
MATH MATTERS

DEPARTMENT OF MATHEMATICS CORNELL UNIVERSITY ITHACA NY NOVEMBER 2011

LETTER FROM THE CHAIR, LAURENT SALOFF-COSTE

Cornell is thinking about its future and facing the daunting task of replacing a large cohort of retiring faculty. In response, the College of Arts and Sciences is supporting an aggressive hiring campaign. Anticipating planned retirements, our department conducted multiple searches and made offers to a number of exciting candidates during the past academic year.

Marten Wegkamp joined Cornell this summer as a tenured full professor. He holds a joint appointment in Statistics and in Mathematics and works in non-parametric

statistics. His wife, Florentina Bunea, joined the Statistics Department. Lionel Levine accepted a position of assistant professor in our department and will join us on July 1, 2012, together with his wife, Karola Meszaros, who will hold a postdoctoral position. Karola works in combinatorics and Lionel works in probability and combinatorics. Ana Rita Pires (symplectic geometry) and Clinton Conley (logic) are holding H.C. Wang Assistant Professorships. Anastasia Raymer will spend the next two years with us thanks to our NSF supported

Research Training Grant in Probability. We are currently searching to fill two more tenure-track faculty positions and two postdoctoral H.C. Wang positions.

Congratulations to Yuri Berest and to Martin Kassabov who were promoted to the rank of full professor. Welcome to Melissa Totman who is joining the staff as the new graduate field coordinator.

The Cornell Strategic Plan 2010-2015 provides a context for our recruiting efforts. This plan

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GIVING MATHEMATICS A VOICE

LIBRARY DIGITIZES HISTORIC COLLECTION OF EUGENE DYNKIN INTERVIEWS

Cornell University Library has acquired a collection of interviews of mathematicians conducted by Eugene Dynkin, Cornell's Emeritus A. R. Bulis Professor of Mathematics.

Dynkin worked with the Library's Division of Rare and Manuscript Collections (RMC) and Digital Scholarship Services to organize and digitize his revolutionary conversations, many of which are interviews with Russian mathematicians. They are now available online at:

www.dynkincollection.library.cornell.edu.

The interviews, which Dynkin recorded for more than half a century, serve as a rich source of



information not only about mathematics but history as well, providing insight into academic life under a repressive Soviet regime. The collection contains nearly 150 audio and video recordings, plus

biographical information about each mathematician and a select group of photographs.

"Professor Dynkin made extremely important contributions to mathematics, starting at a very young age, and in a wide range of different areas," said Laurent Saloff-Coste, chair of the Cornell's Department of Mathematics. "As an important figure of the mathematics community, Professor Dynkin has had direct contacts with a great many mathematicians all

around the world. The collection of Dynkin's interviews is probably unique in all of the sciences and unlikely to be ever replicated."

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UPPER MATH GOES THROUGH THE ROOF

BY MICHELLE KLINGER

Interested in math? For a growing number of undergraduates, the answer is clear. Enrollments in upper-level math courses have increased by over 30% during the last five years. Major applications have jumped 33% in just one. This year's graduating class is expected to be the largest in many years, more than double those of a decade earlier. The numbers are startling. And we couldn't be happier.

Most undergraduates take at least one or two math courses during their time at Cornell, including students in Arts and Sciences, Agriculture and Life Sciences, Architecture, and Human Ecology. Engineering students and science majors take at least two years of math. All told, we teach entry-level math, primarily calculus and linear algebra, to around 5,000 students every year. That number hasn't changed much in the last 10 years. What has changed, and quite dramatically, is the number of students who continue their math education into junior- and senior-level courses, often beyond what is strictly required.

For those students who wish to further their study, we offer a rich variety of upper-level undergraduate courses in algebra, number theory, combinatorics, analysis, topology and geometry, logic, probability and statistics, and applied mathematics for seniors, juniors, and advanced sophomores. Surprisingly, fewer than half of the students taking upper-level math today are majors. The balance includes economics students, engineers, computer scientists, and numerous science majors.

While it is true that the number of math majors is growing, the enrollment growth at this level cannot be attributed solely to math majors.

