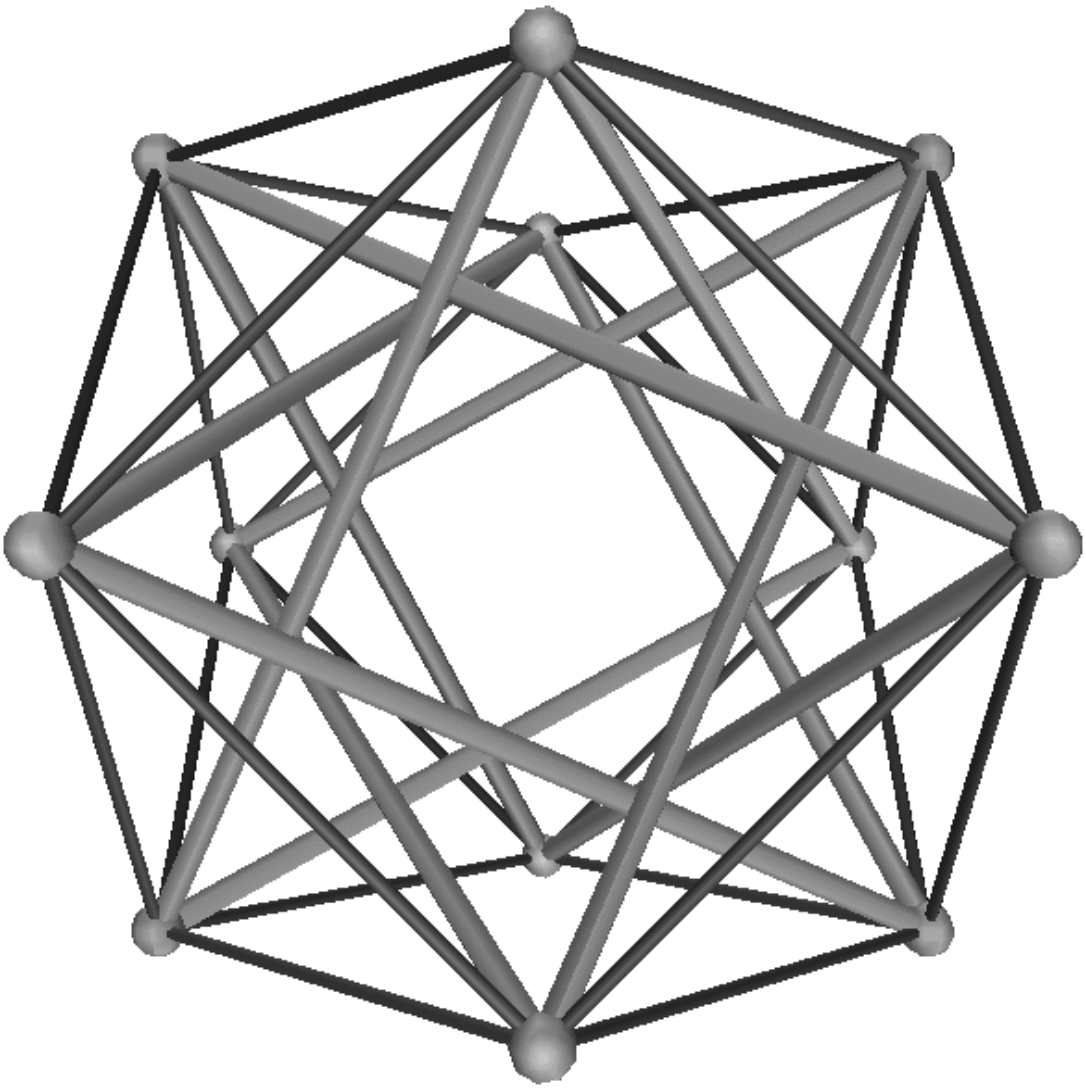
Department of Mathematics

Cornell University

Annual Report 1998–99



The image on the cover is taken from a catalogue of several hundred "symmetric tensegrities" developed by Professor Robert Connelly and Allen Back, director of our Instructional Computer Lab. (The whole catalogue can be viewed at http://mathlab.cit.cornell.edu/visualization/tenseg/tenseg.html.) The 12 balls represent points in space placed at the midpoints of the edges of a cube. The thin dark edges represent "cables," each connecting a pair of vertices. If two vertices are connected by a cable, then they are not permitted to get further apart. The thick lighter shaded diagonals represent "struts." If two vertices are connected by a strut, then they are not permitted to get closer together.

The examples in the catalogue — including the one represented on the cover — are constructed so that they are "super stable." This implies that any pair of configurations of the vertices satisfying the cable and strut constraints are congruent. So if one builds this structure with sticks for the struts and string for the cables, then it will be rigid and hold its shape.

The configurations in the catalogue are constructed so that they are "highly" symmetric. By this we mean that there is a congruence of space that permutes all the vertices, and any vertex can be superimposed onto any other by one of those congruences. In the case of the image at hand, all the congruences can be taken to be rotations.

Department of Mathematics

Annual Report 1998–99

Year in Review:
Mathematics Instruction
and Research

Cornell University
first among private institutions
in undergraduates who later earn Ph.D.s.

Ithaca, New York, the home of Cornell University, is located in the heart of the Finger Lakes Region. It offers the cultural activities of a large university and the diversions of a rural environment.

Mathematics study at Cornell is a unique experience. The University has managed to foster excellence in research without forsaking the ideals of a liberal education. In many ways, the cohesiveness and rigor of the Mathematics Department is a reflection of the Cornell Tradition.

Robert Connelly, chair
Department of Mathematics
Cornell University
320 Malott Hall
Ithaca, NY 14853-4201

Telephone: (607) 255-4013
Fax: (607) 255-7149
e-mail: math@math.cornell.edu

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The Year in Review 1998–99

This year we were very pleased to hire two excellent people for our tenure/tenure-track faculty, Professor Michael Nussbaum from the Weierstrass Institute in Berlin, Germany, and Assistant Professor Yuri Berest from the University of California at Berkeley. Professor Nussbaum is a leading statistician in the field of nonparametric function estimation. We had been looking for a top-rate statistician for some years since Professor Larry Brown left, and we are pleased that Professor Nussbaum decided to join us. Professor Berest is very highly regarded in the fields of partial differential equations, mathematical physics and algebra.

We were not able to hire any new H.C. Wang Assistant Professors this year, but for the 1999–2000 academic year, we will have two new H.C. Wang Assistant Professors who were hired during the 1997–98 academic year, but who deferred their start date to July 1, 1999. Peter Topping, who works on the theory of partial differential equations and differential geometry, replaces Miklós Erdélyi-Szabó. Vlada Limic is an expert in Lie algebras and Lie groups. She replaces Noel Brady, who left June 30, 1998.

This year the department benefited from the efforts of Professor Stephen Chase as associate chair, Professor Dan Barbasch as director of graduate studies and Senior Lecturer Tom Rishel as director of undergraduate teaching. In addition, Professor Lou Billera served as chair of the computer committee, Allen Back as director of the instructional computer lab, Professor Oscar Rothaus as director of math majors, Professor Birgit Speh as chair of the faculty search committee and Professor Anil Nerode as chair of the curriculum committee.

We congratulate Professor Roger Farrell on his retirement and subsequent appointment as emeritus professor beginning July 1, 1999. During the past several years he has worked hard to upgrade the content of Mathematics 171 (*Statistical Theory and Application in the Real World*). As a result, this course is quite popular and continues to evolve. Roger has served the department very well over the many years that he has been at Cornell and we are all in his debt.

This was the second year of the originally planned three-year experiment in the restructuring of our teaching of engineering calculus. We were assisted in teaching Math 193, Math 191 and Math 192 during the fall 1998 semester by several faculty from throughout the campus, by additional instructional teaching assistants, and an additional H.C. Wang Assistant Professor in mathematics. We are happy with the performance of all these people, and we feel that the experiment is going well. In addition, it has been decided that the restructuring will be continued essentially in its present form for at least two more years, for the fall of 2000 and the fall of 2001.

Seven of our regular faculty members were on leave for all or part of the 1998–1999 academic year. Professor Mark Gross spent the academic year at the University of Warwick, England. Mark has since resigned from Cornell effective July 1, 1999, and has taken a permanent position at Warwick. Professor Persi Diaconis spent the academic year at Stanford University. Professor Moss Sweedler spent the academic year at the National Security Agency, and Professor John Hubbard spent the spring semester at the University of Marseilles in Marseilles, France. In addition, Professor Allen Hatcher was on sabbatical in the fall, and professors Kenneth Brown and Richard Durrett were on sabbatical in the spring.

In the summer of 1998, a conference in probability in honor of Harry Kesten was held at Cornell, organized by Rick Durrett and Maury Bramson (Minnesota). Fourteen of the world's most prominent probabilists, including seven who were speakers at the 1998 ICM in Berlin, gave lectures in honor of Harry's 66 $\frac{2}{3}$ birthday. Much time during the fall semester was devoted to the details of getting the 21 papers together that will make up the volume to be published in Birkhäuser's Progress in Probability Series.

Several people in our department have received awards and honors. Professor Harry Kesten received two very remarkable honors. He was recently elected as a Fellow of the American Academy of Arts and Sciences for his great contributions to probability theory and its applications. The university also recognized his achievements when he was named Goldwin Smith Professor of Mathematics in the College of Arts and Sciences at Cornell. Professor Cliff Earle has been awarded an honorary professorship at Warwick for a five-year term starting this September. Caroline (Carly) Klivans, a graduating senior, received the Alice T. Shafer Prize for undergraduates from the Association for Women in Mathematics. Assistant Professor Irena Peeva received a Sloan Research Fellowship in mathematics for young faculty, and Denis Hirschfeldt, one of our graduate students, received a

Sloan Doctoral Dissertation Fellowship. Graduate students, Chris Hruska, Swapneel Mahajan, and Kathryn Nyman were awarded Hutchinson Fellowships for spring 1999.

During the course of the past year, Professor John Guckenheimer completed his term as president of SIAM (the Society for Industrial and Applied Mathematics). Professors Irena Peeva and Michael Stillman organized a special session in commutative algebra at the AMS meeting in Chicago, September 1998. Sr. Lecturer Thomas Rishel and John Meier (Lafayette College) conducted a minicourse at the joint AMS-MAA meetings based on materials developed in their recent book on writing in mathematics. In addition, Professor Oscar Rothaus participated in the U.S. and Mexican National Academy of Sciences review of Mexican graduate programs in the sciences and mathematics.

Each year, we award the Kieval Prize to an outstanding undergraduate student, and this year it was given to Harold Fox. Harold was a double major (mathematics and computer science) who graduated *magna cum laude* in May 1999. In addition, the Kieval Endowment provides for lectures with special appeal to undergraduate students interested in mathematics. This past October, Professor John Milnor delivered the Kieval Lecture. Professor Milnor, from the State University of New York at Stony Brook, is an eminent mathematician who was the 1962 recipient of the Fields Medal. His work has spanned topology, algebra and geometry from all parts of mathematics. His talk, which was attended by over 150 people, was about how to glue two Julia sets together.

This year's Visiting Faculty Program participants were: Professor Karl David, Wells College in Aurora, New York; Professor Samer Habre, Lebanese American University in Beirut, Lebanon; James Hall, Westminster College in New Wilmington, Pennsylvania; Rachel Hastings, Ph.D. Cornell University, August 1998; Kevin MacEwen, Ph.D. Cornell University, January 1999; Shayan Sen, M.Sc. Cornell University, August 1995. (For information about their experiences at Cornell, see pages 75–76.) Recruitment efforts have produced five participants for the 1999–2000 academic year.

This year we had an exceptionally large number of graduate students leave and an exceptionally large number of entering graduate students. There were 19 new students, with 186 applications and 900 inquiries.

The biggest event of the year was the departmental move from our "ancestral" location in historic White Hall, where mathematics has been housed at Cornell since the 1880s, to new and far more spacious quarters in Malott Hall. Despite the trauma of moving and the inevitable problems during the move, we are all excited about our new home. It looks as though it will be spacious, convenient and functional. As faculty liaison, Professor John Smillie had primary responsibility for coordinating this move. His leadership, good sense and careful planning made this event bearable and successful. Please refer to page 9 for additional information about our relocation to Malott Hall.

Robert Connelly, who has served the department as chair for three and a half years, will step down at the end of the 1998–99 academic year. Many thanks to Bob for his good works and dedicated efforts on our behalf. He will spend the next year on a well-deserved sabbatical leave and administrative leave at the University of Washington in Seattle, Washington. John Smillie has been selected by the faculty to serve as department chair for a three-year term and will assume his duties on July 1, 1999.

Support Staff

This was an eventful year for the departmental support staff, beginning with staff turnover and culminating with the department's move to Malott Hall.

Staff Turnover: Cheri Farnsworth, our undergraduate coordinator since 1997, resigned in September 1998. She left to matriculate in the post-baccalaureate student teaching program at Wells College to work towards certification as a secondary school social studies teacher. Cheri was a gracious receptionist and a strong advocate for our undergraduate majors. We were sorry to see her go but proud of her efforts to realize a long-term personal goal.

We were very lucky to find Nora Balfour for the undergraduate coordinator position. She started working for us on October 1, 1998. Nora spent the previous year and a half as the receptionist and administrative assistant in the Dean's Office at Cornell's College of Arts and Sciences. Since she has been with us, she has resurrected the semiannual undergraduate newsletter as a web-based publication to help with undergraduate preenrollment periods, and took over the editorship of our annual newsletter, *Math Matters*. Nora is amiable and energetic, and we are very happy she has joined the staff.

Malott Move: The first two weeks of June 1999 were spent moving 150 department members into 111 offices

in Malott Hall, our new home at Cornell. The employees were integrally involved in the move. We have approximately 80 faculty (including tenure and non-tenure track faculty, visiting program participants, senior lecturers and adjunct faculty, as well as teaching and research visitors), 11 support staff and approximately 60 graduate students. To facilitate the physical move and provide much needed help and direction to our academic staff, the 80 academics were divided up among our clerical support staff, who became their move coordinators, and the graduate students were helped by Donna Smith, the graduate field coordinator. Graduate student concerns were admirably managed by the careful planning of graduate student representatives, Leah Gold and Matthew Horak, with the assistance of fellow graduate student Walker White.

For weeks before the actual start date, the staff disseminated information, provided packing supplies and advice, collected move-related data (furniture trades, need for additional bookcases, special needs and arrangements, etc.) for each of their faculty. In the days before the move they were responsible for meeting with each of their faculty and inspecting their offices to make sure everything was marked and ready to be moved.

At Malott, the staff put furniture layout floor plans in each faculty office. The clerical staff served as office "foremen" for their faculty offices, reading the layout and directing the movers where to place each piece of furniture. They also noted damages, checked to see if the faculty received all the furniture they had in White Hall and looked for unwanted furniture to place in other faculty offices where additional furniture had been requested. The administrative manager, Colette Walls, coordinated the move, overseeing the staff effort and serving as liaison between the college, movers, interior designer, contractor and construction crews.

The physical move of the department's computer room machines and network and the reinstallation of faculty and staff computers in Malott Hall was coordinated and implemented by our computer support staff, Doug Alfors and Robert Terrell. Their considerable efforts and dedication to excellence resulted in a nearly flawless network conversion.

All of the staff pitched in and did whatever needed to be done. They worked long hours, neglecting their families, hobbies and households for weeks to respond to the immediate needs of the move. Overall, we're happy to report that it was a positive, enriching experience for the staff, who came away from this experience with the satisfaction that comes from learning you are capable of doing more than you thought you could.

Graduate Program

The Cornell Mathematics Department is rated among the top in the country by the American Mathematical Society, typically somewhere between 10th and 15th in various "by reputation" surveys. The *US News and World Report* placed Cornell 9th in the nation in its 1997 national ranking of graduate mathematics programs.

The graduate program included 56 graduate students during the 1998–1999 academic year. The total number of students in the academic year 1999–2000 will be 63. We received eight outside fellowships in 1998–1999 and were awarded ten full Graduate School fellowships for summer 1998. Ph.D.s were awarded to twelve students, while seven earned master's degrees.

The entering class will be formed of nineteen new Ph.D. students. Lee Gibson and Hway Kiong Lim will each hold a one-year Graduate School fellowship. Christopher Francisco and James Belk were awarded National Science Foundation scholarships which pay tuition and stipend for three years. In addition they will receive a Graduate School fellowship in their fourth year of study.

The graduate students play an essential role in all aspects and functions of the department: teaching, conducting research, mentoring undergraduates and participating in community outreach programs. They were particularly active this year in the recruitment of new students and helped make it a success.

In addition to the local seminars which include talks at Ithaca College, Wells College and other local universities, several graduate students gave talks at meetings and conferences away from Cornell: Suzanne Lynch at Centro de Recerca Mathematica in Barcelona, Spain, and at the University of Arkansas; Stephen Bullock at the Notre Dame University geometry and topology seminar; Andrei Caldararu at seminars in Warwick, England; Denis Hirschfeldt at an AMS session in Gainesville, Florida, a seminar talk at the University of Chicago and at the European summer meeting in Prague; Walker White at the AMS meeting in Gaithersburg; Chris Hruska at a topology conference in Utah; Antal Jarai at the 4th Hungarian Colloquium on Limit Theorems in Probability and Statistics; and David Brown at the University of Arkansas Conference on Complex Dynamics. Sudeb Mitra gave two talks for the AMS, one for the MAA and the Einstein Institute at the Hebrew University of Jerusalem,

and Nathaniel Miller gave an invited talk at the Center for the Study of Language and Information at Stanford University.

The Olivetti Club is devoted to expository talks on current research areas and is run entirely by graduate students. The representatives and organizers were Jonathan Todd and Swapneel Mahajan for the fall semester, and Matthew Horak and Steven Sinnott for the spring semester.

Class representatives were: Luis 0'Shea (6th year), Walker White (5th year), Chris Hruska (4th year), David Revelle (3rd year), Shannon Kelly (2nd year) and Reba Schuller (1st year). The Graduate and Professional Student Representative was Suzanne Lynch.

The Hutchinson fellowship was awarded to Chris Hruska, Swapneel Mahajan and Kathryn Nyman. They each received a semester of stipend and tuition. Denis Hirschfeldt received the Battig Award and Kathryn Nyman received the York Award.

Undergraduate Program

The undergraduate program in mathematics included 93 majors this year, and bachelor's degrees were awarded to 28 students (p. 27). One of our graduates, Daniel Gardner, was a banner bearer for the class of 1999. This honor is bestowed upon seniors with the highest GPA in the college. Vladimir Livshits, another 1999 graduate, was chosen as a Merrill Presidential Scholar, an honor granted students in the top 5% of their graduating class who exhibit academic achievement, strong leadership ability and potential for contributing to society.

The Association for Women in Mathematics awarded the ninth annual $1000 Alice T. Shafer Prize to Carly Klivans, a senior who graduated in January 1999. Please refer to page 5 for details about the prize.

The Math Club's fall semester began under the excellent leadership of returning president Caroline Klivans. Brenda Posipanko (May 1999) took over as president for the spring semester, bringing her boundless enthusiasm and energy to every meeting. The club continued to meet weekly and had some popular and successful presentations. Recent topics included geometry, algebra, juggling, chaos, number theory, bartending, probability, rigidity and combinatorics. The meetings were held each Wednesday afternoon during the fall and moved to Fridays during the spring semester. The students themselves were responsible for inviting speakers, coordinating topics of discussion and providing refreshments. (See Department Colloquia, pp. 28–35, for a list of talks.) Professors Graeme Bailey and Ravi Ramakrishna provided expert assistance and guidance as the Math Club's advisors.

The Math Table continued this year, meeting each Friday evening in Risley Dining Hall, where a table was reserved for interested undergraduate students to meet and share a meal with graduate students and faculty. The focus of Math Table is to reach out to the undergraduate community and increase awareness of mathematics and the math major.

Research and Professional Activities

Department sponsored research expenditures totaled $1,505,714 for the 1998–99 fiscal year. This included 44 grants and contracts from federal, state and private agencies awarded to 30 faculty. Faculty submitted 22 new grant proposals, 11 of which have been funded to date, and requested the continuation of 24 awards. For information regarding specific faculty activities, see *Faculty Profiles*, pages 42–74.

Editorships include: Louis Billera as associate editor of the *Journal of Algebraic Combinatorics* and *Discrete and Computational Geometry*; James Bramble as editor of *Mathematics of Computation, Math. Model. Num. Anal.* and *Numerical Functional Analysis and Optimization*; Robert Connelly as editor of *Betreige für Algebra und Geometrie*; Richard Durrett as editor of *Annals of Applied Probability*; Clifford Earle as managing editor of *Proceedings of the AMS*; José F. Escobar as international editor of *Innovación y Ciencia*; Leonard Gross as associate editor of the *Journal of Functional Analysis* and the *Soochow Journal of Mathematics*; John Guckenheimer as editor of the *Journal of Experimental Mathematics*; Timothy Healey as a member of the editorial board of *Journal of Elasticity*; Harry Kesten as associate editor of the *Indiana University Mathematics Journal* and the *New York Journal of Mathematics*; Anil Nerode as editor of *Constraints*, *Annals of Mathematics and Artificial Intelligence, Mathematics and Computer Modelling*, and the *Journal of Pure and Applied Mathematics*; Lawrence Payne as a member of the editorial boards of *Mathematical Methods in the Applied Sciences*, the *Glasgow Mathematical Journal* and the *Journal of Elasticity*; Richard Rand on editorial board of *Journal of Vibration and Control*; James Renegar as associate editor of the *SIAM Journal on Optimization* and the *Journal of Complexity*; Laurent Saloff-Coste as associate editor of *Annals of Probability* and *Annales de la Fac-*

ulté des Sciences de Toulouse; Richard Shore as editor of *Studies in Logic and the Foundations of Mathematics* and managing editor of *Bulletin of Symbolic Logic*; Birgit Speh as editor of the *New York Journal of Mathematics* and the *Journal of Representation Theory*; Robert Strichartz as executive editor of the *Journal of Fourier Analysis and Applications*; Karen Vogtmann as associate editor of the *Bulletin of the American Mathematical Society*; Lars Wahlbin as managing editor of *Mathematics of Computation*; and James West as editor of *Fundamenta Mathematicae*.

Faculty Changes

Roger Farrell retired at the end of this fiscal year. The tenured faculty subsequently voted to confer emeritus professor status on him effective July 1, 1999.

Mark Gross resigned effective July 1, 1999. Mark has been on leave of absence at the University of Warwick (England) since January 1998. He has since accepted a permanent position there.

Bob Connelly finished his term of three and a half years as department chairperson at the end of June 1999. The faculty selected Professor John Smillie for a 3-year term as the next chairperson. His term begins July 1, 1999.

On leave for 1998–99:
Kenneth Brown, sabbatical leave, spring 1999
Persi Diaconis, leave, academic year
Richard Durrett, sabbatical leave, spring 1999
Mark Gross, leave, academic year
Allen Hatcher, sabbatical leave, fall 1998
John Hubbard, leave, spring 1999
Moss Sweedler, leave, academic year

On leave for 1999-2000:
Robert Connelly, sabbatical leave, fall 1999
Robert Connelly, administrative leave, spring 2000
Persi Diaconis, leave, academic year
Alfred Schatz, sabbatical leave, spring 2000
Moss Sweedler, leave, academic year
Karen Vogtmann, sabbatical leave, academic year
Lars Wahlbin, sabbatical leave, spring 2000

Other department personnel changes are noted in the *Department Directory*, pages 12–13.

New Faculty for 1999–2000

Yuri Berest, Assistant Professor, obtained a Ph.D. in mathematics from the University of Montreal in 1997. His research interests include the fields of partial differential equations, mathematical physics and algebra. Prior to coming to Cornell, he was an assistant professor at the University of California at Berkeley.

Vlada Limic, H. C. Wang Assistant Professor, received a Ph.D. in statistics from the University of California at Berkeley in 1998. Her research interests are in probability and stochastic processes. Prof. Limic spent the past year as an NSF Postdoctoral Fellow at the University of California at San Diego.

Michael Nussbaum, Professor, obtained a Ph.D. in mathematics from the Academy of Sciences Berlin in 1979. His current research focuses on developing a better theoretical understanding of the asymptotic theory of statistical experiments, in connection with statistical smoothing and curve estimation and nonparametric inference for stochastic processes. In 1998, he was elected a Fellow of the Institute of Mathematical Statistics. He comes to Cornell from the Weierstrass Institute for Applied Analysis and Stochastics, Berlin, where he was the head of the Department of Stochastic Algorithms and Nonparametric Statistics.

Peter Topping, H. C. Wang Assistant Professor, received a Ph.D. in mathematics from the University of Warwick in 1997. His research interests are in nonlinear partial differential equations and the calculus of variations. Prof. Topping spent the 1998–99 academic year as a Postdoctoral Fellow at MSRI (Mathematical Sciences Research Institute).

Gifts

We continue to appreciate the kindness and generosity of alumni and other friends of mathematics. During the 1998–99 academic year, designated donor gifts increased the principal of various department endowments. In addition, the department received some unrestricted gift donations. Unrestricted gifts to the department are used to supplement departmental activities for the mathematics community at Cornell.

In many cases, contributions were received in response to the department newsletter, *Math Matters*. By distributing this newsletter, we hope to keep our many friends current on department activities.

Awards and Honors

Alice T. Shafer Prize: The Association for Women in Mathematics awarded the ninth annual Shafer prize to

Caroline Klivans, who received her bachelor's degree in mathematics with magna cum laude honors in January 1999. The Shafer Prize, named for the AWM's founding member and former president, is awarded annually to an undergraduate woman for excellence in mathematics. Candidates are evaluated based on the quality of performance in advanced mathematics courses and special programs, a demonstration of real interest in mathematics, the ability for independent work in mathematics, and performance in mathematical competitions at the local or national level. The $1000 prize was presented to Carly at the Joint Mathematics Meetings in San Antonio, Texas, in January.

Carly's interests lie in discrete geometry and algebraic combinatorics. She was president of the undergraduate Math Club for two years, arranging weekly lectures by faculty and graduate students to introduce undergraduates to a broad range of topics. Last summer she participated in the Research Experiences for Undergraduates program at Rutgers University, where she researched computational geometry at Rutgers' Center for Discrete Mathematics and Theoretical Computer Science. After graduation, Carly attended the Budapest Semester in Mathematics program in Hungary during the spring 1999 semester. She will be attending MIT in the fall to pursue a Ph.D. in applied mathematics.

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 Eleanor York Award for 1998–99 was awarded to Jeremy Darling and Julia Rathbun in the Astronomy Department and will be presented to a Mathematics Department graduate student at the Fall Reception to be held in August 1999. The previous winner in Mathematics was Kathryn Nyman.

Freshman Math Prize: At the suggestion of Prof. Ravi Ramakrishna, the department sponsored a prize exam for freshmen for the first time in several years. The exam was in the spirit of the Hoover Prize exam that the department used to administer about 15 years ago. Prizes for the new exam were funded by the winnings of the department's putnam team. (The William Lowell Putnam Mathematics competition is an extremely difficult exam given nationally every December.) In the mid-1990s Cornell teams placed second twice and in the top ten twice, competing against over 250 teams.

