
MATH MATTERS

DEPARTMENT OF MATHEMATICS ♦ CORNELL UNIVERSITY ♦ ITHACA NY NOVEMBER 2004

LETTER FROM THE CHAIR, KENNETH S. BROWN

No one could be more surprised than I am to tell you that I am writing this while sitting in the Dubai airport, 7000 miles from Ithaca, having completed the first leg of a long trip from Qatar to Ithaca. What am I doing here? Let's go back just over a year, when former Cornell Mathematics major Jeff Lehman was inaugurated as Cornell's eleventh president.

President Lehman's inauguration was spread out over a week and began at Cornell's third campus, the Weill Cornell Medical School in Qatar (WCMC-Q). The text of the address that President Lehman delivered there, the first of three inaugural addresses, can be found at inauguration.cornell.edu/news/stories/doha_first_address.cfm. The president is a strong believer in the "transnational university" and is proud to be part of an initiative that is using higher education to build bridges between different cultures.

Jeff's enthusiasm made me want to see for myself what's going on at Cornell's third campus. (The second campus, by the way, is the Weill Cornell Medical School in New York.) So, when given an opportunity to visit Qatar, I agreed to do so. My official purpose was to evaluate the mathematics part of the two-year pre-med program at WCMC-Q. There is one mathematics course, which is taught by Tom Rishel, a former Senior Lecturer in our department.

Although I was initially skeptical, I was pleasantly surprised by what I saw. The pre-med courses are taught by a dedicated group of teachers who believe deeply in what they are doing,

and the students are as highly motivated and hard working as any group of students I've ever seen. I played the role of the TA one day and found it to be a real delight to interact with them. They recognize that they have a unique opportunity, and they do not want to squander it. I will watch with interest as the program develops. Incidentally, the Dean of WCMC-Q is Dan Alonso, whose brother Juan was a mathematics graduate student some years ago.

Closer to home, we are actively engaged in recruiting new faculty here in Ithaca. In last year's Math Matters I wrote about our preparations for an external review. That review, our first in about 30 years, was the major event of last year. The review team was outstanding and made many good suggestions, mostly concerning hiring. The reviewers were Alice Chang (Princeton University), Phil Hanlon (University of Michigan), Ron Stern (University of California at Irvine), and Dan Stroock (Massachusetts Institute of Technology). As a direct result of the review we held our first ever department retreat, at which we discussed our needs and made a hiring plan for the next 5-10 years. With the support of the deans, we are now working to carry out that plan.

We have several initiatives under way, including an effort to fill the position left vacant after José (Chepe) Escobar's tragic death. (See page 2.) With Chepe's passing, we lost a friend and a colleague who was a major force in the recruiting of minority graduate students. He was also our only specialist in geometric analysis. I hope

you will read in next year's *Math Matters* that we successfully recruited outstanding new faculty members, including one filling Chepe's position.

Speaking of outstanding new faculty members, we had an extremely successful postdoc hiring season. We hired five new postdocs, including four H.C. Wang Assistant Professors and one NSF postdoc. We had one offer refused, so the five who are here are five of our top six candidates.

We are also pleased to have hired a new tenure-track assistant professor, Alex Vladimírsky, and a new senior lecturer, Dave Bock. Alex is a talented and energetic applied mathematician with broad interests. Dave, who just retired from Ithaca High School after a 35-year teaching career, is coordinating our K-12 outreach programs.

We hope to include more alumni news in future issues of *Math Matters*. (See page 7.) Please let us hear from you. Unfortunately, the only alumni news to report in this issue is the tragic death of Raju Chelluri. (See below.) Raju was my advisee, and I was greatly saddened to hear of his death. I offer my deepest condolences to his family. I also offer them heartfelt thanks on behalf of the department for their generosity, which will create the Chelluri Lecture Series to honor Raju's memory. We expect to have the first Chelluri Lecture in 2005-06.

Thyagaraju (Raju) Chelluri, B.A. Mathematics 1999, died in August 2004. Please visit www.math.cornell.edu/News/news.html for the full article.

JOSÉ FERNANDO ESCOBAR

It is with heavy hearts that we announce the death of Professor José Fernando (Chepe) Escobar, 49, on January 3, 2004.

Chepe was born in Manizales, Colombia, on December 20, 1954. He was educated in Colombia, Brazil, and in the US, obtaining his Ph.D. from the University of California, Berkeley, in 1986. As a young person in Colombia, he was a competitive diver and was the national champion. He was also an avid soccer player and salsa dancer.

