Donald Coxeter Celebrates Ninetieth Birthday.

On Sunday, February 9, a Celebration of Mathematics in the Arts to honour Professor Donald Coxeter on his ninetieth birthday was held at the Fields Institute. Following a public lecture by Ronnie Brown from the University of Wales at Bangor on "the Symbolic Sculptures of John Robinson", Dr. Coxeter delivered a lecture on "Three Geometric Artists: John Robinson, George Odom and M.C. Escher". In recognition of the event, a sculpture, "Intuition" executed by John Robinson, was unveiled in front of the Institute Building. This sculpture was the gift of Damon de Laszlo and Robert A. Hefner III with the support of John Chadam, Frederick Helson and James Stewart. Professor Coxeter also received a portable sculpture "Firmament" depicting five spheres with radii in geometric progression and the smallest tangent to its predecessors.

Donald and Rien Coxeter

The afternoon event concluded with a reception. Among those present were two of Professor Coxeter's earliest doctoral students, William O.J. Moser and F. Arthur Sherk.

Fred Helson, John Chadam, Ron Brown, Donald Coxeter

Letter from the Chair

It is a pleasure to greet our friends, alumni and colleagues once again, after a refreshing year on leave in France and at the Fields Institute. The Department is an exciting place to come back to, however, and its growing strength is attracting increasing attention around the world.

Our most striking news is the success of our fundraising efforts for the Coxeter Scholarship Fund in Mathematics. Over 150 individuals have now given or pledged over $100,000. (Over half of this comes from members of the Department.) Since the donations are matched by

the University and by the Province, this means we currently have an endowment of over $300,000. I particularly want to thank George Duff, and his committee who have led this effort, and our graduate students for their valiant and successful telethon.

Almost all of our donations have been in the $100 - $1000 range, and it is a remarkable tribute to Donald that so many have given to bring the total to over $100,000. We continue to hope that some individuals or corporations will be able now to make a gift of significant size, because the impact on future students will be so tremendous.

On other fronts the Department continues its normal hectic pace of activity. This year we are conducting five tenure stream searches, in Algebra and Number Theory, Algorithmic Mathematics, Analysis, Applied Probability and Geometry. Many of our colleagues are heavily involved in the Fields Institute program in Singularity Theory. Our colleagues at Erindale are moving forward with the Risk lab in Mathematical Finance. And this spring we are looking forward to the Blyth Lectures given this year by Jeff Cheeger of the Courant Institute on "The Small Scale Structure of Spaces of Bounded Curvature."

A highlight of the fall was the award of an honorary degree to Cathleen Morawetz, 4T5, former Director of the Courant Institute and currently President of the American Mathematical Society, and on February 9 we celebrated Donald Coxeter's 90th birthday with the unveiling of a sculpture in his honour at the Fields Institute.

Within the Department we are beginning a thorough review of our undergraduate programs, led by Ed Bierstone who will take on the responsibility of Undergraduate Coordinator this coming July 1. I would like to take this opportunity to say a very warm thank-you to Peter Botta for his outstanding work in this position over many years. We all have reason to be grateful to him, most especially our students whom he has unfailingly tried to help.

You will read elsewhere in this Newsletter of our work with high school students, spearheaded by Nami Bland and Eugene Kantorovich. We are making a serious effort to provide support to such students with a talent for and interest in mathematics. Members of the Department are also actively involved in efforts to improve the high school mathematics curriculum.

Finally, I want to extend a special thanks to Ed Barbeau, who has taken on the Editorship of this Newsletter, and also the organization of our first formal Alumni Association, with founding meeting this spring. Ed has been a tower of strength for years within the Department, and we will all benefit from this latest addition to his responsibilities.
– Steve Halperin

The Coxeter Scholarship Fund in Mathematics

An Interim Report and Renewed Appeal.

At the end of November, an appeal to support the Coxeter Scholarship fund was circulated to our Alumni Newsletter readers. Response to this appeal has been gratifying and has increased the total of contributions and pledges to over $100,000 by the middle of January. With such a good start from the members and alumni of the mathematics department, approaches are now being made to possible supporters abroad and various corporations. However, if the fund is to reach its original goal of being able to support three substantial scholarship awards each year, a further appeal is needed. Since the provincial and university commitments to match contributions apply only to funds pledged by March 31, 1997, and paid by March 31, 1999, we are asking all those who have considered making a contribution but have not yet acted to give further consideration and make their most optimistic possible pledge as soon as this can be done. Pledge cards were circulated with the original appeal and are available by calling 416-978-3317 or faxing 416-978-4107. However any handwritten or typed signed and dated statement of intention will be received and welcomed.