The annual Freshman Math Prize Exam is now funded in perpetuity. Over 40 students took the the 1999 exam. David Kuo and Gun Srijuntongsiri tied for first prize; and Levy Lorenzo, Joon Leng Tan, Samson Yao and Yun Wang tied for second prize.

Goldwin Smith Professorship: Harry Kesten was elected Goldwin Smith Professor of Mathematics this year. The first Goldwin Smith professorships were established in 1912 in the fields of Latin, English literature, American history, political science and English. Since that time they have been awarded in a number of other fields, including mathematics. In 1989 the professorships were expanded from 11 to 15.

Prof. Kesten works in probability theory, and one of his main interests is percolation, a probabilistic model that is of interest in statistical physics because it is the simplest model that exhibits a phase transition. His study *Hitting probabilities of single points for a process with independent increments* is considered a work of seminal influence. Prof. Kesten was also elected a fellow of the American Academy of Arts and Sciences this year.

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. This year's recipients were Christopher Hruska, Swapneel Mahajan and Kathryn Nyman.

Ithaca High School Senior Prize: Each year for the past several years the Cornell Mathematics 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. This year's prize was awarded to Julie Dawson. Julie is a very strong math student whose primary interest is in biology/agriculture. She will attend Cornell in the fall.

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 endow-

ment, 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 by the student and faculty recommendations. The winner of the 1998–99 prize was Harold Fox. Harold graduated with a double major in mathematics and computer science and has been awarded *magna cum laude* honors in mathematics.

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. This year's Merrill Scholar was mathematics major Vladimir Livshits.

Robert John Battig Graduate Prize: Recipients of the Battig Prize are graduate students in mathematics at Cornell who have passed their A-exam (typically in their second year of study). Any such graduate student meeting is eligible regardless of social and financial background. A department committee composed of the Chair, the Director of Graduate Studies and three members of the Graduate Admissions Committee select a recipient each year based on excellence and promise in mathematics. This year's recipient was Denis Hirschfeldt.

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. Denis Hirschfeldts was the recipient of a fellowship this year.

Sloan Research Fellowship: Irena Peeva was among four Cornell faculty to receive a Sloan Foundation Research Fellowship this year. Sloan fellows are engaged in research at the frontiers of physics, chemistry, computer science, mathematics, neuroscience and economics. The fellowships allow scientists to continue their research with $35,000 each over two years. Fellows are free to pursue whatever research is of most interest to them. Prof. Peeva's research involves problems lying at the interface between several mathematical areas: commutative algebra, algebraic geometry, topology and combinatorics. Over the next two years, she will pursue research on free resolutions, Hilbert schemes and toric varieties.

Instructional Activities

The faculty taught 119 courses in 209 lectures and 177 sections during the 1998–99 academic year, generating 22,596 credit hours. They taught 5,782 students aided by 90 teaching assistants and associates. The enrollment figures are reflected on pages 10–11. The Dept. of Theoretical and Applied Mechanics shares the teaching of engineering calculus and is accredited with 50% of the credit hours for Math 191 and 193 in the fall and Math 293 and 294 in the fall and spring; the remaining 18,586 credit hours are accredited to Mathematics.

Summer Program

During the Summer of 1998, we offered 11 courses ranging from Precalculus through Statistics and Engineering Mathematics. By offering a variety of summer courses, we enable students to take classes needed to fulfill their graduation requirements or just get ahead. We also offer special courses, such as Math 103, which can cover a variety of different topics—often providing an entertaining and appealing introduction to the breadth of application of mathematics in the modern world. Even for traditional calculus courses, the special characteristics of summer study allow a much greater interaction between students and faculty, which makes for a more exciting educational experience for both. A total of 263 students enrolled in our courses, including students from Cornell, other colleges, and high schools. One of the major attractions for high school students is the opportunity to experience the vitality of mathematical life at Cornell; in fact, many of these students apply to Cornell the following year. In addition to our own department members, visiting faculty from colleges and universities in Pennsylvania, Oklahoma, Maryland and Ohio join us in the summers to teach our courses. Mathematics graduate students appointed as teaching assistants provided support to all of our instructors this summer.

3-Week Session (June 3–June 26, 1998):

103 Mathematical Explorations
T. Rishel; K. Sollers, $\frac{1}{2}$TA

8-Week Session (June 15–August 11, 1998):

293 Engineering Mathematics
V. L. Turner; E. Hueffmeier, TA

294 Engineering Mathematics
R. Terrell; E. Hueffmeier, $\frac{1}{2}$TA
G. Cochell; E. Hueffmeier, $\frac{1}{2}$TA

6-Week Session (June 29–August 11, 1998):

103 Mathematical Explorations
M. Terrell; J. Todd, $\frac{1}{2}$TA

105 Finite Mathematics for Biologists
D. Alfors; Q. Lu, $\frac{1}{2}$TA

109 Precalculus Mathematics
A. Roy, Czar; A. Diaz, TA
K. Bezdek; Q. Lu, TA

111 Calculus
K. David, Czar; L. DeCandia, TA
C. DeSilva; C. Lee, TA
A. Back; J. Todd, TA

112 Calculus
G. Bailey; C. Lee, $\frac{1}{2}$TA

171 Statistical Theory and Appl. in the Real World
R. Cleary; P. Molnar, $\frac{1}{2}$TA

192 Calculus for Engineers
H. Rosenzweig; W. Zhao, TA

193 Calculus for Engineers
M. White; L. DeCandia, $\frac{1}{2}$TA

Curriculum Changes

During the 1998–99 academic year, a new professional-level course in mathematical education was offered, and two more were designed for introduction into our curriculum during the following year. The clientele for these courses is expected to consist of graduate students in the departments of Mathematics and Education, and perhaps some undergraduate mathematics majors, who are interested in the teaching of mathematics at the secondary and/or undergraduate levels.

Math 503, *History of Modern Mathematics*, was taught in spring 1999 by Prof. Anil Nerode. The course covers certain aspects of the discovery and development of mathematics during the 18th and 19th centuries, and presumes a knowledge, on the part of the students, of a substantial amount of mathematics at the undergraduate level.

Math 505, *Educational Issues in Undergraduate Mathematics*, will examine various educational issues in undergraduate mathematics from a variety of different viewpoints, and the relationship of these issues to the mathematics itself. The course will be taught in fall 1999 by Professor David Henderson. Math 505 may well be one of the very few courses offered in American universities on the teaching of college-level mathematics.

Math 507, *Teaching Secondary Mathematics: Theory and Practices*, will provide direct experience of new approaches, curricula, and standards in mathematics education by means of videotapes of classroom teaching, in-class exploration of mathematics problems, examination of software environments and their uses in the secondary school classroom, and other activities. The course will be taught by Senior Lecturer Avery Solomon. It will be open to all Cornell students who are interested in the teaching of mathematics in the secondary schools, and complements a very similar course, Math 508, that Dr. Solomon has offered during each of the last six years to Ithaca area school teachers.

In spring 1999, the Mathematics Department offered, for the first time in many years, a freshman writing seminar under the auspices of the John S. Knight Writing Program. The seminar, Math 189, *Reasoning About Reasoning*, was designed and taught by Teaching Assistant Nathaniel Miller, a fifth-year graduate student, with the assistance of Senior Lecturer Thomas Rishel as course leader. Students in the seminar reasoned about a variety of problems and puzzles, then analyzed their reasoning and thought processes in essays, treating such issues as: How can one tell if an argument is valid? What makes an argument convincing? Are there limits to what one can learn through deductive reasoning? The problems explored in the seminar were drawn both from traditional mathematical contexts, such as plane and spherical geometry, and from other contexts in which reasoning is used, such as logical puzzles.

Interdisciplinary Instructional Activity

Mathematics/Engineering Liaison: This year we have been revamping the syllabi for the second year *Engineering Mathematics* courses, Math 293 and 294. There are several reasons for this. First, the Computer Science Department would like their students to be able to take linear algebra before differential equations. Second, there is a fairly large duplication of material at present: matrices and eigenvalues are introduced in both courses. While it is true that this is an important topic, and that seeing it twice is useful, it is also the case that we are basically trying to cram five semesters of engineering calculus into four semesters, and the time can be better spent on other topics. An advantage to removing the eigenvalue material from Math 293 is that it is possible to move the topics around so that Math 293 and 294 no

longer depend on each other. Then it would be possible for students to choose which course they need first. We are still in the process of deciding the new syllabi. We want to make sure that we don't make Math 293 more difficult than it already is. We hope to have the new syllabi ready this fall, so it can be phased in the following year.

Engineering Restructuring: This year was the second year of the originally planned three-year experiment in the restructuring of our teaching of *Engineering Calculus*. The object of this experiment was to provide instruction to the fall semester engineering calculus students in Math 193, Math 191 and Math 192 which involved classes of about 25 students or less. Instruction was provided by faculty from Cornell, including H.C. Wang Assistant Professors, and four lectures were taught by experienced graduate student teaching assistants.

This required recruitment of faculty highly qualified for teaching the mathematics relevant to engineering calculus. We were pleased to have Prof. Michael Duncan (one section) from Chemical Engineering, Prof. Richard Lovelace (one section) from Applied and Engineering Physics, Prof. Christine Shoemaker (two sections) from Civil and Environmental Engineering and Prof. Emeritus Roger Livesay (one section) from our own Mathematics Department. In addition, Prof. Leigh Phoenix from the Department of Theoretical and Applied Mechanics (two sections) and Prof. Bing Cady (one section) served as additional recruited faculty.

Reports from student participants indicate that the experiment is going well. Recruiting additional faculty for next year was also successful. One tangible benefit during the past two years seems to be that the number of engineering students forced to leave or repeat courses because of difficulties with engineering mathematics has been somewhat lower than in prior years.

With the encouragement and support of Dean Philip Lewis in the College of Arts and Sciences and Dean John Hopcroft of the Engineering College, it has been decided that the restructuring will continue in its present form through fall 2001. This represents an additional commitment for at least two more years beyond the original plan of three years. We feel that this is an excellent decision, and it will help all the students in engineering mathematics.

Malott Hall Relocation

During the first two weeks in June 1999, the Cornell Department of Mathematics moved from White Hall, which mathematics has called home since the 1880s, to Malott Hall. This move has been long in coming, and many were doubtful that it would ever happen, even as the event approached! Malott Hall was built in 1964 to house the Johnson Graduate School of Management, which moved to Sage Hall in fall 1998. Over the years many people were involved with the planning and preparation for our move. Professors Keith Dennis, Moss Sweedler and Cliff Earle worked at the job of faculty liaison that was eventually taken over by Professor John Smillie. Our former business manager, Diane Downing, also played an important role before she left the department in July 1996. Jane Pedersen, the Associate Dean for Administration in the College of Arts and Sciences, worked tirelessly for many years to identify funding and coordinate the many institutional elements of such an endeavor. John Smillie carefully and creatively shepherded us through the past three years of planning and renovation of the Malott Hall facilities. His leadership skills were successfully tested and honed on this project, which helped prepare him to be our new chairperson, effective July 1, 1999.

We want to thank everyone involved in the project. We greatly appreciate the work of Gary Wilhelm, the university architect in charge of the renovation project. Thanks to John Barradas of the local firm Downing, Barradas and Magre Architects, who was the mastermind behind the renovation plan. Thanks to Anne Adesso who worked long hours creating an interior design plan tailored to our needs and desires. We want to thank Jim Holley and the Welliver and McGuire crew for carrying out the construction and doing a great job. Thanks also to David Newman who supervised construction from the Cornell side, and to Henry Crans who contributed his time to the success of our move. Our administrative manager Colette Walls worked hard helping Anne to create a plan for the administrative wing which would allow the staff to better serve the department. Steve Rockey helped create a plan for the enlarged and improved library. We appreciate their efforts on our behalf. We all owe a special thanks to the departmental support staff, Doug Alfors, Nora Balfour, Gayle Davis, Arletta Havlik, Joy Jones, Michelle Klinger, Donna Smith, Cathy Stevens and Bob Terrell, led by Colette Walls, all of whom worked tirelessly to ensure that the move went as smoothly as possible.

Mathematics Course Enrollment Statistics

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
103	Mathematical Explorations	Lecture	Morley, Solomon	69	207	Fall 1998
103	Mathematical Explorations	Lecture	Morley, Taimina, B. West	57	171	Spring 1999
105	Finite Mathematics for Biologists	Lec/Sec	M. Terrell	200	600	Fall 1998
106	Calculus for Biologists	Lec/Sec	Artemov	138	414	Spring 1999
111	Calculus	Lecture	Cohen, David, Hall, Hastings, Kahn, MacEwen, J. West	438	1,752	Fall 1998
111	Calculus	Lecture	Kahn, Shayan Sen	130	520	Spring 1999
112	Calculus	Lecture	Berenstein, Bezdek, Epstein, Veselov	226	904	Fall 1998
112	Calculus	Lecture	Habre, Hall, MacEwen, Shankar Sen	241	964	Spring 1999
121	Modern Calculus	Lecture	Henderson	27	108	Fall 1998
122	Calculus	Lec/Sec	Buzzard, Strichartz	67	268	Fall 1998
122	Calculus	Lec/Sec	Buzzard, Epstein	40	160	Spring 1999
150	From Space to Geometry	Lecture	Rishel	20	60	Fall 1998
150	From Space to Geometry	Lecture	Rishel	23	69	Spring 1999
171	Statistical Theory and Applications	Lec/Sec	Farrell, Hwang	51	204	Fall 1998
171	Statistical Theory and Applications	Lec/Sec	Back, Farrell, Lloyd	79	316	Spring 1999
189	FWS: Reasoning about Reasoning	Lecture	N. Miller	17	51	Spring 1999
191	Calculus for Engineers	Lec/Sec	Artemov, Healey (T&AM)*	70	280	Fall 1998
192	Calculus for Engineers	Lec/Sec	Duncan (Chem. Eng.), Kable, Livesay, Lovelace (A&EP), Okun, Peeva, Rand (T&AM)*, R. Terrell, J. Wang	384	1,536	Fall 1998
192	Calculus for Engineers	Lec/Sec	Guckenheimer, R. Terrell	294	1,176	Spring 1999
193	Calculus for Engineers	Lec/Sec	Cady (T&AM)*, Erdélyi-Szabó, Gasharov, Phoenix (T&AM)*, Ramakrishna, Shoemaker (C&EE)	235	940	Fall 1998
193	Calculus for Engineers	Lec/Sec	Erdélyi-Szabó	16	64	Spring 1999
213	Calculus	Lec/Sec	B. West	27	108	Fall 1998
213	Calculus	Lec/Sec	Barbasch	43	172	Spring 1999
221	Linear Algebra & Calculus	Lec/Sec	Billera, Brown, Sjamaar	108	432	Fall 1998
221	Linear Algebra & Calculus	Lec/Sec	Gasharov, Kable, Nerode	72	288	Spring 1999
222	Calculus	Lec/Sec	Back, He	32	128	Fall 1998
222	Calculus	Lec/Sec	Deck, He, Saloff-Coste, Speh	75	300	Spring 1999
223	Honors Linear Algebra and Calculus	Lec/Sec	Hubbard	20	80	Fall 1998
224	Honors Linear Algebra and Calculus	Lec/Sec	Guckenheimer	15	60	Spring 1999
231	Linear Algebra	Lecture	Dennis	15	45	Spring 1999
281	Formal Logic	Lecture	Hodes (Philosophy)	0	0	Fall 1998
293	Engineering Mathematics	Lec/Sec	Jenkins (T&AM)*, Schatz	503	2,012	Fall 1998
293	Engineering Mathematics	Lec/Sec	Stillman	382	1,528	Spring 1999
294	Engineering Mathematics	Lec/Sec	Ruina (T&AM)*, Zehnder (T&AM)*	339	1,356	Fall 1998
294	Engineering Mathematics	Lec/Sec	Rand (T&AM)*, Ruina (T&AM)*, Zehnder (T&AM)*	476	1,904	Spring 1999
321	Applicable Analysis	Lec/Sec	Bailey	21	84	Fall 1998
332	Algebra and Number Theory	Lecture	Chase	22	88	Fall 1998
336	Applicable Algebra	Lecture	Berenstein, Billera, J. West	59	236	Spring 1999
356	Groups and Geometry	Lecture	Cohen	11	44	Spring 1999
401	Honors Seminar: Topics in Modern Math.	Lecture	Strichartz	3	12	Spring 1999
403	History of Mathematics	Lecture	Taimina	7	28	Spring 1999
408	Mathematics in Perspective	Lecture	Solomon	6	24	Spring 1999
411	Introduction to Analysis	Lecture	Speh	10	40	Fall 1998
413	Introduction to Analysis	Lecture	Kesten, Smillie	46	184	Fall 1998
414	Introduction to Analysis	Lecture	Sjamaar	19	76	Spring 1999
418	Function Theory of One Complex Var.	Lecture	L. Gross	16	64	Spring 1999
420	Applicable Analysis	Lecture	Hubbard	16	64	Fall 1998
420	Applicable Analysis	Lecture	Veselov	23	92	Spring 1999
422	Applicable Analysis	Lecture	Veselov	12	48	Fall 1998
422	Applicable Analysis	Lecture	Rothaus	9	36	Spring 1999
423	Applicable Analysis	Lecture	Wahlbin	7	28	Spring 1999
425	Num. Solutions of Differential Equations	Lecture	Schatz	6	24	Spring 1999
427	Intro. to Ordinary Differential Equations	Lecture	Wahlbin	6	24	Fall 1998
428	Intro. to Partial Differential Equations	Lecture	J. Wang	7	28	Spring 1999
431	Introduction to Algebra	Lecture	Ramakrishna	27	108	Fall 1998
432	Introduction to Algebra	Lecture	Kable	5	20	Spring 1999
433	Introduction to Algebra	Lecture	Dennis	27	108	Fall 1998
434	Introduction to Algebra	Lecture	Vogtmann	15	60	Spring 1999
436	Applications of Abstract Algebra	Lecture	Dennis	7	28	Spring 1999
451	Euclidean and Spherical Geometry	Lecture	Taimina	11	44	Fall 1998
452	Classical Geometries	Lecture	Bailey	16	64	Spring 1999

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
453	Introduction to Topology	Lecture	J. West	3	12	Fall 1998
454	Introduction to Differential Geometry	Lecture	J. Wang	4	16	Spring 1999
471	Basic Probability	Lecture	Saloff-Coste	19	76	Fall 1998
472	Statistics	Lecture	Hwang	5	20	Spring 1999
481	Deductive Logic	Lecture	Artemov	10	40	Spring 1999
482	Topics in Logic	Lecture	Hodes (Philosophy)	2	8	Spring 1999
486	Applied Logic	Lecture	Constable (Computer Science)	3	12	Spring 1999
490	Supervised Reading and Research	Ind Stud	Faculty	8	29	Fall 1998
490	Supervised Reading and Research	Ind Stud	Faculty	4	12	Spring 1999
500	College Teaching	Lecture	Rishel	5	5	Fall 1998
503	History of Modern Mathematics	Lecture	Nerode	3	12	Spring 1999
508	Mathematics for Secondary School Teachers	Lecture	Solomon	15	57	Spring 1999
611	Real and Complex Analysis	Lecture	Dynkin	22	88	Fall 1998
612	Real and Complex Analysis	Lecture	Rothaus	18	72	Spring 1999
615	Mathematical Methods in Physics	Lecture	L. Gross	5	20	Fall 1998
617	Dynamical Systems	Lecture	Ilyashenko	6	24	Fall 1998
618	Smooth Ergodic Theory	Lecture	Smillie	6	24	Spring 1999
619	Partial Differential Equations	Lecture	Escobar	10	40	Fall 1998
620	Partial Differential Equations	Lecture	Wahlbin	7	28	Spring 1999
621	Measure Theory and Lebesgue Integration	Lecture	L. Gross	7	28	Fall 1998
622	Applied Functional Analysis	Lecture	Epstein	1	4	Spring 1999
631	Algebra	Lecture	Shankar Sen	20	80	Fall 1998
632	Algebra	Lecture	Berenstein	3	12	Spring 1999
649	Lie Algebras	Lecture	Dynkin	19	76	Fall 1998
651	Introductory Algebraic Topology	Lecture	Hatcher	18	72	Spring 1999
652	Differentiable Manifolds	Lecture	Henderson	7	28	Fall 1998
661	Geometric Topology	Lecture	Connelly	9	36	Fall 1998
671	Probability Theory	Lecture	Kesten	10	40	Fall 1998
672	Probability Theory	Lecture	Kesten	5	20	Spring 1999
674	Introduction to Mathematical Statistics	Lecture	Hwang	3	12	Spring 1999
681	Logic	Lecture	Shore	8	32	Spring 1999
711	Seminar in Analysis	Seminar	Saloff-Coste	7	28	Fall 1998
712	Seminar in Analysis	Seminar	Earle	5	20	Spring 1999
713	Functional Analysis	Lecture	He	4	16	Spring 1999
717	Applied Dynamical Systems	Lecture	Guckenheimer	8	32	Fall 1998
731	Seminar in Algebra	Seminar	Dennis	9	36	Fall 1998
732	Seminar in Algebra	Seminar	Ramakrishna	4	16	Spring 1999
735	Topics in Algebra	Lecture	Billera	11	44	Spring 1999
737	Algebraic Number Theory	Lecture	Speh	9	36	Fall 1998
739	Topics in Algebra II	Lecture	Peeva	5	20	Spring 1999
740	Homological Algebra	Lecture	Hatcher	11	44	Spring 1999
751	Seminar in Topology	Seminar	Wise	2	8	Fall 1998
752	Seminar in Topology	Seminar	Vogtmann	4	16	Spring 1999
753	Algebraic Topology	Lecture	Vogtmann	5	20	Fall 1998
757	Topics in Topology	Lecture	Okun	1	4	Fall 1998
758	Topics in Topology	Lecture	Wise	2	8	Spring 1999
762	Seminar in Geometry	Seminar	Escobar	7	28	Spring 1999
771	Seminar in Probability and Statistics	Seminar	Seminar	0	0	Fall 1998
772	Seminar in Probability and Statistics	Seminar	Seminar	0	0	Spring 1999
777	Stochastic Processes	Lecture	Durrett	15	60	Fall 1998
778	Stochastic Processes	Lecture	Dynkin	4	16	Spring 1999
781	Seminar in Logic	Seminar	Nerode	6	24	Fall 1998
782	Seminar in Logic	Seminar	Erdélyi-Szabó	6	24	Spring 1999
784	Recursion Theory	Lecture	Shore	7	28	Spring 1999
787	Set Theory	Lecture	Shore	5	20	Fall 1998
788	Topics in Applied Logic	Lecture	Platek	3	12	Fall 1998
790	Supervised Reading and Research	Ind Stud	Faculty	19	102	Fall 1998
790	Supervised Reading and Research	Ind Stud	Faculty	15	66	Spring 1999

TOTALS	Courses	Lectures	Enroll	Dept* Cr Hrs	Total Cr Hrs
Academic Year	119	209	5,782	18,586	22,596
Fall Semester	55	115	3,253	10,437	12,731
Spring Semester	64	94	2,529	8,149	9,865

* The Dept. of Theoretical and Applied Mechanics shares the teaching of engineering calculus and is accredited with 50% of the credit hours for Math 191 and 193 in the fall and Math 293 and 294 in the fall and spring; the remainder are accredited to Mathematics.

Note: Enrollment figures in seminars may not reflect total attendance. Faculty and graduate students do not normally register.

Mathematics Department Directory 1998–99

Professors:
Dan Barbasch
Louis Billera
Kenneth Brown
Stephen Chase, associate chair
Marshall Cohen
Robert Connelly, chair
R. Keith Dennis
Persi Diaconis
Richard Durrett
Eugene Dynkin
Clifford Earle
José Escobar
Roger Farrell
Leonard Gross
John Guckenheimer
Allen Hatcher
David Henderson
John Hubbard
Gene Hwang
Yulij Ilyashenko
Peter Kahn
Harry Kesten
Michael Morley
Anil Nerode
Oscar Rothaus
Laurent Saloff-Coste
Alfred Schatz
Shankar Sen
Richard Shore
John Smillie
Birgit Speh
Michael Stillman
Robert Strichartz
Moss Sweedler
Karen Vogtmann
Lars Wahlbin
James West

Professors Emeritus:
James Bramble
G. Roger Livesay
Paul Olum
Lawrence Payne
Alex Rosenberg

Associate Professors:
Mark Gross
Richard Platek

Assistant Professors:
Irena Peeva
Ravi Ramakrishna
Reyer Sjamaar

Adjunct Professors:
Graeme Bailey

Adjunct Associate Professors:
Maria Terrell
Robert Terrell

H.C. Wang Assistant Professors:
Arkady Berenstein
Gregery Buzzard
Adam Epstein
Miklós Erdélyi-Szabó
Vesselin Gasharov
Anthony Kable
Jiaping Wang
Daniel Wise

Senior Lecturers:
Thomas Rishel
Avery Solomon
Beverly West

Visiting Faculty:
Sergei Artemov
Károly Bezdek
Thomas Deck
Hongyu He
Boris Okun
Daina Taimina
Vladimir Veselov

Visiting Program Participants:
Karl David
Samer Habre
James Hall
Rachel Hastings
Kevin MacEwen
Shayan Sen

Visiting Scholars:
David Finston
Jane-Jane Lo
Zhonggen Su

Teaching Associates:
Richard Furnas

Graduate Students:
Henrique Araujo
Sebastien Blachere (nondegree)
David Brown
Ryan Budney
Stephen Bullock
Andrei H. Caldararu
Nelia Charalambous
Dan Ciubotaru
Alan Robert Demlow
Maria G. Fung
Yuval Gabay
Suman Ganguli
Gonzalo Garcia
Ferenc Gerlits
Ilya German
Leah Gold
Noam Greenberg
Denis Roman Hirschfeldt
Matthew Horak
Geoffrey Hruska
Samuel Hsiao
Antal Jarai
Shannon Kelly
Chow Ying Lee
Dmitriy Leykekhman
Lek Heng Lim
Yi Lin
Qi Lu
Jennifer Lynch
Swapneel Mahajan
Brian A. Meloon
Joseph Stephen Miller
Nathaniel G. Miller
Robert Saxon Milnikel
Sudeb Mitra
Steven Morris
Kathryn Louise Nyman
Luis O'Shea
Wei Ouyang
Maria-Christina Patron
Ofer Porat
Rajmohan Rajagopalan
David Robert Revelle
Rebecca Schuller
Shayan Sen

Steven Sinnott
Sarah Spence
Catherine Anne Stenson
David Stephenson
Jonathan Todd
Roman Tymkiv
Juan Carlos Uribe
Anke B. Walz
Walker McMillan White
Russell Woodroofe
Yan Zhang
Wenhuan Zhao
Huibin Zhou

Visiting Graduate Students:
Sandrine Roussel

Administrative Support Staff:
Nora Balfour
Gayle Davis
Arletta Havlik
Joy Jones
Michelle Klinger
Donna Smith
Catherine Stevens
Colette Walls, manager

Computer Consultants:
Douglas Alfors
Robert Terrell

Mathematics Support Center:
Douglas Alfors, director
Richard Furnas

Instructional Computer Lab:
Allen Back, director

Library Staff:
Deborah Gagnon
Michelle Paolillo
Steven Rockey, librarian
Raj Smith

Changes for 1999–2000

New Professor:
Michael Nussbaum

New Professor Emeritus:
Roger Farrell

New Assistant Professor:
Yuri Berest

New H.C. Wang Asst. Professors:
Vlada Limic
Peter Topping

New Graduate Students:
James Belk
Cynthia Bowers
Jean Cortissoz
Christopher Francisco
Lee Gibson
Radu Haiduc
Spencer Hamblen
Christopher Hardin
Patrick Higgins
JaEun Ku
Hway Kiong Lim
Florian Milanovici
Melanie Pivarski
William Ritter
Fernando Schwartz
Maria Sloughter
Aaron Solo
Shawn Walker
Yan Zeng

Faculty Departures:
Arkady Berenstein
Miklós Erdélyi-Szabó
Mark Gross
Jiaping Wang

Faculty Leaves:
Robert Connelly, academic year
Persi Diaconis, academic year
Alfred Schatz, spring 2000
Moss Sweedler, academic year
Karen Vogtmann, academic year
Lars Wahlbin, spring 2000

Special Programs and Activities

Kieval Lecture

The eminent mathematician John W. Milnor presented the 1998 Kieval Lecture in Mathematics on Thursday, October 22, 1998, in the Hollis E. Cornell Auditorium at Goldwin Smith Hall. Professor Milnor is renowned for both his mathematical research and his expository skills. His lecture, entitled *Pasting together Julia sets*, was intended for both undergraduate students and the general public.

