

# Mathematics



Department of Mathematics

University of Toronto

July 2000

## Message from the Chair



Prof. John Bland, Chair

It is with a mixture of trepidation and excitement that I enter upon my term as Chair. Steve Halperin has left very large shoes to fill. During a period of unprecedented budget and funding cut-backs (including a 15% cut in 1995 following the Social Contract), our department has thrived and grown

stronger under Steve's superb leadership. During his tenure, we attracted the Fields Institute for Research in Mathematical Sciences to its new location on College Street on the southern edge of the campus. A new professional Master's Program in Mathematical Finance was launched. MITACS - the Mathematics of Information Technology and Complex Systems -- was funded as a Network of Centres of Excellence (NCE) to promote academic-industrial collaborations in research and the training of highly qualified personnel. Steve was not only instrumental in the bid for the centre, but he also became the first Program Leader. Throughout it all, the department actually shrank in size, but increased in international stature through strong and active recruitment. We all owe Steve an enormous debt of gratitude and wish him well in his new endeavours.

My excitement comes with the possibilities and challenges which lie ahead. Our dire space shortage is our most pressing need, but we are now faced with the real possibility of the creation of a mathematical sciences complex along with many inherent new opportunities. Our department is committed to increasing the size and strength of our graduate program, and we are seeking advice and support in this area. Our recently revamped undergraduate program includes new streams designed to train highly qualified personnel for targeted areas in the Ontario marketplace. In addition to these new developments, demographic projections indicate an unprecedented growth in the number of people seeking post-secondary education over the next five to ten years, and

the University must work with the Ontario government to devise a plan for educating them as they deserve.

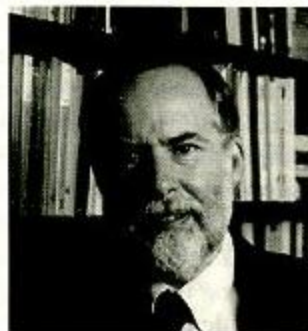
Mathematics at the University of Toronto is healthier today than at any point in its history, and I look forward to your support and encouragement, along with that of my colleagues, over the next five years.

— John Bland

## Stephen Halperin now Dean at University of Maryland

We are sorry to lose Stephen Halperin as Chair of the Department. He will go down in the annals of the Department as one of the truly great heads. Every aspect of the Department's mission received his detailed attention and benefited from his leadership – its position as a leading base of research, its role as a leading department in Canada, its relationship with professional organizations, its fostering of excellent programs and instruction at the undergraduate and graduate levels, its intervention in the debates about education in the schools, its relationship with alumni and its fundraising activities. He resigned as Chairman of the Department six months before the end of his term to become Scientific Leader of the newly-created Mathematics of Information Technology and Complex Systems (MITACS) network created by the three institutes for mathematical research in Canada, the Centre de Recherches Mathématiques (CRM) in Montreal, the Fields Institute and the Pacific Institute for the Mathematical Sciences

Prof. Stephen Halperin



(PIMS) in Vancouver. During this period, he filled in for Professor Heather Monroe-Blum from May 1 until July 31 as Vice-President, Research and International Relations at the University of Toronto during the incumbent's research leave.

Steve was appointed Dean of the College of Computer, Mathematical and Physical Science at the College Park Campus of the University of Maryland, near Washington, DC, and began his duties in September, 1999. The College employs about 200 faculty in six departments (astronomy, physics, computer science, mathematics, geology and meteorology) and a number of institutes. He is on leave from the University of Toronto. We wish him well in his new position.

Michael Sigal was acting Chair of the Department for the remainder of Steve's term until John Bland took over in this capacity on July 1, 1999.

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## Obituary

### Earle Peter Botta

Students, alumni and colleagues were saddened by the death of Professor Peter Botta on May 5, 1998. He was born in Vancouver on April 13, 1934. Peter had an unusual childhood. His father was an independent logger who made his living on the West Coast. The Botta home was on a barge, which could be tied up near a stand of timber while the family logged and, when they were finished, moved on to the next inlet. Peter grew up with his younger brothers and sister, but apart from them, there were no children within fifty miles.

Fortunately for Peter, his mother was a trained teacher, so she was able to supplement his correspondence school lessons. The lessons never seemed to take very long, so Peter had considerable time on his hands for exploring. His father gave him a small boat with a tiny inboard motor which took him all around the coves and islands. Peter learned to take the motor apart and clean it, so he never had to worry about being stranded. He also developed a lifelong love of nature and the outdoors.

After high school, Peter worked for a while in a paper mill in Ocean Falls, but eventually went to Vancouver for university. After receiving his degree from the University of British Columbia in 1961, he did his graduate work with Marvin Marcus at the University of California at Santa Barbara. He held a position at the University of Michigan before joining the Mathematics Department at the University of Toronto in 1967. In his 31 years in the Department he played a key role in developing programs and services for students, and his generosity with his own time was legendary.

Among his many accomplishments should be recorded the Mathematics Reprise Program for first-year students

in difficulty after the first term, the Mathematics Survival Guide for incoming first year students and the Department's first Mathematics Specialist Program for students not heading for graduate school. As Associate Chair for Undergraduate Affairs, a position he filled for almost a decade, Peter helped bring out the best in students and colleagues.



Prof. Peter Botta

Peter loved discussing mathematics, which he would do by the hour. For years, he played an important role in running the Department's Putnam teams. While he always wanted them to do well, he avoided pressuring the students to approach the contest in an overly competitive spirit. He encouraged anybody who was interested to participate, making the event into a convivial exercise in knowledge for the fun of it. He also enjoyed running the Mathematics Department's display at the annual U of T Day open house. He introduced the celebrated doughnut competition (What is the largest number of pieces into which a standard doughnut can be divided with three straight knife cuts?), an activity with the happy bonus that successes and failures are equally delicious.

