielles ou la Société canadienne de recherche opérationnelle. Ces initiatives ne nuiront certainement pas, mais, pour atteindre notre plein potentiel, nous avons besoin de votre aide, vous, les lecteurs. Dites-nous ce que vous pensez de notre travail et ce que nous pourrions faire pour rendre les *Notes* encore plus utiles intéressantes. Et s'il vous prenait l'envie de sortir votre plume pour écrire un article, une critique de livre ou autre chose, n'hésitez pas à nous faire signe!

Peter Fillmore

CMS Endowment Fund Task Force Report – A Summary

H. E. A. Eddy Campbell, Chair

The Task Force recommends the creation of a CMS Endowment Grants Committee (EGC) as a standing committee of the CMS to administer the distribution of some portion of the endowment fund income, as recommended by the Finance Committee, on an annual basis. Funded proposals should contribute to the broader good of the mathematical community as defined in the CMS purpose statements, and the emphasis should be on funding many smaller projects rather than few bigger projects.

A review of the EGC and its mandate should take place after three years. The CMS Board of Directors should delegate to the EGC committee the authority to make final decisions on funding and provide an annual report to the Board.

The membership of the CMS EGC will consist of one current or recently serving member of each of the Executive, the Research Committee, the Education Committee, the Publications Committee and the Board. No committee member may be party to a proposal for funding. Members are expected to serve for two years and membership of the committee would be suggested for election by the Nominating Committee. The Nominating Committee should ensure that the EGC has appropriate representation by language, gender and region.

Proposals for funding must address the goal of the CMS and the CMS purpose statement:

The goal of the Canadian Mathematical Society is to support the promotion and advancement of the discovery, learning, and application of mathematics. The CMS statements of purpose are: To unify and support Canadian mathematicians through effective communication, broad membership, sponsorship of diverse activities, and partnerships with like professional societies; to support mathematics research through the communication of current research to both the specialist and non-specialist, public recognition of research accomplishments and collaboration with the research institutes and granting agencies; to support the advancement of mathematics education through joint projects with mathematics educators at all levels, promotion of educational advancements, and partnerships with provincial ministries of education and organizations supporting mathematics education; to champion mathematics through initiatives that explain, promote and increase the general understanding of mathematics, provide extra-curricular opportunities for students, and encourage partnerships with corporate, government and not-for-profit agencies.

Proposals must come from CMS members (or, if joint, at least one principal applicant must be a CMS member). The committee will favour proposals where CMS funds can be leveraged or where proposals have no other natural funding body to which to apply. It will consider funding proposals for a maximum of three years and to a maximum of $5K per year (in exceptional circumstances, to $10K per year).

The Committee will not fund sabbatical salary top-ups, overhead costs or activities that are funded by NSERC or the Institutes. Course buy-outs and travel costs may be permissible in some circumstances as part of a larger project. Subsidizing undergraduate mathematics conferences is permissible, for example to permit the conference to fund some student travel. Funding support for mathematics camps or the like is permissible, as is some support for conferences and visitors. Summer salaries for undergraduates are permissible as part of a larger proposal.

However, NSERC now funds summer research students at all institutions, so we would not expect the EGC to fund this form of activity.

The EGC will publish data on each competition on Camel including the number of proposals and the number of proposals funded. All successful proposals are required to submit a one page report at the end of the funding period. Successful proposals and reports will be posted on Camel.

It is expected that some $60,000 might be available annually to fund the Endowment Grants programme. A possible time-frame would see a call for proposals in the spring with a submission date in September and decisions made in December. Since some endowment income has already been allocated to WMY2000 activities, the first call for proposals may be deferred to the spring of 2000.

The Task Force membership consisted of Eddy Campbell (Chair), Jennifer Hyndman, Georg Schmidt, Bob Rosebrugh, Tom Salisbury and Graham Wright. Their full report, as approved by the Board in December, can be found at the CMS website (http://cms.math.ca/CMS/Projects/1998/future.html).

(continued from page 1)

- substantial discounts off the regular list price for each CMS periodical (the Journal, Bulletin and CRUX with MAYHEM),
- on-line only access to the Canadian Journal of Mathematics and the Canadian Mathematical Bulletin - for 1999 the fee is only $50.00 (US),
- substantial discounts off the regular list price of books published by the CMS (Book Series, Conference Proceedings Series and other publications), and
- a 50% discount in the registration fees for CMS meetings.

For the year 2000, individual members of the CMS, who reside outside the United States at the time their dues are paid, will be eligible for reciprocity membership in the AMS.

The annual fee for a reciprocity member of the AMS, residing outside the United States at the time their dues are paid, is 50% of the higher ordinary dues amount. If the reciprocity member is residing in the United States at the time their dues are paid and, their privilege journals are going to be shipped to their United States address, then that member is required to pay the appropriate ordinary dues rate for membership. If the reciprocity member is residing in the United States at the time their dues are paid and, their privilege journals are going to be shipped to an address outside the United States, and they plan to be residing outside the United States in a short period of time, then that member would be allowed to pay the rate of 50% of the higher ordinary dues amount (the usual rate for the reciprocity member).

Based upon the existing AMS higher ordinary dues amount, this means that **an individual CMS member will be able to save approximately $100.00 (CDN) in their AMS membership dues**.

AMS reciprocity members receive

- the Notices and Bulletin of the American Mathematical Society - at no cost
- in even-numbered years and upon request, the Combined Membership List - at no cost
- email forwarding service for members,
- substantial discounts off the regular list price of books and journals published by the AMS (and are also entitled to discounted prices on selected publications from some other publishers such as A. K. Peters, Johns Hopkins University Press, Kluwer, Oxford University Press, etc.),
- the normal member registration fees at all AMS meetings, and
- have the right to present papers at AMS meetings.

Establishment of this agreement between the AMS and the CMS will result in significant savings and benefits for members of both societies and it will not affect, in any way, the present arrangement that exists whereby Canadian institutions can become institutional members of the AMS and obtain 20% discounts on subscriptions to journals of the AMS and to Math Reviews.

I am extremely pleased that we have been able to obtain a reciprocal agreement with AMS and I wish to extend my thanks and those of the CMS to Dr. John Ewing, Executive Director of the AMS, for his assistance and cooperation in establishing this agreement.

DU BUREAU DU DIRECTEUR ADMINISTRATIF

La SMC et l'AMS : nouvelle entente de réciprocité

(see page 1 for the English version)

Il me fait très plaisir de vous annoncer qu'à la réunion de décembre 1998 du Conseil d'administration de la Société mathématique du Canada, et à la réunion de janvier 1999 du Conseil de l'American Mathematical Society (AMS), une entente de réciprocité entre les deux sociétés a été conclue. Cette nouvelle entente entrera en vigueur pour le renouvellement des adhésions de l'an 2000.

La SMC a conclu, depuis de nombreuses années, des ententes de réciprocité avec quinze autres sociétés mathématiques internationales (*Australian Mathematical Society, Sociedad Brasileira-Matematica, Société mathématique de France, Deutsche Math-Vereinigung, London Mathematical Society, Sociedad Matematica Mexicana, New Zealand Mathematical Society, Polish Mathematical Society, Hong Kong Mathematical Society, Union Matematica Italiana, Allahabad Mathematical Society, Union-Bulgarian Mathematicians, Calcutta Mathematical Society, Indian Mathematical Society et GAMM*). Selon ces ententes réciproques, les membres de ces sociétés qui habitent à l'extérieur du Canada peuvent adhérer à la SMC pour la moitié du tarif approprié. Les membres de la SMC peuvent également adhérer à n'importe laquelle de ces sociétés pour la moitié du tarif habituel et s'abonner aux publications de ces sociétés à des prix considérablement réduits.

Maintenant que l'AMS et la SMC ont conclu une entente réciproque semblable, pour les adhésions de l'an 2000, les membres de l'AMS (qui habitent à l'extérieur du Canada) pourront devenir membre de la SMC à 50 % du tarif pertinent. Par exemple, un membre individuel de l'AMS (n'habitant pas au Canada) épargnera jusqu'à 58,00 $ (US) sur son tarif d'adhésion à la SMC et, en tant que membre de la SMC, il recevra :

- les Notes de la SMC - gratuitement;
- le répertoire des membres de la SMC et un cartable - gratuitement;
- le droit d'accès à la section réservée aux membres du site Web de la SMC (www.cms.math.ca);
- des rabais considérables sur le prix habituel des périodiques de la SMC (Journal, Bulletin et CRUX with MAYHEM);
- le droit d'accès en ligne seulement au Journal canadien de mathématiques et au Bulletin canadien de mathématiques - pour l'année 1999, le tarif n'est que de 50,00 $ (US);
- des rabais considérables sur le prix habituel des livres publiés par la SMC (collection de livres, comptes rendus de conférences et autres publications);
- un rabais de 50 % sur les droits d'inscription aux Réunions de la SMC.

À partir de l'année d'adhésion 2000, les membres individuels de la SMC, qui n'habitent pas aux État-Unis au moment de payer leurs frais d'adhésion, pourront bénéficier de notre entente de réciprocité avec l'AMS.

Les frais annuels d'un membre d'une société réciprocitaire de l'AMS, qui habite à l'extérieur des États-Unis au moment de payer ses frais d'adhésion, correspond à 50 % du tarif normal le plus élevé. Si le membre d'une société réciprocitaire habite aux États-Unis au moment de payer ses frais et si les journaux auxquels il a droit seront expédiés aux États-Unis, alors ce membre doit payer les frais d'adhésion normaux. Si le membre d'une société réciprocitaire habite aux États-Unis au moment de payer ses frais, si les journaux auxquels il a droit seront expédiés à l'extérieur des États-Unis et si ce membre a l'intention d'habiter à l'extérieur des États-Unis dans quelque temps, alors ce membre a droit au tarif correspondant à 50 % du tarif normal le plus élevé (le tarif normalement accordé aux membres d'une société réciprocitaire).

Compte tenu des frais normaux les plus élevés de l'AMS, cela signifie **qu'un membre individuel de la SMC économisera environ 100,00 $ CAN sur ses frais d'adhésion à l'AMS**.

Les membres d'une société réciprocitaire qui adhèrent à l'AMS reçoivent :

- les Notices et le Bulletin of the American Mathematical Society - gratuitement;
- aux années paires et sur demande, la liste combinée des membres - gratuitement;
- l'accès à un service de réacheminement du courrier électronique réservé aux membres;
- des rabais considérables sur le prix habituel des livres et des journaux publié par l'AMS (ainsi qu'à des rabais sur certaines publications d'autres éditeurs : A. K. Peters, Johns Hopkins University Press, Kluwer, Oxford University Press, etc.);
- le droit de payer les droits d'inscription normaux des membres à toutes les réunions de l'AMS;
- le droit de présenter des communications aux réunions de l'AMS.

Grâce à cette entente, conclue entre l'AMS et la SMC, les membres des deux sociétés bénéficieront d'économies et d'avantages considérables. L'entente ne modifiera d'aucune façon l'entente actuelle selon laquelle les établissements canadiens peuvent devenir membres institutionnels de l'AMS et obtenir 20 % de rabais sur l'abonnement aux journaux de l'AMS et aux Math Reviews.

Je suis vraiment très heureux que nous ayons réussi à conclure cette entente réciproque avec l'AMS et je tiens à remercier, en mon nom et au nom de la SMC, le professeur John Ewing, directeur administratif de l'AMS, pour son aide et sa collaboration entourant la conclusion de cette entente.

ANDY LIU - PROFESSOR OF THE YEAR

Ed Barbeau, University of Toronto

Andy Liu

Listeners to the CBC program "As it happens" on January 11, 1999 were treated to an uncommon experience, an interview with a mathematics professor. The interviewee was our colleague, Professor Andy Liu, of the University of Alberta, who has just been named "Professor of the Year" by the Canadian Council for Advancement in Education. The hook for the broadcast appeared to be his ability to write upside down so he can explain mathematics to a student across a desk. But as the citation for the award makes clear, there is much much more.

It spoke of his lively sense of humour, his ability to create a comfortable learning environment for his students and his ability to explain difficult concepts in a very clear way. His teaching is guided by the principle that students must not settle into passive learning, but must be active participants in the mathematics they study.

Professor Liu's eminence has long been recognized among his colleagues. In 1996, he was the recipient of the David Hilbert Award of the World Federation of National Mathematical Competitions. Many of us are aware of the exemplary work that he has done in recognizing and nurturing mathematical talent among the young and supporting gifted students through his mathematical club in Edmonton and his writing. For years, he has been a prominent contributor to such respected international journals as Crux Mathematicorum with Mathematical Mayhem and Mathematics and Informatics Quarterly, both devoted to mathematical problems and elegant results.

Across the world, he is well known for his Olympiad activities. He has trained competitors for the International Mathematical Olympiad from Australia, Canada, Hong Kong, Taiwan and the United States; for many years, he and Murray Klamkin led the US team to top standing in the IMO. He is particularly valued for his knowledge of the problem literature, and chaired the problems committee in 1995 when the IMO was held in Toronto, as well as played an important role in various recent Asian IMOs. Currently, he is serving the Canadian Mathematical Society as a member of the Education Committee.

Anyone who knows Professor Liu will be aware of his zest for mathematics, including all sorts of games and puzzles, and his devotion to the young students that come within his orbit. On behalf of the Canadian Mathematical Society – Congratulations, Andy!