Professor Milnor received the Fields Medal in 1962. In addition, Professor Milnor has received the National Medal of Science (1967); the Steele Prize (1982); and the Wolf Prize (1989). He was elected to the National Academy of Science in 1963, and he is a member of the International Mathematical Union and the American Mathematical Society.

The Kieval lecture series is funded through the bequest of the late Dr. Harry S. Kieval (Cornell '36). Kieval was a long-time professor of mathematics at Humboldt State University in Arcata, California, who died in 1994. In addition to this lecture, his estate provides funding to Cornell University for a similar lecture in physics, as well as annual prizes awarded to outstanding seniors in both mathematics and physics.

Conference in Probability in Honor of Harry Kesten

From Sunday, June 28 to Tuesday, July 1, 1998, a *Conference in Probability in Honor of Harry Kesten* was held at Cornell. The event, which was sponsored by small grants from the National Science Foundation and the National Security Agency, featured lectures by 14 of the best probabilists in the world today. In chronological order the speakers (and their affiliations at the time) were: Ruth Williams (University of California at San Diego), S. R. S. Varadhan (New York University), Michel Talagrand (Paris VI and Ohio State University), Gordon Slade (McMaster University and Microsoft), Roberto Schonmann (UCLA), David Aldous (University of California at Berkeley), Jennifer Chayes (Microsoft), Persi Diaconis (Cornell University), Charles Newman (New York University), Greg Lawler (Duke University), Jean Francois LeGall (Paris VI), Ed Perkins (University of British Columbia), Claudia Neuhauser (University of Minnesota), and Geoffrey Grimmett (Cambridge University).

The quality of the speakers involved can be seen from the fact that seven of these individuals gave invited or plenary talks at the International Congress in Berlin later that summer. This rather distinguished set of individuals came not to enjoy summer in Ithaca, which suddenly turned hot and humid for the Monday afternoon hike, but instead to honor Harry Kesten on his 66 $\frac{2}{3}$ birthday for 40 years of impressive achievements in probability. About three dozen people came from outside Ithaca to attend the conference, and in a typical lecture were joined by an equal or larger number of people from campus. An important component of the audience were 13 young investigators, whose travel and local expenses were partailly supported by the NSA and the NSF, who had a chance to have casual conversations about their research (and other topics) with some of the best people in their field.

Those of you who were not fortunate enough to attend the conference can find many of the lectures and ten other articles by students and colleagues in *Perplexing Problems in Probability: Festschrift in Honor of Harry Kesten.* This volume was edited by the conference organizers, Maury Bramson (University of Minnesota) and Rick Durrett (Cornell University) and has recently been published by Birkhauser, Boston, as volume 44 in its *Progress in Probability*. You can buy it on the web at amazon.com, but you'll get a better deal buying directly from Birkhauser. Earlier titles in this series include the *Dynkin Festschrift* (Volume 32, 1994) edited by Mark Freidlin, and a collection of papers in honor of Frank Spitzer (Volume 28, 1991) edited by Durrett and Kesten.

Spring Concert Series

On the evening of Monday, May 10, 1999, a group of talented faculty, visitors, graduate students, undergraduates and friends of the Mathematics Department performed before an appreciative audience of 100 people in the department's ninth annual Spring Concert, held at the A. D. White House. As the program below shows, performers entertained the audience with a variety of selections, ranging from classical to modern, and including a skit and several original compositions.

Two Folksongs, arr. Benjamin Britten: 1. The Ash Grove; 2. O Waly, Waly; Douglas Alfors — tenor; Clifford Earle — piano.

Prelude & Fugue No. 9 (E-major), J. S. Bach: from the Well-Tempered Clavier, Vol. 2; Noam Greenberg — piano.

Untitled Composition, Nina Tillman & Douglas Huang: 1. Kalahari Desert 4:00 AM; 2. Manhattan 12:00 PM; 3. Grand Canyon 12:00 AM; Nina Tillman — flute; Douglas Huang — piano.

Cello Suite No. 4 in E-Flat, J. S. Bach: *Sarabande and Allemande*; Bob Milnikel — bass clarinet.

Valses Nobles et Sentimentales (1, 5, 6, 7), Maurice Ravel: Robert Strichartz — piano.

Trio, Opus 1, No. 1, Ludwig Beethoven; *2nd movement — Andante cantabile*: Clifford Earle — piano; Greg Buzzard — violin; Graeme Bailey — cello.

Ladle Rat Rotten Hut (a dramatization), H. L. Chace: Kathryn Nyman, Nora Balfour, Doug Alfors, Tom Rishel, Dick Furnas, Beverly West.

If Ye Love Me, Thomas Tallis: Kathryn Nyman — soprano; Cathy Stenson — alto; Bob Milnikel — tenor; Nat Miller — bass.

Five Hungarian Songs, Traditional: 1. A Csitari hegyek alatt; 2. Erik a szolo; 3. Csillagok, csillagok; 4. Hej, igazitsad; 5. Bus a kis gerlice; Antal Jarai — soprano, recorder

Ave Maria, J. S. Bach: Francis Ng — violin; Graeme Bailey — piano.

Salut d'Amour, Edward Elgar: Weining Qiu — piano; Brenda Posipanko — flute.

Czardas, Robert Strichartz: Greg Buzzard — violin; Robert Strichartz — piano.

Dream with Me, Leonard Bernstein: Kathryn Nyman — soprano; Nat Miller — cello; Cliff Earle — piano.

Revoada, Denis Hirschfeldt: Denis Hirschfeldt — guitar; Bob Milnikel — clarinet; Nat Miller — cello.

The Interview (Original Skit/Song), music by Robert Strichartz: Diane Downing, Kathryn Nyman — sopranos; Bob Milnikel — clarinet; Nat Miller — cello; Robert Strichartz — piano.

Topology Festival

The topology/geometry group of the Mathematics Department hosted the thirty-seventh annual Topology Festival on May 7–9 this year. Now an internationally known tradition, the festival was founded in part by Paul Olum in 1963 as a small regional conference that celebrated the return of spring and reviewed the outstanding results in topology during the preceding year.

The current festival attracts fifty to eighty topologists and geometers annually and is funded by the National Science Foundation. In the current era of highly specialized conferences, the Topology Festival is noteworthy in that—representing the interests of the current faculty—it presents a broad spectrum of current mathematics, usually featuring topics in geometric and algebraic topology, geometric group theory and geometry.

The festival consists of seven or eight one-hour lectures interspersed with thirty-minute breaks for discussion of results, conjectures and new theorems. Other activities include an opening reception, a dinner, an open house and a picnic. This format encourages a lively and open exchange of ideas and promotes mathematical collaboration. This year's featured speakers and their topics were:

Steve Boyer, University of Quebec: *A Proof of the Finite Filling Conjecture*

Robert Edwards, UCLA: *Cantor Groups, their Classifying Spaces and their Actions on ENRs*

Yakov Eliashberg, Stanford University: *Introduction to Symplectic Field Theory*

Misha Kapovich, University of Utah: *Group Actions on Coarse Poincaré Duality Spaces*

Peter Shalen, University of Illinois at Chicago: *Boundary Slopes of Knots and 3-Manifolds with Cyclic Fundamental Group*

Dani Wise, Cornell University: *Subgroup Separability of the Figure 8 Knot*

Chris Woodward, Rutgers University: *Eigenvalue Inequalities and Quantum Cohomology of the Grassmannian*

Wolfgang Ziller, University of Pennsylvania: *Curvature and Symmetry of Milnor Spheres*

The 38th Cornell Topology Festival will be held during the first week of May 2000.

Preparing Future Professors

The department's Preparing Future Professors program continues to prepare graduate students for the professorate while it attracts attention from outside administrative agencies. The program was funded this year by the Office of the Dean of the Arts College, again under the direction of Prof. Thomas Rishel.

Cornell graduate students gave ten talks on such topics as *The mathematics of juggling* and *Maps and map making* to a mixed audience of faculty and students at Hobart and William Smith, Wells and Ithaca Colleges. This experience afforded participants the opportunity to talk about their work in ways that anticipate both professional meetings and job searches. Graduate students Maria Fung, Kathyrn Nyman, David Brown and Leah Gold coordinated these talks. Some of the student speakers were David Revelle, David Brown, Chris Papadapoulous and Maria Fung. In April, Sudeb Mitra and Anke Walz were invited through the program to speak at the MAA sectional meeting in Syracuse, New York.

The National Science Foundation has funded a national Professors for the Future program administered through the AMS and MAA. Tom Rishel has been asked to chair the committee to choose the participating schools. In April Rishel was also asked to speak in Syracuse to a Project NExT meeting on concerns of junior faculty.

Expanding Your Horizons

Expanding Your Horizons is an annual day of hands-on workshops in mathematics and science for 7th, and 8th grade girls. The program is organized and run by women in mathematics and science, with the intention of generating interest in these subjects and of motivating the girls to continue taking mathematics and science courses throughout high school. On April 10, 1999, the graduate women of the Mathematics Department once again contributed to the success of the day by offering a sticky-fun workshop on"bubbles."

In this workshop, *Smart Bubbles*, Suzanne Lynch, Kathryn Nyman, Leah Gold and Sarah Spence illustrated some basic minimal surfaces and networks using bubbles as a tool. The girls dipped skeletons of the platonic solids into bubble solution, so see what minimal surface would form, after they had tried to guess it for themselves. They also had time to create their own skeletal shape with wire, and guess it's minimal surface, then experiment by dipping into solution. Some distorted their shape to observe the affect on the minimal surface. We also discussed the problem of connecting cities with a minimal number of road length, and found the solution for various city patterns, including the first few regular polygons, using the bubble solution. They learned that even mathematicians can utilize experimentation, and it can be fun!

Mathematics Awareness Week

Each year for the last several years, the American Mathematical Society has encouraged universities to support the idea of a mathematics awareness week in April. The Department of Mathematics has participated in this practice since its inception. This year we continued the tradition of sponsoring a T-shirt contest at Ithaca High School. The teachers at the high school chose their four favorites among the designs submitted by students, and the Cornell Department of Mathematics chose a winner from the four. The Departments of Mathematics at Cornell University and Ithaca High School kindly underwrote the cost of producing the T-shirts that were given to Cornell and Ithaca High School staff, used as prizes, and sold at cost. During the awareness week itself, each morning at Ithaca High School an interesting quote or math fact was read over the loud speaker and a problem of the day announced. The problems were designed to be accessible to almost all students, and usually over one hundred students and teachers submit solutions. T-shirts were awarded each day for five correct answers. In all, the week increased awareness of mathematics as an ongoing experience and produced many smiling faces.

Research Experiences for Undergraduates Program

The Cornell Mathematics Department has a grant from the National Science Foundation to run a summer program for undergraduates to participate in research projects. We are one of about 20 such Research Experiences for Undergraduates (REU) programs, and the summer of 1998 was the fifth year of our participation. (Our current grant goes until 2001.) In addition, we received some funding from Cornell to enhance the program. We had 10 students who participated from schools across the country, from Harvard to the University of Northern Iowa to Berkeley. Karl Papadantonakis represented Cornell. The research projects were Dynamical Systems, supervised by Professor John Hubbard of Cornell, and Analysis on Fractals supervised by professors Robert Strichartz from Cornell and Jun Kigami from Kyoto University. Graduate student Christian Henriksen and postdocs Sze-Man Ngai and Alexander Teplyaev (a fresh Ph.D. from Cornell) assisted them.

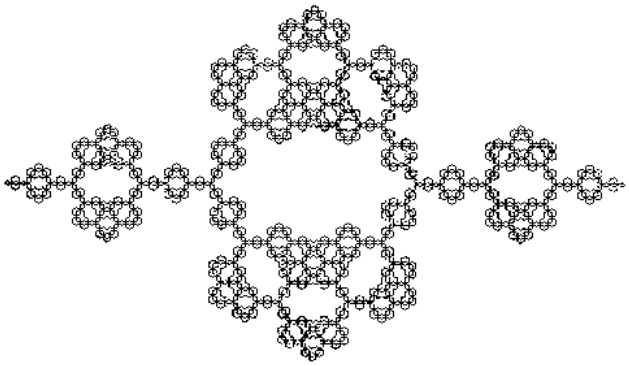

Figure 1

Analysis on Fractals

By now everyone has seen pictures of fractals and has heard that fractals are used to model many objects in the real world, such as ferns, snowflakes and clouds. But in order to make these models really useful, it is necessary to be able to do analysis of functions defined on fractals—to find the analog of the processes of calculus, and to solve 'fractal differential equations.' Kigami has been one of the leaders in creating such a theory, and the REU students were able to contribute to the development of the subject. One project involved setting up the basis for a spline theory to do explicit numerical analysis. Another was devoted to the properties of the Green's function, which allows one to invert the Laplacian on fractals. Several students were involved in an ambitious project to try to extend the class of fractals that can be dealt with. One new fractal now included in the theory is the fractal diamond shown in Figure 1.

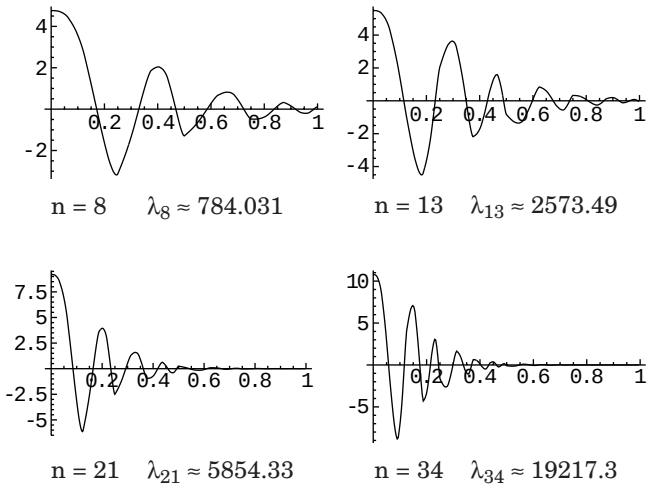

Figure 2

Not all fractal analysis involves fractal sets. One project dealt with an analog Fourier series for the ordinary unit interval, but based on a fractal measure. The analog of the usual sines and cosines are oscillating functions that have one derivative (but not two) but do not appear to follow a predictable pattern. However, a remarkable fact uncovered in this research is that if we index the functions f_n in a natural way (f_n has exactly n zeroes) then the ones associated with $n = 1, 2, 3, 5, 8, 13\ldots$ (the Fibonnaci sequence) do exhibit a regular pattern. You can see this in Figure 2.

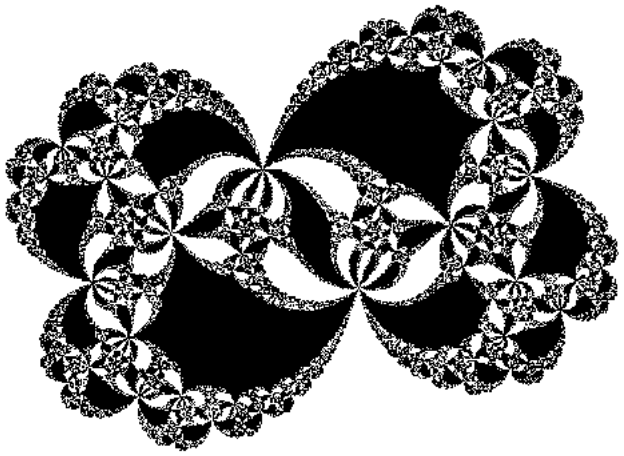

Figure 3

Dynamical Systems

One project dealt with matings of polynomials, resulting in a program called Medusa, which finds rational functions with special combinatorial properties. The un-

derlying mathematical result is a theorem of Thurston's, but implementing this theorem was a major challenge. An example of a mating is shown in Figure 3.

For the second project, Cornell's Karl Papadantonakis wrote programs to investigate the parameter space for Henon mappings; this has been a challenge in dynamical systems for many years. He tried a 3-pronged attack with all three prongs inspired by a result of Bedford and Smillie. One of these approaches requires solving polynomials of degree 2^k for values like $k = 12$, and finding all the roots. The third project resulted in a program to find homoclinic bifurcations of maps $f : R^2 \to R^2$. This again is a long-standing challenge, which was addressed by using carefully adapted splines to approximate stable and unstable manifolds.

The REU program will continue in the summer of 1999. There will be more Analysis on Fractals directed by Strichartz, Complex Dynamics directed by Adam Epstein, and a project on the Kepler Conjecture directed by Karóly Bezdek of the University of Budapest. The Kepler Conjecture concerns the optimal packing of spheres of radius one in 3-space. Recently, Thomas Hales of the University of Michigan has announced an affirmative solution. The project will be devoted to checking out the proof, to see if it is correct, to see if it can be improved or simplified, and to see if the ideas of the proof can be used to tackle other questions.

A new feature of the REU program for 1999 will be the inclusion of high school teachers, who will be working alongside the undergraduates on the research projects.

Centers and Institutes

Center for Applied Mathematics

Cornell's Center for Applied Mathematics (CAM) was established to promote research and advanced study in applied mathematics and to bring together students and professors with interests in various branches of the subject. Stephen Vavasis was acting director of CAM this year and Steven Strogatz served as director of graduate studies during spring 1999. The environment for applied mathematics at Cornell today is rich and varied. Viewed nationally, Cornell is a major center of activity in applied mathematics and scientific computations, and its students are among the best at Cornell. The 80 center faculty are drawn from the Department of Mathematics and 13 other departments in engineering and the sciences.

Mathematics Professors: L. Billera, R. Connelly, P. Diaconis, R. Durrett, E. B. Dynkin, J. F. Escobar, R. H. Farrell, L. Gross, J. Guckenheimer, J. H. Hubbard, H. Kesten, A. Nerode, A. H. Schatz, J. Smillie, M. Stillman, M. Sweedler and L. B. Wahlbin.

Center for the Foundations of Intelligent Systems

The Center for the Foundations of Intelligent Systems, directed by Anil Nerode, is part of a consortium of Berkeley, Stanford and Cornell devoted to all aspects of intelligent systems, and funded by DOD under a MURI (multiple university research initiative), administered by the Army Research Office. At Cornell the emphasis is on two areas at present: hybrid systems and non-monotonic reasoning systems. The center also has Air Force DOD support under a subcontract on architectures for command and control.

The Field of Statistics

The graduate field of statistics is a prominent example of the flexibility of graduate study at Cornell. In consultation with a special committee chosen from faculty members in six departments, including the Mathematics Department, students in the graduate field of statistics plan a program of study best suited to their individual needs.

The new Department of Statistical Science was formed effective July 1, 1997, by the combined efforts of the affiliated faculty, college deans and university administration. The department currently has approximately 27 faculty with primary and joint appointments in other departments. This new organizational structure allows better coordination of teaching, consulting, research and computing. The department has received approval to begin an applied master's program in August 2000. The Department of Statistical Science moved into Malott Hall in June 1999, along with the Department of Mathematics.

Mathematics Library

The Mathematics Library recently moved from the space they occupied in White Hall for over a century to a newly renovated facility in Malott Hall. The new library offers some vast improvements. With floor space tripling and a 50% increase in shelving, there is now plenty of room for the library's 50,000 volumes and for a predicted 15 years of collection growth. The new facility also boasts a media/conference room, a current periodicals area displaying over 550 journal titles in mathematics and statistics, over 60 study carrels and a photocopying room. The Mathematics Library collection at Cornell is one of the finest in the nation and supports research and instruction in mathematics and statistics for the Cornell community. The move brings with it new additions to

this collection, including holdings in mathematics education that were previously housed in Mann Library.

The research collection consists of works on mathematics, statistics, applied mathematics, mathematics education and the history of mathematics. For undergraduates with an interest in mathematics, the library is a wonderful resource for materials to support instructional and career needs as well as expository and recreational reading. The library collection has great historic depth and breadth, and includes materials from around the world in many languages.

The Mathematics Library encourages and welcomes all patrons in the Cornell community to use its resources. Reciprocal interlibrary loan agreements with other institutions make Cornell's resources available throughout the world and open the world to Cornell researchers. The need for quantification, analysis and more mathematical sophistication in the social, biological and engineering sciences attracts a spectrum of patrons from across the campus and generates frequent use of the collection. A full range of reference, circulation, printing and photocopy services are available in person and via phone, e-mail or the World Wide Web.

The library staff consists of Steven Rockey, the Director of the Library, Deborah Gagnon, Access Services Supervisor, and approximately a dozen part-time undergraduate student employees. The veteran professional staff and the competent student employees are always ready to serve the public and they welcome feedback. A primary goal is to make the library experience for the staff and patrons interesting, productive, and enriching in a small and personal environment.

The Mathematics Library's World Wide Web home page is http://math.cornell.edu/~library/. The Web page has information about the Mathematics Library, including services, hours of operation, pointers to relevant databases such as MathSciNet, links to mathematical science resources and an extensive bibliography of "collected works" of mathematicians. Library personnel are always adding new and relevant links to this home page. Visit our library, our home page, or contact us electronically or by telephone to find out how the Mathematics Library can serve you.

Digital Books

Five hundred seventy-six out-of-print and out-of-copyright mathematics books have been scanned into a digital storage system and archival quality hard copy produced for each. These books are a significant fraction of all research level mathematics books from the late nineteenth and early twentieth centuries. The Mathematics Library is on the leading edge of digital imaging for preservation of brittle books. The bibliography of the books that have been scanned includes pricing and ordering information and is available via the Mathematics Library home page. It can also be reached directly at: http://math.cornell.edu:/~library/reformat.html.

To date we have sold several hundred books printed from the digital files to individuals and other libraries. A new viewer has been developed for remote access to the full text of the book that is much more reliable and easier to use. You can view the books remotely by going to: http://library5.library.cornell.edu/math.html

Project Euclid

Mathematics Library staff are currently working on a Cornell University Library initiative called Project Euclid (http://euclid.library.cornell.edu), an electronic publishing endeavor to support cost-effective, timely, and creative scholarly communication in theoretical and applied mathematics and statistics. A cooperative undertaking of the Cornell University Department of Mathematics and the Cornell University Library, Project Euclid has received a planning grant from the Andrew W. Mellon Foundation that will allow it to expand into a collaborative venture with scholarly societies and associations, authors, publishers, and libraries.

Through partnerships with others engaged in the dissemination, evaluation, and use of mathematical research, Project Euclid seeks to facilitate the electronic publication of scholarly communications by developing a streamlined set of best practices. The goal is to create a unified and reliable source of electronic information relating to mathematics and statistics that is economical and widely accessible to scholars and others.

Special Instructional Support

Computer Lab

In 1998-99, the Math Lab continued to support the large range of courses and activities that it has in recent years. These include statistics, a wide range of geometry courses, differential equations, and most of the sophomore-level courses taught by the Mathematics Department.

The lab machine configuration now consists of 10 Macintosh Power PC's, 5 mostly recent Linux/Windows NT machines, an SGI Indigo 2, a number of older Macs, and several other older workstations. Major capabilities in the lab include easy projection from a variety of platforms, a high quality scanner, a CD writer, a VCR and color printing—all available and used for a range

of mathematical needs. The lab serves as a visualization center for the department as well as a high quality support place for undergraduate research, conferences, mathematical movies, and other events.

In past years, the most popular programs fueling lab activities have been easy to use Mac applications, powerful integrated mathematical environments like Maple and network applications, as well as Unix programming and visualization tools. The lab continues to offer excellent support and materials development in these areas, but has been reaching out to broaden its range. All machines have at least Student Matlab as well now, and there are a limited number of copies of Mathematica available. We have begun to boot our PCs into Windows NT mode for various classes and events to support the many users who prefer that mode, and also to more fully explore the advantages and needs of that platform.

Highly focused, easy to use, externally written applications as well as integrated mathematical environments will continue to play a major role in the lab, and the lab will continue to develop materials for them. The lab has also been taking steps over the last year to more actively develop mathematical software for others to use, an activity Lab Director Dr. Allen Back has considerable experience in, and one he hopes will be an increasingly valuable part of the Mathlab's contribution.

Mathematics Support Center

An academic support arm of the Mathematics Department, the Mathematics Support Center provides free one-on-one and small group tutoring, workshops and review sessions on topics of common concern in mathematics, approximately fifty brief printed capsules on various mathematical topics, and advice, encouragement, or referrals for students. Although the center focuses on support of introductory courses, it employs both undergraduates and postgraduates (about six each year) of diverse backgrounds and provides some limited tutoring even in upper-level courses. Douglas S. Alfors directs the operations of the MSC and coordinates its efforts with the instructors of the introductory calculus sequence. During the past year, the MSC has begun preparing a website. Watch this space for further announcements about its appearance!

All staff at the center are looking forward to our new space in Malott Hall. We anticipate that the doubling, if not tripling, of available space will make a much more inviting center for undergraduates. We have recently acquired a number of mathematics videos as well as an on-site television to augment further the learning experiences of our clients. We hope in the future to replace some antiquated computer equipment. As use of computers increases in the undergraduate mathematics curriculum, it is vital that our equipment be updated with machines capable of running current mathematical software.

Learning Strategies Center

The Learning Strategies Center (LSC) provides academic support in a variety of subjects across campus, including biology, chemistry, physics, economics, writing, study skills and mathematics. The mission of the LSC is to provide academic assistance to students during their transition from high school students to accomplished Cornell students. Studies have shown that students who successfully complete their freshman year generally go on to graduate from Cornell. Therefore, most of the LSC's efforts are directed to supporting large, primarily freshmen, courses.