He had his first bout with cancer while he was in graduate school, and despite a hopeless diagnosis from his doctors, he was able to recover completely. This experience helped shape his personality, making him a man of great strength, compassion, and optimism.

Chepe was a world-renowned expert in the field of Differential Geometry that studies geometric problems using methods of differential equations. He joined the faculty at Cornell on July 1, 1994, after teaching at Indiana University, the University of Chicago, and the Courant Institute at New York



University. During his career, Chepe received numerous academic awards and honors, most notably an Alfred P. Sloan Dissertation Fellowship (1985-86) and a Presidential Faculty Fellowship in pure mathematics (1992-97). At Cornell, he was a thesis advisor to many graduate students and a mentor to several postdoctoral associates. Chepe was also deeply involved in encouraging mathematical development in South American countries and helped the Mathematics Department recruit many graduate students from that part of the world. He was a vital part of our community, and he is sorely missed.

Chepe's family and many friends gathered at a memorial service in Anabel Taylor Hall on Monday, February 16, 2004, to say goodbye.

HONORS & AWARDS

The 2003 awards were presented at our annual holiday party in December.

Teaching Awards: Senior Lecturer **Maria Terrell**, H.C.



Maria Terrell

Robert John Battig Prize: **James Belk** and **Harrison Zhou**.

Eleanor Norton York Award: **Farkhod Eshmatov**.

Hutchinson Fellowships: **Jason Martin** and **Melanie Pivarski**.

ACADEMY OF ARTS & SCIENCES

The American Academy of Arts & Sciences announced the election of 178 new Fellows for 2004, including Professor **Leonard Gross**.



Leonard Gross

Lenny joins three of his Cornell colleagues who have been elected to the Academy: Richard Durrett (2002), Harry Kesten (1999), and Eugene Dynkin (1978).

CLARK TEACHING AWARD

Graduate Student **Christopher Francisco** received a Clark Distinguished Teaching Award from the College of Arts & Sciences on May 11.

Past Mathematics Graduate Student recipients of the Clark Teaching Award include Kathryn Nyman (2001), David Brown (2000), David Reed Solomon (1998), Hal Schenck (1997), Jeffrey Mitchell (1996), Lisa Orlandi (1995), and Vee Ming Lew (1993).



Chris Francisco



Dan Zaffran

Wang Assistant Professor **Dan Zaffran**, and Graduate Student **Dan Ciubotaru**.



Dan Ciubotaru

Additional Graduate Student awards presented at the party were:

VIGRE PROGRAMS AT ITHACA HIGH SCHOOL

by Rick Durrett

Our department has developed closer ties to Ithaca High School over the last three years. The senior seminar, which began in 2002-2003, is a course designed for students who have taken all of the math courses available at IHS. This idea was developed by then high school teacher Dave Bock, VIGRE postdoc and IHS alumnus Lawren Smithline, and three Cornell graduate students—Kristin Camenga, Todd Kemp, and Jeff Mermin—who taught the first year's modules. The class meets for one period (45 minutes) during school hours every Monday, Wednesday, and Friday at the high school. The first six months are taught as three two-month modules, each by one of the graduate students. Then in the final two months the students do projects. There were ten students the first year. In 2003-2004, the seminar continued in its previous format with fifteen students. The graduate students and their modules were Sharad Goel (game theory), Jim Belk (topology), and Jay Henniger (combinatorics). The 2004-2005 graduate students and their topics are: Jason Martin (cryptography), Jeff Mermin (continued fractions), and Deena Schmidt (probability).

Our second outreach activity is the Math Explorer's Club, an after school club at Ithaca High School meeting Thursdays 2:45-3:30. Our efforts for 2003-2004 were supported by a grant from the Provost that allowed four graduate students a semester off from teaching to develop materials and lead club activities. The Fall of 2003 began with activities that involved learning probability by playing games and

were led by Rick Durrett with the assistance of CAM graduate student Sharad Goel.

After Christmas break, Kristin Camenga got things started by introducing the students to concepts in graph theory by playing a number of games: Sprouts, Slither, Chomp, Nim, Ramsey Graph games, and using graphs to solve the puzzle Instant Insanity. While the students were having fun, they were exposed to a lot of graph theory and even learned a little about proofs in the analysis of optimal strategies.