As Associate Chairman, Peter took great delight in his responsibility for dealing with students caught cheating. He revelled in being able to get them to confess their crimes. His most effective technique was to ask Marie or Nadia to sit through the interview, quietly taking notes and glaring disapprovingly at the accused, while Peter explained how much more ferocious the student would find the Dean if he or she refused to confess right away.

He was a great favourite with the office staff, and after his death, his wife, Harriet made a generous donation which provides an annual feast for them in his honour. Apparently, this is the first such bequest ever made at the university, and it is an apt memorial.

Peter will always be remembered for two wonderful qualities: absolute integrity, and an utter lack of selfishness. His work with students, on curriculum committees and in resolving problems was tireless there were no bounds to his patience. He had no time for bureaucratic folly, cheating or political correctness; these provoked in him not anger, but an ironic sense of wonder at the follies and foibles they represented. He never refused a request from the Department, and he never asked for anything for himself.

In an era of accountability, assessments, evaluations and employment qualification Peter believed in the primary importance of learning for its own sake, and individual responsibility. He spent a month each year in the far North, alone with his dog and fishing rod, except for

the occasional polar bear, but part of him was a cosmopolitan gourmet who enjoyed living in downtown Toronto. He was deeply appreciated by staff students and faculty, and a rock of support for all of us.

Peter is survived by his loving wife Harriet and will be forever missed by his many friends, colleagues, and a host of students, past and present. A mathematician with a love of knowledge and a gift for conveying it, he inspired generations of young scientists and shaped the mathematics programme at the University of Toronto. He was an intellectual in an age of Philistines, a man of principle in a world of elastic values, watching it all with an impish sense of humour. We have lost a gem.

— Joe Repka

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## The Legacy of John Charles Fields

The International Mathematical Congress for 1924 was originally planned for New York City. But, for some reason, the Americans withdrew their offer in April, 1922, in favour of Toronto. However, there was a lot of work to be done, and without the dedication and energy of University of Toronto professor, John Charles Fields (1863-1932), the Congress might well not have occurred. But he managed to secure funding from the Dominion and Ontario Provincial Governments, and the Congress opened in the summer of 1924 under the presidency of Professor Fields.

Fields took his baccalaureat from the University of Toronto in 1884 and his doctorate from Johns Hopkins in 1887. After five years of teaching in the United States, he continued his studies in Europe for ten years, before accepting an appointment at the University of Toronto in 1902. He used his position as president of the IMC to press for an international award, and, in 1931, the organizing committee passed a resolution to devote \$2,500 of the surplus to providing medals to be awarded at each Congress to two outstanding researchers. It was anticipated that the medals should not have "have attached to them in any way the name of any country, institution or person". In the summer of 1932, Fields died of a cerebral hemorrhage, and bequeathed a sum of money to defray expenses of the prizes. And so, at the Congress of 1932, it came to pass that the honour was inaugurated with Fields' name attached and the University of Toronto became the Trustee of the funds. The first Fields medals were awarded in 1936 at Oslo to Lars V. Ahlfors and Jesse Douglas. After a hiatus because of the Second World War, on each fourth year from 1954, two and sometimes

four Fields Medals were awarded at the IMC and they were recognized as having the status of Nobel Prizes.

Now, almost seventy years after his death, on June 7-9, 2000, the Fields Institute organized a symposium on the Legacy of John Charles Fields. The invited lecturers were Sir Michael Atiyah (1966), Alan Baker (1970), Richard Borcherds (1998), Alain Connes (1982), Timothy Gowers (1998), Vaughan Jones (1990), Maxim Kontsevich (1998), John Milnor (1962) and Stephen Smale (1966) (the years indicate when they received their medals). In addition, lectures by Fields medalists David Mumford (1974) and Efim Zelmanov (1994) gave lectures at the meeting of the Canadian Mathematical Society in Hamilton immediately afterwards. Historical lectures at the symposium were provided by Tom Archibald of Acadia University in Nova Scotia and Michael Monstrysky of the Institute for Theoretical and Experimental Physics in Moscow.

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## James Arthur Receives Awards of Excellence

This has been a very good year for our colleague, James G. Arthur, one of the few honoured as University Professor. He is the first University of Toronto scientist to receive the Canada Gold Medal for Science and Engineering, and internally has won the Faculty Award given by the University of Toronto Alumni Association.

The Canada Gold Medal for Science and Engineering from the Natural Sciences and Engineering Research Council (NSERC) is awarded in recognition of outstanding and sustained contributions to Canadian research. Professor Arthur's award, announced on April 30, 1999, was in recognition of his contributions to research and the development of the next generation of Canadian mathematicians. He has followed the pioneering number theory work of Robert Langlands in revealing how entwined are the fields of algebra and analysis. He invented his trace formula in the early 1980s, and this along with one of its products, the so-called Arthur packets are widely recognized as important steps in the development of Langlands' theories.

In honour of this award and the 150th anniversary of the Royal Canadian Institute, the Royal Canadian Institute and NSERC are establishing a series of annual "Foundation" lectures, to be given by the recipients of the Gold Medal. The first of these, entitled Number Theory: Mystery and Beauty was delivered by Dr. Arthur on Tuesday, November 9, 1999.

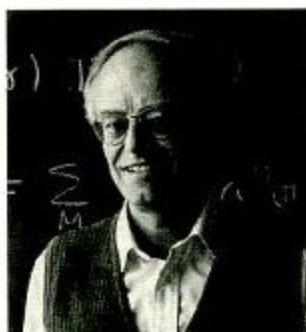
At a ceremony in the Great Hall of Hart House on Wednesday, April 21, 1999, Dr. Arthur received the Faculty Award from the University of Toronto Alumni Association. Here is an excerpt from the citation:

James Arthur is generally considered Canada's leading active research mathematician. His work, which included the discovery of the Arthur Trace formula, has established him as an international leader in the fields of automorphic forms and representation theory. Arthur's research has played a major role in the development of modern mathematics. He is a popular and admired teacher and an outstanding member of the university community.