This is an extraordinary and probably unique opportunity to make our contributions count three times over for a highly effective contribution to mathematical scholarships. We are fortunate we can dignify the awards with the name of our greatest scholar.
– George Duff

Mathematical Finance Comes to the University of Toronto

In the late seventies and early eighties, the banking and investment industry embraced sophisticated mathematical techniques in pricing stocks, bonds and investment certificates. A milestone development in this direction is the Black and Scholes pricing theory for equity options.

An option is a financial instrument that gives the holder the right, but not the obligation to buy or to sell a certain stock at a given price at a certain time in the future. Options are special cases of "financial derivatives", also called "contingent claims", which are instruments whose value depends on that of an underlying more basic asset. Before the work of Black and Scholes, options were traded but they were not nearly as popular as they are today because of the lack of an adequate pricing theory. Black and Scholes solved the problem in the idealized case in which a stock's growth is modeled by geometric Brownian motion — a special form of random fluctuations superimposed on exponential growth. Their insight was that the payoff of any option can be exactly replicated by a portfolio consisting of bonds and of shares of the underlying stock. The composition of this replicating portfolio is dynamically adjusted as time goes on, but these adjustments do not require any inflow or outflow of cash. Hence, Black and Scholes concluded that the price of the option had to be equal to the price of the replicating portfolio. This fundamental breakthrough lead to a phenomenal growth in the market for derivative investment instruments, and the use of sophisticated methods to hedge positions. These techniques, combined with advances in computer hardware and software, have led to a revolution within the financial services industry, and a demand for sophisticated mathematical techniques both at the theoretical level and the industrial and developmental level.

These developments have opened the doors for synergistic interaction between the financial community and the mathematical community. On the one side, there is a need to model the stochastic processes followed by the prices of stocks, bonds, currencies and commodities as well as of the corresponding derivative instruments. On the other side, there is a need to price and hedge large institution-wide portfolios of assets and derivatives in such a way as to accurately assess and find ways to reduce the global risk exposure. To date, this synergistic interaction is most highly developed with the banking and investment community; however, study of these basic questions will soon open the doors to more fundamental issues: how can one measure and manage risk in a wide variety of settings — from investment positions to insurance products to environmental risk.

Those in the Mathematical Sciences have responded to this situation in a variety of roles, and indeed, are now taking a leadership role. The Fields Institute for Research in the Mathematical Sciences was jointly founded and sponsored by the Universities of Toronto, McMaster and Waterloo to promote research and interaction in the broader mathematical sciences. Three years ago while still at the University of Waterloo, the Fields Institute initiated a monthly seminar in Mathematical Finance, an academic seminar which is open to personnel working in the Banking and Investment industry. This seminar has been immensely popular with industry, and last year, during the inaugural year for its new home on College Street in Toronto, it attracted an average audience of one hundred participants.

This year, a new industrial research lab in mathematical finance was started on the Erindale campus of the University of Toronto. Started by Professors Claudio Albanese and Luis Seco of the Department of Mathematics, this laboratory utilizes some of the latest software in risk management and risk metrics and builds on the underlying mathematical models and the numerical code used in the implementation. In its first six months of operations, it has grown to a staff of 12 people including senior and postdoctoral researchers, along with several students working in the lab on a part time basis. It now attracts research and development contracts from major banks around the world.

The third component in this triad of outreach to the financial community lies in the development of a new Master's degree program in Financial Mathematics. The development of this exciting program has been spearheaded by the Mathematical Sciences at the University of Toronto, but involves the cooperation of several departments scattered over the three faculties of Applied Science & Engineering, Arts & Science, and Management. A key component of the program will be the computer laboratory. The laboratory will house hardware meeting the most advanced industry standards, a storehouse of historical data, real time data feeds for simulated trading, and some of the most sophisticated software for pricing exotic options and measuring and managing risk. Working in concert with the local financial community, students will work on real problems and projects throughout the program, and spend a four month internship working on site in one of the local corporate members of the financial services industry. This fully self funded program will be seeking startup funds to build the laboratory and to endow a Chair in Financial Engineering to spearhead the program.