The second spring module on Secret Codes was led by graduate student Treven Wall and VIGRE postdoc Lawren Smithline. The first lesson began with simple substitution ciphers like the Crytoquip in the newspaper. The level of complexity was then increased to more complex substitution schemes, and after a quick course in modular arithmetic, the students were introduced to "public key" systems that take advantage of the fact it is difficult to factor the product of two large primes.

In the final module led by graduate student Sunny Fawcett, students had "Fun with Geometry." The first week the students ate toruses (donuts) and played chess and Tic Tac Toe on toruses and Klein bottles. In later sessions they built models of solids and surfaces with plastic polygons, and explored minimal surfaces with soap bubbles. For more about what we did in 2003-2004, visit: www.math.cornell.edu/~mec/ a web page created by Carla Martin, a CAM graduate student who received support in Spring 2004 from the VIGRE grant.

As mentioned in the last issue of Math Matters, we submitted a proposal to the National Science Foundation to fund the Math Explorer's Club for five years and to export the idea to other communities across the country. Unfortunately our proposal was not one of the four winners from the forty submitted. Despite this setback, the Club continues this year supported by the VIGRE grant and the Gowin line for math education activities.

This fall again began with games led by Rick Durrett and Sharad Goel, but this time for only five weeks, and we played games of strategy: Connect Four, Othello, a game based on percolation, and the ancient board game Go, which proved to be very popular with the students. As this is being written, we are about to begin a six-week module on fractals, led by graduate student Bryant Adams and using three Dell laptops for our explorations. Plans for Spring 2005 are not yet complete, but we will begin with a module on dynamical systems and chaos.

A new connection with the high school this year is our sponsorship of the Math Team. IHS math department member Andrew Bridy, who coincidentally was a participant in the 2003 REU Program and worked on a project with Rodrigo Perez, is paid a modest stipend for running weekly practice sessions. In addition, the department provides a small amount of money so that the team can travel more comfortably on commercial buses rather than school buses and stay as a group in a hotel rather than being scattered with different host families or getting up very early to avoid an overnight stay.

RESEARCH EXPERIENCES FOR UNDERGRADUATES

by Bob Strichartz, John Guckenheimer & Alex Meadows

The Cornell Mathematics Department has offered a Research Experiences for Undergraduates (REU) Program, sponsored by the National Science Foundation, every summer since 1994. This program brings talented undergraduates from Cornell and colleges across the country to work on research projects directed by Cornell faculty.

The projects in Summer 2004 were Analysis on Fractals, directed by Robert Strichartz, Dynamic Models of Excitable Cells, directed by John Guckenheimer and Visiting Professor Warren Weckesser, and Differential Equations Arising in Geometry, directed by Alex Meadows. Cornell graduate students Joshua Bowman, Matthew Noonan, and Erik Sherwood assisted with the projects. In addition to their research work, students attend a Smorgasbord Seminar where the Cornell faculty give talks about different areas of mathematics. The students gave presentations on their work to each other in a weekly Jam Session and also to the whole Cornell Mathematics community at the final Undergraduate Research Forum. Several papers based on the research are in preparation.

Analysis on Fractals has been an area of research for REU students since 1996, and the cumulative results have had a considerable impact on the field. The approach is experimental: Students write and run computer programs to explore possibilities, generate and test hypotheses, and identify fruitful questions for further research. Proofs of experimental conjectures sometimes come quickly, but often

are years in the making. This summer's work centered on the theme of the spectrum of the Laplacian on fractals and fractal graphs.

Shawn Drenning (Cornell) studied the spectrum for a class of fractals constructed by iterations chosen between two different construction schemes, so the resulting fractal is not self-similar, using the method of spectral decimation. Shawn is also a Cornell Presidential Research Scholar and is continuing his work during the academic year being supported by that program. Adam Allan (Clarkson U.) studied spectral operators on the Sierpinski gasket. In particular, he was able to extend observations of a new kind of periodicity in the behavior of the heat kernel that first appeared in the work of Nitsan Ben-Gal in Summer 2003. Mariya Bessonov (North Carolina State) and Michael Jennings (Cornell) obtained experimental evidence for spectral gaps and a new phenomenon of eigenvalue clustering for a variety of different Laplacians on the Sierpinski gasket in the "lattice case". It will be quite a challenge to explain these observations theoretically! They also ran a series of experiments to exhibit the degradation of the spectrum of a Sierpinski graph as it undergoes random perturbations and becomes more like a random 4-regular graph. Certain features of the spectrum degrade very rapidly, while other features linger long after half the original edges have been changed. This work was inspired by the "small world networks" work of Watts and Strogatz who looked at other,

nonspectral, features of graphs under perturbation, and found sudden "phase transitions". In the fractal/spectral work, no such phase transitions were found.