In May, 2000, it was announced that Jim has been awarded a Guggenheim Fellowship.

Jim has also been selected to receive the Wilbur Lucius Cross Medal of the Yale Graduate School Alumni Association in the year 2000. This medal was established in 1966 to honour graduates of the Yale Graduate School for outstanding achievements. He received this award at the Yale Graduate School Convocation in May.

Achievement in mathematics is a characteristic of the next generation of the Arthur family. Jim's son, David, represented Canada in the International Mathematical Olympiad, held in July, 1999, in Bucharest, Romania. David brought home a bronze medal. David has been invited to be a member of the Canadian team in Korea in July, 2000.



*Prof. James Arthur*

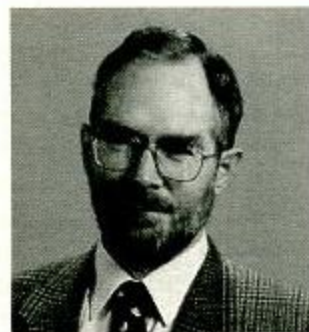
whom the Fields Medal is named. In 1888, Lyman P. Duff was the first graduate of the mathematics department and he eventually served as Chief Justice in Canada.

George Elliott has endowed two OGSST graduate fellowships, named in honour of his father, Lloyd George Elliott, and his doctoral thesis supervisor, Israel Halperin.

Israel Halperin graduated at Toronto in 1932 and, as a graduate student at Princeton, wrote his thesis under John von Neumann (perhaps the only person to do so). During his career at Queen's, and since 1966, at Toronto, Israel gained recognition as one of the people most responsible for developing the theory of von Neumann's "rings of operators" (algebras of operators in Hilbert space), over a seventy-year period into the many-faceted and widely interacting subject it is today.

Lloyd George Elliott was a graduate of Dalhousie University and MIT. He was one of the early members of the National Research Council nuclear research project at the University of Montreal. Later this moved to Chalk River, and became Atomic Energy of Canada Limited. At the time of his death in 1970, Lloyd was Director of Research at AECL's Chalk River Laboratories. An undergraduate prize awarded by the Canadian Association of Physicists is named after him.

Each fellowship is valued at \$15,000. The department is deeply grateful for this act of generosity.



*Prof. George Elliott*

## Fellowships Endowed by Members of the Department

George Duff has endowed an OGSST (Ontario Graduate Scholarship in Science and Technology) graduate fellowship in honour of Sir Lyman P. Duff. Lyman P. Duff was the first cousin of George's grandfather and a friend of J.C. Fields, former head of mathematics at Toronto after

*Prof. George F.D. Duff*



## New Faculty Appointments

Professor Robert McCann joined the department of mathematics in the fall of 1998.

Professors Robert Almgren and Katia Consani have accepted tenure-track positions in the Department of Mathematics, effective July 1, 2000. Dr. Almgren has accepted the position in Algorithmic Mathematics and Theoretical Computer Science, and is jointly appointed by the Department of Computer Science. Dr. Consani has accepted the position in Algebra and Number Theory.

Robert McCann grew up in Windsor, Ontario and received a BSc from Queen's University before completing a Ph.D. at Princeton University in 1994 under the direction of Elliott Lieb. He was a Tamarin Assistant Professor at Brown University for

four years – interrupted by extended visits to the Institut des Hautes Etudes Scientifiques in Paris, the Max-Planck Institute at Leipzig, and the Courant Institute of Mathematical Sciences in New York – before taking up an appointment in Toronto.

In his doctoral dissertation, McCann developed a convexity theory which led to the solution of two problems from mathematical physics: the first modelled an interacting gas, while the second involved the shape of crystals in an external field. He has also studied interacting electrons and rotating stars. His subsequent work with Wilfrid Gangbo has focused on a series of long-standing questions about optimal maps between mass distributions. This research can be motivated by the following economics problem:

Given a distribution of iron mines throughout the countryside, and a distribution of factories which require iron ore, decide which mines should supply ore to each factory in order to minimize the total transportation costs. The cost per ton of ore transported from each mine to each factory is given by a function, so the problem can be formulated as a linear program. However, when the mines and factories are distributed continuously throughout a Riemannian manifold, and the cost function derived from the geodesic distance, the problem yields a rich structure and deep connections with geometry and non-linear PDE which have only begun to be explored.

Further interests are developing in the direction of economics, geometry, physics and PDE, while current collaborations with Luis Caffarelli (Austin), José Carillo (Granada), Dario Cordero-Erausquin (Paris), Mike Cullen and Rob Douglas (Reading), Mikhail Feldman (Madison), Michael Schmuckenschlager (Linz), Felix Otto (Bonn), and Cedric Villani (Lyon) keep him busy working on applications and travelling around the globe.

Robert Almgren comes to Toronto from the University of Chicago, where he was an Assistant Professor and then a Senior Lecturer. He obtained his bachelor's degrees in physics and in mathematics from the Massachusetts Institute of Technology, and his Ph.D. in Applied and Computational Mathematics at Princeton University. He then became a postdoctoral researcher at New York University

Courant Institute of Mathematical Sciences and at the University of Paris, before moving on to Chicago.

His research interests are the uses of mathematical methods to study the physical world. He is especially interested in analytical and computational methods for studying the free boundary problems that arise in describing phase change in materials science, such as the complicated shapes–snowflakes and metallic microstructure–formed when a gas or a liquid freezes. He has also worked on free boundary problems in fluid mechanics and on the structure of the singularities formed when two interfaces come together. This work has been supported by the US National Science Foundation and the Sloan Foundation.

More recently, he has been interested in financial mathematics and financial data analysis. With a co-author at Goldman Sachs Asset Management, he showed how to use the calculus of variations to balance volatility risk against market impact costs in optimal trading of large portfolio positions. He has taught computer-aided geometry to teachers from the Chicago Public Schools. In his spare time he is an avid sailor and sailplane pilot.