EDUCATION NOTES

Ed Barbeau, University of Toronto

SPRING CONFERENCES AT BROCK

This spring, the Canadian Mathematics Education Study Group (CMESG) will be gathering at Brock University. Its conclave will be preceded by a conference on "Technology in Mathematics Education", which begins on Thursday, June 3 at 8:30 am and concludes the following day at 4 pm. The plenary speakers are Jonathan Choate (Groton School), Paul Zorn (St. Olaf College), Jon Borwein (Simon Fraser University), Stephen Watt (University of Western Ontario) and Loki Jörgenson (Simon Fraser University and CMS). There will be limited registration, and each applicant should indicate a focus group to which they plan to adhere. Look for information on the website

http://spartan.ac.brocku.ca/mathconf/tech/index/html

The CMESG/GCEDM meeting will be from Friday, June 4 until Tuesday, June 8. The plenary speakers are Jon Borwein (Simon Fraser University), William Langford (Fields Institute), Walter Whiteley (York University), Jill Adler (University of Witswatersrand) and Bill Barton (University of Auckland). Information is available on the web at:

http://spartan.ac.brocku.ca/mathconf/cmesg/index/html

GROUPE DE DIDACTIQUE PROCEEDINGS

The *Groupe de Didactique des Mathématiques du Québec* (GDM) helds its annual *colloque* in May, 1998 at Concordia University. The proceedings are now available for $12 (including postage). Those desiring a copy should mail a cheque for this amount to:

Professor Anna Sierpinska
Department of Mathematics and Statistics
7141 Ouest Rue Sherbrooke Street West
Montréal, QC

Professor Sierpinska can be reached at:
`sierp@vax2.concordia.ca`.

PROGRAMS AT CORNELL

One of the talks at the Education Session in the recent CMS meeting at Kingston was by Thomas Rishel of Cornell University (`Rishel@math.cornell.edu`). He outlined a number of initiatives there, including Teaching Assistant Training Programs, College Teaching Courses, "Teaching Issues" Seminars, Professors for the Future Programs and Assistance in getting Jobs for Graduate Students.

The TA training course, running over one to five days, is intended to be practical, acquainting its adherents with administrative detail and fostering basic competence in taking up problems and handling queries. The Professors for the Future program is more complex, and includes a series of talks by graduate students, attendance at professional meetings, job fairs and sessions on calculus reform. Future units will treat the use of calculators in calculus, provide a course on college teaching and develop peer mentoring. In assisting graduates students to land jobs, Cornell invites faculty from nearby institutions to give sessions on what they look for in faculty members and sets up opportunities for graduates to give undergraduate level talks at these institutions.

AUTONOMOUS STUDENTS

At the Kingston meeting, my attention was caught by a monograph, "How to Study Mathematics: Effective Study Strategies for College and University Students" written by Peter Shiavone of the University of Alberta and published by Prentice Hall (ISBN 0-13-906108-8). This is a practical guide to students that treats studying successfully, preparing for a new course, using lectures, texts, assignments and tutorials effectively, solving problems and writing examinations. A lot of this is good common sense that most of us probably try to convey to our students more informally; however, it may be useful to advise some of your students to pick up a copy.

ONTARIO: A CASE STUDY IN EDUCATION

Recently, a woman phoned me to say that she was interested in doing a thesis on the development of mathematics education in Ontario. I did not know what was already available, but I encouraged her to look further into the matter as it seemed to be beneficial to have a longitudinal study of education in Ontario if only as a case study for what can go right and what can go dreadfully wrong. The system established by Egerton Ryerson, the first Superintendent of Education in Upper Canada, in the middle of the nineteenth century, was securely established and became over its first century one of the strongest in North America. The province still can count many fine teachers and schools, but somehow over the last three decades, it has lost the ability to build upon and generalize its strengths. It would be fascinating to study the role of politics, educational ideology, community values and social trends in bringing this about.

One would surely point to the downsizing and decentralization of the Ministry of Education since 1970 in depriving it of the capacity to provide effective and consistent leadership. Even so, it maintained the reins of control and mandated changes in curriculum and assessment that were often hurriedly implemented, poorly founded and not given room to develop, but were great sinkholes for the taxpayers' dollars. The destreaming of grade 9 and the Ontario Assessment Instrument Pool are but two examples of this phenomenon. The current government has managed to compound this by requiring, in the space of about a year, the creation of a new curriculum to accommodate the contraction of five years of high school into four. The writing team sponsored by the Fields Institute has responded creditably to the challenge, but has been severely constrained by conditions imposed by the government and so limited in the extent to which it could suggest changes.

There is no doubt that we are due for a radical regeneration of the curriculum, a challenge that can only be effectively handled in a measured way through long term planning. Politically, this requires a stable process robust enough to withstand changes of government, capable of projecting where we need to be two decades from now and overseeing a process to get us there. One would hope that while the government of the day would make proposals and sketch out policy, it would be the work on an all-party standing committee of the legislature to sort out details and make necessary adaptations. In this way, objections could be raised and met and each party, sharing in the decision making, would have a stake in the result — the continuance of Ryerson's dream of a public education system that would reach out to pupils in all walks of life and enable them to enjoy the opportunities of a first class education. The sad fact in Ontario is that we have many teachers demoralized by precipitous and thoughtless changes and many of the middle class disenchanted with the public system.

Where should we be in the year 2020? The heterogeneous classes of today are not going away, and we need to ensure that the weaker students will have a good core of skills and knowledge while the more able and motivated will be challenged by extensions of the core curriculum that are appropriate to their age and stage of development. Achieving this will depend on designing a different sort of curriculum and assessment design, as well as providing pupils from an early age with the skills and background to become more autonomous learners, less dependent on a particular classroom regime and capable of utilizing a variety of resources. While all students will require some secondary qualification, we need to ensure that those going into tertiary education are especially well prepared.

The curriculum should ensure the acquisition of necessary arithmetic skills by grade 6 for most students. The middle school years should consolidate and contextualize these as well as lay the foundation for analysis, reasoning, symbolic manipulation and problem solving; we might look to recreations, games and puzzles, as well as numerical and geometric investigations, to handle these themes.

Students in the upper grades will need not only a command of algebra and elementary functions, but be exposed to other mathematics that has become important but not yet been incorporated into the standard curriculum. This would certainly include a broader approach to geometry, combinatorics, design of algorithms, recursions, dynamical systems and appropriate exploitation of technology. All this will need to be connected into courses with strong themes and manageable syllabi.

To get there from here, we need to establish discipline-based programs of formation and professional development of teachers, run pilot projects to work out the bugs, produce provisional and polished textual material, and continually monitor and analyze the results. This, of course, will be expensive, but it will be money allocated as an investment and not thrown down some rathole created by softheaded politics and facile nostrums. If we had taken this approach thirty years ago, the money spent on one false start after another could instead have provided a school system much better attuned to our era and one which Egerton Ryerson might have seen as the capstone of the foundation he so carefully laid over a century ago.

In these pages, it would be nice to embark on a discussion (that could spill over to the electronic media) about what a thoroughly modern curriculum should be like and how we can set up a program to achieve it.

1998 COXETER-JAMES PRIZE LECTURE

Elliptic curves and p-adic uniformisation

Henri Darmon, McGill University

This is a transcription of the author's Coxeter-James Lecture given at the CMS Winter Meeting in Kingston in December 1998. It is a pleasure to thank Massimo Bertolini and Adrian Iovita for many fruitful exchanges over the years, and the Canadian Mathematical Society for its invitation to deliver the Coxeter-James Lecture.

Henri Darmon

Elliptic curves. An *elliptic curve* is a curve of genus one with a distinguished rational point. It can be described by a homogeneous equation of the form

$$E : Y^2Z = 4X^3 + aXZ^2 + bZ^3, \tag{1}$$

where the parameters $a, b \in \mathbb{Z}$ satisfy the condition

$$\Delta := -2^{12}(a^3 + 27b^2) \neq 0.$$

The Diophantine theory studies the rational solutions $(X, Y, Z) \in \mathbb{Q}^3$ of equation (1). It is convenient to ignore the trivial solution $(0, 0, 0)$ and to identify solutions if they differ by multiplication by a non-zero scalar. Solutions to (1) are thus viewed as points in the *projective plane* $\mathbb{P}_2(\mathbb{Q})$. Let $E(\mathbb{Q}) \subset \mathbb{P}_2(\mathbb{Q})$ denote this solution set. More generally, if F is any field, let $E(F) \subset \mathbb{P}_2(F)$ be the corresponding set of solutions with values in F. It is identified with the set of $(x, y) \in F^2$ satisfying the associated affine equation

$$y^2 = 4x^3 + ax + b, \tag{2}$$

together with the "point at infinity" corresponding to $(X, Y, Z) = (0, 1, 0)$.

Among all the *projective*[1] curves over $\mathbb{Q}$, the elliptic ones are worthy of special consideration, because they alone are

[1] i.e., defined by a system of homogeneous equations.

algebraic groups: the set $E(\mathbb{Q})$ is equipped with a binary composition law

$$E(\mathbb{Q}) \times E(\mathbb{Q}) \longrightarrow E(\mathbb{Q})$$

defined by a system of polynomials with rational coefficients, making $E(\mathbb{Q})$ into a commutative group, with identity element the distinguished point at infinity. The same set of polynomials endows $E(F)$ with a natural addition law[2], admitting a simple geometric description in terms of the *chord and tangent method*: viewing points in $E(F)$ as points on the affine plane by equation (2), one simply sets $P + Q + R = 0$ whenever P, Q, and R lie on the same line. (See for example [ST], ch. I.) The Diophantine study of E is facilitated and enriched by the presence of this extra structure.

The group $E(\mathbb{C})$ is isomorphic to the quotient of $\mathbb{C}$ by a lattice Λ. For a suitable Λ, the inverse isomorphism sends $z \in \mathbb{C}$ to $(\wp(z), \wp'(z)) \in E(\mathbb{C})$, where

$$\wp(z) = \frac{1}{z^2} + \sum_{\lambda \in \Lambda - 0} \left(\frac{1}{(z-\lambda)^2} - \frac{1}{\lambda^2} \right)$$

is the *Weierstrass $\wp$-function* attached to Λ. The group law on $E(\mathbb{C})$ corresponds to the usual addition law of complex numbers on $\mathbb{C}/\Lambda$. This explicit analytic description yields the structure of $E(\mathbb{C})$ and $E(\mathbb{R})$: the former is a product of two circles, and the latter is either a circle or the product of a group of order 2 with a circle.

The structure of $E(\mathbb{Q})$ lies deeper. In the case of the elliptic curve

$$E : y^2 = x^3 + 877x, \tag{3}$$

Bremner and Cassels [BC] showed that $E(\mathbb{Q})$ is generated by the point $(0, 0)$ of order 2 together with a certain point of *infinite* order.

For the elliptic curve[3]

$$y^2 + xy + y = x^3 - 20333x + 203852, \tag{4}$$

it turns out that $E(\mathbb{Q})$ is generated by the six points $P_j = (x_j, y_j)$ with

$$\begin{array}{lll} P_1 = (-51, 1078), & P_2 = (3, 376), & P_3 = (165, 1078), \\ P_4 = (-24, 835), & P_5 = (-132, 835), & P_6 = (136, 106). \end{array}$$

In fact, a point in $E(\mathbb{Q})$ can be written *uniquely* as $n_1P_1 + \cdots + n_6P_6$, with $n_j \in \mathbb{Z}$.

In general, how are the rational solutions to equation (2) calculated? As with many fundamental questions in number theory, the first progress dates back to Fermat, who introduced his famous method of *infinite descent* and used it to show that certain elliptic curves, related to the Fermat equation with exponent 4 and 3, have finitely many solutions. Fermat's descent was later adapted by Mordell[4] to prove the following general result about $E(\mathbb{Q})$, which is suggested by the special cases (3) and (4).

Theorem *The group $E(\mathbb{Q})$ is a finitely generated abelian group, i.e.,*

$$E(\mathbb{Q}) \simeq T \oplus \mathbb{Z}^r,$$

where T is a finite group (identified with the torsion subgroup *of $E(\mathbb{Q})$).*

The integer r is called the *rank* of $E(\mathbb{Q})$: it represents the minimal number of solutions needed to generate a finite index subgroup of $E(\mathbb{Q})$ by repeated application of the chord and tangent law. The rank depends in a subtle way on E, and can get quite large[5].

Unfortunately, the proof of Mordell's theorem, based on Fermat's descent, is not *effective*; it is not known whether Fermat's descent procedure always terminates eventually. The following basic question remains open.

Question: *Is there an* algorithm *to compute $E(\mathbb{Q})$?*

What is desired is a deterministic recipe which, given a and b in equation (1) (say) yields a description of $E(\mathbb{Q})$. The torsion subgroup T can be calculated without difficulty; the key challenge arises in computing the rank r and a system of generators for $E(\mathbb{Q})$.

The Birch and Swinnerton-Dyer conjecture. Further insights about $E(\mathbb{Q})$ may be gleaned by studying E over other fields, such as the finite field $\mathbb{F}_p$ with p elements consisting of the residue classes modulo a prime p. The set $E(\mathbb{F}_p)$ is finite. A simple heuristic argument suggests that its cardinality N_p is roughly $p + 1$. Indeed Hasse proved that the "error term" $a_p := p + 1 - N_p$ satisfies

$$|a_p| \leq 2\sqrt{p}.$$

Reduction of solutions modulo p gives a natural map $E(\mathbb{Q}) \longrightarrow E(\mathbb{F}_p)$. One might expect the presence of a large supply of rational points in $E(\mathbb{Q})$ to have an impact on the size of $E(\mathbb{F}_p)$ on average. Compelled by this insight,

[2] provided that the equation (1) remains non-singular over F, which is the case for example if the characteristic of F does not divide Δ.

[3] its equation is not given in Weierstrass form as in equation (1), but can be brought to this form by a simple change of variables.

[4] The proof was then further generalized by Weil to cover *abelian varieties* over *number fields*. An abelian variety is a projective (commutative) algebraic group; it is a natural *higher dimensional* generalization of elliptic curves. For this reason Mordell's theorem is often referred to as the Mordell-Weil theorem, and $E(\mathbb{Q})$ is called the *Mordell-Weil group* attached to E.

[5] It is expected that it can get arbitrarily large, although this is not proved. The record so far is an elliptic curve of rank ≥ 22 [Fe].