For more information about any of these exciting initiatives and outreach programs, contact:

Professor Claudio Albanese, Risklab
(905) 828-5356, albanese@math.utoronto.ca

Professor John Bland, Master's Program
(416) 978-4031, bland@math.utoronto.ca

Professor Don Dawson, Director of the Fields Institute
(416) 348-9710, ddawson@fields.utoronto.ca

or visit the Website, located through the main departmental server: http://www.math.toronto.edu
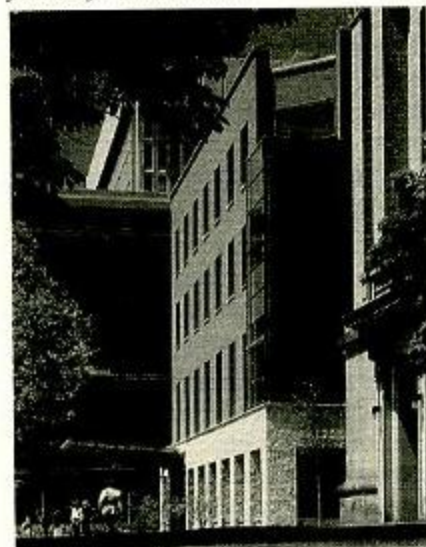
– J. Bland

Department Members Collaborate in Singularity Theory and Geometry Program at Fields Institute

From January to June, 1997, the Fields Institute is sponsoring a program in Singularity Theory and Geometry. This has been organized by a committee consisting of University of Toronto mathematics professors: Edward Bierstone, Arnold Khovanskii, Pierre Milman, Alex Nabutovsky and Mark Spivakovsky.

The areas of concentration are geometric and topological applications of singularity theory, resolutions of singularities and subanalytic geometry, fewnomials and subanalytic sets, as well as geometry and complexity.

Looking west across College Street facade of Fields Institute

Three workshops are planned. During the week of January 6-10, S. Akbulut, G. Mikhalkin and O. Viro organized a workshop on real algebraic geometry. From May 5 to May 11, there will be a workshop on geometry and complexity organized by A. Khovanskii and A. Nabutovsky, and from June 23 to June 27, a workshop on symplectic geometry organized by Y. Eliasberg and B. Khesin. The Fields Institute has also planned some related events, including a workshop on the model theory of analytic functions (March 17-21) and a conference in honour of V.I. Arnold (June 15-21).

From January to April, four graduate courses will be offered: differential topology and geometry from a recursion-theoretic viewpoint (A. Nabutovsky), fewnomials (A. Khovanskii), resolution of singularities (E. Bierstone or P. Milman) and normal forms, limit cycles, desingularization and bifurcations (Y. Ilyasmenko, Moscow).

George Elliott and James Arthur Receive CRM/Fields Institute Prize

Three years ago, the Centre de Recherches Mathématiques (CRM) and the Fields Institute inaugurated a joint prize in recognition of exceptional achievement in the mathematical sciences. The first winner of the prize in 1995 was Professor H.S.M. Coxeter.

The second and third winners are also from the University of Toronto. George Elliott received his award in 1996 and delivered the Prize Lecture "How many stars in the sky? ... How many C*-algebras?" at the Fields Institute on March 18. It has just been announced that James Arthur is the 1997 prize winner. Recipients are chosen on the basis of outstanding contributions to the advancement of research, with the research having been done primarily in Canada or in affiliation with a Canadian university.

According to the citation for the prize, "Elliott is a world-wide leader in the area of Operator Algebras. The subject began as a rigorous structure to understand the physics of particle interactions and now has far-reaching applications to disciplines as diverse as the control of complicated systems and the structure of proteins. What Elliott saw was that it had intimate connections with Topology and, over the last decade, his insights have changed the course of research in the area of overlap. His conjectures are well-known and have redirected the approaches of the community worldwide.

"During the special focal period which Elliott helped to organize at the Fields Institute in 1994-95, there was explosive activity and many of Elliott's conjectures were shown to be true. Following two recent papers, one on a K-theoretic classification of certain inductive limit C*-algebras and the other (with D. Evans) showing that the irrational rotation algebras fits into the scheme, Elliott made the extremely provocative conjecture that all amenable C*-algebras fit into the scheme. If the conjecture were true it would be the most powerful and positive result in C*-algebras and would surely have repercussions in other branches of topology and analysis.

"In the last year or so Kirchberg has proved some deep results that show Elliott's program is in fact quite plausible, proving the main result for a much larger class of simple amenable C*-algebras than was known before. For a C*-algebra not to fit into the scheme it would have to be quite exotic. And such exotic structures would be extremely interesting so that Elliott's ideas will be the centre of abstract C*-alge-

bra research for some years to come. Aside from the CRM/Fields Institute Prize, Elliott has received several awards recently which honour these scientific accomplishments, including the NSERC Killam Fellowship, a Connaught Transformative Award from the University of Toronto and a Collaborative Research Grant from NSERC."

Kumar Murty Shares Ferran Sunyer I Balaguer Award

The Institut d'Estudis Catalans has awarded the fourth Ferran Sunyer i Balaguer Prize jointly to Prof. Kumar Murty of our department and Prof. Ram Murty of McGill University for their monograph, *Non-vanishing of L-functions*. This book will be published by Birkhäuser Verlag in their "Progress in Mathematics" series.

