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# Math Matters

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Department of Mathematics • Cornell University • Ithaca, New York

Fall 1997

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## ***Letter from the Chair, Robert Connelly***

Several noteworthy events have happened in our department in the course of the past year. Phil Lewis, Dean of Arts and Sciences, nominated Persi Diaconis for the David Duncan endowed chair in the physical sciences, previously held by Carl Sagan in astronomy. Persi, who visited the department last year from Harvard University, has joined our tenured faculty and holds a joint appointment in Mathematics and Operations Research and Industrial Engineering. We congratulate Phil for his excellent choice, and we congratulate Persi for this great honor.

Persi is one of three new faculty members this year. Yulij Ilyashenko from Moscow has started a five-year half-time faculty appointment, which will enable him to alternate between Moscow and Cornell. This semester he has been teaching first-year graduate courses on dynamical systems and measure theory, subjects in which he is one of the world's leading experts. We are very fortunate that we can all benefit from this special arrangement. Laurent Saloff-Coste of the Université Paul Sabatier has also accepted a position on our faculty as full professor, although he is on leave this year. Searches continue for two more faculty positions. We are looking for a senior-level person who is a leader in statistics, and for someone at the beginning tenure-track level in the general area of algebra, algebraic geometry, analysis, or applied mathematics.

Several innovations have been introduced in our undergraduate teaching program this year. Persi

Diaconis and Lou Billera have instituted two new senior-level courses on combinatorics, subjects in which they are leading contributors. John Hubbard has instituted a new two-semester sophomore honors sequence on linear algebra and calculus. John is also busily editing and perfecting a new book for this sequence.

Implementation of the restructuring of fall-semester Math 192 — the second course in engineering calculus — has proceeded. Formerly a large-lecture course in *both* semesters, Math 192 was taught this fall for the first time in small classes of about 25 students, enabling entering freshmen to take *any* freshman-level calculus course in this format. Many additional instructors contributed to the teaching effort, including faculty from Physics, Civil and Environmental Engineering, and Electrical Engineering. We are hopeful that this experiment will prove successful.

We recently received news from Associate Dean Bidy Martin of Arts and Sciences that, starting next year, the tenured faculty will receive a much appreciated and generous research and travel allowance. These funds can be used at the discretion of individual tenured faculty members to attend meetings, invite visitors to Cornell, and generally enhance our research environment. The department will also receive a special allowance enabling us to invite three or four visiting speakers a year for our Oliver Club colloquium talks.

A good place to learn more about our department is through our web

site at <http://math.cornell.edu/>, which is expertly maintained by Rachel Engler. Through this site visitors can learn more about the department, its members and programs, courses and colloquia. The department's annual report is also available on the web and contains a wealth of information on the department's activities. A particularly interesting feature of our site is the Oliver Club home page — maintained by Karen Vogtmann — which contains a collection of beautiful color pictures related to the Oliver Club talks. They alone are worth a visit.

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### **What do the students think of project calculus?**

“I must admit I never would have thought that I would be determining how to rescue Houdini from his watery grave or how far a fly travels between oncoming bicycles... Yes, I like [the projects and group activities]. They make me think of how to apply Calculus to real yet somewhat fantastic situations.”

“I think the group activities are helpful because they bring the class closer together, which is a much different atmosphere from my previous math courses.”

“I would definitely recommend the project sections to anyone taking Math 112. ...I enjoyed the learning experience of working in groups and found it beneficial — you learn from those around you, and they in turn learn from you.”

*(More calculus news on p. 5)*

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## Diaconis to be Awarded David C. Duncan Professorship

by Gene Hwang

Persi Diaconis was first invited to Cornell University by Operations Research and Industrial Engineering to give the Fulkerson Lecture Series in 1986. Subsequently he held a six-year appointment as A. D. White Professor at Large starting in 1992 and terminating early when he took leave from Harvard to come to Cornell as a visiting professor last year. Upon his acceptance this year of a full professorship in both Mathematics and OR&IE, Persi was recommended for the David C. Duncan Professor in the Physical Sciences endowed chair in the College of Arts and Sciences. This prestigious title, which was previously held by world-renowned astronomer Carl Sagan, will take effect in February of 1998.

Persi has had a dazzling career as a mathematical statistician who has worked, among many other fields, in the areas of probability theory and Bayesian statistics. He has often been consulted by organizations such as Scientific American, Bell Labs and the Stanford Linear Accelerator. His achievements have included receipt of the MacArthur Award, and memberships in the American Academy of Arts and Sciences and the National Academy of Sciences. Persi is also the current president of the Institute of Mathematical Statistics, which publishes the prestigious mathematical statistics journal *Annals of Statistics*.

Persi has studied and become an expert in many real-life problems, such as statistical problems related to ESP, birthday problems, gambling and fast picture generating. His famous solution to the problem “How many times should a deck of cards be

shuffled to mix it?” (*seven*) has caught nationwide attention not only in academia but also among the general public, including the audiences of numerous radio talk shows.