Birch and Swinnerton-Dyer studied the asymptotic behaviour of $\prod_{p<X} N_p/p$ as X gets large. On the basis of numerical experiments, they were led to conjecture that

$$\prod_{p<X} N_p/p \simeq C_E(\log X)^r, \tag{5}$$

where C_E is a constant depending only on E. This striking conjecture asserts that the rank r - an *a priori* subtle *global* invariant of the arithmetic of E over $\mathbb{Q}$ - can be read off from the asymptotic behaviour of the N_p, reflecting information about E of a "local" nature.

Subsequently, Birch and Swinnerton-Dyer gave a more sophisticated formulation of the conjecture in terms of the *Hasse-Weil L-function* $L(E,s)$ attached to E. Let s be a complex variable, and for $p \not| \Delta$ let

$$L(E,p,s) := (1 - a_p p^{-s} + p^{1-2s})^{-1} \tag{6}$$

be the *local L-function* attached to E at p. There is also a simple definition of $L(E,p,s)$ for the finite set of primes dividing Δ, whose precise nature need not concern us here. (See for example [Si].) The L-function $L(E,s)$ of E over $\mathbb{Q}$ is then defined by the "Euler product"

$$L(E,s) := \prod_p L(E,p,s), \tag{7}$$

where the product is taken over all the primes. The Hasse bound $|a_p| \leq 2\sqrt{p}$ implies that it converges for $\mathrm{Re}(s) > 3/2$. In particular, the point $s = 1$ is outside the domain of absolute convergence. However, the fundamental Shimura-Taniyama conjecture, which will be discussed further below, implies that $L(E,s)$ has an *analytic continuation* to all of $\mathbb{C}$.

Noting the identity (for $p \not| \Delta$)

$$L(E,p,1) = \frac{p}{N_p},$$

and comparing it with the quantity occuring in (5), Birch and Swinnerton–Dyer were led to conjecture that the rank r should be reflected in the order of vanishing of $L(E,s)$ at $s = 1$.

Conjecture BSD: *The function $L(E,s)$ satisfies*

$$\mathrm{ord}_{s=1} L(E,s) = r.$$

A more precise version of this conjecture expresses $L^{(r)}(E,1)$, the rth derivative of $L(E,s)$ at $s = 1$, in terms of various quantities associated to E over $\mathbb{Q}$, most notably a "regulator term" measuring the arithmetic complexity of a system of generators for $E(\mathbb{Q})$, and the order of a *conjecturally finite* group known as the Shafarevich-Tate group of E, and denoted by the Cyrillic letter Sh. The precise definition of this group would take the reader too far afield; suffice it to say that $Sh(E)$ measures the *difficulty* of computing $E(\mathbb{Q})$ by Fermat's descent method. In particular, its finiteness implies that Fermat's descent terminates when applied to E. It is for this reason that the Shafarevich–Tate conjecture, which predicts the finiteness of $Sh(E)$ for all E, is widely viewed as the most important outstanding question in the arithmetic of elliptic curves.

Concerning the Birch-Swinnerton Dyer conjecture, Tate once wrote [Ta1]

> "This remarkable conjecture relates the behaviour of a function L, at a point where it is not at present known to be defined, to the order of a group Sh, which is not known to be finite."

This quote accurately summarized the state of knowledge (or perhaps, ignorance) on the question, until around 1987, when the results of Gross-Zagier and Kolyvagin, and then Wiles, led to dramatic breakthroughs[6].

The Shimura-Taniyama conjecture and Wiles' theorem. The fact that *a priori* $L(E,s)$ is not even known to be *defined* at $s = 1$ presents an obvious obstacle to tackling the Birch and Swinnerton-Dyer conjecture. In 1993, Wiles established the analytic continuation of $L(E,s)$ for a large class of elliptic curves by relating E (and its L-function) to modular forms.

Given an integer N, let $\Gamma_0(N)$ be the group of matrices in $\mathbf{SL}_2(\mathbb{Z})$ which are upper triangular modulo N. It acts as a discrete group of Möbius transformations on the Poincaré upper half-plane

$$\mathcal{H} := \{z \in \mathbb{C} | Im(z) > 0\}.$$

A *cusp form of weight 2 for* $\Gamma_0(N)$ is an analytic function f on $\mathcal{H}$ satisfying the relation

$$f\left(\frac{az+b}{cz+d}\right) = (cz+d)^2 f(z), \quad \text{for all } \begin{pmatrix} a & b \\ c & d \end{pmatrix} \in \Gamma_0(N), \tag{8}$$

together with suitable growth conditions on the boundary of $\mathcal{H}$. For example, the invariance in equation (8) implies that f is periodic of period 1, and one requires that it can be written as a power series in $q = e^{2\pi i z}$ with no constant term:

$$f(z) = \sum_{n=1}^{\infty} \lambda_n q^n.$$

The Dirichlet series

$$L(f,s) = \sum \lambda_n n^{-s}$$

[6] Prior to this one should also mention the work of Coates and Wiles establishing partial results towards the Birch and Swinnerton-Dyer conjecture for elliptic curves with *complex multiplication* – a restricted class, but one which has played an important role in the development of the theory.

is called the L-function attached to f. A direct calculation reveals that $L(f,s)$ is essentially the *Mellin transform* of f:

$$\Lambda(f,s) := \Gamma(s)L(f,s) = (2\pi)^s \int_0^\infty f(iy)y^{s-1}dy. \quad (9)$$

The space of cusp forms of weight 2 on $\Gamma_0(N)$ is a finite-dimensional vector space and is preserved by the involution W_N defined by

$$W_N(f)(z) = Nz^2 f(\frac{-1}{Nz}).$$

Hecke showed that if f lies in one of the two eigenspaces for this involution (with eigenvalue $w = \pm 1$) then $L(f,s)$ satisfies the functional equation:

$$\Lambda(f,s) = -w\Lambda(f,2-s). \quad (10)$$

In particular, $L(f,s)$ has an analytic continuation to all of $\mathbb{C}$.

The curve E is said to be *modular* if there exists a cusp form f of weight 2 on $\Gamma_0(N)$ for some N such that

$$L(E,s) = L(f,s).$$

Taniyama and Shimura conjectured in the fifties that every elliptic curve over $\mathbb{Q}$ is modular. This important conjecture gives a framework for proving the analytic continuation and functional equation for $L(E,s)$, and illustrates a deep relationship between objects arising in arithmetic, such as E, and objects, such as f, which are part of an ostensibly different circle of ideas – related to Fourier analysis on groups, and the (infinite-dimensional) representation theory of adelic groups, as described in the ambitious Langlands program.

The conjecture of Shimura-Taniyama, as refined by Weil, predicts that the integer N is equal to the so-called *arithmetic conductor* of E. This integer can be computed effectively in terms of an equation defining E, and is divisible only by the primes dividing Δ, but with different exponents in general. From now on, the letter N will be used to denote the conductor of E.

Thanks to the work of Wiles [Wi], Taylor-Wiles [TW] and its extensions [Di], [CDT], one now knows that E is modular, at least provided that E satisfies a mild technical restriction.

Theorem STW. *If 27 does not divide N, then E is modular.*

Complex uniformisation. The modularity of E can also be formulated as a statement about the complex uniformisation of the Riemann surface $E(\mathbb{C})$. (Cf. [Ma2]).

Theorem STW$_\infty$: *If 27 does not divide N, then there is a complex analytic uniformisation*

$$\varphi_\infty : \mathcal{H}/\Gamma_0(N) \longrightarrow E(\mathbb{C}).$$

The classical uniformisation theorem of complex analysis states that every Riemann surface is expressible as a quotient of $\mathcal{H}$ by the action of *some* discrete subgroup Γ of $\mathbf{SL}_2(\mathbb{R})$. The above statement lies deeper. Its arithmetic content comes from the fact that it makes a precise statement about the nature of Γ, and relates it to the arithmetic of E over $\mathbb{Q}$. Groups like $\Gamma_0(N)$ which are defined by simple congruence conditions on the matrix entries, are examples of what are called *arithmetic subgroups* of $\mathbf{SL}_2(\mathbb{Z})$.

Evidence for the Birch–Swinnerton-Dyer conjecture. As Mazur writes in [Ma1],

> " It has been abundantly clear for years that one has a much more tenacious hold on the arithmetic of an elliptic curve $E/\mathbb{Q}$ if one supposes that it is [...] parametrized [by a modular curve]."

This sentiment is supported by the following result, following from the work of Kolyvagin [Ko] and earlier work of Gross and Zagier [Gr2].

Theorem GZK. *Let E be an elliptic curve over $\mathbb{Q}$ of rank r. Suppose that E is modular, and that $ord_{s=1}L(E,s) \leq 1$. Then*

$$ord_{s=1}L(E,s) = r,$$

and the Shafarevich-Tate conjecture is true for E.

The theorem (or rather, its proof) even supplies a procedure for computing $E(\mathbb{Q})$, based on the theory of complex multiplication, which relies on the modularity of E and is more efficient than the descent method of Fermat.

Higher order zeroes. The following question remains as the ultimate challenge concerning the Birch and Swinnerton-Dyer conjecture.

Question: What if $\text{ord}_{s=1}L(E,s) > 1$?

In this case the relation between r and the order of vanishing of $L(E,s)$ at $s=1$ remains mysterious. It appears that the inequality

$$\text{ord}_{s=1}L(E,s) \geq r \quad (11)$$

ought to be easier to prove than the reverse inequality[7]. However, even this "easy half" of the Birch Swinnerton-Dyer conjecture seems out of reach for now. The process whereby the

[7] For example, it is known to hold in the function field case, by work of Tate[Ta2]. The reverse inequality seems inextricably linked with questions related to the Shafarevich–Tate conjecture.

presence of "many" rational points in $E(\mathbb{Q})$ forces higher vanishing of $L(E,s)$ at $s=1$ is simply not understood.

There are elliptic curves E for which the sign $-w$ in the functional equation (10) is -1, and for which $r \geq 3$, such as the elliptic curve

$$y^2 = 4x^3 - 28x + 25 \tag{12}$$

of conductor $N = 5077$. In this case $L(E,s)$ vanishes to odd order, and theorem GZK implies that $L'(E,1) = 0$. Hence

$$\text{ord}_{s=1} L(E,s) \geq 3. \tag{13}$$

But this is basically as far as one can go! Indeed the following question remains open:

Question: *Is there an elliptic curve E over $\mathbb{Q}$ with $ord_{s=1}L(E,s) > 3$?*

In his undergraduate summer project [Gh], Alexandru Ghitza evaluated the first few derivatives of $L(E,s)$ at $s=1$ for the curve of rank 6 given by equation (4). In this case $L(E,1) = 0$ and the sign $-w$ in the functional equation for $L(E,s)$ is 1, so that $L(E,s)$ vanishes to even order ≥ 2. Ghitza's numerical calculations (performed on a high-speed computer with an accuracy of around four significant digits after the decimal point) produced

$$\begin{aligned} L''(E,1) &\simeq -0.0000195, \\ L^{(4)}(E,1) &\simeq -0.00000027, \\ L^{(6)}(E,1) &\simeq 717.6663612. \end{aligned}$$

This strongly suggests that $L(E,s)$ vanishes to order 6 at $s=1$, as predicted by the Birch and Swinnerton-Dyer conjecture, but it appears to be an *extremely difficult* theoretical problem to prove that $L''(E,1) = 0$, even for this specific curve!

Using the known elliptic curves with $r \geq 22$, note that a proof of (11) would imply the existence of L-functions for which $\text{ord}_{s=1} L(E,s) \geq 22$.

The work of Goldfeld. Producing L-functions $L(E,s)$ with high order zeroes at $s=1$ has a number of applications. For example, Goldfeld [Go] showed that the existence of a suitable[8] elliptic curve E for which $ord_{s=1}L(E,s) \geq r$ implies the following asymptotic lower bounds on the growth of the class number $h(D)$ of the imaginary quadratic field of discriminant D:

$$h(D) \geq c(\log|D|)^{r-2-\epsilon}.$$

The importance of this estimate lies in the fact that the constant c is *effective*, and can be calculated in terms of the elliptic curve E. Goldfeld's work, using the elliptic curve of equation (12), led to the unconditional estimate

$$h(D) \geq \frac{1}{55}(\log|D|)^{1-\epsilon},$$

and thus to a solution of the celebrated class number problem of Gauss. Note the key role played in this estimate by equation (13), which is based in turn on theorem GZK.

More recently, Ram Murty has informed me that an analogue of a conjecture of Polya about the Riemann zeta-function $\zeta(s)$, which was subsequently shown to be false, ought to be true after replacing $\zeta(s)$ by L-functions $L(E,s)$ admitting a high-order zero at $s=1$. [Mu]

p-adic analysis. In the face of the difficulties associated with understanding the complex L-function, it has proved fruitful to replace the complex variable s by a p-adic one, and the classical Hasse-Weil L-function by a p-adic analogue.

In addition to the usual "archimedean" distance $d_\infty(x,y) = |x-y|$, the rational numbers are equipped (for each prime p) with the p-adic distance $d_p(x,y) = p^{-\text{ord}_p(x-y)}$, according to which two rational numbers are declared to be close to each other if (the numerator of) their difference is divisible by a high power of p. Ostrowski's theorem asserts that the usual absolute value and the p-adic ones, as p ranges over the primes, give a complete list of metrics (up to a suitable equivalence) which are compatible with the field structure on $\mathbb{Q}$.

Just as $\mathbb{R}$ is the completion of $\mathbb{Q}$ with respect to the usual metric, the field $\mathbb{Q}_p$ is the completion of $\mathbb{Q}$ with respect to d_p. It has a greater arithmetic complexity than $\mathbb{R}$, in the sense that its algebraic closure $\bar{\mathbb{Q}}_p$ is of *infinite degree* over $\mathbb{Q}_p$, unlike $\mathbb{C}$ over $\mathbb{R}$. As a consequence, $\bar{\mathbb{Q}}_p$ is not a complete field[9]. The role of $\mathbb{C}$ is played by a larger field, denoted $\mathbb{C}_p$, the *completion* of $\bar{\mathbb{Q}}_p$ with respect to the p-adic metric.