The prize of approximately $18,000 is given in honour of a self-taught Catalan mathematician Ferran Sunyer i Balaguer (1912-1967) who, despite a serious physical disability, taught himself mathematics and gained an internatioinal reputation for research in classical analysis. The prize honours expository monographs of at least 150 pages in an active area of mathematical research to which the authors have made important contributions.

The prize was presented in a formal ceremony at the IES in Barcelona in April 1996. According to the citation for the prize, Murty's book presents a variety of results on the non-vanishing of L-functions and mathematical problems arising in different contexts. Topics include Artin L-functions, Deligne's prime number theorem, modular L-functions, the Sato-Tate conjecture on the distribution of Fourier coefficients of modular forms and average values of L-functions.

Pierre Milman Receives Connaught Research Grant

In September 1996, the Connaught Committee announced the winners of five transformative research grants to professors at the University of Toronto. These subventions are directed to leading researchers in their fields involved in cutting-edge research.

A substantial grant will help Pierre Milman of the mathematics department explore geometric and analytic aspects of the problem of "resolution of singularities". Singularities express irregularities of patterns in many branches of mathematics and its applications. Resolving singularities enables one to apply smooth techniques. The aim of the research is to learn more about singularities from information encoded in their resolution.

Mathematics Faculty Are Honoured

Dietrich Burbulla, a senior tutor, was voted professor-of-the-year by second-year Electrical and Computing Engineering students.

Tim (P.G.) Rooney, professor-emeritus, has been chosen as the recipient of the 1996 Distinguished Service Award of the Canadian Mathematical Society.

Professor **Catherine Sulem** will be the 1998 Krieger-Nelson Lecturer for the Canadian Mathematical Society.

University of Toronto Mathematicians in the International Mathematical Olympiad

In July 1995, the 36th International Mathematical Olympiad was held in Canada at York University, with the jury sequestered at the University of Waterloo to prepare the examination paper. The Chairman of the Academic Committee and Chief Coordinator was Ed Barbeau, but there were many other members of the University of Toronto, both students and faculty, who played an important role in the marking or "coordination" of the papers. The teaching staff was represented by Peter Botta, Man-Duen Choi, Abe Igelfeld, Victor Ivrii, Carlo Lisi, Felix Recio, Arthur Sherk and Mark Spivakovsky. Four mathematics graduate students took part: John Chew, Bruce Cload, Blair Madore and Robert Velazquez. From outside the department came Gabriela Mallen-Ornelas, a

graduate student in astronomy who competed for Mexico in the 1989 International Mathematical Olympiad. In addition, there were some undergraduates some of whom had been competitors: J.P. Grossman, Eric Lai, Edward Leung, Dion Lew, Alexander Nicholson and Naoki Sato. Finally, Eugene Kantorovitch who runs the Toronto section of the Tournament of the Towns and the Gelfand program, and Jeff Higham, a recent graduate, were coordinators.

Awards for Graduate Students

In recent years, the Mathematics Department has instituted a number of awards for its graduate students. Readers of the September 1995 newsletter will recall the Malcolm Slingsby Robertson Fellowships and Prize instituted by the family of Professor Robertson, a 1929 graduate of the University of Toronto who distinguished himself in research in complex analysis. The first annual Robertson Award to a graduating doctoral student for excellence in research was presented on November 30, 1995 by his son, the Venerable John M. Robertson, of the Anglican Church of Canada, to Jingzhi Tie. Tie's Thesis, supervised by Peter C. Greiner, was entitled "Analysis on the Heisenberg Group and applications to the Neumann Problem". The second award will be made to Randall Pyke, whose thesis "Time-periodic solutions of nonlinear wave equations" was written under the supervision of Michael Sigal. Dr. Pyke currently holds an NSERC postdoctoral fellowship at the Courant Institute of mathematical Sciences.

The **John Robert Gilkison Smyth Mathematics Scholarship** was established in May, 1995 through a bequest of Mr. Smyth. The first award was made in 1995 to Marcus Pivato. The 1996 recipient was Ovidiu Calin.