Persi has said that he can’t understand mathematics unless a *real* problem is involved. In fact, he has often learned an additional mathematics field in order to solve a real life problem. “Nothing delights me more than finding a real problem where, to actually understand it, I am going to have to learn a little algebraic geometry or analytic number theory,” he said in a written interview in *Statistical Science*.

Surprisingly, Persi Diaconis did not start his career as a mathematician. Beginning at the age of fourteen Persi went *on the road* as a professional magician, inventing many new tricks, some of which rely on probabilities.

## Dynkin Honored by the Université Pierre et Marie Curie

At a special colloquium in his honor — and devoted in its entirety to a discussion of research based on his work — Professor Eugene Dynkin was awarded the title of Docteur Honoris Causa by the Université Pierre et Marie Curie in February. Prof. Dynkin was only twenty years old when his work on the theory of Lie groups led him to invent the famous “Dynkin diagrams,” which are now in constant use both by algebraists and theoretical physicists. In the years that followed, he obtained many further fundamental results pertaining to the theory of Lie groups; however, he began devoting himself more and more to the theory of probability. He laid the foundations

Ultimately he returned to school because he wanted to read Feller’s book on probability. After completing a bachelor’s degree at the College of the City of New York in two years and a Ph.D. at Harvard in three, Persi went on to teach at Stanford. When “Mother Harvard called” in 1987, he returned to Harvard, but as a professor this time.

Since arriving at Cornell, Persi has astounded audiences by delivering colorful and entertaining academic lectures at the amazing frequency of a lecture every one or two weeks. The unique quality of these lectures — which have attracted large audiences of undergraduate students, graduate students and faculty from all parts of the university — are a reflection of the life that he has lived. We are pleased to be able to welcome him to the Cornell community.

for the general theory of Markov processes, a mathematical concept which represents an appropriate model for most of random phenomena and constitutes the basis on which contemporary research in the field of probability theory has developed. His books on Markov processes, translated into many languages, have had considerable influence. Nevertheless, he has not confined himself to this special area of study: he has discovered fundamental ideas in an extraordinary variety of fields which, to this day, continue to stimulate research by numerous specialists. We would like to congratulate Prof. Dynkin; this honor is richly deserved.

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# Undergraduates Gain Research Experience at Cornell

by Robert Strichartz

During the summer of 1997, the department held its fourth Research Experiences for Undergraduates (REU) program. Sponsored by the National Science Foundation, this program brings talented undergraduates from across the nation to work on research projects directed by Cornell faculty and visitors. This year the department was fortunate to have an additional Cornell grant (President's discretionary funding), which enabled an unusually large number of visitors to assist the program. The eleven student participants came from brand-name (Harvard, Yale) and not so brand-name (University of Missouri at St. Louis) schools, and included two from Cornell — Harold Fox and Jonathan Rynd. The Cornell faculty who directed projects were Richard Ehrenborg, John Hubbard, Kevin Pilgrim, Margaret Readdy and Robert Strichartz. Cornell graduate student Alexander Teplyaev and visitors Adam Epstein (SUNY at Stony Brook), Rick Kenyon (Université de Lyons) and Yang Wang (Georgia Tech) also participated. Several research papers are in the process of being written based on the work accomplished, co-authored by student and faculty participants.

The students in the program devoted most of their time to individual research problems, but they also experienced giving talks based on their research to each other, the public, and the press. (Articles about the program were published in both the *Ithaca Journal* and the *Cornell Chronicle*.) The program also included a lecture series, the Smorgasbord Seminar (open to the

public), in which the broad spectrum of research interests of the department's faculty were showcased. True to the name, the talks were followed by gourmet refreshments, including fresh locally grown strawberries.

The student research projects fell into three general areas: (1) analysis on fractals; (2) dynamics of analytic mappings; and (3) combinatorics of polytopes. Within these areas, students worked either individually or in small groups. Some of the work involved a lot of computer programming, either to implement known algorithms or to explore complex examples in order to generate and test conjectures. Many of the students also participated in the more traditional research activities of finding proofs.

The students working on analysis on fractals were directed by Robert Strichartz, but often found that graduate student Sasha Teplyaev and visitors Rick Kenyon and Yang Wang gave the best advice. They studied the analog of differential equations

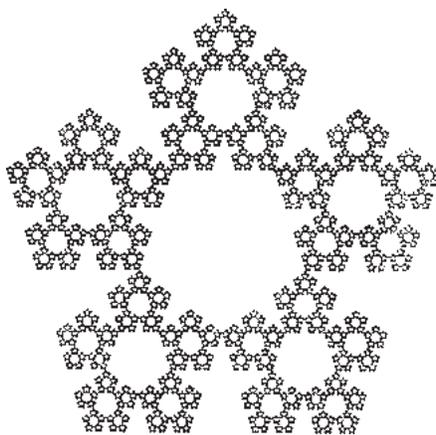


Figure 1

on a class of fractals, including the pentagasket (Fig. 1). This theory, originated by Jun Kigami (currently a visiting professor in the department),

has the advantage of allowing very explicit calculations to be made. The students worked out the details of this theory for a large class of new examples and discovered some new and surprising results. A different project involved self-similar tiles,