Our majors are themselves a diverse group with a variety of interests, and our program allows them to combine a math major with serious study in a related field through an outside concentration (e.g., economics or computer science). Majors in these disciplines often find that our concentrations facilitate adding math as a second major. Unfortunately, some students' interests are not so easily combined. For one thing, the math major is only available to Arts and Sciences students, and even Arts students may find it difficult to meet the requirements for two majors when they have no overlap, like math and government. Until recently, the only alternative to majoring in math was to take a selection of math courses as electives.

Our new math minor makes it possible for students in any undergraduate college to pursue a recognized program of study in mathematics while majoring in another

discipline. Four upper-level math courses are required, compared with nine for the major, so the minor gives students greater flexibility to pursue a variety of interests. In just over two months since its creation, we have admitted eight students to the minor and handed out at least as many more applications.

While we don't yet fully understand the nature of this period of growth, one thing is certain. This infusion of students will shape our program in the years to come. We have a history of evolving in response to the changing needs of our students. We add new courses — recently Prove It!, Computational Algebra, Matrix Groups, and Stochastic Processes — and we encourage majors to work with their advisors to create a program of study that fits their individual interests. Concentrations in math biology and statistics exist today because of past math majors with an interest in these areas. We don't yet know what impact this generation of math students will have, but we look forward to finding out.

CONGRATULATIONS GRADUATES

The past year has been busy and exciting for the math department. We had 56 majors graduate, including 18 with honors. A special congratulations to Zheng Kang Tham who was awarded the *Harry S. Kieval Prize*, given annually to an outstanding undergraduate major.

The graduate students were also hard at work; 15 PhDs were awarded during the 2011 calendar year. Congratulations to all of our graduates!

Please keep in touch!
mathmail@cornell.edu

LETTER FROM THE CHAIR

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promotes the idea of “*One Cornell*,” Cornell University as a single entity. It seeks to sustain Cornell as a comprehensive research university that is one of the most distinguished institutions of higher education in the nation and world, distinctive in how it interweaves the main elements of an Ivy League university with an unusually strong public service mission.

I believe that our department has an essential role to play in *One Cornell*. A vibrant and diverse mathematics faculty is an important resource for other scientific departments at Cornell. Graduate students from different colleges utilize our program to further their mathematical knowledge and skills. We teach quantitative reasoning, calculus and linear algebra to all Cornell undergraduates, and our upper level undergraduate program enrolls many students outside our major. It is clear that *One Cornell* needs a superb department of mathematics.

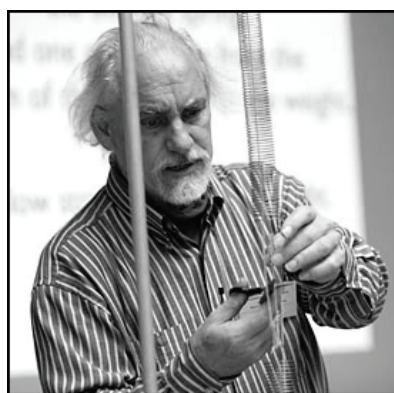
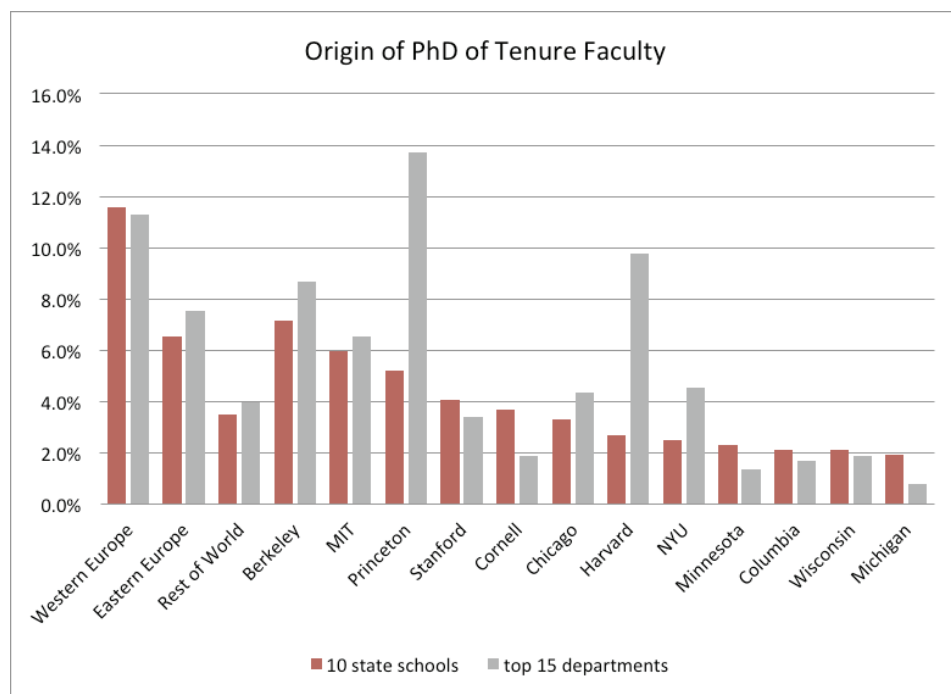
I also believe that the quality of our graduate program is a key element in building a successful future. Attracting the best graduate students