In mathematics this year, the LSC provided academic support for Math 105, Math 106, Math 111, Math 112, Math 171, Math 191, and Math 192. Support for all of these courses (except Math 171) included supplemental courses, tutoring and prelim review sessions. Supplemental or "00" courses meet on Sunday, Monday or Wednesday nights (in mathematics) — subject to the instructors — to review the week's material from the *parent* course. LSC help for Math 105, 106, 111, 112, 191 and 192 was available during the 00 instructors' office hours (and their tutors' office hours) and also by appointment. Prelim review sessions were either included in or provided in addition to the 00 evening sessions, subject to the instructors' discretion. Help for Math 171, as well as other undergraduate statistics courses, was also provided in the Academic Support Center for Undergraduate Statistics (ASCUS) as posted.

Academic support for all of these courses will continue in this fashion during the 1999–2000 academic year. Less formal academic support may be provided for students in Math 193 in the form of informal meetings subsequent to the Math 091 classes.

NSF Undergraduate Faculty Enhancement Workshop

This workshop is funded by an Undergraduate Faculty Enhancement grant from the National Science Foundation. This was the fifth in a series of such week-long workshops held at Cornell for college and university faculty who teach (or soon will teach) an undergraduate geometry course, such as courses typically attended by future or in-service teachers. Thirty-three mathematics faculty attended this year's workshop. In addition, two

participants from previous years acted as mentors. The leaders of the workshop were: David Henderson, Kelly Gaddis (Buffalo State), Jane-Jane Lo, Avery Solomon, and Daina Taimina.

In the mornings, participants experienced a learning and teaching environment, innovative both in terms of content and in terms of teaching methods, that has been developed over the years by David Henderson. The content was the integration of geometries on plane, sphere and hyperbolic plane—presented through problems which emphasize experiencing the meaning in the geometry. Student explorations, small group learning and writing assignments were explored.

In the afternoons, there were seminars and presentations on topics related to the workshop theme, including: *How to Write Good Exploratory Problems*; *Curriculum Developments in School Geometry*; *Using Computer Technology in Geometry*; *Formal versus Intuitive Knowing in Geometry*; *What are in the 8 Undergraduate Geometry Courses at Cornell?*; *Non-test-based Assessments* and *Including All Students by Encouraging Diverse Ideas*. In addition, participants had free time for informal discussions and enjoyment of the geometry of nature in and around Ithaca.

The NSF will support follow-up activities by the participants after the workshop, including local workshops, exchange of related classroom materials and communication of experiences and ideas.

Mathematics Education

Cornell/Schools Mathematics Resource Program

The CSMRP and its predecessor in-service program were initiated in 1985 by Cornell's Committee on Education and the Community. It was developed and initially taught by David Henderson and is now directed by Avery Solomon. The project has received continued funding from Cornell, the area school districts and yearly Title II EESA Grants awarded through New York State.

The CSMRP is aimed at improving the status of mathematics teaching and learning by providing in-service mathematics courses and workshops for teachers, researching and developing materials for use in the classroom which follow a broader approach to mathematics, and supporting and initiating cooperative efforts between Cornell University and local schools. Among other initiatives, the CSMRP has been assisting Ithaca High School and other area schools in making a transition to a new assessment exam for all high school students.

Activities of the CSMRP in 1998–99 included: a series of Saturday workshops for teachers of middle and high school mathematics; workshops for teachers in Ithaca, Broome county, and Norwich, NY; work with teachers individually at DeWitt Middle School, and Ithaca High School; and a four day summer geometry workshop for mathematics teachers held at Cornell University.

Teacher Education in Agriculture, Mathematics and Science

Sponsored jointly by the Departments of Mathematics and Education, this program seeks to help students integrate their knowledge of science and mathematics with the study of education. Cornell mathematics or science majors who wish to become teachers apply to the program during their sophomore or junior year. After earning their bachelors degree with a mathematics major, students complete an additional year. At the end of this fifth year, students receive a Master of Arts in Teaching (MAT) from Cornell and a teaching certificate from New York State. The program is committed to the development of both the theoretical and the practical aspects of education and a thorough knowledge of mathematics.

Mathematics Department Endowments

The department is thankful that alumni, friends and family continue to support the department endowments. Without their generosity, we would be unable to provide many of the offerings which make our department unique. Still in their infancy, the newer endowments are just beginning to provide a return that can be used in support of their foci.

The Colloquium Endowment Fund was instituted to invite distinguished scientists to speak at Cornell. It was initially established much as the library endowment with major contributions coming from faculty who taught extra courses and donated their earnings to the fund. In addition, we receive donations to this endowment from alumni and friends of mathematics. Earnings from this endowment are used to pay for honoraria and travel expenses for guest lecturers who speak at the Oliver Club seminars during the academic year. The Oliver Club was founded (as the Mathematical Club of Cornell University) in January 1891 by James E. Oliver, who was then chair of the department. It's main purpose was to provide a forum for formal talk and discussion for student and faculty interested in mathematics. Renamed The Oliver Mathematical Club of Cornell University in 1898, the club first began to bring in outside speakers in the

1940s. Although the Oliver Club has gone through some structural changes over the years, it still basically fulfills the primary goals of the original club.

The Eleanor Norton York Endowment was established in honor of Eleanor Norton York, a valued employee of the Cornell Astronomy Department who worked closely with graduate students, with the intent of recognizing outstanding graduate students in both Astronomy and Mathematics. The income from this endowment is used to provide annual prizes to a continuing graduate student in both departments at Cornell.

The Faculty Book Endowment was first introduced by former Chairman Keith Dennis in 1988 to enrich the collections of the Mathematics Library. It 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. Income from this important endowment is used to supplement the Mathematics Library acquisition funding.

The Israel Berstein Memorial Fund was established with a donation in his memory from his sister, Gita Fonarov. The fund is administered by a committee of close colleagues of Professor Berstein, who was a professor in this department from 1962 through 1991. The memorial fund has as its central purpose helping young mathematicians in the field of topology. Its earnings are intended to provide occasional funds to assist, promote and support the studies of deserving graduate students and post-doctoral associates in the fields of topology and/or geometry. In addition, an award has been established for an outstanding graduate student in topology or neighboring areas.

The Logic Endowment was established as the direct result of a very generous gift from a former Cornell undergraduate. This endowment seeks to actively support promising logic students in the areas of institutional memberships and travel expenses to the Association for Symbolic Logic meetings and events as well as other activities in the field of logic.

The Robert John Battig Endowment was established by his parents in December 1997, after the untimely death of Robert Battig, a graduate student in mathematics. The current purpose of this fund is to provide an annual prize to an outstanding continuing graduate student in Mathematics at Cornell.

Degrees Granted 1998–99

Doctoral Degrees

August 1998

Debra L. Boutin

Centralizers of Finite Subgroups of Automorphisms and Outer Automorphisms of Free Groups

MS Special, Cornell University, 1995
BS, Smith College, 1991
Committee: Vogtmann, Cohen, Brown

Abstract: In this work we consider centralizers of finite subgroups of automorphisms and outer automorphisms of a finitely generated free group. The work of S. Krstic reveals that the centralizer of a finite subgroup of outer automorphisms (resp. automorphisms) of a free group is generated by isomorphisms and Nielsen transformations of reduced G-graphs (resp. pointed G-graphs). Here this characterization is exploited to find necessary and sufficient conditions for the centralizer of a finite subgroup of outer automorphisms (resp. automorphisms) to be finite.

Maria Mikhail Gordina

Holomorphic Functions and Heat Kernel Measure on an Infinite Dimensional Complex Orthogonal Group

BS, Leningrad State University, 1990
Committee: L. Gross, Barbasch, Schatz, Dynkin

Abstract: The heat kernel measure μ_t is constructed on an infinite dimensional complex group using a diffusion in a Hilbert space. Then it is proved that holomorphic polynomials on the group are square integrable with respect to the heat kernel measure. The closure of these polynomials, $\mathcal{H}L^2(SO_{HS}, \mu_t)$, is one of two spaces of holomorphic functions we consider. The second space, $\mathcal{H}L^2(SO(\infty))$, consists of functions which are holomorphic on an analog of the Cameron-Martin subspace for the group. It is proved that there is an isometry from the first space to the second one.

The main theorem is that an infinite dimensional nonlinear analog of the Taylor expansion defines an isometry from $\mathcal{H}L^2(SO(\infty))$ into the Hilbert space associated with a Lie algebra of the infinite dimensional group. This is an extension to infinite dimensions of an isometry of B. Driver and L. Gross for complex Lie groups.

All the results of this paper are formulated for one concrete group, the Hilbert-Schmidt complex orthogonal group, though our methods can be applied in more general situations.

Craig A. Jensen

Cohomology of $Aut(F_n)$

BS, Utah State University, 1992
Committee: Vogtmann, Hatcher, Cohen

Abstract: For odd primes p, we examine the Farrell cohomology $\hat{H}^*(Aut(F_{2(p-1)}); \mathbb{Z}_{(p)})$ of the group of automorphisms of a free group $F_{2(p-1)}$ on $2(p-1)$ generators, with coefficients in the integers localized at the prime $(p) \subset \mathbb{Z}$. This extends results in [12] by Glover and Mislin, whose calculations yield $\hat{H}^*(Aut(F_n); \mathbb{Z}_{(p)})$ for $n \in \{p-1, p\}$ and is concurrent with work by Chen in [9] where he calculates $\hat{H}^*(Aut(F_n); \mathbb{Z}_{(p)})$ for $n \in \{p+1, p+2\}$. The main tools used are Ken Brown's "Normalizer spectral sequence" from [7], a modification of Krstic and Vogtmann's proof of the contractibility of fixed point sets for outer space in [19], and a modification of the Degree Theorem of Hatcher and Vogtmann in [15].

Other cohomological calculations in the paper yield that $H^5(Q_m; \mathbb{Z})$ never stabilizes as $m \to \infty$, where Q_m is the quotient of the spine X_m of "auter space" introduced in [15] by Hatcher and Vogtmann. This contrasts with the theorems in [15] where various stability results are shown for $H^n(Aut(F_m); \mathbb{Z})$, $H^n(Aut(F_m); \mathbb{Q})$, and $H^n(Q_m; \mathbb{Q})$.

MinJeong Kang

Asymptotic Behavior of Solutions of One Dimensional Parabolic SPDE

BS, Seoul National University, 1991
Committee: Durrett, Kesten, L. Gross

Abstract: We investigate the weak convergence as time $t \to \infty$ of the solutions of SPDE in one dimension with Dirichlet boundary conditions. We first prove a result for the linear case, which is easy since the solution is Gaussian. Then we get a result for non-linear drift case by proving a new comparison theorem for SPDE. To investigate an elliptic SPDE with Dirichlet boundary condition, we set up an equivalence between an elliptic SPDE and a system of SODE. From there, we construct a counter example that shows non-uniqueness of the solution for SPDE, and look at how the Lipschitz constant of the drift term affects the uniqueness.

Wicharn Lewkeeratiyutkul

Perturbation Theorems for Supercontractive Semigroups

MS Special, Cornell University, 1995
BS, Chulalongkorn University, 1991
Committee: L. Gross, Barbasch, Brown

Abstract: Let μ be a probability measure on a Riemannian manifold. It is known that if the semigroup $e^{-t\nabla^*\nabla}$ is hypercontractive, then any function g for which $\|\nabla g\|_\infty \leq 1$ will satisfy a Herbst inequality, $\int \exp(\alpha g^2) d\mu < \infty$, for small $\alpha > 0$. If the semigroup is supercontractive, then the above inequality will hold for all $\alpha > 0$. For any $\alpha > 0$ for which $Z = \int \exp(\alpha g^2) d\mu < \infty$, we define a measure μ_g by $d\mu_g = Z^{-1} \exp(\alpha g^2) d\mu$. We show that if μ is hyper- or supercontractive, then so is μ_g. Moreover, under standard conditions on logarithmic Sobolev inequalities which yield ultracontractivity of the semigroup, Gross and Rothaus have shown that $Z = \int \exp(\alpha g^2 |\log|g||^c) d\mu < \infty$ for some constants α, c. We in addition show that the perturbed measure $d\mu_g = Z^{-1} \exp(\alpha g^2 |\log|g||^c) d\mu$ is ultracontractive.

Jeffrey Jay Mitchell

Short Time Behavior of Hermite Functions on Compact Lie Groups

MS Special, Cornell University, 1996
BS, University of Missouri at Rolla, 1993
Committee: L. Gross, Barbasch, Wahlbin

Abstract: Let $p_t(x)$ be the (Gaussian) heat kernel on R^n at time t. The classical Hermite polynomials at time t may be defined by a Rodriguez formula, given by $H_\alpha(-x,t)p_t(x) = \alpha p_t(x)$, where α is a constant coefficient differential operator on R^n. Recent work of Gross (1993) and Hijab (1994) has led to the study of a new class of functions on a general compact Lie group, G. In analogy with the R^n case, these "Hermite functions" on G are obtained by the same formula, wherein $p_t(x)$ is now the heat kernel on the group, $-x$ is replaced by x^{-1}, and α is a right invariant differential operator. Let $\mathfrak{g}$ be the Lie algebra of G. Composing a Hermite function on G with the exponential map produces a family of functions on $\mathfrak{g}$. We prove that these functions, scaled appropriately in t, approach the classical Hermite polynomials at time 1 as t tends to 0, both uniformly on compact subsets of $\mathfrak{g}$ and in $L^p(\mathfrak{g}, d\mu)$, where $1 \leq p < \infty$, and $d\mu$ is a Gaussian measure on $\mathfrak{g}$. Similar theorems are established when G is replaced by G/K, where K is some closed, connected subgroup of G.

Lisa Anne Orlandi

Actions of Artin Groups and Automorphism Groups on $\mathbb{R}$-Trees

MS Special, Cornell University, 1995
BA, Northwestern University, 1991
Committee: Vogtmann, Cohen, Hatcher

Abstract: This dissertation determines the ways in which two classes of groups act by isometries on $\mathbb{R}$-trees. The first groups studied are the two-generator Artin groups A_{2n+1}, where $2n+1$ is half the length of the relator. In the case where $2n+1$ is prime, all abelian and non-abelian A_{2n+1}-actions are found, thus determining by Bass-Serre theory all of the graph of groups decompositions of A_{2n+1}. The same techniques are applied to a three-generator Artin group, the braid group on four strands, enabling a description of all of its actions on $\mathbb{R}$-trees. The second groups studied are the pure symmetric automorphism groups $P\Sigma_n$ of a free group on n

generators; these groups consist of the automorphisms mapping every generator to a conjugate of itself. All exceptional abelian $P\Sigma_n$-actions on $\mathbb{R}$-trees are found in the sense that their length functions are given. This information determines the Bieri-Neumann-Strebel invariant of $P\Sigma_n$ using Brown's characterization. The invariant tells which normal subgroups of $P\Sigma_n$ with abelian quotient are finitely generated.

Shu-Yen Pan

Local Theta Correspondence and Unrefined Minimal K-Types

MS Special, Cornell University, 1994
BS, National Taiwan University, 1989
Committee: Barbasch, Speh, Chase

Abstract: The local theta correspondence is a one-to-one correspondence between the irreducible admissible representations of two p-adic classical groups which form a reductive dual pair in a symplectic group. In this doctoral dissertation, we study the local theta correspondence by applying A. Moy and G. Prasad's theory of unrefined minimal K-types for p-adic reductive groups. After strengthening an important theorem of J.-L. Waldspurger, we prove that the depths of the two irreducible admissible representations paired by the local theta correspondence for any (type I) reductive dual pairs are equal. Moreover, we prove that the unrefined minimal K-types of the paired representations are related by the theta correspondence for finite reductive dual pairs when the depth is zero, and are related by the orbit correspondence when the depth is positive. In particular, an irreducible admissible representation has nontrivial vectors fixed by an Iwahori subgroup if and only if the irreducible admissible representation paired with it also has nontrivial vectors fixed by an Iwahori subgroup. As an application of our main results, we can describe the first occurrences of depth zero irreducible supercuspidal representations in the theta correspondence for the p-adic reductive dual pairs completely in terms of the first occurrences of irreducible cuspidal representations in the theta correspondence for finite reductive dual pairs. It is expected that this result is useful for further studies of the first occurrences of irreducible supercuspidal representations in the local theta correspondence.

May 1999

Gonzalo Garcia

On Conformal Metrics on the Euclidean Ball

MS Special, Cornell University, 1996
MS, Universidad del Valle, Columbia, 1992
BS, Universidad del Valle, Columbia, 1991
Committee: Escobar, Strichartz, L. Gross
Abstract: Unavailable for publication.

Ilya German

Hedging Options with Small Transaction Costs

MS Special, Cornell University, 1998
BS, Tel-Aviv University, 1993
Committee: Durrett, Kesten, Saloff-Coste

Abstract: Nonzero proportional transaction costs make perfect replication impossible in the Black-Scholes model. We find the distribution of the replication error caused by readjustments of the hedging portfolio at discrete time intervals. Taking a Leland type limit, we find the limiting behavior of transaction costs being paid. Using these two results, we suggest a method for finding the optimal rebalancing interval.

Robert Milnikel

Nonmonotonic Logic: A Monotonic Approach

BS, Carleton College, 1992
Committee: Nerode, Shore, Kozen

Abstract: We present a monotone inductive characterization of the set of skeptical consequences of a nonmonotonic rule system. Nonmonotonic rule systems are an abstraction of the nonmonotonic properties of many systems designed to formalize everyday reasoning, including default logic, autoepistemic logic, and logic programming. We begin with preliminary results about nonmonotonic rule systems and continue by showing their mutual translatability with several other standard nonmonotonic logics. The main result is the soundness and completeness of a tableau proof system (using count-

ably branching tableaux) for skeptical consequence. We conclude by using the tableau result to generate several other monotone proof systems, including a sequent calculus and an axiomatization of skeptical consequence in $L_{\omega_1\omega}$.

Shayan Sen

Representations and Characters of an Extension of $SL(3, R)$ by an Outer Automorphism

MS Special, Cornell University, 1995
BS, Trinity College, Dublin, 1992

Committee: Speh, Barbasch, M. Gross
Abstract: Unavailable for publication.

Master of Science Special

(No Thesis Required)

August 1998

David Brown, Mathematics
BS, Ithaca College, 1995
Committee: Hubbard, Earle, Smillie

Leah Gold, Mathematics
BS, University of Chicago, 1995
Committee: Stillman, Billera, Barbasch

Denis Hirschfeldt, Computer Science
BS, University of Pennsylvania, 1993
Committee: Shore, Kozen, Nerode

Shannon Kelly, Mathematics
BS, University of Washington, 1993
Committee: Durrett, Kesten, L. Gross

Kathryn Nyman, Mathematics
BS, Carthage College, 1995
Committee: Billera, Stillman, Renegar

Walker White, Computer Science
BS, Dartmouth College, 1993
Committee: Shore, Kozen, Nerode

May 1999

Jonathan Todd, Mathematics
BS, Williams College, 1996
Committee: West, Hwang, Morley

Bachelor of Arts

January 1999

Caroline Jane Klivans
Magna Cum Laude in Mathematics
Roman Lobkovsky †
Nelson Ma †

May 1999

Ruzgar Barisik
Thyagaraju Chelluri
Magna Cum Laude in Mathematics
Alexandra Chatanay Dibella
Maneksha Katerine Dumont †
John David Flint
Harold Ober Fox †
Magna Cum Laude in Mathematics
Daniel Elan Gardner †
Cum Laude in Mathematics
Peter Martin Haberlandt
Yondy Kang †
Mary Anne Krabbenhoft
Vladimir Alex Livshits
Summa Cum Laude in Computer Science
Mauro Merolle †
Kevin Edwin Neijstrom †
Tina Ann Nolte †
Cum Laude in Computer Science
Avery Travis Pickford
Brenda Posipanko
David Edward Rogers †
Adam Michael Rosen †
Susan Rebecca Rushmer †
Nikhil M. Shanbhag †
Cum Laude in Mathematics
Dhruv Singhal †
Jun Hyung Sung
Cum Laude in Mathematics
Westley Richards Weimer †
Summa Cum Laude in Computer Science
Cum Laude in Mathematics
Benjamin Eli Yokell
Richard Anthony Zentko

† **Distinction in all subjects**

Department Colloquia

Analysis Seminar

September 98

Laurent Saloff-Coste, Cornell University: *Weak Gaussian bounds: a variation on Davies' method*

Robert Strichartz, Cornell University: *Calculus on fractals through Taylor's theorem*

Frederico Xavier, Notre Dame University: *Why no complete embedded simply connected minimal surfaces have been discovered since 1776*

October 98

Jiaping Wang, Cornell University: *Spaces of harmonic functions*

Clifford Earle, Cornell University: *Asymptotically conformal mappings and extremal quasiconformal mappings, with some examples*

José F. Escobar, Cornell University: *An isoperimetric inequality and the first Steklov eigenvalue*

November 98

Sudeb Mitra, Cornell University: *Universal holomorphic motion and applications*

McKenzie Y. Wang, McMaster University: *The cohomogeneity on Einstein equations*

Christopher Atkin, Victoria University: *An infinite dimensional Riemannian manifold that is geodesically complete but metrically incomplete*

January 99

Alexander Bendikov, Mathematisches Institut, Erlangen-Nurenberg: *On some Markov semigroups on the real line*

February 99

Alexandru Ionescu, Princeton University: *An endpoint estimate for the Kunze-Stein phenomenon and related maximal operators*

Yuri Berest, University of California at Berkeley: *Lacunas for hyperbolic differential operators with variable coefficients*

Clifford Earle, Cornell University: *Some maximal holomorphic motions*

March 99

Laurent Saloff-Coste, Cornell University: *Invariant Dirichlet spaces on the infinite dimensional torus*

Michael Solomyak, Weizmann Institute of Science: *Rozenblum-Lieb-Cwikel inequality and its further development*

Robert Strichartz, Cornell University: *Analysis on fractals vis-a-vis analysis on manifolds*

April 99

Paul Yang, Princeton University: *A nonlinear boundary value problem for the fourth order Paneitz operator*

Bjorn Walther, Royal Institute of Technology (Stockholm): *Regularity and decay estimates for dispersive equations and best constants*

May 99

Timothy Healey, Cornell University: *New existence results in nonlinear elasticity*

Combinatorial and Algebraic Geometry Seminar

September 98

Irena Peeva, Cornell University: *Monomial resolutions and cohomology of subspace arrangements*

Eva Maria Feichtner, Institute for Advanced Study: *Cohomology of ordered configuration spaces of spheres*

Eva Maria Feichtner, Institute for Advanced Study: *Intersection cohomology of toric varieties and the proof of the g-theorem*

Swapneel Mahajan, Cornell University: *The abc (and d) of the Boolean lattice*

October 98

Vesselin Gasharov, Cornell University: *On the singular locus of a Schubert variety*

Patricia Hersh, MIT: *Flag f-vectors, symmetric functions and chain decomposition*

David Finston, New Mexico State University and Cornell University: *Additive group actions on complex affine space*

Michael Stillman, Cornell University: *Computing sheaf cohomology on projective spaces and on toric varieties*

November 98

E. Graham Evans, University of Illinois at Urbana and Queens University: *Minimal Betti numbers for R/I with given Hilbert function*

December 98
John Hubbard, Cornell University: *The structure at infinity for Newton's method in several variables*

February 99
Kenneth Brown, Cornell University: *Random walks and ring theory: combinatorial aspects*
Michael Stillman, Cornell University: *Local cohomology and monomial ideals*

March 99
Catherine Stenson, Cornell University: *The early history of Mobius inversion*
Christos Athanasiadis, University of Pennsylvania: *The graph of monotone paths on a convex polytope*
Irena Peeva, Cornell University: *Toric Hilbert schemes*
Yurii Burman, Independent University of Moscow: *Quadratic Poisson brackets on associative algebras*

April 99
Hema Srinivasan, University of Missouri: *Bounds for shifts in resolutions*
Dale Cutkosky, University of Missouri: *Regularity of resolutions*
Hal Schenck, Northeastern University: *Poincaré polynomials of hyperplane arrangements*

May 99
Ira Gessel, Brandeis University: *What's new with trees?*

Dynamics and Geometry Seminar

September 98
Adam Epstein, Cornell University: *Quadratic mating discontinuity* (in four parts)

October 98
John Hubbard, Cornell University: *Implementation of the spider in the Medusa algorithm*
Suzanne Lynch, Cornell University: *A cubic mating surprise*
John Milnor, SUNY at Stony Brook: *Rational maps with two critical points*
Greg Buzzard, Cornell University: *Solenoids at infinity for Henon maps* (in two parts)

November 98
Yulij Ilyashenko, Cornell University: *Complete abelian integrals and infinitesimal Hilbert problem* (in two parts)
Vadim Kaloshin, Princeton University: *Growth of the number of periodic orbits for prevalent diffeomorphisms*
Anton Gorodetski, Moscow State University: *Diffeomorphisms derived from random dynamical systems*

December 98
Amie Wilkinson, Northwestern University: *Ergodic theory of diffeomorphisms: a global perspective*
Saeed Zakeri, SUNY at Stony Brook: *Mating Siegel quadratic polynomials*

February 99
Adam Epstein, Cornell University: *Infinitesimal Thurston rigidity and the Fatou-Shishikura inequality*
John Guckenheimer, Cornell University: *The Lorenz attractor*
Richard Rand, Cornell University: *The dynamics of resonance capture*
Jim Sethna, Cornell University: *Hysteresis, avalanches and Barkhausen noise in magnetic systems*

March 99
Yakov Dimant, Cornell University: *Bounded asymptotic solutions of a dynamical set of three quasilinear ODE for complex variables*
Andre de Carvalho, SUNY at Stony Brook: *1- and 2-dimensional real and complex dynamics*

April 99
Adam Epstein, Cornell University: *Discontinuity of straightening, tuning and mating for maps of degree 3 or more*
John Hubbard, Cornell University: *The topological classification of "solenoidal" maps*
David Brown and Suzanne Lynch, Cornell University: *A taste of Fayetteville here in Ithaca: spiders and matings*
Richard Durrett, Cornell University: *Mutual invadability implies coexistence*

May 99
John Guckenheimer, Cornell University: *Neural systems and dynamical systems*

Educational Issues in Undergraduate Mathematics Seminar

September 98

David Henderson, Cornell University: *A mathematician looks at RUME (Research on Undergraduate Mathematics Education)*

February 99

David Henderson, Cornell University: *Visualization and imagination in mathematics*

Nathaniel Miller, Cornell University: *Intuition vs. formal systems: how symbols acquire meaning*

Nathaniel Miller, Cornell University: *Diagrams and formality as a route to understanding*

Avery Solomon, Cornell University: *Platonism meets constructivism: kinds of understanding in mathematics*

March 99

Dorothy Buerke, Ithaca College: *What is intuition in mathematics?*

Samer Habre, Cornell University: *Visualization skills in a combined multivariable calculus and differential equations class*