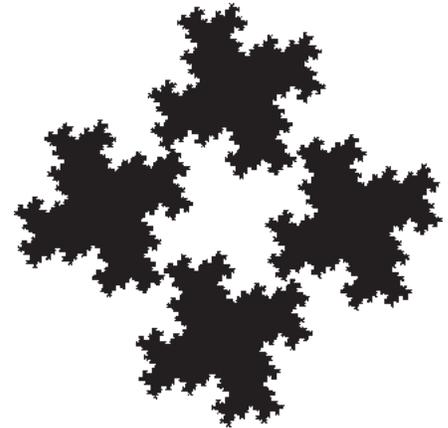


Figure 2

such as the fractal Red Cross (Fig. 2), which tile the plane by translation and have the property that several translates of the tile combine to form one enlarged tile (in the case of the fractal Red Cross, five tiles combine to form a tile that is rotated and enlarged by the factor  $\sqrt{5}$  in each direction). The project implemented an algorithm to compute the dimension of the boundary of the tile.

Students working on dynamics of analytic mappings were directed by Kevin Pilgrim, Adam Epstein and John Hubbard. One project involved a census of dynamically interesting rational maps, which had been begun the previous summer by other students of Kevin Pilgrim. This summer's work involved finding all conjugacies between maps on the list. The completed census has no duplications and will soon be available on a web site. Another project involved studying universal relationships

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# Travels With Lang: A Math Club Excursion

by Michael G. LaRocque

The first official excursion of the Cornell Undergraduate Math Club happened this past October with a road trip to the AMS South-Eastern Sectional Conference, funded by the SAFC (Student Activities Finance Committee). The conference, which was held in Atlanta, GA, this year, is an annual event attracting mathematicians from around the region to discuss new topics of research, share ideas, and keep abreast of the field.

The pilgrimage was made by Math Club President Carly Klivans, guest speaker Joe Miller (a graduate student at Cornell) and myself, the secretary. A rented Dodge Neon, a copy of Lang's *Algebra* (containing in its 900(!) pages all the mathematics one could ever want to know), and a

fervent interest in mathematics were all that was necessary to get this band on the road, and to keep us moving for 18 hours straight between departure and destination.

Once at the conference, we attended dozens of talks on various topics ranging from the solution of the equicordal point problem (Marek Rychlik) to *Tilings of the Plane* (Charles Radin). We were sure not to miss the refreshingly clear and accessible presentation given by department Chair Bob Connelly on *Minimal Translation Covers*, based on some work done with former Cornell visitor Karoly Bezdek, who missed the conference due to illness. We also made a special note to see Professor Cliff Earle's delightful "commercial for the merits of quasi-conformal mapping".

Exposure to such active branches of research mathematics was both invigorating and enticing. A good time was had by all, and despite a modest aversion to Waffle Houses acquired by the participants, the trip was decidedly a smashing success. Hopes are high that this will become a Math Club tradition, enjoyed by uncountably many future generations of aspiring mathematicians. (Copy of Lang not necessarily included.)

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## REU Program

(continued from p. 3)

between derivatives at periodic points for quadratic rational maps  $\left(\frac{az^2 + bz + c}{ez^2 + fz + g}\right)$  on the Riemann sphere, generalizing results of John Milnor. The project directed by John Hubbard involved an ambitious attempt to find the analog of the Mandelbrot set for a class of mappings (Henon maps) in two complex variables. The computational approach requires the ability to find all roots of certain polynomial equations of very high degree.

Richard Ehrenborg and Margaret Readdy directed students working on combinatorics. A polytope is just the  $n$ -dimensional analog of a convex polygon. A polytope has a certain number of vertices, edges, faces, and

so forth, but also a certain number of vertices in edges, vertices in faces, edges in faces, and so forth. All this information is recorded in the flag  $f$ -vector. Combinatorists have discovered that a certain noncommutative polynomial, called the **cd**-index, which is derived from the flag  $f$ -vector, actually gives a better approach to understanding the same information. The student projects succeeded in analyzing the behavior of the **cd**-index under two basic geometric operations: (1) Cartesian product of polytopes, and (2) slicing off an  $i$ -dimensional face from a  $d$ -dimensional polytope.

The summer of 1998 will bring another group of students to Cornell for our fifth REU program. Details of the program are still being arranged, but information should be available at our web site by the end of 1997,

### Congratulations!

Jade Vinson, who participated in the REU program in 1996, working with Robert Strichartz and Karoly Bezdek, is the 1997 recipient of the Morgan Prize for undergraduate research. This is a national prize, administered jointly by the AMS, MAA and SIAM. Much of the research for which he received the award was done at Cornell. Vinson completed his undergraduate work at Washington University in St. Louis and is now a graduate student at Princeton.

with applications due at the end of February 1998. The NSF sponsors about 20 of these programs nationwide, and students are encouraged to apply to several programs since the selection process is competitive. Research should be part of the experience of every senior mathematics major, and the summer is a good time to gain this experience without the distraction of taking all those courses!