and faculty are the two halves of a virtuous circle, each naturally reinforcing the other.

I would like to share with you the results of a study I conducted to better grasp where we stand, identify our competitors and determine what challenges lay ahead. The following bar graph captures the contributions of various graduate programs to the present population of tenured faculty at two groups of departments: the top 15 departments (grey

bars) and a group of 10 large state universities (red bars). For instance, the graph indicates that, among the present tenured faculty at the top 15 departments, 14% received their Ph.D. from Princeton, 4% from University of Chicago and 2% from Cornell.

What this study tells me is that our past encourages us to be ambitious, but that we must be prepared to face the challenges of fierce competition with our peers.



Robert Barker/University Photography

MATH AWARENESS MONTH

BY MARY ANN HUNTLEY

This year's theme for Math Awareness Month was “Mathematics and Complexity.” Consistent with this theme, faculty member John Hubbard gave a public lecture on April 30, 2011 entitled, *The Price of Anarchy*. For more details about the event, see the article

in the Cornell Chronicle Online www.news.cornell.edu/stories/May11/AnarchyMathCover.html

In the photo to the left, Professor John Hubbard is using a model of strings, springs, and weights to illustrate concepts from his talk.

GIVING MATHEMATICS A VOICE

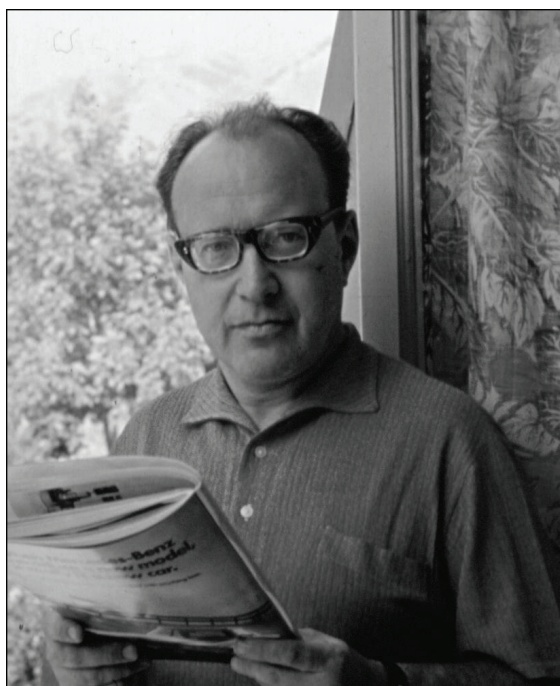
LIBRARY DIGITIZES HISTORIC COLLECTION OF EUGENE DYNKIN INTERVIEWS

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Throughout his career, Dynkin recorded conversations with mathematicians all over the world as a way to broaden their contact with others in the field.

He was born in Leningrad in 1924. He received a PhD in 1948 from Moscow State University, where he continued for many years as a member of the faculty in the Department of Mechanics and Mathematics. Informal contact with Western colleagues was impossible during the Stalin era.

“Western mathematical journals in the library were stamped ‘Restricted Access. Only for Official Use,’” he said. “Even after Stalin’s death, like most Soviet mathematicians, I was not permitted to travel to Western countries. However, I was able to record a few conversations with foreign visitors to Moscow.”