April 99

Beverly West, Cornell University: *Successful take-home exams, where students show what they can do, instead of what they can not*

Marcia Ascher, Ithaca College: *What is mathematics? (and who decides?)*

Nathaniel Miller, Cornell University: *My experiences teaching a Freshman Writing Seminar in mathematics*

Geometry Seminar

November 98

Thomas C. Hales, University of Michigan: *The dodecahedral conjecture*

Thomas C. Hales, University of Michigan: *The Kepler conjecture*

Lie Groups Seminar

September 98

Hongyu He, Cornell University: *An analytic compactification of Sp(2n,R)*

Ravi Ramakrishna, Cornell University: *P-adic Galois representations*

Anthony Kable, Cornell University: *Prehomogeneous vector spaces and asymptotic counting problems in arithmetic*

October 98

Stephen Bullock, Cornell University: *Handbook of non-positively curved symmetric spaces*

Stephen Bullock, Cornell University: *L2 constructions of weighted cohomology*

Luis O'Shea, Cornell University: *Sesqui-symplectic convexity*

Maxim Braverman, Ohio State University: *Cohomology of the Mumford quotient*

November 98

Arkady Berenstein, Cornell University: *Total positivity and canonical bases*

Alexander Braverman, MIT: *Schwartz functions on the basic affine space (joint work with D. Kazhdan)*

February 99

Vesselin Gasharov, Cornell University: *The singular locus of a Schubert variety*

Stephen Miller, Yale University: *The Laplace spectrum and cuspidal cohomology of modular quotients*

Laurent Saloff-Coste, Cornell University: *Some problems in analysis on compact simple Lie groups in high dimensions*

March 99

Maria Fung, Cornell University: *Analytic torsion of hyperbolic spaces*

Jim Cogdell, Oklahoma State University: *The converse theorem for $GL(n)$ with twists by $GL(n-2)$*

Juergen Rohlfs, Katholische Universitaet Eichstaett: *Group cohomology with growth conditions*

Yurii Burman, Independent University of Moscow: *Quadratic Poisson brackets on associative algebras*

April 99

Thomas Deck, University of Manheim and Cornell University: *Generalized functions on compact Lie groups—another aspect of heat kernel analysis*

E. Vinberg, Moscow State University: *A remarkable generalization of symmetric spaces*

Stephen Bullock, Cornell University: *Weighted cohomology of arithmetic groups*

Henri Darmon, McGill University: *Modularity of fibers in rigid local systems*

Logic Seminar

September 98

John Rosenthal, Ithaca College: *Finite dimensional Steinitz exchange systems with undecidable theories*

Joseph Miller, Cornell University: *Forgetful determinacy*

Richard Platek, Cornell University: *Nonstandard analysis* (in three parts)

Joseph Miller and Suman Ganguli, Cornell University: *The decidability of S2S via determinacy* (in three parts)

October 98

Robert Milnikel, Cornell University: *Reduction of nonstandard mathematics to standard* (in two parts)

Moshe Vardi, Rice University: *Church's problem revisited: synthesis with incomplete information and alternating tree automata*

Walker White, Cornell University: *Radically finite probability theory* (in two parts)

Robert K. Meyer, Australian National University: *Introduction to relevant logics*

Sergei Artemov, Cornell University: *On the Brouwer-Heyting-Kolmogorov semantics for intuitionistic logic*

November 98

Suman Ganguli, Cornell University: *Automata and modal logics*

Walker White, Cornell University: *Radically finite probability theory: culminating in the law of large numbers*

Suman Ganguli, Cornell University: *Construction of automata for temporal logics*

Joseph Miller, Cornell University: *Computational complexity issues related to decidability*

Joseph Miller, Cornell University: *A few complexity results for decidable structures*

Jennifer Davoren, Cornell University: *A very brief introduction to the modal mu-calculus*

Anil Nerode, Cornell University: *An introduction to the calculus of variations*

Jennifer Davoren, Cornell University: *Formal analysis and verification of hybrid systems using extensions of the modal mu-calculus*

December 98

Anil Nerode, Cornell University: *The nonstandard calculus of variations* (in two parts)

January 99

Nathaniel Miller, Cornell University: *A diagrammatic formal system for Euclidean geometry*

February 99

Jeffrey Roland, Cornell University: *Large cardinals I: inaccessibility, Mahloness and measurability*

Walker White, Cornell University: *Robinson forcing*

Jeffrey W. Roland, Cornell University: *Large cardinals II: measurability*

Walker White, Cornell University: *Effective Robinson forcing*

Suman Ganguli, Cornell University: *Large cardinals III: compactness; elementary embeddings*

Robert Milnikel, Cornell University: *A Gentzen system for nonmonotonic logics*

Suman Ganguli, Cornell University: *Large cardinals IV: elementary embeddings*

Noam Greenberg, Cornell University: *Easy PCF* (in four parts)

March 99

Suman Ganguli, Cornell University: *Large cardinals V: elementary embeddings; indescribability*

Noam Greenberg, Cornell University: *Large cardinals VI–IX: partition properties* (in four parts)

April 99

Cris Carlude, University of Aukland (New Zealand): *Recent progress on the complexity of computable enumerable random reals*

Denis Hirschfeldt, Cornell University: *Degree spectra of relations on algebraic structures*

Jennifer Davoren, Cornell University: *Using the modal mu-calculus: synthesis of feedback controllers for hybrid systems*

David W. Kueker, University of Maryland: *Constructing models from smooth families of finite structures*

Sergei Artemov, Cornell University: *On the metamathematics of formal verification*

May 99

Noam Greenberg, Cornell University: *Large cardinals X: 0#, conclusion*

Walker White, Cornell University: *Large cardinals XI and XII: Solovay's theorem* (in two parts)

Occasional Seminar

September 98

David Henderson, Cornell University: *A mathematician looks at RUME (Research on Undergraduate Mathematics Education)*

Avery Solomon, Cornell University: *Making geometric conjectures with Sketchpad*

October 98

Beverly West and Samer Habre, Cornell University: *Exploiting visualization in the teaching/learning of multivariable calculus*

Thomas Rishel, Cornell University: *A mini-mini-minicourse on writing in math*

Jane-Jane Lo, Ithaca College and Cornell University: *Performance assessment from TIMMS and NAEP what are the implications for college teaching?*

November 98

J. E. Hall, Cornell University: *Working principles for teaching and learning: bypasses*

Dorothy Buerke, Ithaca College: *Gender and mathematics*

Richard Cleary, St. Michael's College and Cornell University: *Student evaluations of traditional and nontraditional courses*

Allen Back, Cornell University: *Creative uses of technology in the classroom*

Oliver Club

September 98

Greg Buzzard, Cornell University: *Dynamical stability for polynomial diffeomorphisms of* $\mathbb{C}^2$

Reyer Sjamaar, Cornell University: *Linear inequalities and Schubert cycles*

Louis Billera, Cornell University: *Enumerating flags in polytopes*

October 98

Harry Kesten, Cornell University: *Percolation of arbitrary words in* $\{0,1\}^{\mathbb{N}}$

John Conway, Princeton University: *Tangles, bangles and knots*

Benson Farb, University of Chicago: *The asymptotic geometry of groups*

Maxim Braverman, Ohio State University: *Morse theory for multi-valued functions*

November 98

Ricardo Perez-Marco, UCLA: *The butchered Riemann sphere and the new renormalization*

F. T. Farrell, Binghamton University: *Topological rigidity*

December 98

Yulij Ilyashenko, Cornell University: *Non-local bifurcations and random dynamical systems*

January 99

Jon Wellner, University of Washington: *Longest increasing subsequences in random permutations*

February 99

Michael Nussbaum, Weierstrass Institute (Berlin): *Asymptotic equivalence of statistical experiments*

Dan Rockmore, Dartmouth College: *Conjectures, applications and algorithms for Fourier analysis on* $SL_2(F_p)$

Allen Hatcher, Cornell University: *Knots and symmetry*

Alfred Schatz, Cornell University: *Errors in the finite element method*

March 99

R. Keith Dennis, Cornell University: *The number of groups of order n*

Jim Cogdell, Oklahoma State University: *Arithmetic Dirichlet series and automorphic forms*

John Smillie, Cornell University: *When is a horseshoe not a horseshoe?*

April 99

Yuri Burman, Independent University of Moscow: *Trees, quadrangulations and moduli spaces*

Joel Spencer, Courant Institute, New York University: *The strange logic of random graphs*

E. B. Vinberg, Moscow State University: *A remarkable generalization of symmetric spaces*

Alice Chang, Princeton University: *On the Chern-Gauss-Bonnet integral on 4-manifolds*

Henri Darmon, McGill University: *Fermat est mort, vive Fermat!*

May 99

Yakov Eliashberg, Stanford University: *Introduction to symplectic field theory*

Olivetti Club

September 98

Swapneel Mahajan, Cornell University: *Eulerian partially ordered sets and the cd-index*

Catherine Stenson, Cornell University: *DNA and topology*

Ravi Ramakrishna, Cornell University: *Algebra and analysis in number theory*

David Revelle, Cornell University: *The drunk who starved to death (and other lessons from Mardi Gras)*

October 98

Suzanne Lynch, Cornell University: *Polynomial matings and the Medusa algorithm*

Suman Ganguli, Cornell University: *How to know if you have mud on your forehead: an introduction to reasoning about knowledge*

David Brown, Cornell University: *Spider algorithm, complex dynamics and combinatorics*

November 98

Walker White, Cornell University: *Nonstandard probability: discrete math for graduate students*

Leah Gold, Cornell University: *Rings and the combinatorics of simplicial complexes*

Irena Peeva, Cornell University: *Monomial resolutions*

December 98

Antal Jarai, Cornell University: *A brief introduction to percolation*

February 99

Swapneel Mahajan, Cornell University: *Coxeter groups*

Thomas Ungar, North Dakota State University: *The Thomas precession*

Sudeb Mitra, Cornell University: *Quasiconformal mappings, holomorphic motions and Teichmüller spaces*

March 99

David Brown, Cornell University: *Complex dynamics of the exponential map*

Antal Jarai, Cornell University: *Phase transitions and percolation*

Matthew Horak, Cornell University: *Group presentations*

Henrique Araujo, Cornell University: *Differentiable manifolds and PDE*

April 99

Chris Hruska, Cornell University: *An introduction to hyperbolic groups*

Steve Sinnott, Cornell University: *Gröbner bases*

Alan Demlow, Cornell University: *An introduction to finite element methods*

Ryan Budney, Cornell University: *The Cauchy-Crofton theorem*

Probability Seminar

September 98

Ted Cox, Syracuse University: *Rescaled voter models converge to super-Brownian motion*

Kenneth Brown, Cornell University: *Random walks and ring theory*

Gennady Samorodnitsky, Cornell University: *When are multiple stochastic integrals independent?*

Laurent Saloff-Coste, Cornell University: *The number of visited sites and exotic behaviors of random walks on Cayley graphs*

October 98

Eugene Dynkin, Cornell University: *Super-Brownian motion and Riemannian geometry*

Jochen Geiger, Frankfort: *The genealogy of the voter model*

Radhu Zharapol, Binghamton: *The existence of attractive probability measures for iterated function systems*

November 98

Mark Huber, Cornell University: *Exact sampling from Markov chains using coupling from the past*

Haya Kaspi, Technion and Cornell University: *Nonlinearly skewed Brownian motion*

Walker White, Cornell University: *Radically finite probability (an explanation for probabilists)*

Ted Cox, Syracuse University: *Rescaled voter models converge to super-Brownian motion*

January 99

Jon Wellner, University of Washington: *Longest increasing subsequences in random permutations*

February 99

Eric van den Berg, Cornell University: *Heavy tail modeling in time series and telecommunications*

Chris Hoffman, University of Maryland: *Return probabilities of simple random walk on percolation clusters*

Y. M. Suhov, University of Cambridge and University of California at Santa Barbara: *The spectrum of the generator of an infinite-dimensional diffusion*

Thomas Deck, University of Manheim and Cornell University: *Solving stochastic parabolic differential equations with methods from white noise analysis*

March 99

Steve Evans, University of California at Berkeley: *Random spanning trees of Cayley graphs and compactifications of groups*

Gerard Letac, University of Toulouse and Pennsylvania State University: *Stationary sequences with joint Poisson distributions*

Richard Durrett, Cornell University: *Goo Movies: Convergence of rescaled particle systems to measure-valued diffusions*

Antal Jarai, Cornell University: *Incipient infinite clusters in percolation*

April 99

Ilya German, Cornell University: *Hedging options with small transaction costs*

Sebastien Blachere, Cornell University: *Internal diffusion limited aggregation*

Michael Marcus, CUNY: *A generalized Ray-Knight theorem and the most visited site of a Levy process*

David Stephenson, Cornell University: *Annihilating and coalescing random walk*

May 99

Dan Brown and Todd Vision, Cornell University: *Sampling from genetic mapping populations via stochastic optimization: applications, methods and results*

I. Evstigneev, Central Mathematics and Economics Institute, Russian Academy (Moscow): *A functional central limit theorem for equilibrium paths of economic dynamics*

Topology and Geometric Group Theory Seminar

October 98

David Cruickshank, University of Glasgow: *New invariants for groups*

Benson Farb, University of Chicago: *Discrete groups acting on compact manifolds*

November 98

Martin Lustig, Bochum: *Free group automorphisms of exponential growth*

Karóly Bezdek, Cornell University: *The isoperimetric problems of Voronoi cells in unit ball packings of E^d*

F. T. Farrell, Binghamton University: *Calculating Whitehead groups (or at least trying to)*

February 99

Steve Zdancewic, Cornell University: *Topology in programming language semantics*

Alan Durfee, Mt. Holyoke College: *Polynomial knots*

Christopher Hruska, Cornell University: *The B. B. Newman spelling theorem*

March 99

James West, Cornell University: *Introduction to controlled topology* (in three parts)

April 99

Ilya Kapovich, Rutgers University: *On mapping tori of endomorphisms of free groups*

Ryan Budney, Cornell University: *Diffeomorphism groups of manifolds*

Peter Abramenko, University of Bielefeld: *Some group theoretic applications of buildings*

Peter Abramenko, University of Bielefeld: *On some generalizations of the Solomon-Tits theorem*

Undergraduate Mathematics Club

September 98

John Hubbard, Cornell University: *The dynamics of the forced pendulum*

Puzzles/Problems/Riddles session

Carly Klivans, Cornell University: *Mobile robotics navigation*

Movie: *Fermat's last theorem $x^n + y^n z^n$*

October 98

David Revelle, Cornell University: *The mathematics of juggling*

Ravi Ramakrishna, Cornell University: *Why we can't trisect an angle*

November 98

Daina Taimina and David Henderson, Cornell University: *How to trisect an angle and other "impossible" constructions*

February 99

Robert Strichartz, Cornell University: *Summer REU program*

Video: *N is a number: a portrait of Paul Erdös*

Adam Epstein, Cornell University: *Everything you ever wanted to know about pasting together Julia sets (but were afraid to ask John Milnor); Part 1: the preliminaries*

March 99

Suzanne Lynch, Cornell University: *Everything you ever wanted to know about pasting together Julia sets (but were afraid to ask John Milnor); Part 2: the pasting*

April 99

Shannon Kelly, Cornell University: *An application of linear algebra to Markov chains*

Kenneth Brown, Cornell University: *What's the chance that 2 random integers are relatively prime?*

Shannon Kelly, Cornell University: *The hidden uses of Math 221*

Harold Fox, Cornell University: *Happiness and success through random tilings*

Greg Buzzard, Cornell University: *Does close really count in horseshoes?: weird objects in dynamics*

1998–99 Faculty Publications

Louis J. Billera and Eric K. Babson, *The Geometry of Products of Minors*, Discrete and Computational Geometry **20** (1998), 231–249.

Louis J. Billera, Richard Ehrenborg and Margaret Readdy, *The* **cd***-Index of Zonotopes and Arrangements*, Mathematical Essays in Honor of Gian-Carlo Rota (B. Sagan and R. Stanley, eds.), Birkhäuser Boston, 1998.

Louis J. Billera, Clara Chan and Niandong Liu, *Flag Complexes, Labelled Rooted Trees and Star Shellings*, Advances in Discrete and Computational Geometry (B. Chazelle, J. E. Goodman and R. Pollack, eds.), American Mathematical Society, Providence, RI, 1999.

Kenneth Brown and **Persi Diaconis**, *Random Walks and Hyperplane Arrangements*, Annals of Probability **26** (1998), 1813–1854.

Persi Diaconis and **Laurent Saloff-Coste**, *What Do We Know About the Metropolis Algorithm?*, Journal of Computer and System Sciences **57** (1998), 20–36.

Persi Diaconis and **Laurent Saloff-Coste**, *Walks On Generating Sets of Groups*, Inventiones Mathematicae **134** (1998), 251–299.

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Eugene Dynkin and S. E. Kuznetsov, *Fine Topology and Fine Trace on the Boundary Associated with a Class of Semilinear Differential Equations*, Comm. Pure & Appl. Math. **51** (1998), 897–936.

Eugene Dynkin, *Semilinear Parabolic Equations, Diffusions and Superdiffusions*, J. Functional Analysis **158** (1998), 325–356.

Eugene Dynkin and S. E. Kuznetsov, *Extinction of Superdiffusions and Semilinear PDEs*, J. Functional Analysis **162** (1999), 346–378.

Vesselin Gasharov, *Factoring the Poincaré Polynomials for the Bruhat Order on S_n*, J. Combin. Theory (A) **83** (1998).

Vesselin Gasharov, *Green and Gotzmann Theorems for Polynomial Rings with Restricted Powers of the Variables*, J. Pure Appl. Algebra **130** (1998).

Vesselin Gasharov, *A Short Proof of the Littlewood-Richardson Rule*, European J. Combin. **19** (1998).

Vesselin Gasharov, *On the Neggers-Stanley Conjecture and the Eulerian Polynomials*, J. Combin. Theory (A) **82** (1998).

John Guckenheimer, *Computer Simulation and Beyond —for the 21st Century*, Notices of the Amer. Math. Soc. **45** (1998), 1120–1123.

John Guckenheimer and W. G. Choe, *Computing Periodic Orbits with High Accuracy*, Computer Methods in Applied Mechanics and Engineering **170** (1999), 331–341.

Allen Hatcher and **Karen Vogtmann**, *Rational Homology of $Aut(F_n)$*, Math. Res. Letters **5** (1998), 759–780.

Allen Hatcher and **Karen Vogtmann**, *The Complex of Free Factors of a Free Group*, Oxford Quarterly **49** (1998), 459–468.

Allen Hatcher and **Karen Vogtmann**, *Cerf Theory for Graphs*, J. London Math. Soc. **58** (1998), 633–655.

Timothy Healey and H. Simpson, *Global Continuation in Nonlinear Elasticity*, Archive for Rational Mechanics and Analysis **143** (1998), 1–28.

David Henderson and Daina Taimina, *Experiencing Geometry, NORMA-98*, Nordic Mathematics Education Conference Proceedings, Kristiansand, Norway, 1998.

David Henderson, *Giving Professors Permission to Change their Teaching*, Teaching Mathematics on the Undergraduate Level, International Commission on Mathematics Instruction Study Conference, Singapore, 1998.

John Hubbard and Barbara Burke Hubbard, *Vector Calculus, Linear Algebra and Differential Forms, A Unified Approach*, Prentice Hall, 1999.

C. A. Tsao and **J.T. Gene Hwang**, *Improved Confidence Estimators for Fieller's Confidence Sets*, Canadian Journal of Statistics **26** (1998), 299–310.

Yulij Ilyashenko and Weigu Li, *Nonlocal Bifurcations*, a monograph, Mathematical Surveys and Monographs series, vol. 66, AMS, 1998.

Yulij Ilyashenko, *Covering Manifolds for Analytic Families of Leaves of Foliations by Analytic Curves*, Topological Methods in Nonlinear Analysis **11** (1998), 361–373.

Blinchevskaya and **Yulij Ilyashenko**, *Estimate for the Entropy Dimension of the Maximal Attractor for k-Contracting Systems in an Infinite-Dimensional Space*, Russian J. Math. Phys. **6** no. 1 (1999), 20–26.

Anthony Kable, *The Main Involutions of the Metaplectic Group*, Proc. AMS **127** no. 4 (1999), 955-962.

Anthony Kable, *Power Bases in Dihedral Quartic Fields*, J. Numb. Thy. (1999).

Harry Kesten and R. A. Maller, *Random Walks Crossing Power Law Boundaries*, Studia Sci. Math. Hungarica **34** (1998), 219–252.

Harry Kesten and R. A. Maller, *Random Walks Crossing High Level Curved Boundaries*, J. Theor. Probab. **10** (1998), 1019–1074.

Harry Kesten, V. Sidoravicius and Y. Zhang, *Almost All Words Are Seen in Critical Site Percolation on the Triangular Lattice*, Elec. J. Probab. **3** no. 10 (1998).

Dexter Kozen, *On Hoare Logic and Kleene Algebra with Tests*, ncstrl.cornell/TR98-1723, Cornell University, Computer Science (1998).

Mark Hopkins and **Dexter Kozen**, *Parikh's Theorem in Commutative Kleene Algebra*, ncstrl.cornell/TR99-1724, Cornell University, Computer Science (1999).

K. A. Ames and **Lawrence Payne**, *Asymptotic Behavior for Two Regularizations of the Cauchy Problem for the Backward Heat Equation*, Math. Methods and Models in Appl. Sci. **8** (1998), 187–202.

Lawrence Payne, P. W. Schaefer and J. C. Song, *Bounds and Decay Results for Some Second Order Semilinear Equations*, Math. Methods in Appl. Sci. **21** (1998), 1571–1591.

Lawrence Payne, P. W. Schaefer and J. C. Song, *Growth and Decay Results in Heat Conduction Problems with Nonlinear Boundary Conditions*, Nonlinear Analysis **35** (1998), 269–286.

Lawrence Payne and B. Straughan, *Analysis of the Boundary Condition at the Interface Between a Viscous Fluid and a Porous Medium and Related Modeling Questions*, J. Math. Pure Appl. **77** (1998), 317–354.

Lawrence Payne and B. Straughan, *Convergence for the Equations for a Maxwell Fluid*, Studies in Appl. Math., Acad. Nay. Lincei (1998), 77–104.

Lawrence Payne and B. Straughan, *Structural Stability for the Darcy Equations of Flow in Porous Media*, Proc. Roy. Soc. London A **454** (1998), 1691–1698.

Lawrence Payne and B. Straughan, *Convergence and Continuous Dependence for the Brinkman-Forchheimer Equations*, Studies in Applied Math. **102** (1999), 419–439.

Irena Peeva and Bernd Sturmfels, *Generic Lattice Ideals*, Journal of the American Mathematical Society **11** (1998).

Irena Peeva, Dave Bayer and Bernd Sturmfels, *Monomial Resolutions*, Mathematical Research Letters **5** (1998).

Irena Peeva and Bernd Sturmfels, *Syzygies of Codimension 2 Lattice Ideals*, Mathematische Zeitschrift **229** (1998).

Irena Peeva, Vic Reiner and Bernd Sturmfels, *How to Shell a Monoid*, Mathematische Annalen **310** (1998).

Irena Peeva, Vic Reiner and Volkmar Welker, *Cohomology of Real Diagonal Subspace Arrangements Via Resolutions*, Compositio Mathematica **117** (1999).

R. S. Zounes and **Richard Rand**, *Transition Curves in the Quasiperiodic Mathieu Equation*, SIAM J. Appl. Math. **58** (1998), 1094–1115.

S. Wirkus, **Richard Rand** and A. Ruina, *Modeling the Pumping of a Swing*, The College Mathematics Journal **29** (1998), 266–275.

Richard Rand, R. Zounes and R. Hastings, *Dynamics of a Quasiperiodically Forced Mathieu Oscillator*; in IUTAM Symposium on New Applications of Nonlinear and Chaotic Dynamics in Mechanics (F. C. Moon, ed.), Kluwer Academic Pubs. (1998), 61–70.

R. Haberman, **Richard Rand** and T. Yuster, *Resonant Capture and Separatrix Crossing in Dual-Spin Spacecraft*, Nonlinear Dynamics **18** (1999), 159–184.

W. I. Newman, **Richard Rand** and A. L. Newman, *Dynamics of a Nonlinear Parametrically-Excited Partial Differential Equation*, Chaos **9** (1999), 242–253.

Thomas Rishel, *The Academic Job Search in Mathematics*, AMS Publications (1998).

Laurent Saloff-Coste, *Simple Examples of the Use of Nash Inequalities for Finite Markov Chains*; in Stochastic Geometry, Likelihood and Computation (O. E. Bamdorff-Nielsen et. al., eds.), Chapter 9, Chapman & Hall, 1999, pp. 365–400.

C. Pittet and **Laurent Saloff-Coste**, *Amenable Groups, Isoperimetric Profiles and Random Walks*; in Geometric Group Theory Down Under (J. Cossey et. al., eds.), W. de Gruyter, 1999, pp. 293–316.

Reyer Sjamaar, *Convexity Properties of the Moment Map Reexamined*, Adv. Math. **138** (1998), 46–91.

E. Meinrenken and **Reyer Sjamaar**, *Singular Reduction and Quantization*, Topology **38** (1998), 699–762.

Birgit Speh, *Seiberg Witten Equations on Locally Symmetric Space* (1998).

Robert Strichartz, *Remarks on "Dense Analytic Subspaces in Fractal L^2-Spaces" by P. E. T. Jorgensen and S. Pedersen*, Journal d'Analyse Math. **75** (1998), 229–231.

Beverly West, *ODE Architect*, with C•ODE•E (NSF Consortium for ODE Experiments), an interactive teaching, learning and research environment on CD Rom with Companion Book of 269 pages, John Wiley and Sons, 1998.