The **Daniel B. DeLury Teaching Award** was established by the Department in recognition of the importance of encouraging its graduate students to be good teachers. It provides for up to three annual awards, and four sets of awards have been given:

1993: Clifton Cunningham, Carlo Lisi, Paul Szeptycki
1994: Peter Austin, Randall Pyke, Ulrich Schanz
1995: Heather Betel, Blair Madore, Andrzej Wodsinski
1996: Cristina Ballantine, Bruce Cload, William Traves

Reaching out to Secondary Students

This past summer the mathematical science departments inaugurated SOAR-Summer Opportunities in Applied Research. This was a summer day camp designed to enable Secondary School Students to explore advanced topics in the mathematical sciences. Almost 40 students attended the university camp to learn about the theory and applications of fractals. They covered a wide range of topics starting with fixed points of iterated functions and cobweb diagrams and working through to an introductory understanding of fractal based computer image compression. Ron Lewis of the Sudbury Board of Education kindly opened the camp with a thorough introduction to iterates of functions, fractal dimension and fractal boundaries. Other special guest lecturers discussed applications to current research such as chaotic pendulums, computer graphics, and wavelet image compression. The camp was laboratory intensive and students learned to program in maple (a symbolic manipulator which differentiates functions), LaTeX (a mathematical typesetting language) and HTML. Perhaps one of the most enjoyable side benefits for the students was the time spent with other students sharing their excitement for the mathematical sciences and problem solving.

In the fall, high school students enjoyed the opportunity to attend a series of Saturday seminars in the Mathematical Sciences. Jointly sponsored by the mathematical science departments of the U. of T., these seminars were designed to introduce students to the wide range and applicability of mathematical thinking and problem solving techniques. The seminars covered topics as diverse as scheduling problems for hospital rooms or examination timetables and

John Del Grande is on the right

problems in actuarial science (or how to price insurance policies and financial bonds). Dr. Ken Norwich (B.Sc. 1967) spoke on the mathematics of drug absorption rates in clinical medicine and Dr. Brendan Kelly (M.Sc. 1968; Ph.D. 1972) presented problems and solution techniques in cryptography. Students wishing to participate were invited to submit their solutions to a related problem before attending the seminar; this encouraged them to consider the topic in advance and provided the faculty members with the opportunity to adjust the level of the seminar to the benefit of the participating students. These seminars included problem solving sessions in which students participated by discussing their questions and solutions with other students and faculty members. These were but two of the ways in which the University of Toronto has committed itself to supporting mathematical education in the secondary schools. We welcome the opportunity to involve our U. of T. alumni in our efforts. Last year, it was a pleasure to hear Dr. Gregory Baker (B.Sc. 1965; Ph.D. 1970), the Co-author of "Chaotic Dynamics", as a special guest lecturer in SOAR, and to welcome Dr. John Del Grande (BA. 1944; MA. 1949; Ph.D. 1986), George Andrews (BA. 1960), Ray Nowak and Dr. George Duff (BA. 1948; MA. 1949) as visitors to the program. We would like to extend our message of the importance and significance of mathematics and the mathematical sciences to all secondary school students throughout the province; to support teachers in their efforts to involve students of all levels of ability and achievement in their mathematical programs and to encourage talented students to continue their studies in the mathematical sciences at a post-secondary level. If you would like to be involved in this effort, please contact the coordinator at the address below. Your commitment need be no more than 15 minutes talking to a group of students, or sending us some examples of the use of mathematics in your life: the students will value your support.

For more information and details about the next round of seminars contact:
Nami Bland (416) 978-3472
(namib@math.utoronto.ca).
– *Nami Bland*

Developing Good Mathematics Teachers

There has been much contention about public education. One certainty is that high quality schools depend on teachers who are well-versed in their subjects. It is here that universities can make the most productive contribution, and, at the University of Toronto, programs are underway on all three campuses to help ensure that future teachers of elementary and secondary students become proficient in and comfortable with mathematics.

Our goals are captured very neatly in the prospectus for a new course at Erindale College (MAT 478), taught this year by Mark Spivakovsky:

"Of all things in the world, what I like doing most in my spare time is to solve math problems. Doing mathematics is a daily adventure, full of emotions, dangers, unexpected turns and breathtaking views. The greatest challenge in my work as a teacher is transmitting this attitude to the students. One of the reasons this is important is that some of our students will, in turn, become teachers of mathematics and pass on their enthusiasm to other students at all levels of the education process. Conversely, if the teachers themselves do not enjoy what they do and regard math as a sequence of boring steps or manipulations to be memorized and carried out mechanically, the same unfortunate point of view will inevitably be adopted by the students; the vicious circle will continue. ... In order to remedy this state of affairs, we must train some good teachers first.

"The purpose of this course is to experience mathematics as a creative activity, as it is experienced by most people who do it for a living. Together we will work on problems selected from a range of topics, some of them suitable for use in high school curriculum, such as combinatorics and counting arguments, elementary number theory, some introductory ideas about groups, set theory, etc. This course is experimental, not only in content, but also in the style of teaching. In addition to doing some 'fun' mathematics, the goal is to try out what I believe to be the most effective way of teaching math: through participation, dialogue and discussion."