Dynkin and his wife immigrated to the United States in 1976. At Soviet customs, he said, the authorities examined their belongings for two days, checking “every page of every book,” because taking abroad any manuscript or audio recording needed the approval of an expert committee. It was impossible to arrange in the short time given for him to exit, so Dynkin transferred his interviews from cassettes to small reels and left them with his friends. They later gave the reels to traveling American or Canadian colleagues to bring back to Dynkin in Ithaca, where he had become a professor in Cornell’s Department of Mathematics.

At Cornell, he continued his interviews with mathematicians in the United States, Canada, France, Great Britain, Germany, Japan, India and many other countries — although the Russian part of his collection was restricted to conversations with émigrés. With the end of the Cold War, renewed contact with Russian colleagues became possible, giving Dynkin the opportunity to augment his collection with interviews of former colleagues.

During the interviews, mathematicians discuss their family history, other famous members of the field and current research. Most of the interviews were taped in his home or in hotel rooms at conferences, but in a few cases, he recorded in restaurants, cars and even

a rowboat. Although mathematics is the central focus of most of the interviews, a few contain hidden gems of mathematicians singing folksongs, performing operatic arias and playing musical instruments.

“My original intention was simply to digitize.... I wanted it to be preserved, and I planned to deposit it at the Mathematics Library,” Dynkin said. But after Steven Rockey, head of the Math Library, suggested the collection might be more valuable, Dynkin agreed the collection should be put online to provide wider access.

Through the American Mathematical Society, some funds were made available for the translation of the Russian-language so that it would be accessible to the international community, but many more still need to be addressed before the site can assemble a complete English-language archive.

RMC is seeking assistance to continue the process of making the collection accessible to researchers. Anyone who listens to the interviews can help by submitting lists of the topics they cover to rareref@cornell.edu, or contact RMC online for more information.

“We’re thrilled to be able to put this valuable collection online for the world to see, and we hope that others will help us continue to make it more complete and accessible,” said University Archivist Elaine Engst. “First-person oral histories obviously have great research value, but they also do a wonderful job of personalizing history for future generations of students and scholars.”

www.dynkincollection.library.cornell.edu

SATURDAY MATH WORKSHOPS FOR TEACHERS

BY MARY ANN HUNTLEY

Since 1985, during each academic year the Mathematics Department has offered a series of four full-day workshops for secondary mathematics teachers and others who are interested in issues related to the teaching and learning of secondary mathematics. During workshop sessions participants examine principles underlying the content of the secondary school mathematics curriculum, including connections with the history of mathematics, technology, and mathematics education research. During the 2010-2011 school year, attendance at the workshops ranged from 15-25 people per session. Participants included 24 teachers from

12 different schools, 17 students and faculty from 5 colleges/universities, and 2 others who are interested in mathematics. Presenters included Mathematics Department faculty members Robert Connelly (*Geometry: Three Dimensions are Back*), John Hubbard (*The Price of Anarchy*), Mary Ann Huntley (*Analyzing Mathematics Textbooks – Beyond the “Flip Test”*), Timothy Riley (*Big Numbers, Graph Coloring, and Hercules’ Battle with the Hydra*), and Robert Strichartz (*Self-Similar Tiles with*

Fractal Boundaries).

In this photo Professor Robert Connelly is discussing three-dimensional geometry with the teachers at a recent workshop.



MATH CLUB IN 2010-11: PUZZLES, PROBLEMS, AND PIZZA

BY TIM RILEY

Math Club, our mathematics club for undergraduates, was very busy in 2010-11 under the direction of president Richard Gustavson.

New to MathClub this past year were evenings of “Puzzles, Problems, and Pizza”, whose spirit is perhaps best captured in the words of the undergraduate organizers: “Like working on interesting math problems and puzzles? Like getting to know other people who like math? Like pizza? Then come to the 5th Floor Lounge! We’ll have a problem to work on while you enjoy the company of your fellow math lovers. Stop by every other Thursday for more puzzles!”

Also in the past year, Math Club has played an increased role as a source of guidance for

undergraduates interested in mathematics, hosting panel discussions on applying to graduate school, student presentations on mathematical typesetting, and talks on undergraduate research programs from both undergraduate and faculty perspectives.

As usual, there were lectures from faculty. Highlights were the opening meeting of the year where Bill Thurston spoke on “Modular Construction of Surfaces” and the Keival Lecture given by Peter Winkler from Dartmouth University on “How Puzzles Shape our Intuition.”