Research Grant Activity

Funded and Continuing Grants

Source	Amount	Starts	Ends	Title
NIST	$25,000	9/1/98	8/31/99	HELP The Missing Data
NSA	$9,310	1/1/98	12/31/98	A Conference in Probability at Cornell—In Honor of Harry Kesten
NSA	$31,200	3/24/98	3/23/00	Markov Processes, Stochastic Analysis and Related Problems
NSF	$9,310	1/1/98	12/31/98	A Conference in Probability at Cornell—In Honor of Harry Kesten
NSF	$135,956	8/15/96	7/31/99	A Software System for Algebraic Geometry Research
NSF	$207,369	4/15/99	3/31/02	A Software System for Algebraic Geometry Research
NSF	$221,722	7/1/97	6/30/00	Algorithms and Numerical Analysis for Partial Differential and Integral Equations
NSF	$233,527	7/1/97	6/30/00	Algorithms and Numerical Analysis for Partial Differential Equations
NSF	$147,563	9/1/98	8/31/01	Analysis and Geometry of Certain Markov Chains and Processes
NSF	$204,086	6/1/96	5/31/99	Branching Measure-Valued Processes and Related Nonlinear Partial Differential Equations
NSF	$89,300	6/1/97	5/31/00	Calabi-Yau Threefolds and Birational Geometry
NSF	$76,943	7/1/97	6/30/00	Complexity in the Constructive and Intuitionistic Theory of Reals
NSF	$27,630	4/1/97	3/31/00	Computability, Logic and Complexity
NSF	$248,788	3/15/97	2/28/02	Cornell's Summer REU Program in Mathematics
NSF	$59,939	8/1/98	7/31/01	Dynamics of Birational Maps/Green's Functions of Hyperbolic Surfaces
NSF	$82,338	6/1/97	5/31/00	Dynamics of Polynomial Diffeomorphisms
NSF	$191,360	6/1/98	5/31/01	Enumeration and Subdivision in Polytopes and Arrangements
NSF	$219,800	7/1/96	6/30/99	Geometric and Algebraic Topology
NSF	$558,978	6/1/99	5/31/02	Geometric and Algebraic Topology
NSF	$82,710	4/1/96	3/31/99	Harmonic Analysis and Self-Similarity
NSF	$86,493	7/1/99	6/30/01	Hilbert Type Numbers & Related Topics in Analytic Differential Equations
NSF	$65,014	7/1/99	6/30/01	Homology of Monomial and Toric Ideals
NSF	$149,230	7/1/98	6/30/01	Logic and Computability
NSF	$216,000	7/1/96	6/30/99	Particle Systems: Theory for Applications to Biology
NSF	$363,000	9/1/94	2/28/99	Presidential Faculty Fellow: Linear and Nonlinear Analysis in Geometry
NSF	$198,601	7/1/99	6/30/02	Problems in Probability Motivated by Questions in Ecology
NSF	$225,000	6/1/97	5/31/00	Representation Theory and Automorphic Forms
NSF	$71,692	5/1/99	4/30/02	Representation Theory, Quantum Groups & Piecewise-Linear Combinatorics
NSF	$89,632	7/1/99	6/30/02	Residual Finiteness and Negative Curvature
NSF	$172,796	7/1/96	6/30/99	Some Problems in Probability Theory
NSF	$195,063	7/1/99	6/30/02	Some Problems in Probability Theory: Random Walks and Percolation
NSF	$150,000	6/15/97	5/31/00	Some Variational Problems in Differential Geometry
NSF	$182,257	6/1/99	5/31/02	Stochastic Processes and Semilinear Partial Differential Equations
NSF	$243,836	4/15/95	3/31/99	Stochastic Spatial Models
NSF	$97,707	6/1/97	5/31/00	Symplectic Geometry and Stratified Spaces
NSF	$51,770	7/15/97	6/30/99	Teichmüller Theory and Quadratic Differentials
NSF	$70,796	8/1/97	7/31/00	The Geometry of Kernel Subgroups of Nonpositively Curved Cube Complex Groups
NSF	$73,357	6/1/97	5/31/00	The Structure of Expanding Rational Maps as Holomorphic Dynamical Systems
NSF	$100,000	1/1/98	12/31/99	Undergraduate Faculty Enhancement in Mathematics
NSF	$18,000	6/1/99	5/31/00	Workshop on Mathematical Problems in Ecology & Genetics
NYS	$25,000	9/1/98	8/31/99	Cornell Mathematics Inservice Project
Sloan	$35,000	9/16/96	9/15/98	Alfred P. Sloan Research Fellowship for Dr. Reyer Sjamaar in Mathematics
Subcontract	$48,768	4/1/99	3/31/00	Subaccount with Genetics & Development for Course Buyoffs
Subcontract	$535,000	8/1/96	11/30/99	Subcontract with University of California/Intelligence Systems

Total Sponsored Research Expenditures for the 1998–99 Fiscal Year=$1,505,714

Pending Proposal Submissions

Source	Amount	Starts	Ends	Title
NSF	$173,681	4/1/99	3/31/02	Analysis on Fractals
NSF	$69,933	7/1/99	6/30/02	Constructions of Galois Representations
NSF	$3,040,377	9/1/99	8/31/02	Multiple Agent Hybrid Systems Architecture and Tools for Real Time Heterogeneous Distributed Databases
NSF	$65,978	9/1/99	5/31/00	POWRE; Automorphisms of Free Groups
NSF	$8,128	5/30/99	5/29/00	Representation Theory and Automorphic Forms
NSF	$164,781	9/1/99	8/31/01	Research Computing in the Cornell Mathematics Department
NSF	$280,368	7/1/99	6/30/02	Stochastic Spatial Models in Ecology
NSF	$140,461	6/15/99	6/14/02	The Stability and Rigidity of Discrete Structures
NYS	$40,197	9/1/99	8/31/00	Cornell Mathematics Inservice Project
Subcontract	$214,519	5/19/99	12/31/99	Agile Control of Military Operations (Subcontract with Rockwell International Corporation)
Subcontract	$167,757	7/1/99	6/30/02	New Approaches to Kinematic & Conformational Analysis (Subcontract with Harvard University)

Total Proposal Submissions—22: Funded—11; Pending—8; Declined—3

The Faculty and their Research

Dan Barbasch, Professor; Ph.D. (1976) University of Illinois; Representation theory of reductive Lie groups.

Louis Billera, Professor; Ph.D. (1968) City University of New York; Geometric and algebraic combinatorics.

James H. Bramble, Professor Emeritus; Ph.D. (1958) University of Maryland; Numerical solutions of partial differential equations.

•**Kenneth S. Brown**, Professor; Ph.D. (1971) Massachusetts Institute of Technology; Algebra, topology, group theory, probability.

Stephen U. Chase, Professor and Associate Chair; Ph.D. (1960) University of Chicago; Algebra, algebraic number theory, homological algebra.

Marshall M. Cohen, Professor; Ph.D. (1965) University of Michigan; Topology, geometric (combinatorial) group theory.

Robert Connelly, Professor and Chair; Ph.D. (1969) University of Michigan; Geometry, rigidity, topology.

R. Keith Dennis, Professor; Ph.D. (1970) Rice University; Commutative and non-commutative algebra, algebraic K-theory.

•**Persi Diaconis**, Professor; Ph.D. (1974) Harvard University; Mathematical statistics, probability theory, combinatorics

•**Richard Durrett**, Professor; Ph.D. (1976) Stanford University; Probability theory, especially applications to biology.

Eugene B. Dynkin, Professor; Ph.D. (1948), Dr. of Science (1951) Moscow University; Probability theory, Lie groups.

Clifford J. Earle, Professor; Ph.D. (1962) Harvard University; Complex variables, Teichmüller spaces.

José F. Escobar, Professor; Ph.D. (1986) University of California at Berkeley; Partial differential equations; differential geometry.

Roger H. Farrell, Professor; Ph.D. (1959) University of Illinois; Mathematical statistics, measure theory.

Leonard Gross, Professor; Ph.D. (1958) University of Chicago; Functional analysis, constructive quantum field theory.

•**Mark Gross**, Associate Professor; Ph.D. (1990) University of California at Berkeley; Algebraic geometry.

John Guckenheimer, Professor; Ph.D. (1970) University of California at Berkeley; Dynamical systems.

•**Allen Hatcher**, Professor; Ph.D. (1971) Stanford University; Geometric topology.

Timothy Healey, Professor of T&AM; Ph.D. (1985) University of Illinois; Nonlinear elasticity, nonlinear analysis, partial differential equations.

David W. Henderson, Professor; Ph.D. (1964) University of Wisconsin; Geometry, educational mathematics.

•**John H. Hubbard**, Professor; Doctorat d'Etat (1973) Université de Paris Sud; Analysis, differential equations, differential geometry.

J.T. Gene Hwang, Professor; Ph.D. (1979) Purdue University; Statistics, confidence set theory.

Yulij Ilyashenko, Professor; Ph.D. (1969) Moscow State University; Dynamical systems.

Peter J. Kahn, Professor; Ph.D. (1964) Princeton University; Algebraic topology, differential topology, and connections with symplectic geometry and mathematical physics.

Harry Kesten, Professor; Ph.D. (1958) Cornell University; Probability theory, limit theorems, percolation theory.

Dexter Kozen, Professor of Computer Science; Ph.D. (1977) Cornell University; Computational theory, computational algebra and logic, logics and semantics of programming languages.

G. Roger Livesay, Professor Emeritus; Ph.D. (1952) University of Illinois; Differential topology, group actions.

Michael D. Morley, Professor; Ph.D. (1962) University of Chicago; Mathematical logic, model theory.

Anil Nerode, Professor and Director of the Center for Foundations of Intelligent Systems; Ph.D. (1956) University of Chicago; Mathematical logic, recursive functions, computer science, mathematics of AI, control engineering.

Lawrence E. Payne, Professor Emeritus; Ph.D. (1950) Iowa State University; Partial differential equations, ill-posed and non standard problems.

Irena Peeva, Assistant Professor; Ph.D. (1995) Brandeis University; Commutative algebra, algebraic geometry and combinatorics.

Richard Platek, Assoc. Professor; Ph.D. (1966) Stanford University; Mathematical logic, recursion theory, set theory, computer science.

Ravi Ramakrishna, Assistant Professor; Ph.D. (1992) Princeton University; Algebraic number theory, in particular Galois representations.

Richard Rand, Professor of T&AM; Sc.D. (1967) Columbia University; Applied mathematics and differential equations.

James Renegar, Professor of OR&IE; Ph.D. (1983) University of California at Berkeley; Computational complexity of mathematical programming.

Oscar S. Rothaus, Professor; Ph.D. (1958) Princeton University; Several complex variables, combinatorics, Sobolev inequalities.

Laurent Saloff-Coste, Professor; Ph.D. (1983) and Doctorat d'Etat (1989) Université Paris VI; Analysis, potential theory, stochastic processes.

Alfred H. Schatz, Professor; Ph.D. (1964) New York University; Numerical solutions of partial differential equations.

Shankar Sen, Professor; Ph.D. (1967) Harvard University; Algebraic number theory.

Richard A. Shore, Professor; Ph.D. (1972) Massachusetts Institute of Technology; Mathematical logic, recursion theory, set theory.

Reyer Sjamaar, Assistant Professor; Ph.D. (1990) Rijksuniversiteit te Utrecht (RUU), the Netherlands; Symplectic geometry.

John Smillie, Professor; Ph.D. (1977) University of Chicago; Dynamical systems.

Birgit E. Speh, Professor; Ph.D. (1977) Massachusetts Institute of Technology; Lie groups, automorphic forms.

Michael E. Stillman, Professor; Ph.D. (1983) Harvard University; Algebraic geometry, computational algebra.

Robert S. Strichartz, Professor; Ph.D. (1966) Princeton University; Harmonic analysis, partial differential equations, analysis on fractals.

•**Moss E. Sweedler**, Professor; Ph.D. (1965) Massachusetts Institute of Technology; Algebra, algorithms.

Karen Vogtmann, Professor; Ph.D. (1977) University of California at Berkeley; Topology, geometric group theory.

Lars B. Wahlbin, Professor; Ph.D. (1971) University of Göteborg, Sweden; Numerical solutions of partial differential equations.

James E. West, Professor; Ph.D. (1967) Louisiana State University; Geometric topology, infinite-dimensional topology.

•*Faculty on sabbatical or other leave during all or part of the 1998–99 academic year.*

Faculty Profiles

Graeme Bailey

Professor of Computer Science
Director of the Computer Science MEng Program
Adjunct Professor of Mathematics

Originally working in low-dimensional topology and combinatorial group theory, through an odd mixture of circumstances I have become actively involved in research in mathematics and medicine. One of two ongoing research projects in this area is the modelling of lung inflation, together with a research group at the Class One Trauma Center in Syracuse. This is in the early stages of a program to extend to various pathologies affecting elasticity and aimed towards effective clinical treatments. We've been fortunate to have made some significant advances in answering some questions which had remained unsolved for over 30 years. The other project is in understanding deformations of transmembrane proteins used in cell-signalling processes. This is a carefully constrained version of the protein-folding problems which have been exciting the mathematical biology community in recent years; the application of a topological viewpoint in collaborating with molecular pharmacologists and structural biologists has already yielded some intriguing insights.

This past year I added an appointment in Computer Science, was declared best Summer Session faculty, served on the Rhodes, Marshall, Churchill and Fulbright Fellowship committees for the nth year — again the university was successful in having several winners — was involved in continuing university discussions on developing more vital faculty/student interactions, was the faculty advisor for the Math Club, which I am passing on to Ravi Ramakrishna, and the Judo Club, remained involved with Cornell EMS, enjoyed my tenth year as a Faculty Fellow at Risley and gave the usual plethora of concerts.

Dan Barbasch

Professor of Mathematics
Director of Graduate Studies

My research is in the field of Representation Theory of Reductive Lie groups. I am particularly interested in the classification of the unitary dual for groups over local fields, and its relation to the orbit structure of the Lie algebra. Furthermore I am interested in the relation of these representations to problems arising from number theory, more precisely automorphic forms.

Professional Activities: Referee for Transactions of the AMS, American Journal of Mathematics and the NSF.

Invited Lectures:

Unitary representations and endoscopy, AMS Regional Conference, Maryland.

Selected Publications:

The Dual Reductive Pairs Correspondence for Complex Groups (with J. Adams), J. Func. Anal. **132** (1995).

The Dual Reductive Pairs Correspondence for Odd Orthogonal Groups (with J. Adams), J. Func. Anal. (1996).

Classification of 1-K Type Representations (with A. Moy), Proc. AMS, to appear.

Unitary Spherical Spectrum for Split Classical p-adic Groups, Acta Applicandae Mathematicae **44** (1996).

The Spherical Dual for p-adic Groups (with A. Moy), Proc. of Conf. in Cordoba, Argentina.

The Associated Variety of an Induced Representation (with M. Bozicevic), Proc. AMS (1998).

Local Character Expansions (with A. Moy), Ann. Sci. de L'Ecole Norm. Sup. (1997).

The Associated Variety of Unipotent Representations, preprint.

Louis J. Billera

Professor of Mathematics

For some time, my research has centered on combinatorial properties of convex polytopes and their relations to algebraic and geometric questions. Some problems are related to the facial structure of polytopes, for example, enumeration of faces or identification of their lattice structure. Others have to do with subdivisions of polytopes, how they might depend on the geometry (as opposed to the combinatorics) of the underlying set, or how the algebraic properties of objects related to a given subdivision, for example the algebra of smooth piecewise

polynomial functions (splines) defined on it, might depend on both combinatorial and geometric issues.

A common theme in much of this has been the construction of polytopes to given specifications: for example the construction with Carl Lee of polytopes satisfying the conditions of McMullen's g-conjecture, showing these conditions to be sufficient to describe the enumeration of faces of all simplicial convex polytopes; or the construction with Bernd Sturmfels of fiber polytopes, showing that certain sets of polyhedral subdivisions of polytopes themselves had the structure of convex polytopes; or the construction with A. Sarangarajan of faces of the traveling salesman polytope, showing this polytope to have every possible 0-1 polytope as a low-dimensional face.

More recently, my attention has turned to applying these ideas to interesting problems arising in biology (structure of phylogenetic trees) and physics (random tilings in the plane).

Professional Activities: Member of the AMS, MAA, and SIAM. Reviewer for the NSF and several journals. Evaluation committee for NSF Mathematical Sciences Postdoctoral Fellowships, 3-year term (1997–2000). Review panel for grants in Combinatorics, NSF Algebra and Number Theory program. Eastern Section Program Committee, AMS.

Co-edited a forthcoming book in the MSRI series, *New Perspectives in Algebraic Combinatorics*.

Philips Lecturer, Haverford College, February 1999.

Invited Lectures:

Flag enumeration in convex polytopes, Conference in Geometric Combinatorics, Kotor, Yugoslavia (Aug.–Sept. 1998).

Enumerating flags in polytopes, colloquium, Department of Mathematics, Binghamton University (Oct. 1998).

Fiber polytopes, Combinatorics Seminar, Department of Mathematics, Binghamton University (Oct. 1998).

Searching for structure among subdivisions and *Subdividing polygons*, Philips Lectures, Haverford College (Feb. 1999).

Selected Publications:

A Proof of the Sufficiency of McMullen's Conditions for f-vectors of Simplicial Convex Polytopes (with C. W. Lee), J. Comb. Theory A **31** (1981), 237–255.

Generalized Dehn-Sommerville Relations for Polytopes, Spheres, and Eulerian Partially Ordered Sets (with M. M. Bayer), Inv. Math. **79** (1985), 143–157.

Homology of Smooth Splines: Generic Triangulations and a Conjecture of Strang, Trans. Amer. Math. Soc. **310** (1988), 325–340.

Modules of Piecewise Polynomials and Their Freeness (with L. L. Rose), Math. Z. **209** (1992), 485–497.

Fiber Polytopes (with B. Sturmfels), Annals of Math. **135** (1992), 527–549.

Duality and Minors of Secondary Polyhedra (with I. M. Gel'fand and B. Sturmfels), J. Comb. Theory B **57** (1993), 258–268.

James H. Bramble

Professor Emeritus of Mathematics

For the past 20 years I have been interested in the development of the theoretical foundation of finite-element methods for the approximation of solutions of elliptic and parabolic partial differential equations. Recently I have concentrated on questions concerning rapid solution of large-scale systems that result from such approximations. Such a question is: Among all the theoretically good approximations to a general class of problems, are there some that can be solved efficiently by taking advantage of modern computer architectures such as parallelism? Answers to questions like this one can bring many problems into the realm of practical feasibility. My current research interest is the design of approximations to solutions to problems in partial differential equations that adequately describe the problem and that can be efficiently solved using modern computing power.

Professional Activities: Professor of Mathematics at Texas A & M University. Consultant for Brookhaven National Laboratory. Member of the AMS and SIAM. Editor of Mathematics of Computation, Math. Model. Num. Anal., Numerical Functional Analysis and Optimization, and Advances in Computational Mathematics.

Selected Publications:

The Construction of Preconditioners for Elliptic Problems by Substructuring I (with J. Pasciak and Alfred Schatz), Math. Comp. **47** (1986).

A Preconditioning Technique for Indefinite Systems Resulting from Mixed Approximations of Elliptic Problems (with J. Pasciak), Math. Comp. **50** (1988), 1–17.

Parallel Multilevel Preconditioners (with J. Pasciak and J. Xu), Math. Comp. **55** (1990), 1–22.

The Analysis of Multigrid Algorithms with Non-nested Spaces or Non-inherited Quadratic Forms (with J. Xu and J. Pasciak), Math. Comp. **56** (1991), 1–34.

Multigrid Methods, Pitman Research Notes in Math. Series, Longman Sci. and Tech., London, Copublished with John Wiley & Sons, Inc., New York, 1993.

Kenneth Brown

Professor of Mathematics

Until recently my main interests have been algebra and topology. I have especially enjoyed using topological methods to study infinite discrete groups. In some of my early work, for instance, I studied Euler characteristics of groups. I obtained formulas relating the Euler characteristic (a topological concept) to purely algebraic properties of groups. When applied in special cases, these formulas unexpectedly led to new results in algebraic number theory. Later, I found topological methods for studying two interesting families of groups: infinite simple groups, and groups which can be presented by means of a complete rewriting system.

I have recently incorporated methods of probability theory into my research. In work with L. Billera and P. Diaconis, for example, we combine tools from geometry, topology, and probability to analyze an interesting family of random walks.

Awards and Honors: Clark Teaching Award, Cornell University (1987).

Professional Activities: Referee for various journals and government agencies. Committee to select algebra speakers for the 1982 International Congress of Mathematicians. Organizing committees for many conferences on topological methods in group theory.

Invited Lectures:

Cohomology of infinite groups, International Congress of Mathematicians, Helsinki (1978).

Buildings lecture series, Univ. Hong Kong (June 1999).

Selected Publications:

Euler Characteristics of Discrete Groups and G-spaces, Invent. Math. **27** (1974), 229–264.

Cohomology of Groups, Springer-Verlag, New York, 1982 (Graduate texts in mathematics 87).

Trees, Valuations, and the Bieri-Neumann-Strebel Invariant, Invent. Math. **90** (1987), 479–504.

Buildings, Springer-Verlag, New York, 1989.

The Geometry of Finitely Presented Infinite Simple Groups; in Algorithms and Classification in Combinatorial Group Theory, Springer-Verlag, New York, 1992, pp. 121–136.

The Geometry of Rewriting Systems: A Proof of the Anick-Groves-Squier Theorem; in Algorithms and Classification in Combinatorial Group Theory, Springer-Verlag, New York, 1992, pp. 137–163.

Random Walks and Hyperplane Arrangements (with P. Diaconis), Ann. Prob. **26** (1998), 1813–1854.

Random Walks and Plane Arrangements in Three Dimensions (with L. Billera and P. Diaconis), Amer. Math. Monthly, to appear.

Semigroups, Rings and Markov Chains, J. Theoretical Probability, to appear.

Gregery Buzzard

H. C. Wang Assistant Professor of Mathematics

Most of my research has been in several complex variables and dynamical systems. My work in several complex variables has centered on the construction of holomorphic maps with certain prescribed properties. In joint work with Franc Forstneric, we proved a version of Mittag-Leffler interpolation for automorphisms of complex n-space. Related ideas led to a joint paper with Steven Lu in which we characterized the set of algebraic surfaces such that there is a holomorphic map of generic rank 2 from complex 2-space into the surface.

In dynamics, much of my work has involved recasting results from real dynamics into the setting of holomorphic maps of two variables. In particular, I proved the existence of persistent homoclinic tangencies and the validity of the Kupka-Smale theorem in the holomorphic setting. This work is part of a more general program to understand the stability of holomorphic maps of two variables: that is, if you change the map a little, does the dynamical behavior of the map change in a correspondingly small way?

Awards and Honors: NSF Postdoctoral Fellowship (1998). Invited guest of IHES (summer 1999).

Professional Activities: Reviewer for Math Reviews and referee for several journals.

Invited Lectures:

Tame sets, dominating maps and complex tori, Hayama Symposium on SCV, Hayama, Japan (1998).

Stability of holomorphic automorphisms, special semester in holomorphic dynamics, Pisa (1999).

Selected Publications:

An Embedding of $\mathbb{C}$ *in* $\mathbb{C}^2$ *with Hyperbolic Complement* (with J. E. Fornæss), Math. Ann. **306** no. 3 (1996), 539–546.

A Carleman Type Theorem for Proper Holomorphic Embeddings (with F. Forstneric), Ark. Mat. **35** (1997), 157–169.

Infinitely Many Periodic Attractors for Holomorphic Maps of 2 Variables, Annals of Math. **145** (1997), 389–417.

Complex Dynamics in Several Variables (with J. Smillie); expository paper in Flavors of Geometry, MSRI Publications, Volume 31, 1997.

Kupka-Smale Theorem for Automorphisms of $\mathbb{C}^n$, Duke Math. J. **93** no. 3 (1998), 487–503.

Nondensity of Stability for Polynomial Automorphisms of $\mathbb{C}^2$, Indiana U. Math. J., to appear.

An Interpolation Theorem for Holomorphic Automorphisms of $\mathbb{C}^n$ (with F. Forstneric), J. Geom. Anal., to appear.

Algebraic Surfaces Holomorphically Dominable by $\mathbb{C}^2$, Invent. Math., to appear.

Stephen U. Chase

Associate Chair and Professor of Mathematics
Director of Undergraduate Studies

My main areas of interest are algebra and algebraic number theory. With the exception of my early work in module theory and homological algebra, the unifying theme of my research has been the Galois theory of rings and fields, and variations of these theories in which the role of the classical Galois group is played by some related structure such as a group scheme, Hopf algebra, or groupoid. This work impinges upon and utilizes techniques from other areas in which I also have strong interests, such as category theory and homological algebra, group schemes and Hopf algebras, algebraic K-theory, representation theory, and class field theory. In the recent past the main focus of my research was on certain questions involving Galois module structure in algebraic number fields, especially the structure of the ring of integers in a Galois extension of such fields as a module over the Galois group. My current interest is the subject of quantum groups, which I expect to study for at least several years.

Selected Publications:

Galois Theory and Galois Cohomology of Commutative Rings (with D. K. Harrison and A. Rosenberg), Amer. Math. Soc. Memoir **52** (1965).

Hopf Algebras and Galois Theory (with M. E. Sweedler), Lecture Notes in Math **97**, Springer-Verlag, 1969.

Infinitesimal Group Scheme Actions on Finite Field Extensions, Amer. J. Math. **98** (1976), 441–480.

Ramification Invariants and Torsion Galois Module Structure in Number Fields, J. of Algebra **91** (1984), 207–257.

Marshall M. Cohen

Professor of Mathematics

I am a geometric topologist and a combinatorial group theorist. Much of my work has dealt with the introduction of combinatorial and algebraic themes into geometric problems or geometric themes into combinatorial and algebraic problems. The work has involved the intermingling of topological manifolds, combinatorial topology, the foundations of piecewise linear topology, simple-homotopy theory, automorphisms of free groups, and spaces of length functions on groups. Currently the second best description of me is *geometric group theorist*.

The title which I most covet is that of *teacher*. The writing of a research paper and the teaching of freshman calculus, and everything in between, falls under this rubric. Happy is the person who comes to understand something and then gets to explain it.

Professional Activities: Member of the AMS and MAA.

Selected Publications:

Simplicial Structures and Transverse Cellularity, Annals of Math. (2) **85** (1967), 218–245.

A Course in Simple-homotopy Theory, Graduate Texts in Mathematics **10**, Springer Verlag, 1973.

Whitehead Torsion, Group Extensions and Zeeman's Conjecture in High Dimensions, Top. **16** (1977), 79–88.

What Does a Basis of $F(a, b)$ *Look Like?* (with W. Metzler and A. Zimmermann), Math. Ann. **257** (1981), 435–445.

On the Dynamics and the Fixed Subgroup of a Free Group Automorphism, Inv. Math. **96** (1989), 613–638.

Very Small Group Actions on R-Trees and Dehn Twist Automorphisms, Topology **34** (1995), 575–617.

The Conjugacy Problem for Dehn Twist Automorphisms of Free Groups, Commentarii Mathematici Helvetici, to appear.

Robert Connelly

Chair and Professor of Mathematics

Discrete geometry, with emphasis on the geometry of rigid and flexible structures, is my main area of interest. A tensegrity is a structure composed of sticks held in mid-air with strings which, nevertheless, holds its shape. This can be modeled very nicely as a configuration of points with upper and lower bounds on the distances between certain pairs of points. This in turn leads to interesting problems in, and applications to, distance geometry and the theory of packings and coverings of spheres.

Another subject of interest is the theory of flexible surfaces. There are triangulated surfaces that flex keeping their edges at a fixed length, and it has recently been shown that such surfaces maintain a fixed volume while they flex. There is no perfect mathematical bellows. This is also related to a polynomial that relates the volume of the surface to the lengths of its edges. This is at the intersection of discrete geometry, algebraic geometry, and topology.

Awards and Honors: *Polyhedra Can Bend But Not Breathe* by Dana Mackenzie, Science **279**, 13 March 1998, p. 1637, discusses the solution of the Bellows Conjecture. *The Bellows Conjecture* by Ian Stewart in his Mathematical Recreations column, Scientific American, July 1998, also discusses the Bellows Conjecture.