Students in the **Dynamic Models of Excitable Cells** project—Justin Brockman (North Carolina State), David Cesa (Northwestern), David LeRay (Worcester Polytechnic Institute), and Ben Robinson (Washington U., St Louis)—studied the dynamics of the Morris-Lecar model of excitable cells. The Morris-Lecar model is a system of differential equations that is a prototype for describing how action potentials arise from ionic currents flowing through membrane channels. Dynamical systems theory can be used to study the solutions to these equations, showing how they depend upon initial conditions and upon parameters in the model. Much of the focus of this project was in investigating bifurcations, qualitative changes in the solutions that occur as parameters are varied. This is a formidable task because the model is nonlinear and has a large number (thirteen) of parameters.

For systems of two differential equations like the Morris-Lecar model, there is an excellent characterization of the types of solutions and a classification of the simplest types of bifurcations. In this project, the students implemented algorithms to compute bifurcations in the Morris-Lecar model. As two parameters are varied simultaneously, bifurcations occur along curves that delimit regions within which the phase portrait of the model remains qualitatively

REU (continued)

unchanged. While computations of this type have been done previously, this project was perhaps the most systematic effort to investigate these phenomena to date.

The **Differential Equations Arising in Geometry** group worked on three distinct projects. A group of students—Frances Hammock (UC Berkeley), Peter Luthy (Connecticut College), and Phillip Whitman (U. of Texas, Austin)—studied the question of the existence of “tornado sequences” of solutions to some particular nonlinear elliptic problems. They were very successful in proving nonexistence in certain

situations. Phillip presented results at the Mathfest in Providence and at the YMC Conference at Ohio State.

Zhuan Pei (Carleton College) studied the geometrical variational problem and associated differential equations concerning the following soap film problem: Consider a cylindrical soap film surface suspended between two coaxial circles of wire. Suppose it has some surface density and rotate it at some rate around the axis. Taking centrifugal forces into account, what is the equilibrium position of the surface? Zhuan had some success generating computer models and

analyzing solutions to a simplified differential equation.

Thomas Peters (Rutgers) worked on generating one-parameter families of constant mean curvature surfaces, using recent ideas of Ferus, Leschke, Pedit, and Pinkall. The mathematica code turned out some expected and some unexpected results and led to many interesting quandaries. Graduate student Matt Noonan worked with Thomas on this project.

The REU Program will continue next summer with projects to be announced.

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TEACHING SEMINAR

The Mathematics Department has an active seminar focused on teaching issues and challenges. Held on Wednesday evenings and organized by Kristin Camenga and Mia Minnes, the Teaching Seminar is a forum for discussion about teaching mathematics and is designed for sharing experiences and examining particular challenges or problems. This seminar evolved from a graduate course that was taught for many years in which fundamental teaching strategies were examined. Since then, we found there was a desire among both new and more experienced lecturers and TA's to reflect on their experiences. The scope of the meetings expanded to include math education research, the deeper mathematical content of the service courses (calculus, linear algebra), and other issues that arise from teaching mathematics. A key

benefit of the seminar is to have participants with a diversity of teaching experiences.

Anyone involved in math and/or teaching is invited. Previous discussions have included grading, using technology in the classroom, the importance of the completeness of the real numbers in teaching calculus, as well as other topics.

MATH 304 PROVE IT!

In Spring 2005, we will introduce a new course on mathematical proof methodology, Math 304, Prove It!, taught by Peter Kahn. Mathematical proof is the backbone or skeleton of mathematics, giving it a level of reliability and conceptual integrity that is unmatched in other intellectual endeavors. Whether one thinks of mathematics as a tool to be used in science or engineering or as a

discipline of intrinsic beauty or value, mathematical proofs play a fundamental validating role.

In Math 304, students will be introduced to the basic techniques and strategies of mathematical proof, both in understanding and analyzing already completed proofs and in attacking and working out proof-problems for themselves. Students will learn the fundamentals of mathematical logic, which is an indispensable tool for “parsing” complex mathematical assertions. They will see illustrations of the methods they have learned by working through an extended development of a basic item of mathematical knowledge: The logical construction of the real numbers will be covered next semester. This will serve not only to impart that knowledge but also to show how complex, large-scale mathematical structures are built from elementary foundations.