This course is part of the Secondary School Teaching Option, just put into place at the college though the efforts of John Bland, Brendan Kelly, Steve Tanny and Bill Weiss. Students are admitted during their undergraduate study on the basis of registration in the Mathematical Sciences Specialist Program and successful completion of the first two years, maintenance of a suitable GPA and membership in the Erindale Math Club. The selection is made by a committee consisting of the Erindale discipline representative, a member of the Faculty of Education and a representative of the Peel Board of Education. Credit for the program requires completion of the Mathematical Sciences Specialist Program and MAT 478. In their third year, students work part-time in the Math Help centre and in fourth year, they work part-time as

teaching assistants in first year calculus tutorials and function as aides to secondary teachers who are expected to serve as mentors. It is hoped that some students will participate in other activities at Erindale, such as practice sessions for competitors in high school contests, the new high school mathematics computer net and the Peel Summer Academy for secondary students.

Of greater vintage is the Early Teacher Project developed in 1990 in collaboration with the Faculty of Education by Scarborough College led by John Perz, Charles Dyer and Steve Halperin. It is designed to qualify teachers for the Honours Specialist Ontario Teacher Certification in mathematics or a science. Participants are registered in the Physical Science Program and take part in an orientation session in second year. In their third and fourth years, they work with experienced teachers in elementary or secondary classrooms and attend workshops or seminars organized by the College and the Faculty of Education. While the Project does not count as part of the 20-course requirement towards a degree, students do obtain academic credit and places are reserved at the University of Toronto Faculty of Education for at least the thirty top students with a grade point average of at least 2.5.

On the main campus for the past four years, there has been a third-year course, Concepts in mathematics (MAT 329Y), for undergraduates headed for elementary teaching. Team-taught by a member of the department, a member of the Faculty of Education and a representative of the Toronto Board of Education, its purpose is to quell the nervousness that such students have about the discipline as well as give them the opportunity to engage the subject and reflect upon their experience as learners and prospective teachers. Each year, about 35 students take the course, all of whom are volunteering as teacher's aides or tutors. Credit in the course is based on problem sets, a review of an article on mathematics education, reflective logs, class participation and a pedagogical project followed by both an oral and a written report. The course is currently taught by Ed Barbeau, of the Mathematics Department, Brendan Kelly, a Ph.D. graduate of the department and professor of education, and Susan Seidman, vice-principal of Swansea Public School.

General Continuity by Gregory L. Baker, PH.D.

This summer I returned to my alma mater, in order to give a morning's worth of lectures on chaotic dynamics[1] to a group advertised as "the forty brightest high school students in the metropolitan Toronto area." These young people were enrolled in an enrichment program called "SOAR in Mathematical Sciences" — a multi-week course on various aspects of fractals sponsored by U. of T.'s mathematics department. My task was to demonstrate that chaotic dynamics leads to fractal geometry. Using copious numbers of diagrams and much handwaving I tried to convince the students that fractals did come from real-life scenarios. The students seemed intrigued and I felt the morning was a success!

Although my degrees are in physics, I am an M and P graduate (6T5) with fond memories of various members of the mathematics faculty. This bit of history gives me some professional, as well as generational, continuity with my great-great uncle Professor Alfred Baker, a former chair of the U. of T. mathematics department. Readers may be interested in a few details of his life and academic career.

Alfred was born about twenty years before Canada, in 1847. Family lore suggests that there was no tuition when Alfred started at the University of Toronto. The first major event in his mathematical career was his baccalaureate graduation in 1869 and the gold medal in mathematics. After a short, frustrating career in secondary mathematics at Upper Canada College and elsewhere he returned to the University, earned a master's degree and joined the mathematics faculty sometime around 1878. In 1887 he became department chair serving for thirty-two years until 1919[2]. From 1912 to 1919 he also served as Dean of the Faculty of Arts. In 1919 he concluded his full time career and was granted emeritus status. He served an extraordinary 54 years on the University Senate and passed away October 27, 1942.

Professor Baker was president of the Royal Canadian Society 1915–16. His presidential address began with an extremely long *apologia* for the speaker's lack of qualifications (as was the custom). Yet that did not deter the professor from surveying, at great length, the contemporary state of knowledge in Canada. While Alfred published relatively few mathematical papers he contributed greatly to the life of the University. As well as his many professional activities, Alfred helped organize and became Captain in company K of the Queen's Own Rifles.