The *p-adic upper half plane* $\mathcal{H}_p$ is defined as

$$\mathcal{H}_p := \mathbb{P}_1(\mathbb{C}_p) - \mathbb{P}_1(\mathbb{Q}_p) = \mathbb{C}_p - \mathbb{Q}_p.$$

Note that replacing $\mathbb{C}_p$ by $\mathbb{C}$, and $\mathbb{Q}_p$ by $\mathbb{R}$, yields two copies of the usual Poincaré upper half plane. In the p-adic setting, $\mathbb{C}_p - \mathbb{Q}_p$ does not split naturally into two disjoint connected pieces, so that it is more natural to work with $\mathcal{H}_p$ in its entirety.

The space $\mathcal{H}_p$ is endowed with a rich theory of "p-adic analytic functions" which mirrors the complex-analytic theory. By analogy with the complex case, it could be tempting to define an "analytic" function on $\mathcal{H}_p$ as a $\mathbb{C}_p$-valued function which admits a power series expansion in each open disk. In the p-adic setting, however, two open discs are either disjoint

[8] by "suitable" it is meant that the number of primes dividing N to odd order should be odd if $w=1$, and even if $w=-1$.

[9] for example, if ζ_n is a primitive p^nth root of unity, then $\sum_{n=1}^{\infty} \zeta_n p^n$ does not have a limit in $\bar{\mathbb{Q}}_p$ even though its partial sums form a Cauchy sequence.

or one is contained in the other! The space of "analytic functions" according to this definition turns out to be too large and not "rigid" enough to yield a useful theory: for example, the principle of analytic continuation fails.

A fruitful function theory, obeying many of the principles of classical complex analysis, is obtained by replacing open discs by so-called *affinoid* sets, which are made up of a closed p-adic disc with a number of closed disks deleted. The affinoids cover $\mathcal{H}_p$ and can be used to define a sheaf of *rigid analytic functions* which enjoys many of the same formal properties as the sheaf of complex analytic functions on $\mathcal{H}$.

The group $\mathbf{SL}_2(\mathbb{Q}_p)$ acts on $\mathcal{H}_p$ by fractional linear transformations, just as $\mathbf{SL}_2(\mathbb{R})$ acts on $\mathcal{H}$. If Γ is a discrete subgroup of $\mathbf{SL}_2(\mathbb{Q}_p)$, the quotient $X_\Gamma := \mathcal{H}_p/\Gamma$ inherits a p-adic topology and becomes a *rigid analytic curve*: it is the analogue, in the p-adic realm, of a Riemann surface.

The p-adic uniformisation theory of Mumford addresses the question of which curves $X/\mathbb{C}_p$ can be be written as a quotient $\mathcal{H}_p/\Gamma$, for $\Gamma \subset \mathbf{SL}_2(\mathbb{Q}_p)$. Unlike the complex case, not every curve over $\mathbb{C}_p$ can be so uniformized. Mumford identifies a simple necessary and sufficient condition[10] for X to admit a p-adic uniformisation. Curves over $\mathbb{C}_p$ with this property are called *Mumford curves*. An elliptic curve over $\mathbb{Q}$ is a Mumford curve precisely when its conductor is exactly divisible by p. The p-adic uniformisation theory of elliptic curves with $p||N$ was developped by Tate, and later generalized by Mumford to curves of higher genus.

Rigid analytic Shimura-Taniyama. Let E be an elliptic curve over $\mathbb{Q}$ with $27 \not| N$, so that E is modular in the sense of theorem STW. The following result is a p-adic analogue of theorem STW$_\infty$, and follows by combining the result of Wiles with earlier work of Eichler-Shimizu-Jacquet-Langlands, Shimura, and Cerednik-Drinfeld. (Cf. for example the work of Jordan-Livné [JL].)

Theorem STW$_p$. *Suppose that $p||N$, so that E is Mumford curve over $\mathbb{Q}_p$. Then there exists a discrete* arithmetic *subgroup Γ of $\mathbf{SL}_2(\mathbb{Q}_p)$ and a rigid analytic uniformisation of $E(\mathbb{C}_p)$:*

$$\varphi_p : \mathcal{H}_p/\Gamma \longrightarrow E(\mathbb{C}_p).$$

The key word in this theorem is the word *arithmetic*. It means that the groups involved in the uniformisation are analogous to $\Gamma_0(N)$. The definition of these groups is somewhat more involved. Rather than provide a complete definition, here is an example which gives the flavour of the general case. Let

$$B := \mathbb{Q} + \mathbb{Q}i + \mathbb{Q}j + \mathbb{Q}k$$

be the ring of Hamilton quaternions with coefficients in $\mathbb{Q}$, and let

$$R = \mathbb{Z}[i, j, k, \frac{1+i+j+k}{2}]$$

be Hurwitz's maximal order. If p is an odd prime, then $B \otimes \mathbb{Q}_p$ is isomorphic to the ring $M_2(\mathbb{Q}_p)$ of two by two matrices with entries in $\mathbb{Q}_p$; after choosing such an isomorphism, the group

$$\Gamma = R[1/p]_1^\times \tag{14}$$

of elements of norm 1 in $R[1/p]$ can be viewed as a subgroup of $\mathbf{SL}_2(\mathbb{Q}_p)$. This Γ is an example of a p-adic arithmetic subgroup of $\mathbf{SL}_2(\mathbb{Q}_p)$; in fact, if E is an elliptic curve of conductor $2p$, then $E(\mathbb{C}_p)$ is uniformized by $\mathcal{H}_p/\Gamma$.

The pull-back to $\mathcal{H}_p$ of a suitable invariant differential ω on E yields a Γ-invariant differential $f(z)dz$ on $\mathcal{H}_p$. The function f is a *rigid analytic modular form* of weight two on $\mathcal{H}_p$, i.e., a rigid analytic function on $\mathcal{H}_p$ satisfying the transformation property analogous to (8)

$$f\left(\frac{az+b}{cz+d}\right) = (cz+d)^2 f(z), \quad \text{for all } \begin{pmatrix} a & b \\ c & d \end{pmatrix} \in \Gamma. \tag{15}$$

Schneider's p-adic L-functions. By analogy with the construction of $L(f, s)$, the following goal seems natural.

Goal. *Attach to a rigid analytic modular form f a* p-adic L-function $L_p(f, s)$*, by a process of p-adic Mellin transform.*

What is desired here is a $\mathbb{C}_p$-valued function of the variable $s \in \mathbb{C}_p$ which is rigid analytic, at least in a neighbourhood of $s = 1$. A definition along those lines was proposed by Schneider [Sch], by associating to f a p-adic measure μ_f on $\mathbb{P}_1(\mathbb{Q}_p)$, the p-adic boundary of $\mathcal{H}_p$. This measure behaves like the boundary measure attached to f, and indeed it satisfies the following analogue of the Poisson inversion formula [Te] which allows f to be recovered from μ_f:

$$f(z) = \int_{\mathbb{P}_1(\mathbb{Q}_p)} \frac{d\mu_f(t)}{z-t}.$$

By analogy with formula (9) for the complex L-function, Schneider proposed defining

$$L_p(f, s) := \int_{\mathbb{Z}_p^\times} \langle x \rangle^{s-1} d\mu_f(x), \tag{16}$$

where $\mathbb{Z}_p^\times \subset \mathbb{P}_1(\mathbb{Q}_p)$ is the group of p-adic units and $\langle x \rangle = x/(\lim_{n\to\infty} x^{p^n})$.

This definition does not lead to a satisfactory theory of p-adic L-functions, because the definition of $L_p(f, s)$ is sensitive to

[10] X should have a model over $\mathcal{O}$ (the ring of integers of $\mathbb{C}_p$) whose special fiber is a union of projective lines intersecting transversally at ordinary double points.

the identification of B_p with $M_2(\mathbb{Q}_p)$ used to make Γ act on $\mathcal{H}_p$ and $\mathbb{P}_1(\mathbb{Q}_p)$. It appears that even the order of vanishing of $L_p(f,s)$ depends on these choices, and so it is doubtful that a conjecture analogous to conjecture BSD can be formulated for Schneider's $L_p(f,s)$.

The Iovita-Spiess construction. A definition of a p-adic L-function which is modelled on Schneider's approach, but does lead to a fruitful theory, was proposed by Adrian Iovita in a graduate course at McGill University, and independently by Michael Spiess. The Iovita-Spiess construction is best explained in the special case of the group Γ of equation (14). (The full details are given in [BDIS].) Let K be a maximal commutative subalgebra of the quaternion algebra B. It is isomorphic to a quadratic imaginary field in which the prime 2 is either inert or ramified. Let $\mathcal{O}$ be the ring of integers of K. Replacing K by a conjugate subalgebra, one may assume that

$$K \cap \Gamma = (\mathcal{O}_K[1/p])^\times.$$

In fact, if the p-class group $\mathrm{Pic}(\mathcal{O}[1/p])$ is trivial, the subalgebra K with this property is unique up to conjugation by elements of Γ. Assume for simplicity that this is the case. The identification $B_p = M_2(\mathbb{Q}_p)$ yields an action of $K_p^\times := (K \otimes \mathbb{Q}_p)^\times$ on the boundary $\mathbb{P}_1(\mathbb{Q}_p)$ of $\mathcal{H}_p$, having at most two fixed points and acting transitively on the complement Ω. A choice of base point in Ω thus yields a continuous map

$$\eta : K_p^\times/\mathbb{Q}_p^\times \longrightarrow \Omega \subset \mathbb{P}_1(\mathbb{Q}_p).$$

Let $\mu_{f,K} := \eta^*(\mu_f)$ be the pullback of Schneider's measure μ_f to a measure on $K_p^\times/\mathbb{Q}_p^\times$, and let $\bar{\mu}_{f,K}$ be the measure obtained by composing $\mu_{f,K}$ with complex conjugation on $K_p^\times$. The invariance of μ_f under Γ translates into the invariance of $\mu_{f,K}$ and $\bar{\mu}_{f,K}$ under the action of $\mathcal{O}[1/p]^\times$, and hence yields measures on the compact p-adic group $G_\infty := K_p^\times/(\mathbb{Q}_p^\times \mathcal{O}[1/p]^\times)$. Letting $\mu_{f,K}^{(2)}$ be the convolution measure $\mu_{f,K} * \bar{\mu}_{f,K}$, define, in analogy with Schneider's definition (16):

$$L_p(f,K,s) := \int_{G_\infty} \langle \frac{x}{\bar{x}} \rangle^{s-1} d\mu_{f,K}^{(2)}(x).$$

Note the crucial role played by the quadratic imaginary field K in the definition of $L_p(f,K,s)$. In fact, the measure $d\mu_{f,K}^{(2)}$ interpolates special values of the complex L-function $L(f/K,s)$ of f over K. More precisely, if $\chi : G_\infty \longrightarrow \mathbb{C}_p^\times$ is a non-trivial character of finite order, interpreted as an idèle class character in the usual way, there is the interpolation formula

$$\int_{G_\infty} \chi(x) d\mu_{f,K}^{(2)}(x) = \Omega_p \frac{L(f/K,\chi,1)}{\Omega_\infty}, \qquad (17)$$

where $\Omega_p \in \mathbb{C}_p$ and $\Omega_\infty \in \mathbb{C}$ are suitable p-adic and complex periods, and $L(f/K,\chi,s)$ is the complex L-function of f over K twisted by the character χ. The complex number $\frac{L(f/K,\chi,1)}{\Omega_\infty}$ turns out to be algebraic and is viewed as an element of $\mathbb{C}_p$ by choosing an embedding of $\bar{\mathbb{Q}}$ in $\mathbb{C}_p$. This interpolation formula follows from a generalization of a formula of Gross [Gr1] for special values of L-series. See [BDIS] for details.

The p-adic Birch and Swinnerton-Dyer conjecture. If E is an elliptic curve over $\mathbb{Q}$ satisfying the conclusion of theorem STW_p, so that it is attached to a rigid analytic modular form f on $\mathcal{H}_p$, define

$$L_p(E,K,s) := L_p(f,K,s).$$

Even before the connection with Schneider's approach was made explicit, the p-adic L-function $L_p(E,K,s)$ could be constructed from a different and more general point of view, which does not rely on p-adic analysis and also allows for a definition of $L_p(E,K,s)$ in the good reduction case, where $p \not| N$. In this level of generality, p-adic Birch and Swinnerton–Dyer conjecture for the function $L_p(E,K,s)$ was formulated and studied in a series of articles [BD1], [BD2], [BD3], [BD4] and [BD5].

Because of the presence of the field K in the interpolation formula (17), it is natural to expect the order of vanishing of $L_p(E,K,s)$ to be related to the rank r_K of the Mordell-Weil group $E(K)$. In [BD1], it was conjectured that

$$\mathrm{ord}_{s=1} L_p(E,K,s) \geq r_K.$$

This p-adic variant of the "easy half" (11) of the Birch Swinnerton–Dyer conjecture has recently been proved in [BD6].

Theorem BD. *The p-adic L-function $L_p(E,K,s)$ vanishes to order at least r_K at $s=1$.*

The proof of theorem BD is based on two ingredients.

1. The theory of congruences between modular forms and the Jacquet-Langlands correspondence. This circle of ideas plays a crucial role in Wiles's proof of theorem STW, and in Ribet's earlier reduction of Fermat's Last Theorem to the Shimura-Taniyama conjecture.

2. Kolyvagin's theory of the "Euler systems" of Heegner points, the principal ingredient in the proof of theorem GZK.

Thus, theorem BD relies crucially on the ideas of Gross-Zagier, Kolyvagin, Ribet, and Wiles, which have revolutionized the theory of elliptic curves through the proofs of theorems GZK and STW.

To conclude, here are two natural questions connected with the original Birch and Swinnerton-Dyer conjecture.

1. Theorem BD can be used to exhibit elliptic curves whose p-adic L-function $L_p(E, K, s)$ satisfies

$$\text{ord}_{s=1} L_p(E, K, s) \geq 22.$$

   Does the existence of such p-adic analytic L-functions with high order zeroes have independent applications to other questions of number theory (or mathematics in general), as in Goldfeld's solution of Gauss's class number problem?