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# Calculus Tries New Approach with New Syllabus

by David Henderson

A committee consisting of Marshall Cohen (chair), Kevin Pilgrim, Maria Terrell, David Henderson and Steve Chase (ex officio) formed last spring to study and evaluate Math 111-112 — the department's main calculus sequence for non-physical science majors — and to recommend changes. The committee's work began with a new statement of purpose for the courses which reads in part:

*...Math 111 and 112 aim to provide, to students with little or no prior exposure to calculus, the knowledge that calculus is useful, in that its applications to the physical, biological and social sciences have shaped our world, and beautiful, in that it represents a breathtaking attempt of the human mind to capture the infinitely large and the infinitely small.*

*These courses seek to provide basic understanding, technical skills and sample applications in various fields for the very broad range of students who take them. Topics are studied (as appropriate) by analytic, numerical and graphical methods.*

The committee then searched for a new text that appeared to fulfill these purposes, deciding on James Stewart's *Calculus: Concepts and Contexts* (adopted this semester in both Math 111 and 112). The new book, though one of the "reform calculus" texts, allows for a variety of teaching approaches but emphasizes conceptual understanding through geometric, analytic, and numerical presentations and experiences.

The usual rules for differentiation are not introduced in Math 111 until the sixth week of the semester. In the first five weeks the concepts of differentiation (and anti-differentiation) are

introduced through the usual definitions but also through geometric, graphical, and numerical contexts. Before learning the rules for differentiation of functions, students learn to start with a graph of a function and to sketch the graph of its derivative and, vice-versa, to start with the graph of the derivative and sketch a graph of the function (given an initial value).

Taking advantage of the flexibility of the new text, the Math 111 czar, David Henderson, allowed the 19 instructors (faculty, visitors and graduate students) a fair amount of leeway as to how they taught. He wanted to allow the visitors to try things they have been using at their home institutions and to encourage faculty and graduate students to try out different teaching strategies (with help, if needed). This semester 75% of the student's grade was determined by two course-wide Prelims and a Final Exam, which reflect the new text, and the remaining 25% of the grade was left to the instructor's choice, with the approval of the czar. What instructors have done runs the

gamut of quizzes, a third prelim, projects (individual and group), portfolio problems (extensive problems involving more than one draft), a paper (essay or library research), or just ordinary homework. In almost all cases, instructors used a combination of two or more of these assessment methods.

In addition, we are currently conducting an in-depth evaluation of the course and its students in order to better understand such questions as:

- Who is taking the course and what are their needs?
- What is the affect of previous experience with calculus in high school?
- How do graphing calculators affect the learning?
- Do students find projects and portfolio problems helpful?
- How did the students respond to the new emphases and orderings of topics?

The results of this evaluation will be reported when completed.

## Project Calculus Continues to Evolve

by Maria Fung

In its sixth semester this fall, project-oriented calculus was offered in three lectures of Math 112, taught by experienced graduate students Maria Fung, Chris Hruska and Bob Milnikel. In concert with the modified syllabus and textbook of Math 112 (and Math 111), the project-oriented lectures of Math 112 have undergone some significant changes. This semester students have worked in class mostly on group exercises provided by the Instructor's Guide for the new text —

Stewart's *Calculus: Concepts and Contexts*. In addition, two of the three previously used major projects have been replaced with new ones. Materials provided by the Ithaca College and the New Mexico State project books, as well as those created and collected by Harel Barzilai (Ph.D. Aug. 1997), give instructors a variety of choices in how to present new material through discovery in a cooperative-learning environment and how to supplement methods of traditional lecture with interesting applications of calculus.

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# Engineering Restructuring Plans Become a Reality

by Robert Connelly

Last year we were given the green light to go ahead with our plan to restructure the fall-semester teaching of Math 192 — the second course in engineering calculus. The proposal for this reorganization was cosponsored with the Department of Theoretical and Applied Mechanics in the Engineering School, especially with the help of Jim Jenkins, the chair. Thanks to the approval of the Deans of Arts and Sciences and the Dean of Engineering, we have been able to put this plan into action. In a departure from the previous large-lecture system, where students attended lectures of 200 students or more, Math 192 was taught for the first time this fall in small lectures of about 25 students.

By teaching engineering calculus in smaller groups, we hope to provide freshmen with the opportunity to master and appreciate the material,

while also promoting an environment that will bring students and faculty closer together. To realize this goal, we needed to provide instruction for approximately 12 additional lectures. Four of those lectures are being staffed by the Mathematics Department. We hired an additional H. C. Wang assistant professor to allow us to cover the same courses as before. Four new lectures are being taught by additional instructional TAs, allowing some of the best graduate students from Mathematics and other departments to gain valuable teaching experience. The remaining four additional lectures are being taught by faculty recruited from departments other than Mathematics or T&AM. This year these faculty include Peter Stein from

Physics — who is also the dean of faculty — Paul McIsaac from Electrical Engineering, and Christine Shoemaker from Civil and Environmental Engineering.