Thurston’s talk was characteristically innovative. He has been developing systems for constructing surfaces made from modular interlocking shapes cut from

foam. He described the challenges involved, both mathematical and practical (“an art and a science”), and passed around examples.

To a packed auditorium, Winkler described how mathematical puzzles have entertained and intrigued us for centuries, “sometimes inspiring new areas of research, sometimes merely saving us from boredom.” He explained how some puzzles are useful in keeping the mathematical intuition we use day-to-day from running off the rails, and entertained and provoked his audience with a number of puzzles and a smaller number of solutions.

We look forward to another busy and exciting year for the MathClub.

www.math.cornell.edu/~mathclub

RESEARCH EXPERIENCE FOR UNDERGRADUATES

BY ROBERT STRICHARTZ (DIRECTOR)

For the past 18 consecutive summers, the math department has hosted an REU program, bringing talented undergraduates to Cornell to work on challenging and exciting research problems. During the summer of 2011, there were 13 students receiving support from the National Science Foundation, and a total of 20 students altogether, including international students from as far away as Hong Kong and Padua, as well as 2 Cornell students receiving support from the department. The students worked in three areas, Analysis on Fractals, directed by Robert Strichartz, director of the REU program, with the assistance of graduate student Joe Chen, Combinatorics of Triangulations, directed by Ed Swartz with the assistance of graduate student Gwyn Whieldon, a former REU student, and Generating Sets for Finite Groups, directed by R. Keith Dennis with the assistance of Dan Collins, a former Cornell math major who is now a graduate student at Princeton University.

The students in the Analysis on Fractals group continued in a tradition dating back to 1996 of undergraduates doing experimental and theoretical work in this emerging area. The experimental aspect involves writing programs to work out examples that lead to new conjectures. Then the theoretical work involves trying to prove the conjectures. Often the experiments overturn naive expectations and lead to new insights. Sometimes conjectures seem to announce themselves. Other times we are left scratching our heads... but that is also part of the fun. This summer the students

worked on four different projects: defining Laplacians on Julia sets (continuing work begun in 2008), studying boundary value problems on domains in the Sierpinski gasket (continuing work begun in 2009), trying to define the analog of the x-ray transform on the Sierpinski gasket, and developing a theory of differential forms on fractals.

The Combinatorics of Triangulations group studied various aspects of face counts of triangulations of manifolds and pseudomanifolds. This involved questions such as, “What is the minimum number of edges you need to make a solid torus? What is the most number triangles that can be used to construct a product of spheres using 15 vertices?” There were four projects in this group. One project determined all possible three-dimensional pseudomanifolds on 10 or fewer vertices, finding more than 37 million complexes and over 1500 new homeomorphism types. Another project determined all possible numbers of vertices, edges, triangles and tetrahedra that can be used to construct a variety of three-dimensional manifolds with boundary. The third group proved that certain upper bounds for the number of faces that can be used to form products of spheres are optimal. The last project involved designing a program to search PL-triangulations of manifolds and manifolds with boundary for minimal complexes. The other projects used, and are still using, this program to find many new examples.

Six students participated in the Generating Sets for Finite Groups

project, including 2 from Cornell, Thomas Brooks and Weiyan Chen. The basic problem studied was determining how generating sets of finite groups behave; the starting point, and source of motivation, being the theory of bases of finite-dimensional vector spaces as studied in linear algebra. This work followed up on Dan Collins’ 2010 Cornell senior thesis. Students performed computer experiments on small examples so that they might guess the likely statements of possible theorems. They studied a number of groups such as the dihedral, symmetric, alternating, and various linear groups over finite fields (for example, $PSL(2,p)$). One quickly finds that many of the most innocent sounding questions (e.g., “How many independent generating sets with k elements does a finite cyclic group have?”; “What is the largest size of an independent generating set for the symmetric group S_n ?”) are surprisingly complicated for the first, or cannot be solved without using the most outstanding result known about finite groups (the Classification of the Finite Simple Groups) for the second. Nevertheless the students made significant progress in a number of cases which will result in the publication of 2 or 3 papers.