2. Is it possible to replace the rigid analytic L-functions by classical ones in the proof of theorem BD? The proof in [BD6] is based on congruences in an essential way and breaks down entirely when the prime p is replaced by the "place at ∞". In this sense, it sheds *no light* on the original Birch and Swinnerton–Dyer conjecture, even on the "easy inequality".

As Mazur writes in [Ma3],

> "A major theme in the development of number theory has been to try to bring $\mathbb{R}$ somewhat more into line with the p-adic fields; a major mystery is why $\mathbb{R}$ resists this attempt so strenuously. "

An explanation of the mysterious analogy between the complex and p-adic realms would surely lead to deep insights: it is an issue which lies at the heart of the tantalizing and elusive Birch and Swinnerton–Dyer conjecture.

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THE CMS 1998 WINTER MEETING (KINGSTON)

Anthony V. Geramita, Queen's University

We were apprehensive, when we began this project, that it wouldn't be easy to get people to come to a Winter Meeting in a city like Kingston. But the four of us (Dave Wehlau, the Scientific Co-Director with me, and Leo Jonker and Fady Alajaji, the two Local Organizers) thought that it was an interesting challenge.

I'm delighted to report that we had the largest CMS meeting ever! There were 395 registered participants, with another 20-25 participating in a special Educational Workshop that was organized in parallel to the CMS meeting. Thus, there were well over 400 people taking part in the activities of the meeting, and that doesn't count the members of the general public who swelled the crowd of over 200 who came to Kingston's historic Memorial Hall on the evening prior to the official start of the conference, to hear an inspiring lecture by Donald Coxeter.

Unquestionably, the main reason for the enormous participation was the unusual breadth and depth of the scientific programme (there were over 200 speakers in 16 sessions). We were able to profit from Kingston's favourable location between Montreal and Toronto to have two of the larger sessions be extensions of special activities at the Centre de recherches mathématiques in Montreal (number theory) and the Fields Institute in Toronto (probability). Those sessions, supported by the Institutes and each with over 25 speakers, obviously attracted people who were participating in the activities at the two institutes.

Public Lecturer H.S.M. Coxeter (right) and Coxeter-James Lecturer, Henri Darmon

One can see from this impressive scale of activity what can happen when one has lots of interested special session organizers. In a real sense the success of the meeting was a direct outgrowth of their programmes and their choice of speakers.

A special effort was made to attract graduate students to this meeting. We tried to finance at least a major part of the expenses of each graduate student speaker. We also obtained the agreement of the CMS Executive to lower the registration fee for graduate students to $25 (which basically paid for the luncheon which was offered to every registered delegate). We succeeded beyond anything we had hoped for with this session. The student talks were uniformly of high mathematical quality and the care taken in the presentations was notewor-

thy. The students knew they had a chance to "strut their stuff" and they took clear advantage of that opportunity. I had a chance to see some of my former undergraduates lecture and it was a proud moment for me, so I can imagine what it must have been like for others. Although we had about 15 graduate student speakers in this special session there were graduate students speaking in some of the other sessions as well. In all, the graduate student participation in this meeting was exceptional. That bodes well, I believe, for our future as a viable mathematical society.

Yuri Berest (centre) accepts his Doctoral prize from Cameron Stewart (left) and CMS President, Richard Kane

There was another thing I think was important about this year's meeting which also helped contribute to its success: the low cost for members of the CMS to participate. Hotel rates in Kingston are about half what they would have been in a larger city and with Kingston so well located it was relatively inexpensive for large numbers of mathematicians to come.

Exhibitors at the CMS 1998 Winter Meeting

I think it is also noteworthy that most of the over 200 speakers did not receive any reimbursement for their expenses from the CMS or the Institutes. Of course, the support of the Institutes and the CMS (as well as the more modest support from Queen's University and the Royal Military College) was crucially important for supporting our plenary speakers, prize lecturers, graduate students and the public lecture, as well as allowing us to partially reimburse the expenses of some speakers who had a long way to come. But, it is significant how many mathematicians were willing to come with their own support. I heard comments from people in every session who were enthusiastic about the quality of the talks they'd heard and the opportunity they had had to expound their results to such a large and knowledgeable audience.

Dave Wehlau and I were sure we could break records with a broad and interesting scientific programme. We leave the numbers in attendance at this meeting as a challenge to future organizers. However, we won't be disappointed if the Kingston record doesn't last very long!

Did you know? ...

The CMS Office is on the University of Ottawa Campus. All correspondence from participating Ontario universities can be sent IUTS - **free of charge.**

Saviez-vous que? ...

Le Bureau administratif de la SMC est situé sur le campus de l'Université d'Ottawa. Toute correspondance provenant d'une université ontarienne peut être envoyée **gratuitement** via IUTS.

Summer Meeting
Memorial University of Newfoundland
St. John's, Newfoundland
May 29-June 1, 1999

Third Announcement

Please refer to the Second Announcement in the February issue of the *CMS Notes* for more complete information on the scientific, education and social programmes. This announcement features a preliminary timetable and any changes to the programmes previously announced. The most up-to-date information concerning the programmes, including scheduling, is available at the following world wide web address:

http://www.camel.math.ca/CMS/Events/

Meeting registration forms and abstract forms for contributed papers, and hotel reservation forms may be found in the February issue of the *CMS Notes*.

Programme Updates

Plenary speakers: The confirmed plenary speakers for the meeting are Ed Barbeau (Toronto), Michel van den Bergh (Belgium), Ranee Brylinski (Pennsylvania State), Tom Korner (Cambridge) Douglas Stinson (Waterloo), Luc Vinet (CRM).

Welcoming Reception: The welcoming reception will be held during registration on Friday evening from 7:00 p.m. to 9:00 p.m. not 10:00 pm as originally stated.

Graduate Student Session: In this session, graduate students will have an opportunity to present contributed papers on their research. Abstracts should be prepared as specified in the February issue of the *CMS Notes*. A limited fund will be available to pay part of the costs of travel for student speakers (last year this was about $3,500 at a payment of approximately $500 per speaker). Please contact the Meeting Director for details on funding.

Delegates' Luncheon: A delegates' luncheon will be held on Saturday, May 29, noon to 2:00 p.m., on campus. The cost of this luncheon is included in all registration fees.

General Meeting: The General Meeting of the Society will take place on Sunday, May 30, from 3:00 p.m. to 5:00 p.m. at Memorial University of Newfoundland. All members are invited to attend.

Travel

St. John's is served by Canada's two major carriers, Air Canada and Canadian Airlines. Participants are advised to ensure their airline destination is YYT and **not** YSJ (which will take one to Saint John, New Brunswick).

On arrival: Upon arrival at St. John's airport, taxis are available for the 10 minute ride from the airport to downtown where the conference hotels are located.

Car Rentals: For attendees wishing to rent a car in St. John's, the following car rental agencies are located at the airport:

Avis : 1-800-879-2847
Budget: 1-800-268-8900
Hertz: 1-800-263-0600
National Tilden: 1-800-227-7368
Thrifty: 1-800-367-2277

Parking: Free parking is available for attendees staying at the Hotel Newfoundland as well as at the Quality Hotel.

Acknowledgements

The CMS and the Meeting Committee wish to extend its thanks to the Centre de recherches mathématiques, the Fields Institute, the Faculty of Science of Memorial University of Newfoundland along with its Vice-President (Academic) and Vice-President (Research), from Memorial University of Newfoundland, and the members of the Department of Mathematics and Statistics, for their financial support of the scientific sessions at this meeting.

The CMS wishes to acknowledge the contribution of the Meeting Committee in presenting these exciting scientific, educational, and social programs.

Meeting Committee

Meeting Director: Hermann Brunner (MUN), *Local Organizing Committee:* Richard Charron (MUN), *Ring Theory:* Eric Jespers (Brussels) and Edgar Goodaire (MUN), *Harmonic Analysis:* Kathryn Hare (Waterloo), *Representation Theory:* Abraham Broer (McGill), *Combinatorics:* Nabil Shalaby (MUN) and Douglas Stinson (Waterloo), *Nonlinear Analysis:* Sankatha Singh (MUN) and Bruce Watson (MUN), *Surveys in Mathematics:* Kumar Murty (Toronto) and Niky Kamran (McGill), *Education:* Bruce Shawyer (MUN) and Ed Williams (MUN), Monique Bouchard (CMS), Graham Wright (CMS), Rosalind English (MUN), Wanda Heath (MUN).

Items also published with this announcement

List of speakers
Map of St. John's
Timetable - schedule

In the next issue of the *CMS Notes*

Fourth Announcement
Updated Timetable - block schedule

Réunion d'été
Université Memorial de Terre-Neuve
St. John's, Terre-Neuve
du 29 mai au 1er juin, 1999

Troisième annonce

Veuillez consulter la deuxième annonce dans le numéro de février des *Notes de la SMC* pour obtenir de l'information détaillée sur les programmes scientifique et pédagogique, et les activités sociales. La présente annonce contient l'horaire et tous les changements aux programmes annoncés précédemment. Vous trouverez l'information la plus récente sur les programmes, y compris les horaires, à l'adresse Web suivante:

http://www.camel.math.ca/CMS/Events/

Un formulaire d'inscription et un formulaire de résumé pour communications libres et un formuliare de réservations d'hôtel étaient inclus dans le numéro de février des *Notes de la SMC*.

Changements au programme

Conférenciers principaux : les conférenciers principaux sont Ed Barbeau (Toronto), Michel van den Bergh (Belgium), Ranee Brylinski (Pennsylvania State), Tom Korner (Cambridge), Douglas Stinson (Waterloo), Luc Vinet (CRM).

Réception d'accueil : La réception d'accueil aura lieu pendant l'inscription, le vendredi, de 19 h à 21 h, et non de 19 h à 22 h, comme nous l'avions annoncé précédemment.

Séance pour étudiants diplômés : Au cours de cette séance, les étudiants diplômés sont invités à présenter des communications libres sur leurs recherches. Les résumés doivent être préparés selon les instructions publiées dans le numéro de février des *Notes.* Un crédit limité sera disponible pour contribuer aux frais de déplacement des conférenciers étudiants (l'année dernière, ce crédit s'élevait à 3 500 $, à raison de 500 $ environ par conférencier). Pour de plus amples informations, veuillez communiquer avec le directeur de la Réunion.

Le lunch des participants à la Réunion se tiendra le samedi 29 mai, de midi à 14 h, sur le campus de l'Université Memorial. Ce repas est compris dans tous les frais d'inscriptions.

L'assemblée générale de la Societé aura lieu le dimanche 30 mai, de 15 h à 17 h 00 à l'Université Memorial.

Déplacements

La ville de St. John's est desservie par deux grands transporteurs aériens : Air Canada et Canadian Airlines.

En arrivant : de l'aéroport de St. John's au centre-ville, le trajet en taxi dure environ 10 minutes. Nous encourageons fortement les participants de vérifier que leur destination est bien St. John's (code aérien YYT) et **NON** Saint-Jean, Nouveau-Brunswick (code aérien YSJ).

Locations de voitures : ceux qui désirent louer une voiture à l'aéroport peuvent s'adresser aux agences suivantes :

Avis : 1-800-879-2847
Budget: 1-800-268-8900
Hertz: 1-800-263-0600
National Tilden: 1-800-227-7368
Thrifty: 1-800-367-2277

Stationnement : Le stationnement est gratuit pour les congressistes hébergés à l'un des hôtels du congrès, soit l'Hôtel Newfoundland ou le Quality Hotel.

Remerciements

Le comité organisationnel et la SMC tient à remercier le Centre de recherches mathématiques de l'Université de Montréal, l'Institut Fields, la Faculté des Sciences de l'Université Memorial ainsi que son Vice-Président (Académique) et son Vice-Président (Recherches) pour leurs contributions financières aux séances scientifiques de la Réunion. Nous remercions également le département de mathématiques et statistique pour son support dans l'organisation de la Réunion.

La SMC tient à remercier le comité des Réunions qui a contribué à l'organisation des activités scientifiques et éducatives, ainsi que les activités sociales.

Comité des Réunions

Directeur de la Réunion : Hermann Brunner (MUN), *Président du Comité local* : Richard Charron (MUN), *Théorie des anneaux* : Eric Jespers (Bruxelles) et Edgar Goodaire (MUN), *Analyse harmonique* : Kathryn Hare (Waterloo), *Théorie des représentations*: Abraham Broer (McGill), *Combinatoire*: Nabil Shalaby (MUN) et Douglas Stinson (Waterloo), *Analyse non linéaire*: Sankatha Singh (MUN) et Bruce Watson (MUN), *Éducation*: Bruce Shawyer (MUN) et Ed Williams (MUN), *Études en mathématiques*: Kumar Murty (Toronto) et Niky Kamran (McGill), Monique Bouchard (SMC), Graham Wright (SMC), Rosalind English (MUN), Wanda Heath (MUN).