The restructuring of Math 192 promises to be an interesting and exciting three-year experiment. The students will have a variety of experiences with instructors who would not have otherwise had the opportunity to teach freshmen calculus. Yet these faculty have been chosen expressly because they have the mathematical background to provide top quality instruction. Calculus is a common denominator for many people in many fields, and we have found a way to bring us all together.

## Route 81 Conference Hosted at Cornell This Year

by Hal Schenck

On October 4, 1997, the department hosted the 5th annual Route 81 conference on Commutative Algebra and Algebraic Geometry. The inaugural conference was organized by Anthony Geramita at Queens University, and it has also been held at Syracuse University and SUNY at Albany in the past. This year's conference was organized by Mike Stillman, Mark Gross, and Hal Schenck. Talks were held in Kaufmann Auditorium, and about forty mathematicians attended. The speakers and topics were:

Will Traves, MIT: *Nakai's conjecture for varieties smoothed by normalization*

Hara Charalambous, SUNY at Albany: *Betti numbers of monomial ideals*

Alex Martsinkovsky, Northeastern University: *Linkage of modules*

Irena Peeva, MIT: *Subspace arrangements and resolutions*

Vesselin Gasharov, MIT: *Rationality for generic toric rings*

Keith Pardue, Queens University: *Maximal Betti number problems*

The conference concluded with dinner at the Thai Restaurant and a party at the home of Mark Gross and Rachel Engler.

### Contribute!

*Math Matters* is always looking for interesting articles for future editions. If you have any information or questions relevant to the mathematics community, we want to hear from you!

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## The Oliver Club: Lectures in Mathematics

by Karen Vogtmann

Each week the department invites a distinguished research mathematician to Cornell to present a lecture in the Oliver Club. Speakers are asked to aim their talks at a general audience of mathematicians — including graduate students and faculty in diverse fields — and provide history, background and motivation for the problems they discuss. All members of the mathematical community at

Cornell are warmly encouraged to attend. The Oliver Club is held on Thursday afternoons from 4:15 to 5:15 in 328 White Hall, preceded by tea at 3:45 in the department lounge and often followed by a dinner held in honor of the speaker.

This semester speakers visited from Brandeis University (Peter Heinzner), the University of California at Irvine (Peter Li), the State University of New York at Stony Brook (Mikhail Lyubich), Northwestern University

(John Franks), Université Paul Sabatier in Toulouse, France (Laurent Saloff-Coste, who will be joining the department next year), and the Steklov Institute in Moscow (Sergei Artemov, who is currently visiting Cornell). Also speaking were Cornell mathematicians returning from leaves of absence — Lou Billera, from a peripatetic sabbatical, and José Escobar, from Stanford — and new faculty member Xavier Buff (from University of Paris).

Each week, a poster advertising the Oliver Club is published on the World Wide Web at the address <http://math.cornell.edu/~vogtmann/oliver>. The poster contains the speaker's name and affiliation, the title of the talk, a short abstract describing the content of the talk, and a graphic image relevant to the talk. At the bottom of the Web page are links to posters from all recent Oliver Clubs. We invite you to browse these pages for a fascinating glimpse into several currently active areas of mathematics.

## Plans Developed for Departmental Move to Malott Hall

by John Smillie

The Mathematics Department has been planning to move from its cramped quarters in White Hall to new quarters for quite some time. Over the years different plans have been considered but the current plan is to move to Malott Hall after the Johnson School of Management moves out. We expect to move in the Summer of 1999.

In April, the university hired the Ithaca architectural firm of Downing and Barradas to prepare preliminary plans. These plans are being used by administrators in the College of Arts and Sciences to estimate the costs of the project and do not necessarily represent what will be built. At the same time the existence of plans makes the project seem a little more real.

The biggest change for the department will be a much larger space for the library. Our current library space in White Hall is much too small for our collection. Moving to Malott will give us more shelf space and more study area as well as insuring

that we won't have to store part of our vital collection of books at a remote location.

Other benefits include more space for our graduate students and the Mathematics Support Center. We also expect to have a more efficient layout for our administrative staff. One consequence of this is that we will be able to present a less confusing and more welcoming face to students and other people having business with the department. We look forward to having a large departmental lounge which will provide a pleasant space for faculty, graduate students and undergraduate majors to congregate, as well as providing a location for departmental receptions and teas.

The next step is to have the proposed budget approved by a high level university committee. This budget describes in broad terms where the money for the project will be coming from and how it will be spent. The dean has already earmarked some Arts College funds for the project and is optimistic that the proposed budget will be approved.