Professional Activities: Member of the AMS and the MAA. Reviewer for the Mathematical Reviews. Referee for various journals. Editor for Betreige für Algebra und Geometrie. Gave an invited talk at the Canadian Mathematical Society workshop in Discrete Geometry, Kingston, Ontario (Dec. 1998) Gave an invited talk at the AMS meeting in Montreal, Canada, September 1998. Gave an invited talk at the AMS meeting in Atlanta, Georgia, October 1997. Gave a series of invited lectures at Eótvós University in Budapest, Hungary, November 1997. Gave an invited lecture at the Workshop on *Rigidity Theory and Applications* in Traverse City, Michigan, June 1998.

Selected Publications:

Rigidity; Chapter 1.7 in Handbook of Convex Geometry (P. M. Gruber and J. M. Wills, eds.), North Holland, 1993, pp. 223–271.

Higher-Order Rigidity—What Is the Proper Definition? (with H. Servatius), Discrete Comput. Geom. **11** (1994), 193–200.

Finite and Uniform Stability of Sphere Coverings (with A. Bezdek and K. Bezdek), L. Fejes Tóth Festschrift, Special Volume of Discrete and Comput. Geom. **13** no. 3–4 (1995), 313–319.

Globally Rigid Symmetric Tensegrities (with M. Terrell), Structural Topology **21** (1995), 59–78.

Second Order Rigidity and Prestress Stability for Tensegrity Frameworks (with W. Whiteley), SIAM J. Discrete Mathematics **9** no. 3 (1996), 453–491.

The Bellows Conjecture (with I. Sabitov and A. Walz), Contrib. to Alg. and Geom. **38** no. 1 (1997), 1–10.

Finite and Uniform Stability of Sphere Packings (with A. Bezdek and K. Bezdek), Discrete and Comput. Geom. **20** (1998), 111–130.

Mathematics and Tensegrity (with A. Back), American Scientist March-April (1998), 142–151.

Tensegrity Structures: Why are they stable?; in Rigidity Theory and Applications (M.F. Thorpe and P.M. Duxbury, eds.), Kluwer Academic/Plenum, 1999, 47–54.

R. Keith Dennis

Professor of Mathematics

Most of my research has been in the field of algebraic K-theory. This field is, in some sense, a fancy generalization of linear algebra to arbitrary rings. As such, it has applications in many other areas of mathematics such as topology, algebraic geometry, and even the theory of Markov processes. I have been most interested in the computational aspects of the subject, in particular, the computation of quotients of rings of algebraic integers and in the computation of the Whitehead group for finite abelian groups.

Parts of this work have involved the use of computers to understand a number of examples before formulating and proving the general results. This work has led to the study of questions about group rings, number theory, and theory of finite groups. My current interest lies in studying a number of problems relating to commutators, structure, and invariants of finite groups which can be investigated by computer computations.

Awards and Honors: Humboldt Prize (1993).

Professional Activities: Executive editor of Mathematical Reviews (appointed 1995–97). Consulting editor of Mathematical Reviews (July 1, 1998–). Ref-

eree for the NSF, NSA and various journals. Member of the AMS, MAA, SIAM, LMS, DMV and CSHPM (Canadian Society for the History and Philosophy of Mathematics). Appointed to the Board of Advisors for the American Institute of Mathematics (1997). Editor with Bernd Wegner of the Jahrbuch-Project (http://www.emis.de/projects/JFM/).

Invited Lectures:

The number of groups of order N, University of Essen, Germany and Warsaw, Poland (1994); Purdue University (1995).

Homogeneous functions and algebraic K-theory, University of Bielefeld, Germany, University of Warsaw, Paris K-Theory Conference, Inst. Recherche Mathematique Avancee (1994); Purdue University (1995).

Selected Publications:

Noncommutative Algebra (with B. Farb), Springer-Verlag, 1993.

Homogeneous Functions and Algebraic K-Theory (with Reinhard Laubenbacher), to appear.

The Number of Groups of Order N, to appear.

Persi Diaconis

Professor of Mathematics

David Duncan Professor of Physical Sciences

My current research is at a branch point. I am still actively engaged in the careful analysis of rates of convergence of large finite Markov chains to their stationary distribution as an aid to practical simulation studies. Some old work on strong stationary stopping times has recently seen very active use via "exact sampling."

At the same time I am actively working on the distribution of the eigenvalues of large random matrices. They appear in many applied problems, from the analysis of solitaire to heavy neutron scattering to the zeros of the zeta function.

Awards and Honors: Plenary Speaker, International Congress of Mathematicians, Berlin, 1998. Gibbs Lecturer, American Mathematical Society, 1997. President of the Institute of Mathematical Statistics, 1997–1998.

Professional Activities: Statistical Consultant to Bell Telephone Laboratories, Murray Hill, New Jersey. Statistical Consultant to Stanford Linear Accelerator.

Invited Lectures:

Random iterations: a simple idea in Markov chain theory, Probability Seminar, Cornell Univ. (Sept. 1997).

Random iterations: examples of a simple principle in Markov chain theory, Probability Seminar, Cornell University (Sept. 1997).

The mathematics of solitaire, School of OR&IE, Cornell University (March 1998).

Selected Publications:

Are There Still Things to Do in Bayesian Statistics? (with S. Holmes), Erkenntnis: Probability Dynamics and Casualty **45** (1997), 145–158.

A Non-measurable Tail Set (with D. Blackwell); in Statistics, Probability and Game Theory Papers in Honor of David Blackwell (T. Ferguson, et al, eds.), IMS, Hayward, 1997, pp. 1-5.

Lattice Walks and Primary Decomposition (with David Eisenbud and Bernd Sturmfels); in Festschrift for Gian-Carlo Rota (B. Sagan, ed.), to appear.

Consistency of Bayes Estimates for Nonparametric Regression: Normal Theory (with D. Freedman), Bernoulli, to appear.

What Do We Know About the Metropolis Algorithm? (with L. Saloff-Coste), Jour. Comp. Sci., to appear.

Analysis of a Non-reversible Markov Chain Sampler (with S. Holmes and R. Neal), Tech. Rpt. BU-1385-M, Biometry, Cornell Univ.; Ann. Appl. Prob., to appear.

Consistency of Bayes Estimates for Non-parametric Regression: a review (with D. Freedman); in Festschrift for Lucian LeCam (D. Pollard, et al, eds.), Springer, New York, 1997, pp. 157–166.

Bounds for Kac's Master Equation (with L. Saloff-Coste), Communications Math. Phys., to appear.

Walks on Generating Sets of Groups (with L. Saloff-Coste), Inventiones Math., to appear.

The Graph of Generating Sets of an Abelian Group (with R. L. Graham), Colloquium Math., to appear.

A Bayesian Peek into Feller, Vol. I (with S. Holmes), Statistical Science (1997), to appear.

Random Walk and Hyperplane Arrangements (with K. Brown), Ann. Probab. (1998), to appear.

Geometry and Probability in Three Dimensions (with L. Billera and K. Brown), Amer. Math. Monthly (1998), to appear.

Iterated Random Functions (with D. Freedman), SIAM Review (1998), to appear.

A Place for Philosophy? The rise of modeling in statistics, Quar. Jour. Appl. Math., to appear.

Some New Tools for Dirichlet Priors; in Bayesian Statistics (J. Bernardo, ed.), Oxford Press, Oxford, 97–106.

Richard Durrett

Professor of Mathematics

Most of my research concerns interacting particle systems. These models represent space by a grid of sites that can be in one of a finite number of states and which change at rates that depend on the states of a finite number of neighbors. For the last ten years, I have been interested in the applications of these models in ecology and related fields, much of which has been done in collaboration with Simon Levin in the Ecology Department at Princeton.

Recently I have become interested in probability problems arising from genetics. Some of that work is being done in collaboration with Rich Harrison in Ecology & Systematics, who studies hybrid zones, but most of the projects come from collaboration with Chip Aquadro in Population Genetics and members of his lab. This year I received a grant (more precisely a supplement to Aquadro's NIH grant) that will reduce my teaching load to allow me to learn more genetics.

Awards and Honors: Institute of Mathematical Statistics Fellow. Sloan Fellow (1981–1983). Guggenheim Fellow (1988–1989). Invited Speaker at the International Congress of Mathematicians, Kyoto (1990).

Professional Activities: Editor for Annals of Applied Probability (1997–).

Selected Publications:

Lecture Notes on Particle Systems and Percolation, Wadsworth Publ. Co., 1988.

The Essentials of Probability, Duxbury Press, 1993.

Stochastic Models of Growth and Competition; in Proceedings of International Congress of Math, Kyoto, Springer, 1993, pp. 1049–1056.

Ten Lectures on Particle Systems; in Proceedings of the 1993 St. Flour Summer School, Springer Lecture Notes in Math. 1608, 1993, pp. 97–201.

The Importance of Being Discrete (and Spatial) (with S. Levin), Theoret. Pop. Biol. **46** (1994), 363–394.

Probability: Theory and Examples, Wadsworth Publ. Co., 1990; Second Edition, 1995.

Stochastic Calculus: A Practical Introduction, CRC Press, 1996.

Essentials of Stochastic Processes, Springer-Verlag, 1999.

Eugene B. Dynkin

Professor of Mathematics

A. R. Bullis Chair

Lie groups were the main subject of my earlier research. "Dynkin's Diagrams" are widely used by mathematicians and physicists. After 1954, probability theory became the central field of my interests. Principal efforts were devoted to Markov processes and their connections with potential theory and partial differential equations. Other work includes research in mathematical statistics (sufficient statistics, exponential families), optimal control (optimal stopping, control with incomplete data) and mathematical economics (economic growth and economic equilibrium under uncertainty).

In the 80s I have been working on the relationship between Markov processes and random fields that arise in statistical physics and quantum field theory. One of the results — an isomorphism theorem connecting Gaussian fields with local times for Markov processes — has a considerable impact on the work of a number of investigators. For the last decade, my main efforts are devoted to the theory of measure-valued branching processes (the name "superprocesses" suggested by me for these processes is now standard in mathematical literature). Connections between superdiffusions and a class of nonlinear partial differential equations were established that allows to apply powerful analytic tools for investigating the path behavior of superdiffusions, and that provides a new probabilistic approach to problems of nonlinear PDEs. New directions — the description of all positive solutions of a certain class of nonlinear equations and the study of removable boundary singularities of such solutions — have been started in a series of joint papers of Dynkin and Kuznetsov.

Awards and Honors: Member of the National Academy of Sciences, USA. Prize of Moscow Mathematical Society. Fellow of The American Academy of Arts and Sciences. Fellow of the IMS. Leroy P. Steele Prize for cumulative influence of the total mathematical work. Honorary member of the Moscow Mathematical Society. Doctor Honoris Causa of University Pierre and Marie Curie (Paris VI).

Professional Activities: Member of the AMS and the Bernoulli Society. Advisory boards of Probability Theory and Its App. and Math. in Operations Research. Sci-

entific advisor of the International Center for Mathematical Sciences, Edinburgh, Great Britain.

Invited Lectures: Conference on Functional Analysis, Partial Differential Equations and Applications, Rostock (1998). International Conference on Infinite Dimensional (Stochastic) Analysis and Quantum Physics, Leipzig (1999). Workshop on Interactive Measure-Valued Processes, The Fields Institute, Toronto, Canada (March 1999).

Selected Publications:

Markov Processes I & II, Springer-Verlag, Berlin, 1965.

Superprocesses and Partial Differential Equations, The 1991 Wald Memorial Lectures, Ann. Prob. **21** (1993), 1185–1262.

An Introduction to Branching Measure-Valued Processes, CRM Monograph Series **6**, American Mathematical Society, Providence, RI, 1994.

Superdiffusions and Removable Singularities for Quasilinear Partial Differential Equations (with S. E. Kuznetsov), Communications on Pure and Applied Mathematics **49** (1996), 125–176.

Fine Topology and Fine Trace on the Boundary Associated with a Class of Semilinear Differential Equations (with S. E. Kuznetsov), Comm. Pure & Appl. Math. **51** (1998), 897–936.

Semilinear Parabolic Equations, Diffusions and Superdiffusions, J. Functional Analysis **158** (1998), 325–356.

Clifford Earle

Professor of Mathematics

Most of my research concerns invariants belonging to Riemann surfaces. I am especially interested in learning how these invariants change when the complex structure of the Riemann surface is modified. A useful technique is to consider a family of Riemann surfaces depending holomorphically on some parameters and to study how the invariants of the surface change as we move about in the parameter space. Quasiconformal maps and Kleinian groups have proved to be fundamental tools for the construction of good parameter spaces, so I have studied and used them extensively.

Awards and Honors: John Simon Guggenheim Memorial Fellow (1974–75). Distinguished Ordway Visitor to the School of Mathematics, University of Minnesota (1996).

Professional Activities: Managing Editor of Proceedings of the American Mathematical Society.

Selected Publications:

A Fibre Bundle Description of Teichmüller Theory (with J. Eells, Jr.), J. Diff. Geom. **3** (1969), 19–43.

Families of Riemann Surfaces and Jacobi Varieties, Ann. Math. **107** (1978), 255-286.

Conformally Natural Extension of Homeomorphisms of the Circle (with A. Douady), Acta Math. **157** (1986), 23–48.

Holomorphic Motions and Teichmüller Spaces (with I. Kra and S. L. Krushkal), Trans. Amer. Math. Soc. **343** (1994), 927–948.

Geometric Isomorphisms Between Infinite Dimensional Teichmüller Spaces (with F. P. Gardiner), Trans. Amer. Math. Soc. **348** (1996), 1163–1190.

Adam Epstein

H. C. Wang Assistant Professor of Mathematics

My research interests are complex analytic dynamics and Teichmüller theory. A few years back I had the good fortune to combine these subjects in a general finiteness theorem. More recently I have worked to understand the parameter space of quadratic rational maps.

Invited Lectures: Yale University Analysis Seminar (March 1999).

Selected Publications:

Geography of the Cubic Connectedness Locus: Intertwining Surgery, Ann. Sci. Ec. Norm. Sup.

Miklós Erdélyi-Szabó

H. C. Wang Assistant Professor of Mathematics

My main area of interest is the study of classical models of second order intuitionistic arithmetic, especially their complexity in various languages and language fragments. The results obtained in this area give useful hints about what may be expected to be true constructively (in Bishop's sense) or in an intuitionistic theory of reals, but they are usually easier to get: the model's nice topological structure is a great help. A question which

is of particular interest to me is this: are the fragments of the models which were shown to be decidable implied by constructively or intuitionistically plausible axioms for the reals? There is quite a gap between the results about the models and their constructive counterpart, a fact which should keep me busy as a gap-filler.

Presently I was able to show that true second order arithmetic is interpretable in the ordered ring structure of Scott's model, and I am working on the extension of this result to other models. The next aim in this direction would be to show that this fragment of the model is actually equivalent to true second order arithmetic.

Selected Publications:

Decidability in the Constructive Theory of Reals, Mathematical Logic Quarterly **43** (1997), 343–354.

Decidability of Scott's Model as an Ordered **Q***-Vector Space*, Journal of Symbolic Logic **62** no. 3 (1997).

Undecidability of the Real-Algebraic Structure of Scott's Model, Mathematical Logic Quarterly, to appear.

Undecidability of the Real Algebraic Structure of Models of Intuitionistic Elementary Analysis, Journal of Symbolic Logic, submitted.

José F. Escobar

Professor of Mathematics

My research has focused on the study of linear and non-linear partial differential equations arising in differential geometry. The basic purpose of geometry is to give a good description of a class of geometric objects. The geometric objects I study are the so-called Riemannian manifolds. These are spaces endowed with analytical structures, like the metric which provide us with a way to measure lengths and angles. It is natural to study deformations of these structures to realize what properties in the space remain stable under such perturbations. The description of all these deformations is usually governed by differential equations. The curvature tensor of a Riemannian manifold (a measure for the "non-euclideanness" of a Riemannian space) usually makes such equations non-linear, although as in physics, most of them are of variational nature. I have been able to develop the existence theory of solutions to semilinear elliptic equations with non-linear boundary conditions. These equations appear in the problem of conformal deformation of a Riemannian metric on a manifold with boundary and in some non-linear problems in physics.

Awards and Honors: Presidential Faculty Fellowship (1992–1999), created by President Bush to be given to 15 scientists in the nation each year. Colciencias Award, Category A (1996). Alejandro Angel Escobar Foundation: Mention of Excellence in Science (1995).

Professional Activities: Member of the AMS and the Colombian Mathematical Society. Correspondent member of the Colombian Academy of Sciences. Chairman of III Escuela de Verano en Geometría Diferencial, Ecuaciones en Derivadas Parciales y Análisis Numérico, Universidad de los Andes, Bogotá, Colombia (1995). Chairman of Physical Sciences, Mathematics and Engineering Panel for the 1995, 1996, 1997 & 1998 Ford Foundation Dissertation and Postdoctoral Fellowships.

Editorial Board of the Electronic Journal of Differential Equations since 1993 and Revista Colombiana de Matemáticas since 1992. International editor of Innovación y Ciencia since 1992. Referee for the Journal of the AMS, Journal of Diff. Geometry, Duke Mathematical Journal, Indiana Mathematical Journal, Proceedings of the AMS, Communications in Analysis and Geometry, among others, and the NSF.

Invited Lectures:

A priori estimates for constant scalar curvature metric with minimal boundary, Escuela de Verano en Geometría Diferencial, Ecuaciones Diferenciales Parciales y Análisis Numérico, Bogotá, Colombia (1995).

Conformal geometry, US-Chinese Conference on Recent Developments in Differential Equations and Applications, Hangzhou, P. R. China (1996).

The geometry of the first Steklov eigenvalue, Southern California Geometry Analysis Seminar, Irvine, California (1998).

An isoperimetric inequality and the Steklov eigenvalue, Brazilian School of Geometry, Belo Horizonte, Brazil (1998).

Selected Publications:

Conformal Metrics with Prescribed Scalar Curvature (with R. Schoen), Invent. Math. **86 (2)** (1986), 243–254.

Uniqueness Theorems on Conformal Deformations of Metrics, Sobolev Inequalities and an Eigenvalue Estimate, Comm. on Pure and Appl. Math. **43** no. 7 (1990), 857–883.

Conformal Deformation of a Riemannian Metric to a Scalar Flat Metric with Constant Mean Curvature on the Boundary, Ann. Math. **136** (1992), 1–50.

The Yamabe Problem on Manifolds with Boundary, J. Diff. Geom. **25** (1992), 21–84.

The Differential Form Spectrum on Manifolds of Positive Curvature (with A. Freire), Duke Math. J. **69** no. 1 (1993), 1–41.

Conformal Metrics with Prescribed Mean Curvature on the Boundary, Calculus of Variations and PDE's **4** (1996), 559–592.

Conformal Deformation of a Riemannian Metric to a Constant Scalar Curvature Metric with Mean Curvature on the Boundary, Indiana U. Math. Jour. **45** no. 4 (1996), 917–943.

The Geometry of the First Non-Zero Steklov Eigenvalue, J. Func. Anal. **150** no. 2 (1997), 544–556.

An Isoperimetric Inequality and the First Steklov Eigenvalue, J. Func. Anal., to appear.

Roger Farrell

Professor of Mathematics

My research concerns the application of decision theory methods to statistical problems to try and characterize completely good and bad methods of estimation and testing. Useful decision theory methods can involve development of inequalities, compactification of spaces, and study of the way sequences of measures converge.

Professional Activities: Member of the IMS, AMS and ASA. Occasional reviews for Math Reviews and occasional refereeing.

Selected Publications:

Multivariate Calculation, Springer-Verlag, 1985.

Proof of a Necessary and Sufficient Condition for Admissibility in Discrete Multivariate Problems (with L. D. Brown), J. Mult. Annal. **24** (1988), 46–52.

All Admissible Linear Estimators of the Vector of Gamma State Parameters with Application to Random Effects Models (with W. Klonecki and S. Zontek), Ann. Statist. **17** (1989), 268–281.

A Lower Bound for the Risk in Estimating the Value of a Probability Density (with L. D. Brown), Jour. Amer. Statist. Assoc. **85** (1990), 1147–1153.

Estimations of Accuracy in Testing (with J. T. G. Hwang, G. Casella, C. Robert and M. T. Wells), Ann. Statist. **20** (1992), 490–509.

Spitzer and Bohnenblust, Revisited (1997), preprint.

Vesselin Gasharov

H. C. Wang Assistant Professor of Mathematics

My work is in commutative algebra and algebraic combinatorics. I am especially interested in the interplay of ideas and the rich connections between these two fields. More specifically, I am interested in Hilbert functions, symmetric functions, free resolutions, total positivity, Schubert varieties, toric varieties, Gröbner bases theory and monomial ideals.

Professional Activities: Coorganizer of a special session in Algebraic and Geometric Combinatorics at the AMS Meeting in Providence, RI (1999). Referee for various journals.

Selected Publications:

Incomparability Graphs of $(\mathbf{3}+\mathbf{1})$*-Free Posets are s-Positive*, Discrete Math. **157** (1996).

Complete Intersection Dimension (with L. Avramov and I. Peeva), Publ. Math. IHES **86** (1997).

On the Neggers-Stanley Conjecture and the Eulerian Polynomials, J. Combin. Theory (A) **82** (1998).

Factoring the Poincaré Polynomials for the Bruhat Order on S_n, J. Combin. Theory (A) **83** (1998).

Hilbert Functions and Homogeneous Generic Forms II, Compositio Mathematica **116** (1999).

Rationality for Generic Toric Rings (with I. Peeva and V. Welker), Mathematische Zeitschrift, to appear.

Leonard Gross

Professor of Mathematics

My research could, for the most part, be described as analysis over infinite dimensional spaces. This has sometimes been motivated by problems of mathematical physics, specifically statistical mechanics and the problem of existence of quantum fields. There is usually a naturally arising probability measure on the infinite dimensional space of interest to me which links functional analytic questions to probability theory. In recent years, I have been interested in properties of the Dirichlet form associated to pinned Brownian motion on loop groups. A long range goal is proof of a Hodge-deRham theorem for these manifolds of maps. This has led, most recently, to a study of Dirichlet forms in holomorphic function spaces over a complex manifold.

Awards and Honors: Guggenheim Fellow (1974–75). Humboldt Prize (1993). Bourbaki Lecture, Paris, France (1998).

Professional Activities: Editorial boards of the Journal of Functional Analysis, Reviews in Mathematical Physics, Soochow Journal of Mathematics, Revista Colombiana de Matemématicas and Electronic Research Announcements of the American Mathematical Society. Board of Governors of the Institute of Mathematics and Its Applications, Minnesota (1989–91). Co-organizer of special session at American Mathematical Society meeting (Apr. 1998)

Invited Lectures:

Quantization on compact Lie groups and the universal enveloping algebra, Von Neumann Symp., MIT (1994).

Hilbert spaces of holomorphic functions on complex Lie groups, Taniguchi Symp., Warwick, England (1994).

The mathematical ramifications of Wiener's program in statistical physics, Wiener Centenary Symposium, Lansing, MI (1994).

Hall's transform via the Segal-Bargmann Map, London Mathematical Society (1995).

Hall's transform and quantum mechanics, Probability Towards 2000, Columbia University (1995).

Hilbert spaces of holomorphic functions on complex Lie groups, Paris, France (1996); Bochum, Germany (1996); Mannheim, Germany (1996).

Hypercontractivity over complex manifolds, Paris (1998); London (1998).

Analysis on loop groups, Kusadaci, Turkey (1998).

Selected Publications:

Abstract Wiener Spaces, Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability, Vol 2, pt. 1 (1965), 31–41.

The Cauchy Problem for the Coupled Maxwell and Dirac Equations, Comm. Pure App. Math. **19** (1966), 1–15.

Existence and Uniqueness of Physical Ground States, J. Func. Anal. **10** (1972), 52–109.

Logarithmic Sobolev Inequalities, Amer. J. Math. **97** (1975), 1061–83.

Convergence of $U(1)_3$ Lattice Gauge Theory to its Continuum Limit, Comm. Math. Phys. **92** (1983), 137–162.

A Poincaré Lemma for Connection Forms, J. Func. Anal. **63** (1985), 1–46.

Logarithmic Sobolev Inequalities on Loop Groups, J. Func. Anal. **102** (1991), 268–313.

Uniqueness of Ground States for Schrödinger Operators Over Loop Groups, J. Func. Anal. **112** (1993), 373–441.

A Local Peter-Weyl Theorem (1997), to appear.

Hypercontractivity Over Complex Manifolds (1998), Acta Math., to appear.

Mark Gross

Associate Professor of Mathematics

My interests at the moment center on the classification of algebraic threefolds. In the last several years, I have been focusing on the classification of Calabi-Yau threefolds, which play an important role in the overall classification of algebraic threefolds. Furthermore, they arise in theoretical physics as natural choices of six real dimensional compact manifolds to compactify the ten dimensions required in superstring theory down to the four dimensions of ordinary space-time. As a result, there has been much cross-fertilization between physics and this area of algebraic geometry, with the physics suggesting a number of interesting dualities, including mirror symmetry, and with the mathematics suggesting new areas of inquiry in physics. This has recently led to exciting developments in the understanding of the structure of Calabi-Yau manifolds via special Lagrangian fibrations.

Professional Activities: Reviewer for Math Reviews.

Selected Publications:

The Distribution of Bidegrees of Smooth Surfaces in $Gr(1, \mathbf{P^3})$, Math. Ann. **292** (1992), 127–147.

Elliptic Three-folds I*: Ogg-Shafarevich Theory* (with I. Dolgachev), J. Alg. Geom. **3** (1994), 39–80.

A Finiteness Theorem for Elliptic Calabi-Yau Three-folds, Duke Mathematics Journal **74**, 1994, 271–299.

The Deformation Theory of Calabi-Yau n-folds with Canonical Singularities Can Be Obstructed, Essays on Mirror Manifolds II, to appear.

Deforming Calabi-Yau Threefolds, Math. Ann., to appear.

Primitive Calabi-Yau Threefolds, J. Diff. Geom., to appear.

Mirror Symmetry Via 3-Tori for a Class of Calabi-Yau Three-folds (with P. M. H. Wilson), Math. Ann., to appear.

John Guckenheimer

Professor of Mathematics

My research involves dynamical systems. The theory seeks to elucidate general phenomena that occur over long periods of time when a system is governed by deterministic rules. Much of my theoretical work has involved study of the iterations of a single real valued function. Though at first glance these models seem too simple to reflect the dynamics observed in the real world, detailed analysis of their properties has revealed many features subsequently observed in diverse experimental realms. I have also investigated the influence of symmetry on generic features of dynamical systems.

In addition to extending the theory, I am also interested in its application to many fields of science and engineering. I have worked with applications in biology, chemistry, engineering and physics. My current work focuses upon applications to the neurosciences and to problems of control. Computation plays a large role in this work. The term bifurcation describes the changes in qualitative properties of a system that occur as parameters are varied. The development of more effective algorithms for computing bifurcations is a central theme in my research.