Documents publiés avec cette annonce

Liste des conférenciers
Carte de St. John's
Horaire et programme

Dans le prochain numéro des *Notes de la SMC :*

Quatrième annonce du congrès
Horaire et programme à jour

CMS SUMMER MEETING 1999 RÉUNION D'ÉTÉ DE LA SMC
SCHEDULE - HORAIRE
MEMORIAL UNIVERSITY OF NEWFOUNDLAND - UNIVERSITÉ MEMORIAL DE TERRE-NEUVE
ST. JOHN'S, NEWFOUNDLAND

<table>
<tr><th>Time
Heure</th><th>Thursday / jeudi
May 27 mai</th><th>Friday / vendredi
May 28 mai</th><th>Saturday / samedi
May 29 mai</th><th>Sunday / dimanche
May 30 mai</th><th>Monday / lundi
May 31 mai</th><th>Tuesday / mardi
June 1 juin</th></tr>
<tr><td>8:00</td><td rowspan="2"></td><td rowspan="3"></td><td colspan="4">Registration open from 8:00 a.m. to 5:00 p.m.
Bureau d'inscription ouvert de 8:00 à 17:00
Coffee will be available in the Exhibit area / Le café sera servi dans l'aire d'exposition</td></tr>
<tr><td rowspan="2">8:30</td><td>8:00 to 17:00
Exhibits - Expositions</td><td rowspan="2">8:00 to 17:00
Exhibits - Expositions</td><td rowspan="2">8:00 to 17:00
Exhibits / Expositions</td><td rowspan="2"></td></tr>
<tr><td>8:30 - 9:00
Opening Remarks
Mots de bienvenue</td></tr>
<tr><td>9:00</td><td rowspan="13">9:00 - 16:00
Executive Committee Meeting
Réunion du Comité exécutif

Columbus Suite
Hotel Newfoundland</td><td>9:00 - 10:00
ED BARBEAU</td><td>9:00 - 10:00
TOM KORNER</td><td>9:00 - 10:00
LUC VINET</td><td>9:00 - 10:00
MICHEL van den BERGH</td></tr>
<tr><td>10:00</td><td colspan="4">10:00 - 10:15
COFFEE BREAK/PAUSE CAFÉ</td></tr>
<tr><td>10:15</td><td rowspan="2">10:15 - 11:45

SESSIONS</td><td rowspan="3">10:15 - 12:15

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SESSIONS</td></tr>
<tr><td>11:00</td><td rowspan="3">11:00 - 13:00

CMS Development Group
Groupe de développement

Columbus Suite
Hotel Newfoundland</td></tr>
<tr><td>12:00</td><td rowspan="4">12:00 - 14:00

DELEGATES LUNCHEON

LUNCH
DES PARTICIPANTS</td></tr>
<tr><td>12:15</td><td rowspan="2">12:15 - 14:00
LUNCH / DÉJEUNER</td><td rowspan="2">12:15 -14:00
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LUNCH / DÉJEUNER</td></tr>
<tr><td>13:00</td><td></td></tr>
<tr><td>13:30</td><td rowspan="2">13:30 - 18:30
Board of Directors Meeting
Réunion du Conseil d'administration

Salon Battery
Hotel Newfoundland</td><td rowspan="2">14:00 - 15:00
JEFFERY-WILLIAMS LECTURE

JOHN FRIEDLANDER</td><td rowspan="2">14:00 - 15:00
DOUGLAS STINSON</td><td rowspan="2">14:00 - 15:00
KRIEGER-NELSON LECTURE

NICOLE TOMCZAK-JAEGERMANN</td><td rowspan="2">14:00 - 15:00
RANEE BRYLINSKI</td></tr>
<tr><td>14:00</td></tr>
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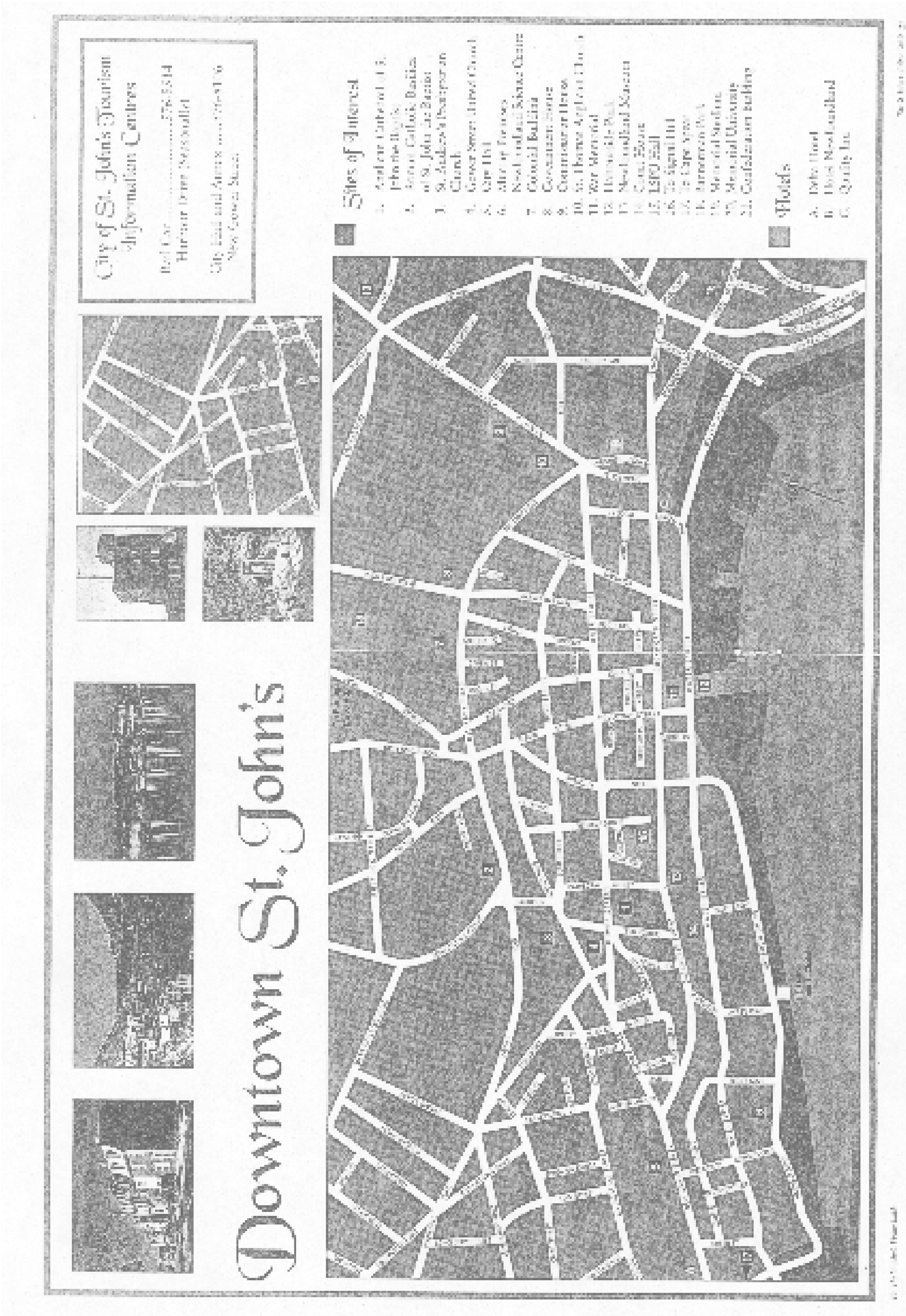
Time Heure	Thursday / jeudi May 27 mai	Friday / vendredi May 28 mai	Saturday / samedi May 29 mai	Sunday / dimanche May 30 mai	Monday / lundi May 31 mai	Tuesday / mardi June 1 juin
15:00	9:00 - 16:00 Executive Committee Meeting Réunion du Comité exécutif Columbus Suite Hotel Newfoundland	13:30 - 18:30 Board of Directors Meeting Réunion du Conseil d'administration Salon Battery Hotel Newfoundland	15:00 - 17:30 SESSIONS	15:00 - 17:00 Annual General Meeting Assemblée générale annuelle	15:00 - 17:00 SESSIONS	15:00 - 17:00 SESSIONS
16:00						
17:00						
17:30						
Evening		19:00 - 21:00 Reception Cash-bar and Evening Registration Réception (bar payant) et inscription Court Garden Salon Hotel Newfoundland	20:00 - 21:00 PUBLIC LECTURE	19:30 - 23:00 Conference Dinner (cash bar at 19:00) *Newfoundland Kitchen Party* The Marine Institute		


City of St. John's Tourism Information Centres
Sites of Interest
Hotels
Downtown St. John's

SCHEDULED SPEAKERS / CONFÉRENCIERS PRÉVUS

Here is a list of the confirmed speakers. Abstracts for all talks may be found at the following world wide web page after May 1:

http://www.camel.math.ca/CMS/Events/

Voici les conférenciers prévus à date. Les résumés pour toutes les conférences seront disponibles à l'adresse Web suivante après le 1er mai :

http://www.camel.math.ca/CMS/Events/

JEFFERY-WILLIAMS LECTURE
CONFÉRENCE JEFFERY-WILLIAMS

John Friedlander (University of Toronto)

KRIEGER-NELSON LECTURE
CONFÉRENCE KRIEGER-NELSON

Nicole Tomczak-Jaegermann (University of Alberta)

PLENARY SPEAKERS
CONFÉRENCIERS PRINCIPAUX

Ed Barbeau (Toronto)
Michel van den Bergh (Belgium)
Ranee Brylinski (Pennsylvania State)
Tom Korner (Cambridge)
Douglas Stinson (Waterloo)
Luc Vinet (CRM)

SPECIAL SESSIONS
SÉANCES SPÉCIALES

COMBINATORICS AND ITS APPLICATIONS
COMBINATOIRE ET APPLICATIONS
(Org: Nabil Shalaby and Douglas Stinson)

Frank Bennett (Mount St. Vincent)
Jeff Dinitz (Vermont)
Katherine Heinrich (SFU)
William Martin (Winnipeg)
Eric Mendelsohn (Toronto)
Chris Rodger (Auburn)
Alexander Rosa (McMaster)
Douglas Stinson (Waterloo)
Luc Vinet (Montreal)

EDUCATION / ÉDUCATION
What Mathematical Competitions do for Mathematics / Ce que contribuent les compétitions au domaine des mathématiques
(Org: Bruce Shawyer and Ed Williams)

Ed Barbeau (Toronto)
Peter Crippen (Waterloo)
Ron Dunkley (Waterloo)
David Leeming (Victoria)
John Grant McLoughlin (Memorial)
Rita Janes (NCTM Director, co-founder Newfoundland and Labrador Mathematics League)
Tony Gardiner (Birmingham)
Shannon Sullivan (MUN student)

GRADUATE STUDENT SEMINAR
SÉANCE POUR ÉTUDIANTS DIPLÔMÉS
(Org: Hermann Brunner)

Speakers: TBA

HARMONIC ANALYSIS
ANALYSE HARMONIQUE
(Org: Kathryn Hare)

J. Benedetto (Maryland)
M. Christ (Berkeley)
C. Finet (Belgium)
B. Forrest (Waterloo)
Jean-Paul Gabardo (McMaster)
E. Granirer (UBC)
H. Henig (McMaster)
Z. Hu (Windsor)
R. Kerman (Brock)
T. Korner (Cambridge)
T. Lau (Alberta)
D. Oberlin (Florida)
J.-O. Ronning (Skode)
G. Sinnamon (UWO)
S. Wainger (Wisconsin)

NONLINEAR ANALYSIS AND ITS APPLICATIONS
ANALYSE NONLINÉAIRE ET APPLICATIONS
(Org: S.P. Singh and Bruce Watson)

Giampietro Allasia (Torino)
Jonathan Borwein (SFU)
Tomas Benavides (Sevilla)
Francesco DeBlasi (Rome)
Antonio Carbone (Calabria)
Paul Gauthier (Montreal)
Kaz Goebel (Lublin)
Farhad Jafari (Wyoming)
Ivar Massabo (Calabria)
Pier Luigi Papini (Bologna)
George Phillips (St. Andrew's)
Luigi Rodino (Torino)
Virendra Sehgal (Wyoming)
Wataru Takahashi (Tokyo)
E. Tarafdar (Australia)
John Whitfield (Lakehead)

PERSPECTIVES IN RING THEORY
PERSPECTIVES DE LA THÉORIE DES ANNEAUX
(Org: Eric Jespers and Edgar Goodaire)

Yuri Bahturin (Moscow)
Margaret Beattie (Mount Allison)
Howard Bell (Brock)
Michael van den Bergh (Belgium)
Gerald Cliff (Alberta)
Jairo Gonçalves (Sao Paulo)
Kanta Gupta (Manitoba)
Narain Gupta (Manitoba)
Klaus Hoechsmann (UBC)
Stanley Juriaans (Sao Paulo)
Keith Nicholson (Calgary)
Jan Okninski (Warsaw)
Donald Passman (Wisconsin)
Mohan Putcha (North Carolina State)
Robert Raphael (Concordia)
Lex Renner (UWO)
Akbar Rhemtulla (Alberta)
Sudarshan Sehgal (Edmonton)
Paul Wauters (Limburgs)

REPRESENTATION THEORY
THÉORIE DES REPRÉSENTATIONS
(Org: Abraham Broer)

Ranee K. Brylinski (Pennsylvania State)
Jon Brundan (Oregon at Eugene)
Clifton Cunningham (Massachusets)
Sam R. Evens (Arizona at Tucson)
Loek Helminck (North Carolina State)
Markus Hunziker (Brandeis)
Alex S. Kleshchev (Oregon at Eugene)
Friedrich Knop (Rutgers)
V. Lakshmibai (Northeastern)
W. Monty McGovern (Seattle)
George McNinch (Notre Dame)
Fiona Murnaghan (Toronto)
Monica Nevins (Alberta)
Mark Reeder (Boston College)
Yasmine Sanderson (Rutgers)
Gordan Savin (Utah)
Eric Sommers (Harvard)
Peter Trapa (Inst. for Advanced Studies)

SURVEYS IN MATHEMATICS
ÉTUDES EN MATHÉMATIQUES
(Org: Kumar Murty and Niky Kamran)

Speakers: TBA

CONTRIBUTED PAPERS
COMMUNICATIONS LIBRES
(Org: Hermann Brunner and Bruce Watson)

Speakers: TBA

CALL FOR NOMINATIONS / APPEL DE CANDIDATURES

1999 Adrien Pouliot Award /Prix Adrien-Pouliot 1999

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 1997 can renew this nomination by simply indicating their wish to do so by the deadline date. Only materials updating the 1998 Nomination need be provided as the original has been retained.