Katia Consani completed her college studies at the University of Genoa (Italy), where she graduated, magna cum laude, in 1986. She then began studying for the Ph.D. at the Universities of Genoa and Turin. During 1991-92, she was a visiting doctoral student at The University of Chicago. In 1993, after defending her Ph.D. thesis in Turin and Rome, she went back to the University of Chicago and there started a second Ph.D. under the direction of Prof. Spencer Bloch, and graduated in 1996. From 1997 to 1999, she was a Moore Instructor at MIT and in 1999- 2000 she was a member at the Institute for Advanced Study in Princeton. She has received research grants from the CNR (National Center of Research) in Italy, the EU and NATO and from the NSF in US, and has been a visiting scholar at IHES (Paris) and at the University of Cambridge (England).

Her research interests are in arithmetical geometry and number theory. Her background studies have been in algebraic geometry and algebraic K-theory, and she is currently working in the field of modular forms and computational number theory.

## Activities and Honours

Marie Bachtis, administrative assistant to the Associate Chair (undergraduate studies) is the recipient for the year 2000 of the *Dean's Student Life Award* in the Faculty of Arts and Science.

Ed Barbeau was the *Plenary Lecturer in Mathematics Education* at the 1999 summer meeting of the Canadian Mathematical Society in St. John's, NF. His talk was entitled, "Men as trees walking". In July, 1999, he was the Leader of the Canadian team of six high school students in the International Mathematical Olympiad in Bucharest, Romania.

In December, 1999, he gave the annual young people's lecture for the Royal Canadian Institute in Toronto; the talk was entitled, "The matching game".

Ed Bierstone is *Chair of the NSERC Grant Selection Committee for Pure and Applied Mathematics (A)*.

Dietrich Burbulla is a recipient for the year 2000 of an *Outstanding Teaching Award* in the Faculty of Arts and Science.

George Elliott is one of fourteen 1999 recipients of the *Royal Society of Canada Awards* for extraordinary achievement and outstanding contributions to research

and scholarship. He receives the *John L. Synge Award* for his researches in operator algebras. The citation draws attention to his exceptional work on derivations, approximately finite-dimensional algebras, non-commutative tori and Schrödinger operators.

**Ilijas Farah**, a recent doctoral graduate of the department, is currently a faculty member at Rutgers University. He has received three awards. He is co-recipient of the *1997 Sacks Prize* with Tom Scanlon of the Mathematical Sciences Research Institute at Berkeley, CA. He received the *Governor General's Gold Medal* for Divisions III and IV of the School of Graduate Studies (U. of T.) for his work on the structure of analytic ideals. Finally, he is the 1998 winner of the *CAGS/UMI Distinguished Dissertation Award* for the best thesis in Canada.

**John Friedlander** was the *Jeffery-Williams Prize Lecturer* at the summer meeting of the Canadian Mathematical Society in June, 1999 in St. John's, NF. He received the *Scarborough College Principal's Research Award* for 1999-2000 for excellence in research in any field; this was in recognition of his joint work with H. Iwaniec of Rutgers on representation of prime numbers. During the academic year 1999-2000, he participated in a "special year" at the Institute for Advanced Study in Princeton.

**Peter Greiner** has been given an *Outstanding Teaching Award* for 1999-2000 by the Association of Part-time Undergraduate Students and the Students' Administrative Council at the University of Toronto.

**Victor Ivrii** has been elected to the *Royal Society of Canada*.

**Lisa Jeffrey** is the winner of a *Premier's Research Excellence Award* in Ontario. This award, provided by the Government of Ontario, is designed to improve Ontario's ability to attract and keep highly talented young researchers and graduate students and support state-of-the-art research. The focus is primarily on science, engineering and mathematics. The maximum value of the award is \$150,000, with the province providing up to \$100,000 and the remainder coming from sources identified by the recipient's own institution; this can be spent over a period of five years on post-doctoral fellows, research associates or students working with the recipient. Professor Jeffrey is the 2000 winner of the *University of Toronto McLean Award*. This award of \$100,000 is funded by an endowment from alumnus William McLean and administered by the university's Connaught Fund committee. She has also been selected to receive the *Krieger-Nelson Prize* at the summer meeting of the Canadian Mathematical Society meeting in 2001; this prize was established in 1995 to recognize outstanding research by a female mathematician.

**Boris Khesin** is the 1999 winner of the *University of Toronto McLean Award*. This award of \$100,000 is funded by an endowment from alumnus William McLean and administered by the university's Connaught Fund

committee. He is also the winner of a *Premier's Research Excellence Award*. Professor Khesin has returned from research leave at the University of California at Berkeley. His areas of research include hydrodynamics, in particular the nature of turbulence, and geometry. Professor Khesin was also awarded the *1997 Aisenstadt Prize* by the Centre de Recherches Mathématiques in Montreal.

**Pierre Milman** has been awarded a *1999 Killam Research Fellowship*. The Killam Trust was established by Mrs. Dorothy J. Killam over thirty years ago in honour of her husband Izaak Walton Killam. Administered by the Canada Council for the Arts, the goal of the trust is to encourage advanced study. The research fellowships are intended to provide release time from teaching and administrative duties for outstanding individual scholars so that they may focus on their research.

**Peter Rosenthal** is the year 2000 recipient of the *Ludwig and Estelle Jus Memorial and Human Rights Prize* given by the University of Toronto Alumni Association. The citation noted that he is not only a creative scientist with deep mathematical insight and a strong collaborative sense, but that he is also a determined resourceful defender of freedom of speech and of individuals against racism and bullying institutions. Several years ago, he took a degree in law so that, as a practising lawyer, he could more effectively argue on behalf of the disadvantaged and powerless.

**Luis Seco** gave a lecture to the Empire Club on November 15, 1998. This was telecast on Rogers Cable TV.

**Michael Sigal** has become the first holder of the *Norman Stuart Robertson Chair in Applied Mathematics* in the Department of Mathematics. This endowed chair was established at the end of 1997 by a donation from Mrs. Marian Robertson in honour of her husband and a matching grant from the University of Toronto.