We have applied to the NSF for funding to continue this program for another 5 years, with projects for next summer to be directed by Robert Strichartz, Robert Connelly, and Xiadong Cao.

www.math.cornell.edu/~reu

HONORS AND AWARDS

Laurent Saloff-Coste was elected to the American Academy of Arts and Sciences. He studies probability theory and geometric group theory. His work examines different aspects of heat diffusion on manifolds from the perspective of partial differential equations and stochastic processes, with a focus on properties that relate to the large-scale geometry of the underlying space.

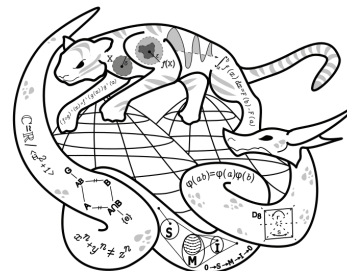


Mary Ann Huntley served on the 8-person expert panel for the “Trends in International Mathematics and Science Study - National Assessment of Educational Progress” Mathematics Comparative Study, held in Washington, DC, October 20-21, 2011. This month she will be serving on the 9-person National Council of Teachers of Mathematics (NCTM) Curriculum Task Force to consider the feasibility of a new NCTM curriculum project.



J. T. Gene Hwang was named a fellow of The American Statistical Association, the nation’s preeminent professional statistical society. Professor Hwang was recognized for his outstanding professional contributions to and leadership in the field of statistical science.

SMI BY TARA HOLM



by Casey Kelleher

The summer of 2011 was the sixth year for the NSF-funded Summer Math Institute (SMI) at Cornell. SMI encourages undergraduates from other schools to explore the world of mathematics and gives them a taste of the rigors of graduate school in mathematics. This year, the main focus was an algebra course taught at the level of Math 4340. In addition to the coursework, students worked on research projects. In their (scant!) spare time, students explored the waterfalls of Ithaca, designed the SMI T-shirt (graphic above), and practiced ultimate frisbee. More info at:

www.math.cornell.edu/~smi

MATH LIBRARY BY JILL WILSON

The Math Library in Malott has absorbed the highest circulating print materials from the Engineering Library, which transitioned to a virtual model this year. We now house high-use applied mathematics, mechanics, astronomy and theoretical physics print materials. The library has also expanded its eBook collections, most significantly from Springer, European Mathematical Society, Oxford and SIAM. EBooks from these collections continue to be frequently downloaded among the math community. Check out our EBooks tab on our main

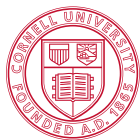
page to access these popular titles!

In general, the Math Library’s e-resources are growing in number, accessibility and use. The space in Malott added more computers and workstations on the third floor. Traffic during peak daytime hours remains high as students enjoy studying in the quiet space. Recently, the library has joined Facebook (EMPSLibraries) and Twitter (#EMPS_Libraries) to reach out to the math community, and has re-vamped the EMPS Libraries blog (blogs.cornell.edu/empsl) to promote library services and activities

among the Math, Engineering and Physical Sciences community.

Natalie Sheridan continues to provide superior service as the branch manager, assisting the math and chemistry departments with reserves, check outs and other access services. Steve Rockey, as director, remains on-site to provide expert and tailored research consultation as requested. New to the library staff this year is Jill Wilson, who provides outreach for the library and assists with collections.

mathematics.library.cornell.edu



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MATHEMATICS DEPARTMENT ENDOWMENTS & GIFTS

We are grateful to alumni, friends, and family for their generosity in supporting our endowments or providing other gifts and donations to the department.

The **Ruth I. Michler Memorial Prize**, established by Gerhard and Waltraud Michler of Essen, Germany, in memory of their daughter, provides funding for the Ruth I. Michler Memorial Prize of the Association for Women in Mathematics. The awardee spends a semester here without teaching obligations.

The **Chelluri Lecture Series** was established by Raju Chelluri's parents in his memory. Funds are used to invite distinguished mathematicians to give annual lectures.

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. Prizes are awarded to graduate students.

The **Colloquium Endowment Fund** was instituted to invite distinguished scientists to speak at the Oliver Club seminars. (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 **Faculty Book Endowment** is dedicated to providing the Cornell community with 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 to 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, please make your check payable to Cornell University, indicate the endowment, or that it is a gift in support of Mathematics, and send it to:

Department of Mathematics Endowments & Gifts
310 Malott Hall, Cornell University
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Gifts can also be made online at
www.giving.cornell.edu