Nominations must be received by the CMS Office no later than **April 30, 1999**. Please send six copies of each nomination the address below:

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 1999**. 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

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

The Publications Committee of the CMS solicits nominations for three 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, 2000. The continuing members (with their end of term) are:

CJM Editors-in-Chief:
J. Carrell and N. Ghoussoub (UBC) (2003)
CMB Editors-in-Chief:
A.J. Nicas and M. Min-oo (McMaster) (2000)
Associate Editors:
J. Bland (Toronto) (2002); 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); and C. Sulem (Toronto) (2003).

The deadline for the submission of nominations is **April 15, 1999**. Nominations, containing a curriculum vitae and the candidate's agreement to serve should be sent to:

Le comité des publications de la SMC sollicite des mises en candidatures pour trois 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 2000. Les membres qui continuent sont :

Rédacteurs-en-chef du JCM :
J. Carrell et N. Ghoussoub (UBC) (2003)
Rédacteur-en-chef du BCM :
A.J. Nicas et M. Min-oo (McMaster) (2000)
Rédacteurs associés :
J. Bland (Toronto) (2002); 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); et C. Sulem (Toronto) (2003).

L'échéance pour proposer des candidats est **le 15 avril 1999**. Les mises en candidature, accompagnés d'un curriculum vitae ainsi que du consentement du candidat(e), devrait être envoyées à :

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

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 1999 Meeting in Montreal, Quebec. Nomination letters should include at least three names of suggested referees. Nomination files will be kept for two years.

The Jeffery-Williams Prize Lectureship recognizes outstanding leaders in mathematics in a Canadian context. The prize lecture will be delivered at the Summer 2000 Meeting in Hamilton, Ontario. Nomination letters should include three names of suggested referees. Nomination files will be kept for three years.

The Krieger-Nelson Prize Lectureship recognizes outstanding female mathematicians. The prize lecture will be delivered at the Summer 2000 Meeting in Hamilton, Ontario. Nomination letters should include three names of suggested referees. Nomination files will be kept for three years.

The deadline for nominations is **September 1, 1999**. Letters of nomination should be sent to the address given below:

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 1999 à Montréal (Québec). Les lettres de mises en candidatures devraient inclure les noms d'au moins trois répondants possibles. Les dossiers des candidats seront conservés pendant deux ans.

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 2000 à Hamilton (Ontario). Les lettres de mises en candidature devraient inclure les noms d'au moins trois répondants possibles. Les dossiers des candidats seront conservés pendant trois ans.

Le prix Krieger-Nelson rend hommage à l'apport exceptionnel des mathématiciennes au Canada. La Conférence sera présentée lors de la réunion d'été 2000 à Hamilton (Ontario). Les lettres de mises en candidatures devraient inclure les noms d'au moins trois répondants possibles. Les dossiers des candidats seront conservés pendant trois ans.

La date limite pour les mises en candidatures est **le 1 septembre 1999**. Les lettres de mises en candidatures devraient être envoyées à :

Martin Barlow
CMS Research Committee / Comité de recherche de la SMC
Department of Mathematics
University of British Columbia
121-1984 Mathematics Road
Vancouver, British Columbia
V6T 1Z2

1999 ELECTIONS / ÉLECTIONS 1999

CORRECTION - In the February issue of the *CMS NOTES* **George Bluman** (UBC) a candidate for the Board of Directors - West was incorrectly identified as George Blum.

CORRECTION - Dans *les Notes de la SMC* de février, nous avons commis une erreur dans le nom d'un des candidats au Conseil d'administration, pour la région Ouest. On aurait du lire **George Bluman** (UBC) et non George Blum.

EUROPEAN MATHEMATICAL SOCIETY

Editorial Note: *Information for this article was taken from the November 1998 issue of the London Mathematical Society Newsletter.*

The history of the European Mathematical Society began in 1976 when the European Science Foundation initiated discussions on the possibilities of European co-operation in mathematics. These discussions led to the creation of a European Mathematical Council, which was established in 1978 at Helsinki on the occasion of the International Congress of Mathematicians. The president of this council was Sir Michael Atiyah.

The task of the Council was mainly to write the statutes of the future EMS. It evolved into a biennial forum having delegates from both Eastern and Western Europe. Discussions on the legal form and the aims of the future EMS continued until unanimous agreement was reached. The first President (1990-1994) was F. Hirzebruch. He was succeeded by P. Bourguignon (1995-98) and R. Jeltsch (1999-2002).

The membership of the EMS consists of the mathematical societies in Europe and 1700 individual members who have joined through their national societies. The governing body of the EMS is its Council, which meets once every two years. The Council, formed from delegates representing the societies and individual members, elects an Executive Committee (EC) of 10 members: a President, Secretary, Treasurer, and 5 ordinary members.

The main purpose of the EMS is to encourage the development of all mathematical activities in European countries with particular attention being paid to those activities that promote a European dimension. The EMS seeks to establish a sense of identity amongst European mathematicians. It aims to promote research in mathematics and in its appplications; it will assist and advise on problems on mathematical education and on the presentation of mathematics to the general public. The work of the EMS is done by the EC and by various subcommittees which the EC has created.

The EMS has achieved a privileged and responsible position in regard to relations between mathematicians and the appropriate directorates of the European Union. Direct access has beeen gained to the highest officials and commmissioners of these directorates with the result that the EMS has been able to exert influence in matters of policy which affect mathematics in Europe.

An important task for the EC has been the consideration of the arrangements for the European Congresses of Mathematics, the first and second of which were held in Paris (1992) and Budapest (1996) respectively. The third congress will be held in Barcelona (10-14 July 2000) under the engaging slogan "Shaping the 21st Century".

The 'classical' part of these congresses consists of plenary talks, parallel conferences and poster sessions. The 'non-classical' part consists of 'round tables' which give an opportunity for the exchange of ideas concerning the relations between mathematics and other sciences, mathematics and education, mathematics and society, etc. To encourage new talent, 10 prizes are awarded at the opening ceremony of a congress to European mathematicians of at most 32 years of age.

The EMS is keen to raise the appreciation, by the general public, of the contribution of mathematics to our modern scientific culture. With this objective the EMS has launched a series of conferences under the title 'Diderot Mathematical Forum'. The attendance at these conferences is widely drawn from philosophers to journalists. Three forums have taken place so far, namely, 'Mathematics and Finance' (1996), 'Mathematics and Environment' (1997), and'Mathematics as a Force of Cultural Evolution' (1998). The next forum is 'Mathematics and Music' (Lisbon, Paris, Vienna, 3-4 December 1999) and others are under consideration.

An EMS Lectureship has been inaugurated and, in order to promote interaction among young mathematicians, two series of summer schools each year (one in mathematics and one in the applications of mathematics) have been arranged. A major innovation, and still in an evolving phase, has been the European Mathematical Information Service (EMIS), which since June 1996 has been run in collaboration with FIZ-Karlsruhe. Its address is http://www.emis.de . The server contains the Electronic Library, general information on mathematical activities and institutions, lists of conferences, the text of the Newsletter, etc. Free electronic access is currently available to 31 journals; other journals, including for example, the Anals of Mathematics, will become available in the future.

The EMS is trying to improve its visibility through publishing ventrues. The Newsletter has recently undergone an improvement in appearance and content. The EMS has become involved as a partner in the Zentralblatt fur Mathematik. A new research journal, the Journal of the European Mathematical Society (JEMS) is to appear early in 1999.

NEWS FROM DEPARTMENTS

Concordia University, Montreal, PQ.:

Deaths: Dr. M. Zaki (1934-1998). Dr Zaki started his career as a lecturer in Aligarh University in 1958 and was hired at Concordia in 1967. He completed his Ph.D. in functional analysis at the University of Montreal in 1974. Dr. Zaki was promoted to an Associate Professor in 1972 and took his retirement in 1996. He was an Adjunct Professor of the Department until his passing.

Dalhousie University, Halifax, N.S.:

Promotions: Keith Thompson and Karl Dilcher, promoted to Full Professor. Shigui Ruan, promoted to Associate Professor. These promotions take effect July 1,1999.

Visitors: Karen Seyffarth (Calgary, AB), Graph Theory, Feb.99; Karen

Thompson (Otago, N.Z.), Statistics, Jan.- June 99; Carol Whitehead (London, U.K.), Graph Theory, Jan.-Feb.99.

Simon Fraser University, Burnaby, B.C.:

Promotions: Randy Sitter - tenure - Summer 98

Retirements: Allen Freedman, January 98; Brian Alspach, September 98

Resignations: Susan Chen and Gary Parker, September 98

University of Northern British Columbia, Prince George, B.C.:

Appointments: Iliya Blushkov, Combinatorics, Term Appointment; Robb Fry, Four-year Assistant Professor position; Chris Pinner, Number Theory, Term Appointment .

Leave: Lee Keener (Sabbatical) 98/99; Ross Niebergal (one-year leave) 98/99.

University of British Columbia, Vancouver, B.C.:

Appointments: The following appointments take effect from July 1,1999: Michael Doebeli (evolutionary biology); Gordon Slade (mathematical physics); Vinayak Vatsal (number theory).

Retirement: Robert Anderson and Erhard Luft (effective Dec.31,1998) and Stan Page (effective July 1,1999).

Awards: Martin Barlow (FRSC) and Michael Ward (Christensen Fellow, Oxford).

University of Saskatchewan, Saskatoon, SK:

Appointment: Mick Bickis, Head of the Department from Jan. 1, 99.

Retirement: Andrew Carson, early retirement from July 1, 99.

Université de Sherbrooke, Sherbrooke, PQ:

Visitors: Sandra Michelena (Argentina), Representation Theory of Algebras, Jan.- Mar. 99; Zygmunt Pogorzaly (Poland), Representation Theory of Algebras, Jan.- Mar. 99; Hailou Yao (Beijing, China), Representation Theory of Algebras, Apr.- June 99.

University of Toronto, Toronto, Ont.:

Visitors: D. Anosov (Moscow), Spring 99; Vladimir Buslaev (St.Petersburg), Spring 99; Yves Felix (Louven), Jan. 99; Istvan Juhasz (Hungarian Acad.) Spring 99; Natan Krugliak (Yaroslavl) Spring 99; Chi-Kwong Li (William Mary) 98/99; Tatiana Masura (Kharkhov) Spring 99; Jean-Claude Thomas (Angers) Jan. 99.

University of Western Ontario, London, Ont.:

Chair (since July 1,1998): Rick Jardine.

Retirement: Aiden Bruen (effective 30 June 1998)

CMS STANDING COMMITTEE CHAIRS
PRÉSIDENT(E)S DE COMITÉS DE LA SMC

Education Committee / Comité d'éducation
Morris Orzech (Queen's) chair-edc@cms.math.ca

Electronic Services Committee / Comité des services électronique
Edgar Goodaire (Memorial) chair-esc@cms.math.ca

Finance Committee / Comité des finances
Gordon Mason (UNB) chair-finc@cms.math.ca

Fund Raising Committee / Comité pour la collecte des fonds
Richard Kane (Western) chair-frc@cms.math.ca

Human Rights Committee / Comité des droits de la personne
David Poole (Trent) chair-hrc@cms.math.ca

International Affairs Committee / Comité des affiares internationales
Peter Fillmore (Dalhousie) chair-iac@cms.math.ca

Mathematical Olympiads Committee / Comité des olympiades mathématiques
Daryl Tingley (UNB) chair-moc@cms.math.ca

Nominating Committee / Comité des mises en candidature
Kenneth Davidson (Waterloo) chair-nomc@cms.math.ca

Publications Committee / Comité des publications
James Mingo (Queen's) chair-pubc@cms.math.ca

Research Committee / Comité de recherche
Niky Kamran (McGill) chair-resc@cms.math.ca

Committee on Women in Mathematics / Comité des femmes en mathématiques
Shelly Wismath (Lethbridge) chair-wmc@cms.math.ca

QUEEN'S UNIVERSITY AT KINGSTON
DEPARTMENT OF MATHEMATICS AND STATISTICS

Applications are invited for a senior faculty appointment in Statistics at the Department of Mathematics and Statistics. The salary will be commensurate with qualifications and experience. The research interests of the present statistics faculty are: statistical design, analysis of experiments, statistical problems in biomechanics, queuing methodology, Bayesian data analysis, and the teaching of statistical consulting.

Opportunities exist for collaboration with groups in several Faculties at the University, including clinical trials, statistical process control, and ergonomics.

The Department offers a range of graduate and undergraduate degrees in statistics, including a Ph.D. programme.

The successful applicant will be expected to demonstrate leadership in scholarship and research, a commitment to excellence in teaching, and a capacity for exercising leadership in the development of Statistics at Queen's. Interested candidates should arrange for a curriculum vitae, a description of research interests, copies of five publications, and five letters of reference, at least one of which should comment on the candidate's teaching, to be sent to the address below by **June 30, 1999.**

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

In accordance with Canadian Immigration regulations this advertisement is directed to Canadian citizens and permanent residents. Queen's University has an employment equity programme and welcomes applications from all qualified women and men, including visible minorities, aboriginal people, persons with disabilities, gay men, and lesbians.

INSTITUTE OF INDUSTRIAL MATHEMATICAL SCIENCES (IIMS)
University of Manitoba

THE SIXTH CONFERENCE OF THE CANADIAN NUMBER THEORY ASSOCIATION (CNTA '99)
June 20 - 24, 1999, Radisson Hotel Winnipeg Downtown

ORGANIZERS: J. Borwein (Simon Fraser), D. Boyd (UBC), C. David (Concordia), R. Murty (Queen's), P. N. Shivakumar (Manitoba), C. Stewart (Waterloo), H. Williams (Manitoba), S. Henderson, Conference Secretary.
PLENARY SPEAKERS: H. Darmon (McGill), J. Friedlander (Toronto), P. Sarnak (Princeton), W. Schmidt (Colorado), C. Skinner (Princeton), T. Wooley (Michigan).
INVITED SPEAKERS: M. Bennet (IAS), F. Beukers (Utrecht), A. Bremner (Arizona State), D. Bressoud (Macalester College, MN), J. Grantham (IDA/CCS), C. Greither (Laval), H. Kisilevsky (Concordia), M. Kolster (McMaster), A. Odlyzko (ATT Labs, NJ), K. Ono (Penn State), B. Poonen (Berkeley), D. Roy (Ottawa), K. Soundararajan (Princeton), G. Stevens (Boston U), S. Vanstone (Waterloo), V. Vatsal (UBC).
SPONSORED BY: Centre de Recherches Mathematiques (CRM), The Fields Institute for Research in Mathematical Sciences
INFORMATION: Information regarding registration, accommodation, contributed papers, financial assistance for Postdoctoral Fellows and graduate students etc. can be found on the IIMS Web Page: www.iims.umanitoba.ca.