I will conclude this little biography with one anecdote reported by my mother. During the 1930s Professor Baker occasional entertained by giving luncheons. After a delicious meal, the housekeeper cleared away the dishes in preparation for the guests to play a game. For the particular occasion my mother described, the guests were all young matrons (like my mother) who were either members of the family or had married into the family. At any rate, no one knew the game since the professor had made up the rules. Furthermore, the rules were so complicated that guests could not participate effectively. As a result, Alfred played each guest's part! At some point he

[1] See, for example, G.L. Baker and J.P. Gollub, (1996) *Chaotic Dynamics: an Introduction* (2nd edition), Cambridge University Press, Cambridge.
[2] Some of this information comes from G. de B. Robinson, (1979) The Mathematics Department in the University of Toronto, 1827–1978. University of Toronto Press, Toronto

declared the game finished and, going to his bookshelf, found a volume that he deemed useful reading for the young woman who was the fortunate but bewildered winner of the game. Clearly, Alfred was a mathematician to the end!

While my own career in academia has been quite different from that of great-great uncle Alfred I felt a strong sense of pride that morning in July to be lecturing, for even a single morning, in the same institution to which he had dedicated his life's work.

In my view (and that of many more objective observers) the University of Toronto is the finest institution of higher learning in Canada, and certainly its mathematics department makes a sig-nificant contribution to that reputation. Nevertheless even great universities must expand their connections with their various constituencies. Therefore, I applaud the resourcefulness of the department of mathematics, both in using alumni resources like myself and, in reaching out to the bright mathe-maticians of tomorrow.

Class of 3T0 Scholarships Still Going Strong

In the mathematics office hangs a doc-ument signed in 1986 by surviving members of the Class of 3T0, who for almost 60 years have awarded a schol-arship to undergraduates in mathe-matics, several of whom have continued into distinguished careers. The class that graduated from Mathematics and Physics in 1930, at the depth of the Great Depression, turned out to be a particularly cohesive group that resolved to meet together every year thereafter. Their reunions were joined by Profes-sors Samuel Beatty and Lachlan Gilchrist, who took them out to dinner. Beatty pointed out that while they may not have been the most academically distinguished class, they were without parallel with respect to spirit and, in 1936, challenged them to express this spirit in a more tangible way. Thus, the idea of the scholarship was born. Over the next couple of years, contributions came in until in 1939 it was possible to make the first award of $50 to E.B. Mac-Naughten. As the founders put it, "in the harsh mid-thirties those of us who man-aged to establish ourselves were aware of the continuing financial problems of undergraduates and were determined to do something about it." As the years rolled on and inflation took its toll, the class was able to increase the size of the award to $100 in 1955, then to $200 in 1964, and by stages to the pre-sent amount of $1000.

The Signatories of the document of 1986 were:
D.S. Collingwood
B.A. Griffith
F.M.E. Holmes
M.M. Holmes (née Bidnell)
L.B. Leppard
S.R. LeRoy Newman
C.R. Ostrander
J.R.C. Smyth
A.H. Snell
J.M. Speirs
J.T. Wilson
M.G. Wyatt

Other alumni involved in the financing and presentation of the award are: J.N. Laing, A.D. May (a 1954 recip-ient) and A. Londry.

As some of the recipients of the Class of 30 Award have joined the spon-soring group, this great initiative will be fulfilled for many years to come.

Alumni News

Gregory L. Baker (B.Sc. 1965; M.Sc. 1967; Ph.D. 1970) is currently profes-sor and chair of Mathematical Sciences at ANC College in Bryn Athyn, PA. He has written a book, *Religion and sci-ence: from Swedenborg to chaotic dynam-ics*, published by Solomon Press, and co-authored an introductory book on chaotic dynamics. The great uncle of Gregory Baker's father was Alfred Baker, who joined the University of Toronto, Mathematics Department in 1875, becoming head in 1887. The elder Baker was dean of arts from 1912 to 1919 and a member of the University Senate from 1887 until his death in 1942.

David Binder (B.Sc. 1971) became fellow of the American Statistical Asso-ciation in 1991. He is the current chair of the Survey Research Methods Section of the American Statistical Association, and became director of Business Survey Methods Division at Statistics Canada in 1994

Azim Dawood (B.Sc. 1991) com-pleted the requirements for the Asso-ciateship of the Society of Actuaries in November 1994.

Harry Down (BA. 1927), possibly our oldest alumnus, celebrated his 90th birthday on January 3, 1997. After grad-uation, he went to work with Sun Life in Montreal as an actuary specializing in evaluation and income tax. He was sent by that company to London, Eng-land, in 1931 to open a new office. He stayed until the period of the Blitz, but in 1942, concerned that the war had ground to a stalemate, resigned and returned to Bruce County in Ontario where he joined his father-in-law as a commercial beekeeper. In the late 1950s, he decided to go into high school teaching. Along with many refugees from the Avro Arrow project includ-ing Elwy Yost, the TV Ontario movie host, he took a summer training pro-gram and then taught in Walkerton, Port Elgin and Kincardine, before set-tling down at Saltfleet High School in Stoney Creek.