### Have you visited our web site?

<http://math.cornell.edu/>

The Cornell Mathematics Department home page offers links to the department's Annual Report, faculty and graduate student home pages, information on the graduate and undergraduate programs, seminar information — such as the Oliver Club posters — and course-related information. New links are added all the time, so browse around!

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## Awards and Honors

### Clark Distinguished Teaching Award

Recipients of the Clark Award have demonstrated their devotion to teaching, student counseling and development of new courses and new methods of student instruction. Among the very best teaching assistants in the college, **Hal Schenck** was presented with the Clark Award at a College of Arts and Sciences convocation in 1996-97 honoring distinguished faculty and students.

### Eleanor Norton York Award

The Eleanor Norton York Award was established by friends of Eleanor York, who died of cancer in 1993. Each year one student in the Mathematics Department and one student in the Astronomy Department, in which Eleanor was employed, are selected to receive this award. The recipients are chosen from those in the middle of their graduate education on the basis of their achievements to date and to encourage them to have even more success in the future. The 1996-97 Eleanor Norton York Awards went to **Jeffrey Mitchell** in Mathematics and jointly to **Katherine Jore** and **Tyler Nordgren** in Astronomy.

### Hutchinson Fellowship

The Hutchinson Fellowship is awarded to mathematics graduate students who have been outstanding in their work as teaching assistants or as students in the graduate program. The award provides one semester of relief from teaching to allow the students to work on their thesis problems. Accordingly, it is given to students who have completed three years of study and are not in their final

year. The 1996-97 recipients were **Sudeb Mitra** and **Nikhil Shah**.

### Ithaca High School Senior Prize

Each year for the past several years the department has awarded a prize to a senior at the Ithaca High School who has demonstrated substantial interest and significant native ability in mathematics. This prize is funded substantially by contributions solicited from various faculty. Typically, the high school selects a short-list of students, whom one or two of our faculty interview. As it was very difficult to select just one person, we awarded two prizes in 1996-97: one to **Benjamin Pollock** and one to **Rajni Raman**. Both of these young and able students received several different awards, not just for pure academics. They each had different strengths that appealed to us: Rajni has a lively, broad view of mathematics and its applications as a whole; and Ben has a nimble and lively mind, having the ability to see unusual ways of viewing a problem. We are actually quite excited because both Ben and Rajni decided to come to Cornell for their undergraduate study.

### Kieval Prize

The Kieval Prize was established in 1934 by Harry S. Kieval '36, a long-time benefactor of the Mathematics Department. Dr. Kieval left an endowment, upon his death in 1994, to continue the Kieval Prize, as well as an honorarium for visiting lecturers and an additional endowment to provide financial aid for undergraduate scholarships in mathematics. The Kieval Prize provides an annual award to an

outstanding graduating senior mathematics major. The recipient of this award is selected by the Mathematics Department's Honors Committee on the basis of academic performance, the quality and variety of mathematics courses taken and faculty recommendations. The co-winners of the 1996-97 prize were **Jeremy Bem** and **Robert Kleinberg**.

### Merrill Presidential Scholar

Merrill Presidential Scholars are graduating seniors who are honored for leadership and scholarship. As a tribute to the importance of teaching in shaping academic success, Merrill Scholars recognize those secondary school teachers who provided inspiration during their high school years. They also cite Cornell faculty who have made the most significant contribution to their education. The Merrill Scholar in 1996-97 was math major **Robert Kleinberg**.

### Putnam Fellowships

**Jeremy Bem** and **Robert Kleinberg**, who both graduated Summa Cum Laude in mathematics from Cornell in May of 1997, were named Putnam Fellows last year, after finishing among the top six individual competitors at the 57th annual William Lowell Putnam Mathematics Competition. Both scored between 76 and 98, the highest range of scores that year. Putnam organizers do not announce individual scores for the six Putnam Fellows. The Putnam competition, considered the Olympics of college mathematics, is so difficult that more than half of the 2,407 competitors scored five or fewer points of a possible 120, and a third scored zero.

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## Faculty Publications

**Richard Durrett's** *Stochastic Calculus: A Practical Introduction* (CRC Press, 1996) is a graduate text which offers a user-friendly introduction to Brownian motion, stochastic integration, stochastic differential equations, diffusion processes, and related partial differential equations. These topics have applications ranging from pricing options on Wall Street to studying harmonic functions in domains in Euclidean space and on manifolds.

**David Henderson's** *Experiencing Geometry: On Plane and Sphere* (Prentice Hall, 1996) invites readers to explore the basic ideas of geometry beyond the formulation of proofs. The text conveys a distinctive approach, stimulating readers to develop a broader, deeper understanding of mathematics through active participation — including discovery,

discussion and writing about fundamental ideas. It provides a series of interesting, challenging problems, then encourages readers to gather their reasonings and understandings of each problem and discuss their findings in an open forum.

**David Henderson's** *Differential Geometry: A Geometric Introduction* (Prentice Hall, 1998) is the only text that introduces differential geometry by combining an intuitive geometric foundation, a rigorous connection with the standard formalisms, computer exercises with Maple, and a problems-based approach. Starting with basic geometric ideas and proceeding to the analytic and algebraic formalisms, this text provides a common and accessible foundation on which all of the various formalisms of differential geometry can be based and from which they can be assessed.