Contact: Dr. P. N. Shivakumar
Director, IIMS
University of Manitoba
Winnipeg, MB R3T 2N2
Telephone: (204) 474 6724 Fax: (204) 474 7602
E-mail: insmath@cc.umanitoba.ca
Or
Dr. H. Williams
E-mail: williams@cs.umanitoba.ca

YORK UNIVERSITY
Faculty of Arts and Pure and Applied Sciences

Faculty Position in INFORMATION TECHNOLOGY

As part of a strategic plan to develop technology-related programs, York University is developing a new interdisciplinary program in Information Technology and its role in Institutions, Communication and Society. Planned to commence in September 1999, this interdisciplinary program draws upon existing strengths in Computer Science, Mathematics, Statistics, Economics, and other units within the Faculty of Arts. The program is anticipated to grow to over 400 students in the next four years. We are seeking to make several appointments including that of an individual who will play a leadership role in the ongoing development of this program. The positions are subject to budgetary approval. The positions are tenure-track, rank commensurate with qualifications and experience, and could carry tenure at the outset.

Applicants should have a PhD and a strong record of teaching and research related to information technology. Applicants with research interests in systems analysis and design, applied computer networks, database systems, Human-Computer Interaction, Information Visualization, are especially encouraged to apply. Applicants with research interests or experience related to operations research, management information, computational Statistics, or Financial/Actuarial Mathematics will also be favourably considered. Given the interdisciplinary nature of the program, the appointment could be in one or more of the departments of Mathematics and Statistics, Economics, and Computer Science.

Enquiries and applications, with curriculum vitae, should be sent to:

Alan S. Dow
ITEC Search Coordinator
Department of Mathematics and Statistics
York University, 4700 Keele Street
Toronto, Ontario
Canada M3J 1P3
E-mail: dowa@yorku.ca

Applicants must also arrange that three letters of reference be sent to this same address. At least one of the letters should address teaching.

More information on the program can be found at http://www.itec.yorku.ca/

In accordance with Canadian immigration requirements, this advertisement is directed to Canadian citizens and permanent residents. York University is implementing a policy of employment equity, including affirmative action for women faculty. Review of applications will begin February 1, 1999 and continue until the positions are filled.

PIMS CALENDAR OF EVENTS

MAY 1999 **MAI 1999**

5–7 Workshop on Computational Graph Theory and Combinatorics, (University of Victoria, Victoria, BC) *Contact: fruskey@csr.csc.uvic.ca*

24–28 Second PIMS Graduate Industrial Mathematics Modelling Camp (University of Alberta)
Organisers: H. Huang (PIMS) and G. Swaters (University of Alberta) Contact: hhuang@math.ubc.ca

31–June 4 Third PIMS Industrial Problem Solving Workshop (University of Victoria, Victoria, BC) *http://www.dmi.usherb.ca/conferences/*

JUNE 1999 **JUIN 1999**

June–August PIMS Thematic Programme in Mathematical Biology levels (University of British Columbia)
Contact: pims@pims.math.ca
Genomics, May 31 - June 11, 1999
Organisers: David Sankoff (Université de Montréal) and Michael Waterman (U. Southern California)
Mathematical Physiology, June 14 - 25, 1999
Organisers: Yue-Xian Li (UBC), Gerda de Vries (U. of Alberta) and Robert M. Miura (UBC)
Mathematical Epidemiology, July 19 - 30, 1999
Organisers: Fred Brauer (Wisconsin and UBC) and Pauline van den Driessche (UVic)

Mathematical Ecology, August 2 - 13, 1999
Organiser: Marc Mangel (UC, Santa Cruz)
Mathematical Cellular Biology, August 16 - 27, 1999
Organiser: Leah Keshet (UBC)

14–18 XIVth Householder Symposium on Numerical Linear Algebra (Chateau Whistler)
Organiser: J. Varah, Computer Science (UBC) Contact: varah@cs.ubc.ca

16–20 First Canadian Conference on Nonlinear Solid Mechanics (PIMS)
Organisers: E.M. Croitoro, B. Tabarrok, D. Leeming, J. Haddow (UVic), G.A.C. Graham (SFU), M. Gadala (UBC), T.B. Moodie, P. Schiavone (U. of Alberta), M. Epstein (U. of Calgary) D. Steigmann (Berkeley), and Y. Chao Chen (U. Houston) Contact: croitoro@math.uvic.ca Sponsored by the PIMS and the University of Victoria.

19–July 19 PIMS Mini-programme in Geometric Functional Analysis (University of Victoria, Victoria, BC)
Organisers: V. Milman (Tel Aviv) and N. Tomczak-Jaegermann (U. of Alberta) Contact: pims@pims.math.ca

SUMMER 1999 **ÉTÉ 1999**

Workshop in Smoothing Applications (University of British Columbia) *Contact: nancy@stat.ubc.ca*

JULY 1999 **JUILLET 1999**

1–September 15 PIMS Mini-programme in Invariants of Three Manifolds (University of Calgary) *Organisers: J. Bryden and P. Zvengrowski (U. of Calgary) Contact: bryden@math.ucalgary.ca*

28–31 International Symposium on Symbolic and Algebraic Computation (Simon Fraser University Harbour Centre)
Organisers: K. Geddes (U. of Waterloo), M. Monagan (SFU) and P. Southeby (SFU) Contact: monagan@cecm.sfu.ca Sponsored by ACM and PIMS.

26–August 11 International Conference and Workshop on Valuation Theory (University of Saskatchewan)
Organisers: F.-K. Kuhlmann, S. Kuhlmann and M. Marshall (U. of Sask.) Contact: fvk@math.usask.ca Sponsored by the Fields Institute, PIMS and the CRM.

AUGUST 1999 **AOÛT 1999**

2–20 Frontiers of Mathematical Physics Summer Workshop on Particles, Fields and Strings (University of British Columbia)
Organisers: T. Lee (Kangwon National University), Y. Makeenko (ITEP, Moscow & NBI, Copenhagen), J. Ng (TRIUMF), S. Nam (APCTP, Seoul), C. Rim (APCTP, Seoul), A. Rutherford (PIMS), G. Semenoff (UBC), K.S. Viswanathan (SFU) and A. Zhitnitsky (UBC) Contact: sandy@math.ubc.ca
Sponsored by the Asia Pacific Center for Theoretical Physics, Centre Recherche Methematique and PIMS.

9–21 First Annual Summer School in Environmental and Industrial Fluid Dynamics (U. of Alberta)
Organisers: T.B. Moodie and B.R. Sutherland (U. of Alberta) Contact: bruce@taylor.math.ualberta.ca

11–14 Workshop on Algorithms and Data Structures (Simon Fraser University)
Organisers: A. Gupta, B. Bhattacharya, T. Shermer, and A. Leistman (SFU) Contact: arvind@cs.sfu.ca

15–18 Eleventh Canadian Conference on Computational Geometry (University of British Columbia)
Organisers: J. Snoeyink and D. Kirkpatrick (UBC) Contact: snoeyink@cs.ubc.ca

23–28 First 3 on 3 Canada-China Math Congress (Tsing Hua University, Beijing, China) *Organisers: PIMS, Fields Institute, CRM and CMS Contact: pims@pims.math.ubc.ca*

24–28 10th International Workshop and Conference In Stochastic Geometry, Stereology Image Analysis (University of Calgary) *Organisers: E. Enns and P. Ehlers (U. of Calgary) Contact: enns@math.ucalgary.ca*

SEPTEMBER 1999 **SEPTEMBRE 1999**

20–22 International Workshop on the Analysis of Vibrating Systems (International Workshop on the Analysis of Vibrating Systems Kananaskis Village, Alberta) *Organisers: P. Lancaster (U. of Calgary), G.M.L. Gladwell (U. of Waterloo), K. Glover (Cambridge), H. Langer (Tech. U. of Vienna) and J.E. Marsden (Caltech) Contact: lancaste@ucalgary.ca*
Sponsored by PIMS and the University of Calgary.

OCTOBER 1999 **OCTOBRE 1999**

2–3 24th Cascade Topology Seminar (University of British Columbia) *Organisers: D. Rolfsen and K. Lam (UBC) Contact: rolfsen@math.ubc.ca*

16–17 West Coast Operator Algebra Symposium (University of Victoria) *Organisers: J. Phillips, I. Putnam (UVic), B. Blackadar (Nevada, Reno), E. Effros (UCLA), N.C. Phillips (Oregon) and D. Voiculescu (Berkeley) Contact: putnam@math.uvic.ca*

CALENDAR OF EVENTS / CALENDRIER DES ÉVÉNEMENTS

MARCH 1999 **MARS 1999**

8–12 Workshop on Interactive Measure-Valued Processes (The Fields Institute, Toronto, Ontario)
measure@fields.utoronto.ca;
www.fields.utoronto.ca/measure.html

22–24 The Seventh Annual R.A.Blyth Lectures in Mathematics: Victor Guillemin, MIT (University of Toronto)
beverley@artsci.utoronto.ca

APRIL 1999 **AVRIL 1999**

9–23 Numerical Methods and Stochastics (The Fields Institute, Toronto, Ontario)
probability@fields.utoronto.ca;www.fields.utoronto.ca

MAY 1999 **MAI 1999**

11–12 Coxeter Lecture Series, (The Fields Institute, Toronto, Ontario) *www.fields.utoronto.ca*

16–23 37th International Symposium on Functional Equations (Marshall University, Huntington,WV)
banks@marshall.edu; janos@aris.ss.uci.edu

18–21 Vision Interface (VI'99)/Quality Control By Artifical Vision (QCAV'99) (Hotel Delta, Trois-Rivières, Québec)
http://www.dmi.usherb.ca/conferences/

20–24 Canadian Operator Theory and Operator Algebras Symposium (University of Prince Edward Island, Charlottetown)
http://www.math-cs.upei.ca/people/gmacdon/cosy/

29–June 1 CMS Summer Meeting / Réunion d'été de la SMC (Memorial University of Newfoundland, St. John's)
http://cms.math.ca/CMS/Events/

JUNE 1999 **JUIN 1999**

3–4 Mathematics Education at the Secondary and Tertiary levels (Brock University, St.Catherines,Ontario)
http://spartan.ac.brocku.ca/ mathconf/default.html

4–8 Canadian Mathematics Education Study Group (Brock University, St.Catherines,Ontario)
http://spartan.ac.brocku.ca/ mathconf/default.html

6–9 Annual Meeting of the Statistical Society of Canada (Regina, Saskatchewan)

13–17 Conference on the Mathematics of Public-Key Cryptography (Fields Institute for Mathematical Sciences, Toronto, Ontario)
Gary Walsh, Chair: gwalsh@mathstat.uottawa.ca
http://fields.utoronto.ca/publickey.html

14–19 14th Householder Symposium on Numerical Linear Algebra (Whistler, British Columbia)
varah@cs.ubc.ca; http://roadmap.ubc.ca/hholder/

20–24 The Sixth Conference of the Canadian Number Theory Association (CNTA'99) (University of Manitoba, Winnipeg)
P.N. Shivakumar: insmath@cc.umanitoba.ca
http://www.iims.umanitoba.ca

JULY 1999 **JUILLET 1999**

5–9 4th International Congress on Industrial and Applied Mathematics (Edinburgh, Scotland)
geninfo.iciam@meetingmakers.co.uk;
http://www/,atjs/ed/ac/uk/conferences.icicam99/

10–22 40th International Mathematical Olympiad (Romania)

15–17 2nd Joint Meeting of British Society for History of Mathematics and Canadian Society for History and Philosophy of Mathematics / Société canadienne d'histoire et de philosophie des mathématiques
(IHPST, Toronto) cfraser@chass.utoronto.ca

26–Aug 4 International Conference and Workshop on Valuation Theory (Saskatoon, Saskatchewan)
Franz-Viktor Kuhlmann (fvk@math.usask.ca)

AUGUST 1999 **AOÛT 1999**

July 26–Aug 4 International Conference on Valuation Theory and its Applications, Conf. dedicated to Paulo Ribenboim (University of Saskatchewan)
fvk@usask.ca; http://math.usask.ca/ fvk/Valth.html

14–19 Mathematical Problems arising from Biology
probability@fields.utoronto.ca; www.fields.utoronto.ca

23–28 First 3 on 3 Canada-China Math Congress (Tsing Hua University, Beijing, China) *http://www.pims.math.ca*

NOVEMBER 1999 **NOVEMBRE 1999**

14–18 International Conference on Mathematics Education into the 21st Century (Cairo, Egypt)
Dr. A Rogerson: arogers@mgs.vic.edu.au

DECEMBER 1999 **DÉCEMBRE 1999**

11–13 CMS Winter Meeting / Réunion d'hiver de la SMC (Université de Montréal)
http://cms.math.ca/CMS/Events/

JUNE 2000 **JUIN 2000**

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

10–13 CMS Summer Meeting / Réunion d'été de la SMC (McMaster University, Hamilton, Ontario)
Monique Bouchard: meetings@cms.math.ca

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

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

JULY 2000 **JUILLET 2000**

11–24 41st International Mathemaical Olympiad (Korea)

SEPTEMBER 2000 **SEPTEMBRE 2000**

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

DECEMBER 2000 **DÉCEMBRE 2000**

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**

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

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

SUMMER 2002 **ÉTÉ 2002**

25th Anniversary Canadian Mathematics Education Study Group Meeting (Queen's University, Kingston)

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