VIGRE PROGRAM

A QUIET YEAR FOR VIGRE

by Rick Durrett

In each of the last four years, the newsletter article on our VIGRE grant has begun with a recitation of the names of the new VIGRE postdoctoral associates and graduate students, a total of seventeen postdocs (including five NSF postdocs) and nineteen graduate students. However, 2004-2005 is the fifth and final year of the current VIGRE grant, so there are no new arrivals.

As the word “current” might suggest, there is a possibility that we can receive a second VIGRE grant to fund activities in 2005-2010. Work began in June 2004 on the new VIGRE proposal. Like today’s college applications, the proposal requires not only the basic information about what we have done and our plans for the future, but also essays on a variety of topics. In the case of the VIGRE proposal, the topics are Organization and Management, Recruitment and Retention, Performance Assessment, Dissemination, and my personal favorite: the Post-VIGRE plan, where one explains how all of the activities will continue after several millions of dollars of funding ends.

The VIGRE program began in 1999 with nine awards. In 2000 there were twelve more (including Cornell). In the early days of the program, when Phillippe Tondeur was the head of the Division of Mathematical Sciences of NSF, and we were in a five-year period where the budget of the Division of Mathematical Sciences (DMS) actually doubled, there was optimistic talk of fifty VIGRE grants

training individuals at all levels for careers in mathematics. By 2002, the program had grown to a little over thirty sites, a number that remained stable until 2004.

At that point, the mess in Mesopotamia and soaring federal deficits caught up with the DMS budget, which is predicted to be flat (even without adjustment for inflation) for the next five years. Cuts had to come from somewhere, so DMS officials decided to reduce the number of VIGRE grants from the current thirty-four to fifteen. Only two awards were made in 2004, meaning that seven of the programs that began in 1999 were discontinued. Three or four awards are projected for 2005, and in the long run there will be about three awards per year.

Taking into account that there were twelve awards in 2000, and that many schools unsuccessful in previous years are likely to try again, we are facing a tight competition. It would be crazy to confidently claim that we will win, but there are reasons to be optimistic.

Cornell has strong undergraduate, graduate, and faculty research programs, and offers a variety of opportunities for interdisciplinary research. The first grant passed its third year review with flying colors. The new proposal builds on the successes of the previous one, but also introduces a number of new innovations at all levels of the program.

It will be a long time before the result is known. The proposal was submitted on the deadline of October

12. Proposals are reviewed by mathematicians from all over the country and then discussed by a panel, which decides on the finalists who will receive a site visit. After all of the site visits are complete, DMS officials compare the merits of the various programs and decide on the winners. Last year when the proposal deadline was in September the first awards were made in late April. Thus it will be a long quiet year of waiting with our fingers crossed.

THE MATHLETES

A department softball team, the Mathletes, was created in 2003 by four graduate students—Henri Johnston, Jason Bode, Will Gryc, and Treven Wall—who had played on an ILR team the previous year. They had a winning record for the season but were not undefeated.

The 2004 Mathletes team included mostly mathematics graduate students and postdocs—Treven Wall, Jason Bode, Will Gryc, Spencer Hamblen, Franco Saliola, Lee Gibson, Brad Forrest, Andrew Cameron, Tim Goldberg, Alex Meadows, Jeff Mermin, Nate Broaddus, Noam Greenberg, Jonathan Needleman, and Joshua Bowman—as well as members from other departments across campus.

This year, the team started the season early with an entry into the spring league, where they met some tough competition. After having gone through “spring training”, they were undefeated in Summer 2004. Congratulations Mathletes!

THE CLASS OF 2004

MATH MAJORS

Commencement ceremonies were held on May 30, 2004. Bachelor of Arts degrees were conferred upon 53 mathematics majors. Seventeen graduates received honors in mathematics:

Summa Cum Laude

Tian Tian Grace Qiu
Asher Walkover*

Magna Cum Laude

Michelle Alison Fullwood
Brian Ross Lukoff

Cum Laude

James Haley Adler
Andrew Donald Bridy
Guanhan Chew
Peter Michael Clark
Austin J. Hedeman
Matthew J. Hirn
Sebastian Mekas
Elizabeth Ann Rach
Matthew Elliot Rhodes
Michael Scott Scullard
Sara Katherine Slater
Samuel McIntire Thomson
Matthew Wachs

*January degree

GRADUATE STUDENT DEGREES

Everilis Santana-Vega, *The Impact of the "Good Questions Project" on Students' Understanding of Calculus Concepts*. Master's Thesis, August.