**Maciej Zworski** has been elected *Fellow of the Royal Society of Canada*; his fields of research are partial differential equations and mathematical physics. He was the *1999 Coxeter-James Prize Lecturer* for the Canadian Mathematical Society. A précis of his talk, "The inverse problem for resonances" was published in the *CMS Notes* 32:2 (March, 2000).

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## Honours for our Graduate Students

The *Malcolm S. Robertson Thesis Award* is awarded annually by the Department to a graduating Ph.D. student who has demonstrated excellence in research. The recipient is chosen by all members of the Graduate Committee who are not supervisors of candidates for the award. This year's committee, chaired by Joe Repka, selected Eric Schippers, whose

thesis, "The calculus of conformal matrices and univalence criteria for holomorphic functions", was written under the direction of Ian Graham.

The *DeLury Teaching Awards* for graduate students of mathematics who have demonstrated exemplary teaching have been awarded in 1998 to Kiumars Kaveh, Ali Mahvidi and Ruben Martinez-Avendano.

The awards for 1999 have been made to Marco Merkli, Andrea McPhee, Ivan Soprounov.

Qun Chen has been awarded the 1998 *Malcolm Slingsby Robertson Prize* by the Graduate Committee for his research on Hilbert-Kunz multiplicity of plane curves and a conjecture of K. Pardue, under the supervision of Ragnar Buchweitz.

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## Norman S. Robertson Scholarships for Undergraduates

In December, 1997, Mrs. Marian Robertson established three Norman S. Robertson Scholarships in honour of her husband, who graduated with a B.A. in Mathematics and Physics from University College in 1914. These are to be awarded annually to three outstanding second year undergraduates who have demonstrated financial need and highest academic success in the study of mathematics. The first scholarships were awarded in the autumn of 1998.

The scholarships awarded in 1999 went to **Bhaskara Marthi**, Eugene Nudelman, Daniel Snaith.

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## Toronto Team gets Honorable Mention in 1998 Putnam Contest

The University of Toronto team consisting of Ryan O'Donnell, Cyrus Hsia and Bhaskara Marthi came ninth in the 1998 Putnam Contest, receiving an honorable mention.

Our top student was Adrian Corduneanu, who receives a prize of \$250 for ranking among the top 26. Shai Cohen and Cyrus Hsia both received honorable mention.

The five winning teams in order of rank were:

1. Harvard University
2. Massachusetts Institute of Technology
3. Princeton University
4. California Institute of Technology
5. University of Waterloo

The five teams gaining honorable mention were:

1. University of Chicago
2. Duke University
3. Johns Hopkins University
4. Stanford University
5. University of Toronto

In all, there were 2581 contestants from 419 institutions, Five University of Toronto students including all members of the team ranked in the top 100. Twenty-one out of the twenty-six Toronto candidates received a positive score; this compares with about 1800 out of the 2581 candidates over all.

In the 1999 Putnam Contest, Pavel T. Gyrya was given Honorable Mention.

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## The Mathematical Sciences Library

Mention of the Putnam Contest brings to the mind of older MU of T graduates Toronto's early distinguished record of winning the contest. The financial awards so garnered were ploughed into the purchase of books for a small departmental library, and some of the graduates will remember this collection being housed in a corner room of the Department's quarters at Baldwin House (33 St. George St.) in the late 1950s. The library slowly grew, and around 1970, incorporated journals from the central library. Shortly afterwards, the library began to receive regular annual grants from the Samuel Beatty Fund, an endowment fund established in 1952 by the graduates of mathematics and physics and administered by a board of trustees including alumni and department chairs. Under the careful administration of our first librarian, Chibeck Mok (later Chibeck Graham), the collection grew enormously into a significant research library, administered by the departments of mathematics and of statistics.

Now located in Room 622 of Sidney Smith Hall, the Mathematical Sciences Library, under the direction of our current librarian, **Bruce Garrod**, with the assistance of **Haleh Vaez**, contains over 35,000 volumes of books and journals. The focus of this collection is primarily mathematics and statistics, however the library is currently increasing its amount of materials it contains on computer science. Through its Website, (<http://www.math.toronto.edu/~math/>), the MSL offers

connections to over 120 mathematics and statistics full-text electronic journals and abstract and index databases to which the University of Toronto holds subscriptions. Included in these are MathSci Net - the search database of the American Mathematical Society; Web of Science - the Internet version of Science Citation Index; and ProQuest Digital Dissertations. The MSL Web page also features instant connections to UTCat, the University of Toronto's catalogue and to the home page of U of T's Gerstein Science Information Centre.

## Obituary Chibeck Graham

We were saddened by the death of Chibeck Graham on September 25, 1998, the founding librarian of the Department of Mathematics as well as the wife of Professor Ian Graham. She was very much loved and respected by her colleagues, and ran the library with quiet efficiency and consummate helpfulness to all members of the department. At a memorial service for Chibeck, a moving eulogy was given by Debby Repka who painted a picture of the individual that we knew. Here are some excerpts:

"Chibeck and I were friends for twenty years. When I think about it, this is an extraordinary statement. In a throw-away world, where possessions and people are discarded when they cease to be interesting, trendy, or useful, it is quite something to have had a friendship for two decades. But that was Chibeck -- loyal and caring, always there when you needed her.

"Both in her personal and professional relationships, Chibeck had the rare ability to be supportive. She was a great source of strength and inspiration to her husband Ian, she encouraged friends through the difficult moments of their lives, and she looked out for the interests of talented colleagues, whom she helped secure permanent jobs. Never did she keep accounts, nor did she have to. She knew that if she nurtured others, they would nurture her. She had the confidence to be unselfish.

"Chibeck was also unusual in her determination to live by her principles, from which she never wavered, even under pressure. No one could convince her to do something she did not think was right. So firm was she in her resolve that I knew I could always count on her in times of crisis. Perhaps she developed this attitude because she was born against the backdrop of the Japanese invasion of China and had learned that peoples' lives could depend on the integrity of those around them.