The text uses basic intuitive geometry as a starting point, which makes the material more accessible and the formalism more meaningful. Topics are based on and introduced through 55 core problems. Working through these problems provides students with a deeper and personal understanding of the material. Includes 19 computer projects for use with Maple.

**Dexter Kozen's** *Automata and Computability* (Springer-Verlag, New York, 1997) is an undergraduate textbook, designed as a well-placed first course in the theory of computation, that introduces students to the basic models of computation and shows how to develop their rich and varied structure. The text leads students all the way from the basic results and methods of the classical theory of automata and formal languages through several supplementary chapters covering more advanced concepts.

The first part of the book is an engaging lesson in finite automata and their properties, including an insightful treatment of state minimization and Myhill-Nerode theory. Then, with pushdown automata providing a broader class of models, Kozen develops the theory of context-free languages, including a special section on parsing techniques. Turing machines are introduced in the remaining chapters, and the book culminates in a unique perspective on effective computability, decidability and Gödel's incompleteness theorem.

Plenty of exercises, ranging from the easy to the challenging, finish off the book to make *Automata and Computability* an ideal first course for students of theoretical computer science.

## Awards and Honors

(continued from p. 8)

Bem and Kleinberg were both exceptional mathematics students who, although enrolled as undergraduates, started their mathematics coursework at Cornell at the graduate level. Bem scored a perfect 42 at the annual International Mathematical Olympiad in Hong Kong four years ago, leading the American team to a national title. He graduated early from Cornell. Kleinberg graduated in the top five percent of the Class of 1997. He won a Goldwater Scholarship two years ago and most recently was named a 1997 Merrill Presidential Scholar. Kleinberg is currently enrolled in the doctoral mathematics program at MIT.

### Sloan Doctoral Dissertation Fellowship

The Sloan Doctoral Dissertation Fellowship awards a stipend plus tuition for one academic year, freeing recipients from other duties to complete their dissertation. Recipients may not be employed as teaching or research assistants; they may not hold other substantial fellowships; and they must have clear and realistic plans for completing the dissertation in the fellowship year. Each year the department submits three nominations to the Sloan Foundation. **Alexander Teplyaev** was awarded with a fellowship in 1996-97.

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## Comings and Goings...

**Reyer Sjamaar** has been appointed for another three-year term as assistant professor. **Jianguo Cao** resigned to accept a position at Notre Dame. The tenured faculty enthusiastically recommended that **Mark Gross** be promoted to associate professor with tenure, effective in fall 1997. Mark has been a very important part of our department, and we look forward to having him as a permanent member of our faculty.

**Roger Livesay**, who has been a dedicated and valued member of our department for 40 years has retired. Roger is a distinguished topologist who has done pioneering work on involutions of the three-sphere with a finite number of fixed points as well as fixed-point free involutions of higher-dimensional homotopy spheres. He has been a highly valued and distinguished member of our department, and the tenured faculty unanimously recommended that Roger be granted emeritus status.

Sadly, Professor Emeritus **Wolfgang Fuchs** died on February 24, 1997, at the age of 81. He was a pleasant, friendly and generous person. Wolfgang had a long and distinguished career that included a term as department chair from 1969 to 1973. His memorial service, held at Anabel Taylor Hall on March 8, 1997, was attended by family, friends and colleagues. We all miss him.

### New Faculty

**Xavier Buff**, H. C. Wang Assistant Professor, received his Ph.D. in mathematics in 1996 from the Université de Paris-Sud (Orsay), where he spent the 1996-97 academic year as a researcher and teacher. His area of expertise is in dynamical systems.

**Persi Diaconis**, Professor, received his Ph.D. in mathematical statistics from Harvard University in 1974. Prior to his appointments with Mathematics and Operations Research and Industrial Engineering at Cornell, he was a professor of mathematics at Harvard. In addition to many honors and awards received during a distinguished career, he is a member of the National Academy of Sciences. Professor Diaconis is a mathematical statistician who works in probability theory and Bayesian statistics.

**Yulij Ilyashenko**, Professor, received his Ph.D. in mathematics from Moscow State University in 1969. He joins us for a five-year, half-time appointment. He will also remain a professor in mathematics at Moscow State University, vice-president of the Moscow Mathematical Society, and dean of the Superior Mathematics College of the Independent University of Moscow. His area of expertise is in dynamical systems.

**Laurent Saloff-Coste**, Professor, received his Ph.D. in mathematics from the University of Paris VI in 1983. Most recently, he served as director of research of the Laboratoire Statistique Probabilité at the Université Paul Sabatier in Toulouse, France. Prof. Saloff-Coste is on leave during the 1997-98 academic year.