James Belk, *Thompson's Group E* . Ph.D. August.

Janet Best, *The Mathematics of Ecological Competition*. Ph.D. January.

Nelia Charalambous, *On the LP Spectrum of the Hodge Laplacian and Logarithmic Sobolev Inequalities on Non-Compact Manifolds*. Ph.D. August.

Dan Ciubotaru, *Unitary Representations of Exceptional P-Adic Groups*. Ph.D. August.

Jean Cortissoz, *On the Ricci Flow in Rotationally Symmetric Manifolds with Boundary*. Ph.D. August.

Christopher Francisco, *Hilbert Functions and Graded Free Resolutions*. Ph.D. August.

Yuval Gabay, *Double Jump Inversions and Strong Minimal Covers in the Turing Degrees*. Ph.D. August.

Noam Greenberg, *The Role of True Finiteness in the Admissible Recursively Enumerable Degrees*. Ph.D. August.

JaEun Ku, *Least-Squares Methods For Second-Order Elliptic Partial Differential Equations*. Ph.D. August.

Dmitriy Leykekhman, *Pointwise Weighted Error Estimates for Parabolic Finite Element Equations*. Ph.D. August.

Yi Lin, *Equivariant Symplectic Hodge Theory and Strong Lefschetz Manifolds*. Ph.D. August.

Shawn Walker, *Shift Techniques and Multicover Inequalities on Colored Complexes*. Ph.D. May.

Huibin (Harrison) Zhou, *Minimax Estimation with Thresholding and Asymptotic Equivalence for Gaussian Variance Regression*. Ph.D. August.

HARRY S. KIEVAL PRIZE

The 2004 *Kieval Prize* was awarded to **Tian Tian Grace Qiu** and **Asher Walkover**.

CORNELL MATHEMATICAL CONTEST IN MODELING

The CMCM was held November 12-15. For contest results, go to www.math.cornell.edu/%7Emcm/.

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ALUM NEWS

We would like to include a section on Alum News in every issue of *Math Matters*. To accomplish this, we need to hear from you!

Please contact us at mathmail@cornell.edu, and give us some news!

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Math Matters is published through the combined efforts of members of the department. Many thanks to Ken Brown, Kristin Camenga, Rick Durrett, John Guckenheimer, Arletta Havlik, Peter Kahn, Michelle Klinger, Alex Meadows, Mia Minnes, Donna Smith, Bob Strichartz, Treven Wall, and Colette Walls.

Catherine Stevens, Editor

MATHEMATICS DEPARTMENT ENDOWMENTS

The department is grateful to alumni, friends, and family who support the department endowments. Without their generosity, we would be unable to provide many of the offerings that make our department unique.

The **Chelluri Lecture Series** was recently established by Raju Chelluri's parents in his memory. (See page 1.)

The **Michael D. Morley Senior Prize in Mathematics** is presented annually to an Ithaca High School student who has excelled in mathematics and who has demonstrated originality and innovative power in mathematics.

Teaching awards for graduate students and faculty were created in 2001. We would like to endow the **Teaching Award for Graduate Students** so that a generous prize can accompany it.

The **Colloquium Endowment Fund** was instituted to invite distinguished scientists to speak at the Oliver Club seminars. The Oliver Club was founded (as the Mathematical Club of Cornell University) in January 1891 by James E. Oliver. (See www.math.cornell.edu/~oliver/.)

The **Eleanor Norton York Endowment** was established in honor of Eleanor Norton York to recognize outstanding graduate students in both Astronomy and Mathematics. The income from this endowment is used to provide annual prizes to a continuing graduate student.

The **Faculty Book Endowment** is dedicated to the goal of providing the Cornell community with immediate access to one of the world's finest collections of mathematics books and publications.

The **Israel Berstein Memorial Fund** was established in honor of Israel Berstein, a professor in this department from 1962-1991. The memorial fund is intended to help young mathematicians in the field of topology.

The **Logic Endowment** was started with a generous gift from a former Cornell undergraduate. This endowment seeks to actively support promising logic students.

The **Robert John Battig Endowment** was established by his parents after his untimely death. Robert was awarded a January 1998 Ph.D. in mathematics. The fund provides an annual prize to an outstanding continuing graduate student in mathematics at Cornell.

If you would like to contribute to any of these endowments, please make your check payable to Cornell University, indicate the specific endowment on the check, and send it to:

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