"She was ethical and fair in her dealings with others and never allowed her emotions to cloud her judgement. Even when plagued by badly behaved students who refused to

pay their library fines, Chibeck kept her temper and tried to reason with the miscreants. If this didn't work, she would become philosophical, remarking that such behavior was to be expected from a generation pampered by affluent parents. Chibeck, of course, had grown up facing harsh economic realities and so had little tolerance for a contemptuous attitude toward money and responsibility.



Chibeck Graham

"The experience of being an immigrant also shaped Chibeck's outlook on life. Many times she described to me affronts she had suffered because of her race and ethnicity. Naturally, she was indignant, but she rose above her anger and calmed herself with the knowledge that everyone, at some time in life, will experience discrimination, if not because of race than because of gender or illness or age. Chibeck also used her lively sense of humour to cope with the hurt. What was most admirable, though, was that through her own bitter experience she was able to become more sensitive to others in the same situation. Chibeck was remarkably free of the prejudices that most people, even the well-meaning ones, exhibit. In this sense, she was truly cosmopolitan.

"The main theme of Chibeck's all-too-short life was what she called 'the disease'. How she coped with the years of invasive therapies, the physical distress, and an energy level that was low to the point where she sometimes could not think clearly I shall never know. Chibeck found relief in being able to talk with me about the details of her treatment and the progression of 'the disease', and I am honored that she trusted me enough to let me know what she was going through. With a sword of Damocles poised above her, Chibeck carried on with far more dignity than most of us could muster. Out of necessity, she developed strategies to sustain herself through the ordeal of treatment and to prepare for those last, terrible months. She met it head on and decided that the best course of action was to derive as much joy as she could from life. And this she did, from the big things like her marriage, friendships, job, and pussycat, and from the little things like the fragrant blossoms of her jasmine plant, beautiful music, good literature, and fine food. She was not, however, a Pollyanna. When it hurt, she let you know. But she had the extraordinary ability to pick herself up and continue on when she was feeling strong again.

"Chibeck's sister Ching has often said that Chibeck had a happy life. Odd though this sounds, considering the grim reality that invaded every day of her life, it is true. She was loving and was greatly loved in return; she was joyous and was uplifted by the joy of others. When I think back on our

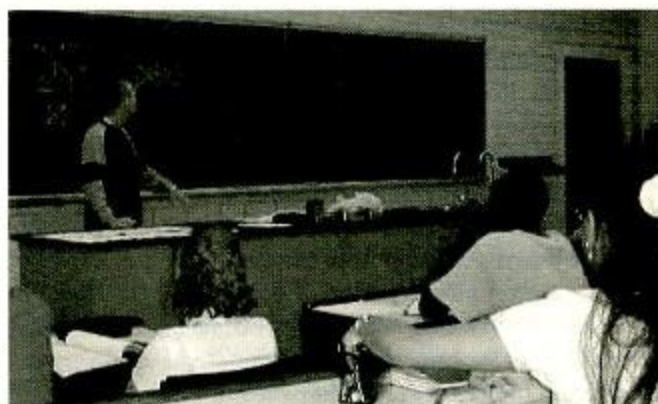


friendship, I am reminded that we spent most of our time together either laughing or eating.

"Chibeck's passing has left a great hole in my life and in the lives of many others. I desperately wish we could have her back. As we cannot, we should try our best to honour her memory by doing all of the things Chibeck did. Namely,

we should be upright in our dealings with others; we should savour all the joys in our lives, both great and small; and above all, we should share dim sum with good friends as often as possible, preferably at Dynasty, seated at a window table so we can enjoy the bright lights of Bloor Street and the elegant passers-by."

## Programs for Secondary Students



*Peter lecturing at SOAR.*

Any Wilk has been working very hard to maintain and extend our contacts with secondary school students and their teachers. In particular, she organized last summer's SOAR (Summer Opportunities in Applied Research), a three week long Mathematical Sciences summer day camp which attracted around 30 students from as far as Sault Ste-Marie and Kingston. The topic was Graph Theory. The program lecture notes were developed in 1998 by Brett Stevens and Peter Dukes while they were both graduate students in our department, working on their Ph.D. and M.Sc. respectively. They have now moved on to other places. Brett is now at Simon Fraser University, in the Mathematics department and Peter is a mathematics doctorate student at the California Institute of Technology. Peter was able to come back for the three weeks and give the lectures. He was joined by Ruben Martinez-Avendaño and Shaloub Razak who acted as his two right hands and guided the students through their learning adventure. There were area teachers such as Bob Farrington, Henry Tam, Vasile Radu, and Elkanah Alagurajah, as well as Irum Godil, a student who had just finished her first year calculus last May in our department, all of whom volunteered as group leaders. There were guest lectures given by Ed Barbeau (Mathematics), Derek Corneil (Computer Science) and Michael Molloy (Computer Science). Preceding this camp, as part of the outreach to the community, was an Educators' Day organized to give teachers and teachers-in-training a taste of what was to happen at the camp. They were given hands on experience with some of the problems the students tackled later in the camp, and listened to a lecture



*Shaloub with a student at SOAR.*

by Eric Mendelsohn on "Which came first the Abacus or Zero? A modern example" and guided through "Careers in Mathematics and Mathematics, a Career" by John Scherk.

On U of T Day, October 16, 1999, there was a SOAR'99 Reunion. The students came back with some of their friends and solved a "reunion problem" that had been posed at the end of the summer camp. SOAR 2000 will be held from July 24 until August 11. This year's topic is Number Theory, and we hope to attract some of the best high school students from Ontario and elsewhere.