**Jiaping Wang**, H. C. Wang Assistant Professor, received his Ph.D. in mathematics from the University of California at Irvine in 1994. He was hired during the 1995-96 academic year, but took a year's deferment to spend at MIT. Prof. Wang was a Szegő assistant professor at Stanford University, 1994-1996. His area of research is geometric

analysis and partial differential equations.

**Daniel Wise**, H. C. Wang Assistant Professor, received his Ph.D. in mathematics from Princeton University in 1996. Professor Wise was also hired in the 1995-96 academic year, but took a year's deferment to accept a visiting position at the University of California at Berkeley. His research interests include geometric group theory, residually finite groups, CAT(0) spaces and 3-manifolds.

### Visiting Program Faculty

|                     |               |
|---------------------|---------------|
| Richard Cleary      | academic year |
| Kenneth Constantine | academic year |
| Karl David          | academic year |
| Kenneth Ross        | academic year |
| Hal Schenck         | academic year |

### Visiting Faculty

|                  |               |
|------------------|---------------|
| Jun Kigami       | academic year |
| Sergei Kuznetsov | academic year |
| Subhashis Nag    | fall 1997     |
| Sze-Man Ngai     | spring 1998   |
| Margaret Readdy  | academic year |
| Daina Taimina    | fall 1997     |
| Vladimir Veselov | academic year |

### Leaves

|                      |               |
|----------------------|---------------|
| Marshall Cohen       | spring 1998   |
| R. Keith Dennis      | academic year |
| Mark Gross           | spring 1998   |
| John Guckenheimer    | academic year |
| Peter Kahn           | academic year |
| Harry Kesten         | fall 1997     |
| Laurent Saloff-Coste | academic year |

### Support Staff Changes

A number of staff changes have occurred during the past six months. In late summer, the department received approval to hire an administrative assistant to provide support for our undergraduate majors program. In addition, this employee

will be the primary departmental receptionist and will oversee our annual faculty recruitment effort. **Cheri Farnsworth** accepted this position, and began working in the department in early November. Cheri comes to us from the College of Arts and Sciences Academic Advising Center, where she has had experience working with undergraduate students. We welcome her gracious manners and calm demeanor, and are confident our undergraduate mathematics majors will be well taken care of.

Long-time graduate field coordinator **Shirley Allen** has decided to retire effective with the new year, 1998. During her 12 years in this position, Shirley has been a fearless advocate for the graduate students. By virtue of her innate kindness and good sense, she has naturally taken on the role of second mother to countless students in our department.

We wish her good luck and happiness in her new role as retiree. Shirley and her husband are planning a move to North Carolina next spring. They are already busy making plans to build their new home.

**Donna Smith** will take over the position of graduate coordinator when Shirley leaves. Donna officially started in this position on December 1, 1997, so she will have a few weeks of crossover training with retiring GFC, Shirley Allen. Donna spent the past 11 years at the Theory Center prior to its downsizing and reorganization earlier this year. She was hired there in 1986 as a secretary and was promoted to conference coordinator for external relations in 1988. As conference coordinator, Donna was responsible for overseeing special events at the Theory Center, including major conferences, training workshops, lecture series and tours. She

was also in charge of program coordination for CTC's Research for Undergraduates Program (SPUR). Prior to working at the Theory Center, Donna was a secretary in the Department of Theater Arts. She comes to us with excellent organizational and interpersonal skills.

**Rachel Engler** will be leaving the department on January 2nd to go to England with her husband, Mark Gross. For the past year she has worked as the department's first full-time, on-site computer support person. During that time, she designed and established the department's web pages. Rachel has been an able and trusted systems administrator, and she will be missed. We are currently in the process of interviewing for this position, and I look forward to announcing his/her name to you in the next newsletter.

## Yes, I would like to help support the Mathematics Department endowments with my donation of \$ \_\_\_\_\_ for:

**The Mathematics Faculty Book Fund.** Provides the Cornell Community with immediate access to one of the world's finest assortments of mathematics books and publications by enriching the collection of the Mathematics Library.

**The Mathematics Colloquium Endowment Fund.** Instituted to invite distinguished scientists to speak at Cornell. Major contributions come from faculty who teach extra courses and donate their earnings to the fund.

**The Eleanor Norton York Award in Astronomy and Mathematics.** Established in honor of Eleanor Norton York, a valued Astronomy Department employee who worked closely with graduate students. Recognizes outstanding graduate students in Astronomy and Mathematics with an annual prize.

**The Israel Berstein Memorial Fund.** Honors the memory of a former Mathematics Department professor with an initial donation from his sister, Gita Fonarov. Funds annual awards for deserving graduate students in the fields of topology and/or geometry.

**The Logic Endowment.** Recently established by a donation from a former Cornell undergraduate. Seeks to actively support promising logic students in the areas of institutional memberships and travel expenses, for Association for Symbolic Logic meetings and events, and other activities in the field of logic.

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## **From the Editor...**

*Math Matters* is published through a joint effort by members of the Mathematics Department. Special thanks to:

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Michelle M. Klinger  
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