John Egsgard (B.A. 1948; M.A. 1953) retired after 47 years of teaching high school mathematics in June 1995. In September 1996, he became editor of the Ontario Mathematics Gazette,

the professional journal for Ontario's teachers.

Harry Farrar (B.A. 1958) took his Ph.D. at McMaster in nuclear physics in 1962 and worked for 29 years at Rockwell International in California in experimental nuclear physics. He is now retired and a consultant to the US Department of Agriculture and the International Atomic Energy Agency on food irradiation.

Jerrold E. Marsden (B.Sc. 1965) was the first director of the Fields Institute from January 1992 to June 30, 1994. In July 1995, he resigned his position as Professor of Mathematics and Electrical Engineering and Computer Science at the University of California in Berkeley to take up a position as Professor of Control Dynamical Systems at the California Institute of Technology.

Edward Maxwell (B.Sc. 1996; M.Sc. 1967; Ph.D. 1969) is currently the chair of the computer studies program at Trent University in Peterborough.

John C. (Jock) Maynard (B.A. 1940), who retired in 1981 from Canada Life Assurance Company as Senior Vice-President and Chief Actuary, was inducted into the University of Toronto Sports Hall of Fame in October, 1996. As an undergraduate, he played ice hockey, tennis and football. He worked his way through the Blues hockey league teams and was captain of the Canadian and international league Championship term in 1939-1940. He was a member of Blues Intermediate tennis champions in 1939-1940 and played junior football in 1937. After graduating, he remained active in U. of T.'s athletic affairs. His undergraduate attainments were also academic, coming in the top five of a Putnam competition (1940) and obtaining a Moss Scholarship.

Cathleen Synge Morawetz (B.A. 1945), Professor at the Courant Institute and retiring President of the American Mathematical Society was granted an honorary Doctor of Science degree at the fall convocation of the University of Toronto on November 19, 1996.

Sal Ritacca (B.Sc. 1974; B.Ed. 1975) cofounded and is currently headmaster

of the Leonardo Da Vinci Academy, an independent elementary school in Etobicoke

Michael Rochester (B.A. 1954; M.A. 1956) was recently awarded the Distinguished Scholar Medal for teaching and research by Memorial University of Newfoundland. His research in theoretical global geodynamics has been recognized by election as a Fellow of the Royal Society of Canada (1983), award of the Tuzo Wilson Medal by the Canadian Geophysical Union (1986), and appointment as University Research Professor in Earth Sciences & Physics by Memorial (1986). He regularly teaches undergraduate courses in mathematical physics.

Andrew Rutenberg (B.Sc. 1987) is currently completing a two-year postdoctoral fellowship in Theoretical Physics at Oxford University.

The University of Toronto Mathematics Alumni Association

We are on the point of formally establishing the University of Toronto Mathematics Alumni Association. Our founding meeting will be held on Saturday, April 5 at 2 pm in the main auditorium (Room 108) of the Koffler Institute for Pharmaceutical Management, a new building, blocking off Bancroft Avenue adjacent to Spadina circle.

Besides approving the constitution and electing our first Board, we will have an informal talk by one of our graduates, Richard Cammidge, who after graduating in 1953, became a United Church Minister and then a parole officer for the Ontario government. This will be the first of what we hope will be a series of talks from our

graduates who have proceeded into all sorts of walks of life. Come along and enjoy some good company.

To defray ongoing expenses and allow for orderly organization of activities, we hope that alumni and friends of the department will become formal members of the organization, with annual dues of $25. A membership form is enclosed with this newsletter. This will ensure that you are kept informed of UTMAA activities and will qualify you to vote on policies and to elect or serve as members of the Board.

Until a properly constituted board can take office, the affairs of the nascent association are in the hands of an interim group consisting of George Andrews (1960), Norman Burgess (1960), John del Grande (1944), Norman Gillespie (1941), Philip Leah (1949, 1952) Louis Levine (1948), Sidney Soanes (1944) and David Sweeney (1955). We are grateful to Dr. Soanes for spending a great deal of time completing our list of alumni and making sure our addresses are correct.

A Coin-shifting Problem

J.P. Grossman (B.A. 1995) describes an interesting invariance that arises in a problem of shifting coins. Let there be a straight line of small trays, and suppose that a finite number of coins are distributed into the trays in any manner whatsoever. Some trays may get several coins and others none. A *move* consists of taking two coins off the top of any pile with at least two coins and distributing them, one each, to the trays on the left and right.

It turns out that, after a finite number of moves, we arrive at a situation in which each tray has at most one coin. Moreover, even though there are many alternative sequences of moves, the number of moves required is always the same and the same final configuration will result. Can you see why?