Apart from SOAR, there are other programs that reach out to students. The Canadian Gelfand Program in Mathematics (CGPM) pursues a course of study by correspondence under the academic direction of Eugene Kantorovitch and organizational direction of George Andrews. The International Tournament of the Towns is held in the autumn and spring each year in many cities in Australia, Canada and eastern Europe. The Toronto centre is directed by Eugene Kantorovitch, who also supervises the Tournament-Gelfand Mathematics Club. In November, 1999, the Saturday Seminar Series in the Mathematical Sciences featured presenters from four different departments: Doug Johnstone (Astronomy) "Energy generation and lifetime of stars"; Sam Broverman (Statistics) "Actuarial Science"; James R. Drummond (Physics) "Satellite Orbits around the Earth"; Mark Spivakovsky (Mathematics) "The first intergalactic congress of mathematicians".

The Mathematics Department and the Canadian Mathematical Society operate a Mathematical Olympiads Cor-

respondence Program for high school students, under the direction of Ed Barbeau. This is for talented high school students interested in writing mathematical competitions, and is used for recruitment to and partial training for the International Mathematical Olympiad, which in the year 2000 will take place in Korea. There is a lower level problems correspondence program under the direction of Ed Barbeau, the International Mathematical Talent Search, which is designed to more broadly reach high school students and help identify students who could benefit by the Olympiads Correspondence Program.

You can keep apprised of these activities by consulting the Website <http://www.math.utoronto.ca/mathnet/>. Alternatively call (416) 978-3472 or send e-mail to [mathnet@math.utoronto.ca](mailto:mathnet@math.utoronto.ca)

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## Mathematics Still Simmering for Teachers

**S**IMMER (Society for Investigating Mathematical Mind-Expanding Recreations) is a monthly meeting jointly funded by the Department and the Fields Institute. Each SIMMER meeting, held at the Fields Institute, features a keynote presentation by an invited speaker, along with a lively discussion of related recreational mathematical problems and ideas. All this takes place over a light supper and refreshments. Since the beginning of 1998, there has been a rich and varied program:

January, 1998: Ragnar-Olaf Buchweitz, How to see in more dimensions.

February, 1998: A.I.F. Urquhart, Numbers – finite and infinite

March, 1998: Jonathan Scott, Hands-on algebraic topology

April, 1998: Alison Gibbs and Martin Van Driel, Hypothesis testing and the chi-squared test of independence

April, 1999: Kumar Murty, Cryptography and elliptic curves

May, 1999: Jeremy Quastel, Pricing financial derivatives

October, 1999: Ed Barbeau, Pell's equation

November, 1999: Mark Spivakovsky, A mathematical 'hodgepodge'

January, 2000: Craig G. Fraser, Problems and puzzles in Babylonian mathematics

February, 2000: Bruce A. Cloud, Escher and you

March, 2000: Cynthia Church and Randall Pyke, Dancing with fractals: the game of chaos (with music)

May, 2000: Greg Martin and Emmanuel Knafo (Mathematics), Split "P" Soup. Partaking of Number Theory

## University of Toronto Mathematics Association

**T**he University of Toronto Mathematics Association held several meetings during the academic year 1998-1999. We began with a visit to the RiskLab at Erindale College on Tuesday, October 20, 1998. Professor Luis Seco showed the group around and described its activities, and then everyone retired to the lounge for a sandwich and salad dinner. On Monday, November 9, members of the Association had the opportunity to meet the new faculty members of the Department, Robert McCann, Eckhard Meinrenken, Lisa Jeffrey and Jeremy Quastel over dinner at the Faculty Club; this was preceded by a visit to the teaching laboratory in New College for the mathematical finance program.

The first meeting of the new year on Tuesday, January 26, 1999, featured Professor Tom Bolton of the University of Toronto Astronomy Department, who spoke on *The Confrontation between Observations and Cosmological Theory: A critical look at the emperor's new clothes*. As usual, everyone repaired to the faculty club afterwards for dinner.

For the second spring event, on Saturday, March 6, we thought that we would try to have a public event, so a Geometry Festival was organized in the Math Aid Centre and advertised to the public. Unfortunately, a major spring snowstorm was also secretly scheduled for this day, so the attendance was lower than we had hoped. However, some teachers, members of the public and children did attend.

They got quite a bit for their effort. A number of geometry films and videos from the University's excellent mathematical collection were shown, and we had a good display of models, a large wooden dodecahedron created by Jock Maynard when he was an undergraduate about 60 years ago, some models of regular and stellated polyhedra executed by Jack Gingrich, and a varied display of structures brought by Professor Walter Whiteley from York University. Some students were on hand to help out and speak to those who came, from the University of Toronto, Andrea McPhee, Anthony Muc, Cyrus Hsia and, from York University, Franco Saliola and Lily Berenchein. Here is one of the problems that people were sent away with:

*A child stands at the edge of a pond pulling at a string attached to a boat in the pond. The string is always kept taut, so that the boat is not allowed to coast ahead. The child pulls in one metre of string. How far will the boat come towards the child: exactly one metre, more than one metre, or less than one metre?*

The Open House in the Mathematics Department was held on Friday, June 4, 1999, in the lounge of the Mathematics Department (Room 5017B of Sidney Smith Hall) as part of the University of Toronto Spring Reunion.

The first meeting for the academic year 1999-2000 was held on Tuesday, October 19. At the Annual General

Meeting, the board consisting of George Andrews (1960), Thomas Cousins (1967), David Oakden (1969), Christine Phillips (1959), Emile State (1963) and Jim Templeton (1947) was confirmed. Then Professor Michael Molloy of the Computer Science Department gave a talk on "Several Variations of Graph Colouring."

On Saturday, November 27, the Association decided to have another attempt at a Geometry Festival. The weather was kinder, and about 50-100 people showed up, including a number of children. After a showing of films, there was a talk by Ed Barbeau on "Some neat things with transformations", and a demonstration by Margaret Sinclair, a Toronto secondary teacher, entitled "Exploring geometry on the computer: Geometer's Sketchpad". One of the members of UTMA, Jack Gingrich, demonstrated some of his fine models of polyhedra. Then Stewart Craven, mathematics co-ordinator with the Toronto District Board of Education, and several of his colleagues, supervised a number of interactive geometry events, including paper-folding and building a geodesic dome. We were grateful to Any Wilk for seeing that everyone was well plied with doughnuts and juice.

The new year opened with a meeting on Tuesday, January 18, 2000, with a talk by James R. Brown of the Department of Philosophy on "Proofs and Pictures". He discussed the role that illustrations play in mathematical reasoning.

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## The Front Office

The Mathematics Department is particularly fortunate in having a friendly and efficient administrative staff in the front office. Some of the readers of this newsletter may have had the pleasure of interacting with them in their dealings with the department. There are probably few businesses that have the range of activity and complexities of operation as a large university department with its payroll, teaching and research functions, outreach activities and stream of visitors and sessional appointees.

We would like to introduce them to you and let you know how they help keep the affairs of the department functioning smoothly.

**Beverley Leslie** is the *Department Manager*, who oversees the administration of the department, supervises administrative staff, is responsible for the departmental budget and is a research assistant to the Chair.

**Pat Broughton** is *Secretary to the Chair* and to the Mathematical Sciences Task Force. Pat looks after the affairs of the University of Toronto Mathematics Association and also maintains the Department's donation database.

**Ida Bulat** is *Graduate Administrative Assistant* who is responsible for all matters concerning the graduate program, colloquia and seminars, and visitors. She is assistant

to the Associate Chair, Ragnar Buchweitz, and to the Graduate Co-ordinator, Ian Graham.

**Marie Bachtis** is the *Undergraduate Administrative Assistant*. She provides counselling to undergraduate students and is responsible for all undergraduate affairs. Marie also organizes the Department's open house activities and is co-ordinator along with Ed Barbeau for the American Mathematics Competition.

**Annette Yu** is the *Financial Administrative Assistant*. She keeps track of operating, trust and research accounts of the department. Annette ensures that all teaching assistants and postdoctoral fellows are paid and that everyone gets reimbursed for expenses.

**Nadia Villani**, who is the *Department Secretary*, coordinates the word-processing pool and provides secretarial services for the Department including typing, manuscripts, examinations and research grant applications. She is responsible for preparing the internal departmental newsletter.

**Miranda Tang** joined us last fall as our *Receptionist* replacing Nadia. Miranda is responsible for answering incoming calls, receiving visitors and processing mail. She is also in the typing pool, where she types a variety of materials and she takes care of our duplicating needs.

**René Weber** joined us last summer to replace Karin Smith, who has taken early retirement. René is our *Systems Administration Assistant*, who provides technical guidance and tutorial service for faculty, staff and students. He also assists the Systems Manager in maintaining our computer system.

**Emile LeBlanc** has for many years been the *Systems Manager*. He is responsible for all aspects of computing and computing support in the Department, including design, upgrade and maintenance of administrative, teaching and research computing systems, and advising staff, faculty and students.

To all of these colleagues, the faculty and students of the Department owe a fervent vote of thanks.

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## Retirement

**Karin Smith**, who has worked as our Technical Administrative Assistant for many years, took early retirement last year. Karin was responsible for the word-processing unit and provided technical guidance for faculty, staff and graduate students. She also assisted the Systems Manager.

# Alumni News

**W**alter Kohn (BA, 1945; MA, 1946) who went through Mathematics and Physics and then continued to a Masters Degree in Applied Mathematics, received a Nobel Prize (jointly with John Pople of Northwestern University) in 1998 for his work in quantum chemistry. Currently at the University of California in Santa Barbara, he developed a new way to study the electronic structure of matter. He explains that it is a conceptual shift that makes possible theoretical explorations of molecules, particularly large aggregates of atoms, whether in DNA crystals, or a drop of water.

Kohn arrived in Canada in 1940 as an Austrian refugee. After an internment of 18 months, he enrolled in Mathematics and Physics along with a group of other students mid-year in January, 1942. Sam Beatty, the head of mathematics, took the group under his wing, tutoring them until they were caught up. "I have never forgotten that," said Kohn. "He was an exceptional human being."

On April 3, 2000, Kohn presented the annual Graham lecture at University College, entitled "Through a glass darkly: a physicist looks into the future".

Nathan Mendelsohn (B.A., 1939; Ph.D. 1942) has been appointed a *Member of the Order of Canada*.

Marc de Grossouvre (M.Sc., 1999) writes to us from Islamabad in Pakistan about his life after graduation: "After my MSc at U of T, I found work in Institut Français du Pétrole which is a big (1500 people) research center in petroleum processes (2nd after UOP in the States). I was working in process engineering, designing refineries in the

part of the company in charge of selling licenses (in fact, they sell a map of the refinery unit together with the specifications of equipments and a handbook to monitor the process, all that is to be done case by case since each refinery is unique -- different crude etc.). I used simulation softwares and fluid mechanics mostly. But I still had to do my military service (which is not the case any more for people born after 1978). I took the opportunity to do it abroad, as part of the civil service but the time doubled to 16 months. I applied for this position in Pakistan and got it! I am working in the Cultural and Scientific Co-operation Section as a Scientific Attaché. That is to say I follow the scientific programmes (under the authority of a counsellor). This is a really interesting job. I can meet so many people from French or Pakistani institutions, researchers in different fields like irrigation canals systems (or how to get farmers involved in the maintenance of the system), geology, medical things, cancerology, etc. Last but not least, Pakistan is an amazing country, with a cultural heritage which is one of the richest in the world, at the crossroad of east and west, Central Asia and Arabic world, Greece and India, China etc. Pakistani people are very very nice."

## Problem

A unit square and a unit equilateral triangle share an edge. There is a unique circle that passes through the vertex of the triangle and the two vertices of the square that are not on this edge. Determine the radius of the circle.

Prof. Edward Barbeau, *Editor*



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*Contributors:* John Bland, Ida Bulat, Bruce Garrod, Debbie Repka, Joe Repka, Nadia Villani, Any Wilk

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