Professional Activities: Chair of the organizing committee for the 1997–98 program at IMA, University of Minnesota. President of SIAM. SIAM Board of Trustees. Ex officio member of the Joint Policy Board on Mathematics and the Conference Board on Mathematical Sciences. Editorial board of the Journal of Experimental Mathematics and the International Journal of Bifurcation and Chaos.

Administrative Activities: Member of the FABIT committee.

Selected Publications:

Computer Simulation and Beyond — for the 21st Century, Notices of the AMS **45** (1998), 1120–1123.

Computing Periodic Orbits with High Accuracy (with W. G. Choe), Computer Methods in Applied Mechanics and Engineering **170** (1999), 331–341.

Using Dynamical Systems Tools in Matlab (with W. G. Choe), Proceedings of IMA Workshops, in press.

An Improved Parameter Estimation Method for Hodgkin-Huxley Models (with A. R. Willms, D. J. Baro and R. M. Harris-Warrick), J. Comp. Neuroscience, in press.

Book Review: Dynamical Systems and Numerical Analysis by Stuart and Humphries, Ergodic Theory and Dynamical Systems, in press.

Torus Maps From Weak Coupling of Strong Resonances (with A. Khibnik), submitted.

Analysis of a Subcritical Hopf-Homoclinic Bifurcation (with A. Willms), submitted.

Allen E. Hatcher

Professor of Mathematics

A common thread through much of my research is the idea of studying the space of all topological objects of a certain kind, for example, the space of all finite polyhedra, the space of all diffeomorphisms of a manifold, or the space of all knots. Recently I have also been writing a couple of graduate-level textbooks in topology, trying to lessen the large gap which has developed between the standard first-year courses and current research.

Awards and Honors: Sloan Fellow (1976–80). Invited address at 1978 Int'l Congress of Mathematicians.

Professional Activities: Referee for the NSF and various research journals.

Selected Publications:

Higher Simple Homotopy Theory, Annals of Math. **102** (1975), 101–137.

A Proof of the Smale Conjecture, Annals of Math. **117** (1983), 553–607.

Algebraic Topology I, an on-line textbook available at http://math.cornell.edu/~hatcher.

Timothy J. Healey

Professor of Theoretical and Applied Mechanics

I am interested in the rigorous analysis of nonlinear partial differential equations arising in continuum mechanics — in particular, nonlinear elasticity. Although the basic theory, being a branch of classical mechanics, is well understood, it produces formidable nonlinear problems the resolution of which is in many cases beyond the reach of present-day mathematics. In other words, there are many open problems. Currently we are developing

and applying generalized degree-theoretic methods for global continuation and bifurcation problems, in many cases yielding the first existence theorems for "large" classical solutions in nonlinear elasticity. Finally, we mention that the theory has a wide range of engineering applications — from flexible structures and solids to shape-memory alloys — from aircraft to lingerie!

Professional Activities: Member of the Editorial Board of the *Journal of Elasticity*.

Administrative Activities: Member of the fields of mathematics and applied mathematics.

Invited Lectures:

New existence theorems in nonlinear elasticity, Universidad de Puerto Rico, Decimocuarto SIDIM (Apr. 1999) and EQUADIFF, Berlin (Aug. 1999).

Global continuation via higher-gradient regularization and singular limits in one-dimensional phase transitions, SIAM Annual Meeting, Atlanta (May 1999).

Global symmetry of twisted elastic rings, University of Maryland (May 1999).

Selected Publications:

Unbounded Branches of Globally Injective Solutions in the Forced Displacement Problem of Nonlinear Elasticity (with P. Rosakis), J. Elasticity **49** (1997), 65–78.

Free Nonlinear Vibrations for a Class of Two-Dimensional Plate Equations: Standing and Rotating Waves (with H. Kielhöfer), Nonlinear Analysis TMA **29** (1997), 501-531.

Global Continuation in Nonlinear Elasticity (with H. Simpson), Archive for Rational Mechanics and Analysis **143** (1998), 1–28.

The Role of the Spinodal Region in One-Dimensional Martensitic Phase Transitions (with A. Vainchtein, P. Rosakis and L. Truskinovsky), Physica D (1998), 29–48.

David W. Henderson

Professor of Mathematics

I would classify my work as pertaining to aspects of mathematics that impinge on the teaching and learning of mathematics — the emphasis is on the mathematics not on education. My main theme is that we should enliven our conception of what "proof" is and that proofs should be a central part of mathematics teaching at all levels, where my definition of "proof" is: A convincing communication that answers — Why?

In addition, I am currently involved in extensive curriculum innovation projects in undergraduate mathematics. My first book, *Experiencing Geometry on Plane and Sphere*, published in August 1995, has been requested by faculty in 50 countries so far and has been translated into Portugese. My second book *Differential Geometry: A Geometric Introduction* appeared in July of 1997. I am now extensively revising and expanding my first book. I have started a third book which will be a calculus supplement giving an accessible foundation for the theory of calculus based on geometry and motion.

Professional Activities: Referee for the NSF and various journals. Panel on Equity and Diversity of the Mathematical Sciences Education Board, National Academy of Sciences. Member of the AMS, MAA, National Council of Teachers of Mathematics. Invited participant in the international ICMI Study Group on the Teaching of Geometry for the Twenty-First Century (Sicily) and the ICMI Study Group on the Teaching of Undergraduate Mathematics (Singapore).

Numerous workshops (at Cornell and other places in the USA and abroad) about geometry and teaching geometry for mathematics professors and high school teachers — in part supported by grants from NSF and Title IIA Federal grants.

Invited Lectures and Workshops:

A mathematician looks at research in undergraduate education, plenary address, Research in Undergraduate Mathematics Education Annual Conference, South Bend, Indiana (Oct. 1998).

Giving professors permission to change their teaching, invited paper, International Commission on Mathematics Instruction invitation-only study conference on Teaching Mathematics on the Undergraduate Level, Singapore (Dec. 1998).

Four one-day workshops for school teachers (with A. Solomon and D. Taimina), Cornell University (1998–99 academic year).

Organizer of a special session, Geometry in the Classroom in the Next Millennium (with C. Mulcahy and B. Schiller), Joint Mathematics Meetings in San Antonio (Jan. 1999).

The eight undergraduate geometry courses at Cornell, invited paper, special session on Mathematics and Educational Reform, Joint Mathematics Meetings in San Antonio (Jan. 1999).

Proof as a convincing communication that answers — why?, invited paper, special session on Proof in Mathe-

matics Education, Joint Mathematics Meetings in San Antonio (Jan. 1999).

Proofs at all levels, University of Northern Colorado (Feb. 1999).

Featured speaker: Making the Theory of Calculus Accessible, Faculty Workshop of the Rocky Mountain Mathematics Consortium (Feb. 1999).

Invited participant: From Preparation to Practice: NSF Teacher Education PI Workshop, Washington, DC (May 1999).

Organized and taught in week-long NSF Undergraduate Faculty Enhancement workshop, *Teaching Undergraduate Geometry* (with K. Gaddis, J.-J. Lo and A. Solomon), Cornell University (June 1999).

Week-long workshop for teachers (with A. Solomon and D. Taimina), Cornell University (June 1999).

Selected Publications:

Compactifications of the Ray with the Arc as Remainder Admit no n-mean (with M. Awartani), Proc. AMS (1995).

Experiencing Geometry on Plane and Sphere, Prentice-Hall, 1996.

Differential Geometry: A Geometric Introduction, Prentice-Hall, 1998.

Building Upon Student Experience in a College Geometry Course (with Lo and Gaddis), For the Learning of Mathematics **16**, 1 (1996), 34–40.

I Learn Mathematics From My Students—Multiculturalism in Action, For the Learning of Math. **16**, 2 (1996).

Square Roots in the Sulba Sutra; in Topics in Applied Geometry, MAA, 1998.

Experiencing Geometry (with D. Taimina), NORMA-98, Nordic Mathematics Education Conference Proceedings, Kristiansand, Norway, 1998.

Giving Professors Permission to Change Their Teaching, Teaching Mathematics on the Undergraduate Level, International Commission on Mathematics Instruction Study Conference, Singapore, 1998.

John Hubbard

Professor of Mathematics

Differential equations are the main way in which mathematical models of real systems are constructed, and understanding their behavior is the main contribution a mathematician can make to applications. I am interested in understanding the behavior of differential equations and their close relatives: iterative systems. In particular, I try to see how such systems behave in the complex domain, largely because complex analysis brings new and powerful techniques to bear on the problems.

The availability of powerful computers and computer graphics has changed the way this sort of research is done. In the course of investigations of even such simple iterative systems as quadratic polynomials, amazing pictures show up, rather as artifacts to be investigated than as man-made objects. I anticipate that this sort of experimental mathematics will become a major trend.

Most of my research over the last five years has been devoted to dynamics in several complex variables. I have co-authored four foundational papers in the field. I am also writing three books on a very advanced level, one giving a treatment of Teichmüller space and its applications in theorems of Bill Thurston, the second on dynamics of one complex variable, and the third on differential geometry.

During the summer I also directed an NSF-funded Research Experiences for Undergraduates program for four students (two from Harvard, one from Cornell, one from Iowa). The resulting presentation by one of these students at the MAA MathFest in Toronto was chosen as one of the outstanding talks at the MAA Student Paper Sessions. During the school year I continued to work with undergraduates on research projects. One of these students, a physics major, was selected as a Merrill Presidential Scholar, and named me as "the faculty member who has had the most positive influence on his education at Cornell."

Of the papers accepted for publication in the past year, two stand out. *A Compactification of Hénon Mappings in $\mathbb{C}^2$ as Dynamical Systems* (with P. Papadopol and V. Veselov), which will appear in Acta Mathematica, builds a bridge between dynamics and algebraic or analytic geometry. The paper uses blow-ups to show that there is a topology on $\mathbb{C}^2 \sqcup S^3$ homeomorphic to a 4-ball such that the Hénon mapping extends continuously. In doing so it proves a result suggested by Milnor, involving embeddings of solenoids in S^3 which are topologically different from those obtained from Hénon mappings. I am currently exploring the application of this method to other problems.

The Forced Damped Pendulum: Chaos, Complication and Control, which will appear in the American Mathematical Monthly, shows how a computer can yield amazing but rigorous results about differential equations using methods accessible to undergraduates. It explores the dynamics of the forced pendulum, as described by the differential equation $x'' + Fx' + \sin \omega x = A \cos t$, for

the parameter values $F = 0.1$, $\omega = 1$ and $A = 1$. This pendulum has an attracting periodic oscillation of period 2π, but if you color the plane of initial conditions $x(0)$, $x'(0)$ according to how many times the pendulum goes over the top before settling down to this oscillation, the corresponding "basins of attraction" are extremely wild; in fact they form "lakes of Wada": every point in the boundary of one basin is in the boundary of all the infinitely many others.

I spent the spring semester on leave in Marseille, France, and took advantage of it to give a number of lectures in Paris and other French cities, and to give invited lectures at meetings in Pisa and Crete.

J. T. Gene Hwang

Professor of Mathematics

Recently, I started to focus mainly on the theory of statistical intervals. Statistical intervals, such as confidence intervals, prediction intervals and tolerance intervals are one of the major areas in statistics. By providing intervals, statisticians demonstrate the possible range of the interested parameters or future observations.

Much of my research is stimulated by scientific and engineering applications. Although my primary interest is in theory, the solutions often can be used directly in application. My recent joint work with the National Institute of Standards and Technology is one example.

Awards and Honors: I. W. Burr Award (1979). NSF grant awards since 1979. IMS Fellow (1988). Elected Member of Int'l Statistical Institute (1989). Senior Research Fellowship at NIST (Sept. 1–Nov. 30, 1993).

Professional Activities: Referee for JASA, Ann. Stat., J. Multivariate, Sankhya. Member of the ASA, IMS and ICSA.

Invited Lectures:

Individual bioequivalence, Bioequivalence conference, Dusseldorf, Germany (1995).

Measurement error models in predicting compressive strength of concrete, Central University and Taiwan University, Taiwan (1995).

Prediction and confidence intervals: why so different?, Central University (1995); Cambridge University, England (1995); and Purdue University (1996).

HELP in NIST, Applied Statistics conference, Baltimore ICSA (1996).

Selected Publications:

Construction of Improved Estimators in Multiparameter Estimation for Discrete Exponential Families (with Malay Ghosh and Kam-Wah Tsui), Ann. Stat. **11**, no. 2, (1983), 351–367. Discussions by James O. Berger, H. M. Hudson and Carl Morris. Reply with Ghosh and Tsui, 375–376.

The Nonexistence of $100\,(1-\alpha)\%$ *Confidence Sets of Finite Expected Diameter in Errors-in-Variables and Related Models* (with L. Gleser), Ann. Stat. **15** (1987), 1351–1362.

Estimation of Accuracy in Testing (with G. Casella, C. Robert, M. Wells and R. Farrell), Ann. Stat. **20**, (1992), 490–509.

Is Pitman Closeness a Reasonable Criterion? (with C. Robert and W. E. Strawderman), JASA **88** (1993), 57–63. Discussed by 8 statisticians. Reply, 74–76.

Confidence Interval Estimation Subject to Order Restrictions (with S. D. Peddada), Ann. Stat. **22** (1994), 67–93.

Confidence Intervals Associated with Tests for Bioequivalence (with J. Hsu, H. K. Liu and S. J. Ruberg), Biometrika **81** (1994), 103–114.

Fieller's Problems and Resampling Techniques, Statistica Sinica **5** (1995), 161–171.

Optimal Confidence Sets, Bioequivalence and the Limacon of Pascal (with L. D. Brown and G. Casella), JASA **90** (1995), 880–890.

Maximum Likelihood Estimation Under Order Restricted Parameters by the Prior Feedback Method (with C. Robert), JASA **91** (1996), 167–172.

An Unbiased Test for the Bioequivalence Problem (with L. D. Brown and Axel Munk), Ann. Stat. **25** (1997), 2345–2367.

Prediction Intervals in Artificial Neural Network (with A. Adam Ding), JASA **92** (1997), 748–757.

Prediction Intervals, Factor Analysis Models and High-Dimensional Empirical Linear Prediction (HELP) (with A. Adam Ding), JASA, to appear.

Yulij Ilyashenko

Professor of Mathematics

My research interests are several branches of dynamical systems both in real and complex domains. They include: limit cycles in real and complex planes; analytic differential equations, with relations to complex analysis and algebraic geometry; local and nonlocal bifurcations and so on. Some main objects to study are:

(1) Limit cycles of polynomial vector fields in the real plane. For instance, in [1] I proved that for a *fixed* polynomial vector field the number of limit cycles is finite.

(2) Geometric properties of foliations determined by analytic vector fields in the complex plane.

(3) Bifurcations of planar polycycles (separatrix polygons).

(4) New nonlocal bifurcations in higher-dimensional spaces, and many others.

Professional Activities: Vice-President of the Moscow Mathematical Society. Member of the editorial boards of the journals: Functional Analysis and its Applications (Nauka, Moscow); Dynamical and Control Systems (Plenum Press, New York and London); Ergodic Theory and Dynamical Systems (Cambridge University Press, UK); Proceedings of Moscow Mathematical Society (Moscow University Press, Moscow); and Mathematical Enlightenment, ser. 3 (Moscow Center of Continuous Mathematical Education, Moscow).

Invited Lectures:

Global and local aspects of the theory of complex differential equations, 45-minute invited talk, International Congress of Mathematicians, Helsinki, 1978.

Finiteness theorems for limit cycles, 45-minute invited talk, International Congress of Mathematicians, Kyoto, 1990.

Selected Publications:

1. *Finiteness Theorems for Limit Cycles*, Amer. Math. Soc., Transl. Vol. 94, 1991, 288 pp.
2. Editor of *Nonlinear Stokes Phenomena*, Advances in Soviet Mathematics, Vol. 14, Amer. Math. Soc., 1993.
3. Editor of *Concerning Hilbert's 16th problem* (with Yakovenko), Amer. Math. Soc., 1995, 219 pp.
4. Editor of *Differential Equations with Real and Complex Time*, a collection of papers, proceedings of the Steklov Institute, Vol. 213, 1996.
5. *Nonlocal Bifurcations* (with Li Weigu), Mathematical Surveys and Monographs Vol. 66, Amer. Math. Soc., 1998.

Anthony Kable

H. C. Wang Assistant Professor of Mathematics

My main research interests are in analytic number theory, more specifically the study of various zeta and L-functions in order to obtain number-theoretic information. The L-functions I study come from two sources, namely automorphic functions (or representations) and prehomogeneous vector spaces. The latter are particularly fascinating because, while they have deep arithmetic applications, they do not seem to fit directly into the standard framework for understanding arithmetically important L-functions.

During the past year I completed a joint project with A. Yukie of Oklahoma State University which we began in 1996. In this work we used a family of zeta functions derived from a prehomogeneous vector space to obtain new information about the statistical properties of the class numbers of quadratic fields. Our results by no means exhaust the information which this family of zeta functions contains, and I expect to continue studying it and several related examples. My other major research project at present is to continue investigating the so-called exceptional representations, which were the subject of my dissertation. Exceptional representations generalize the classical theta functions, one of the most interesting and useful classes of automorphic functions, and they have numerous applications in number theory.

Selected Publications:

Prehomogeneous Vector Spaces and Field Extensions II (with Akihiko Yukie), Inventiones Mathematicae **130** (1997), 315–344.

The Mean Value of the Product of Class Numbers of Paired Quadratic Fields I & II (with Akihiko Yukie), submitted.

The Tensor Square of an Exceptional Representation of the Metaplectic Double Cover of the General Linear Group, preprint.

Peter J. Kahn

Professor of Mathematics

I am a differential and algebraic topologist focusing currently on symplectic topology/geometry and connections with mathematical physics, particularly Donaldson-Seiberg-Witten theory.

Awards and Honors: Humboldt Senior Scientist Award, 1975–76 and Summer 1981.

Professional Activities: Member of the AMS, MAA and AAAS. Reviewer for the AMS Reviews and Zentralblatt. Referee for the AMS Proceedings.

Administrative Activities: Education Policy Committee (1991–93). Chair of the Committee on Quantitative and Formal Reasoning (1991–). Author of report on the Cornell Mathematics Major (1993). Chair of the Department of Mathematics, Cornell University (1993–95). Associate Dean, College of Arts and Sciences (1995–97).

Selected Publications:

Characteristic Numbers and Oriented Homotopy Type, Topology **3** (1965), 81–95.

Self-equivalences of (n–1)-connected 2n-manifolds, AMS Bull. **72** (1966), 562–566.

Chern Numbers and Oriented Homotopy Type, Topology **7** (1968), 69–93.

The Non-Finite Homotopy Type of Some Diffeomorphism Groups, (with P. Antonelli and D. Burghelea), Topology **11** (1972), 1–49.

The Concordance-Homotopy Groups of Geometric Automorphism Groups (with P. Antonelli and D. Burghelea), Springer Lecture Notes **215** (1972).

Mixing Homotopy Types of Manifolds, Topology **14** (1975), 203–216.

Homotopy-Dimension and Simple Cohomological Dimension of Spaces (with K. Brown), Comment. Math. Helv. **52** (1977), 111–127.

Counting Types of Rigid Frameworks, Inventiones Math. **55** (1979), 297–308.

Steenrod's Problem and k-invariants of Certain Classifying Spaces, Springer Lecture Notes **967** (1982).

Equivariant Homology Decompositions, AMS Trans. **298** (1986), 245–271.

Rational Moore G-spaces, AMS Trans. **298** (1986), 273–287.

A Paradigm for Robust Geometric Algorithms (with J. Hopcroft), Algorithmica **7** (1992), 339–380.

A Continuity Property for Local Price Adjustment Mechanisms (with J. Herrmann), Journal of Mathematical Economics, to appear.

Harry Kesten

Goldwin Smith Professor of Mathematics

I am a probabilist. My main research interests are percolation theory and random walks, and in general I like to dabble in models inspired by Statistical Mechanics.

One model I have recently returned to is the first-passage percolation model. To each edge e of the integer lattice in d dimensions one assigns a passage time $X(e)$. These $X(e)$ are assumed independent, identically distributed and nonnegative. One is interested in the random set $B(t)$ of points which can be reached from the origin by time t. In particular how big are the fluctuations of the boundary of $B(t)$? This is a special example of the fluctuations of a random surface. In the case of $B(t)$ I proved the first upper bound for these fluctuations in terms of a power of t. These have now been improved by K. Alexander and lower bounds for the fluctuations have been given by C. Newman and M. Piza. The challenge now is to close the gap between these upper and lower bounds.

Professional Activities: Associate editor of the Indiana University Mathematics Journal and the New York Journal of Mathematics. Advisory board member of Electronic J. Probability. Honorary board member of J. d'Analyse Mathematique.

Awards and Honors: Correspondent, Royal Dutch Academy. Member of the National Academy of Sciences. Recipient of the Polya Prize (1994).

Selected Publications:

Products of Random Matrices (with H. Furstenberg), Ann. Math. Statist. **31** (1960), 457–469.

Hitting Probabilities of Single Points for Processes with Stationary Independent Increments, Memoir no. 93, Amer. Math. Soc. (1969).

Percolation Theory for Mathematicians, Birkhäuser, Boston, 1982.

Aspects of First-Passage Percolation; in Ecole d'été de Probabilités de Saint-Flour XIV, (P. L. Hennequin, ed.), Lecture Notes in Math **1180**, Springer-Verlag, 1986, pp. 125–264.

On the Speed of Convergence in First-Passage Percolation, Ann. Appl. Probab. **3** (1993), 296–338.

Dexter Kozen

Professor of Computer Science
Joseph Newton Pew, Jr., Professor in Engineering
http://www.cs.cornell.edu/kozen/

My research interests include the theory of computational complexity, especially complexity of decision problems in logic and algebra, program logic and semantics, and computational algebra. Recent work includes: new polynomial-time algorithms for type inference in type systems with subtypes and recursive types; algorithms solving systems of set constraints as used in program analysis; a unification algorithm for set constraints and a new constraint logic programming language based on set constraints; development of the theory of rational spaces and their relationship to set constraints; an algorithm for decomposition of algebraic functions; a new polynomial-time algorithm for resolution of singularities of plane curves; efficient algorithms for optimal transmission of encoded video data; optimality results for digital interleavers; and complexity and completeness results for Kleene algebras with tests. Recently I have begun to investigate the application of Kleene algebra and the modal mu-calculus to problems in software security.

Professional Activities: Program committee of IEEE Symp. Foundations of Computer Science (FOCS, 1996) and Fixpoints in Computer Science (Sept. 1998). Supervisory board of the Centre for Basic Research in Computer Science (BRICS), Aarhus University. Organizing committee of IEEE Symp. Logic in Computer Science (LICS). Organizing committee of Dagstuhl Seminar on Tree Automata (Oct. 1997).

Administrative Activities: College of Engineering Undergraduate Admissions Committee. University Arbitration Panel. Faculty advisor for Cornell Men's Rugby Football Club and Johnson Graduate School of Management Rugby Football Club.

Selected Publications:

Efficient Code Certification, ncstrl.cornell/TR98-1661, Cornell University, Computer Science (1998).

Typed Kleene Algebra, ncstrl.cornell/TR98-1669, Cornell University, Computer Science (1998).

On Hoare Logic and Kleene Algebra with Tests, TR98-1723/ncstrl.cornell, Cornell University, Computer Science (1998).

Parikh's Theorem in Commutative Kleene Algebra (with Mark Hopkins), ncstrl.cornell/TR99-1724, Cornell University, Computer Science (1999).

G. Roger Livesay

Professor Emeritus of Mathematics

My major area of research is in Topology, 3-dimensional manifolds with finite cyclic fundamental groups.

Michael Morley

Professor of Mathematics

Professor Morley's primary interest and contribution to the department lies in his devotion to the students. His skill, wisdom, commitment and sensitivity in advising is very well-known throughout the Arts College. Comments about Michael Morley speak to his devotion: "[Mike Morley] is exactly the sort of advisor that Cornell needs..."; "...has a creative and total commitment to taking care of students..."; "...has been available to everyone's advisees who wander in unhappy." These comments speak eloquently of Prof. Michael D. Morley.

Professor Morley's primary research interests lie in the areas of advanced mathematical logic and model theory.

Awards and Honors: Robert A. and Donna B. Paul Award for Excellence in Advising (1996).

Professional Activities: President of the Association for Symbolic Logic (1986–89).

Administrative Activities: Department advising committee (1995–). Associate Chair and Director of Undergraduate Studies (1984–95).

Anil Nerode

Goldwin Smith Professor of Mathematics

I have contributed to automata theory, recursive function theory, recursive algebra, complexity-theoretic algebra, and lately to the theory of concurrent programming, non-monotonic logics, implementing logics by linear programming, and hybrid systems in engineering and science. Hybrid Systems are networks of discrete and continuous devices and can be analyzed by a combination of logical and functional analytic methods. I and my co-worker W. Kohn have concentrated on algorithms for extracting digital control programs forcing continuous systems to satisfy their design requirements. I have been a principal speaker and organizer of many national and international conferences in these fields. I directed NSF grants for thirty years. I was Chair of the Mathematics Department at Cornell for five years. I am involved in extensive university-industrial-military cooperations with Berkeley & Stanford and Maryland and the U.S. Army. I do applied consulting work in many areas.

Professional Activities: Former Vice President of the AMS. Member of the MAA, ACM and IEEE. Former Director of the Mathematical Sciences Institute; Director of the Center for Foundations of Intelligent Systems, a DOD Multiple University Research Institute (MURI) program. Editorial boards of Annals of Mathematics and Artificial Intelligence, Computer Modeling and Simulation, Constraints, and Annals of Pure and Applied Algebra.

Administrative Activities: Member of the graduate fields of Mathematics, Applied Math., Computer Science, Science and Tech. Studies, and Cognitive Studies.

Selected Publications:

Continualization: A Hybrid Systems Control Technique for Computing (with W. Kohn and J. B. Remmel), CESA (1996).

Multiple Agent Hybrid Control for Manufacturing Systems (with W. Kohn, J. B. Remmel and J. James), IFAC (1996).

Feedback Derivations: Near Optimal Controls for Hybrid Systems (with W. Kohn and J. B. Remmel), CESA (1996)

Hybrid Systems: Chattering approximations to relaxed controls (with X. Ge, W. Kohn and J. B. Remmel); in Hybrid Systems III (Alur, Henzinger, Sontag, eds.), LNCS 999, Springer-Verlag, 1996.

Hybrid Knowledge Bases (with J. J. Lu and V. S. Subraahmanian); in IEEE Trans. Knowledge and Data Engineering, 1996, pp. 773–785.

Complexity of Predicate Logic Abduction (with V. Marek and J. B. Remmel); in Proceedings of the Eleventh Annual IEEE Symposium on Logic in Computer Science (LICS '96), 1996.

Logic for Applications (with R. Shore), second edition, Springer-Verlag Computer Science Series, 1997.

Distributed Hybrid Models for Traffic Control (with W. Kohn and J. B. Remmel); in Hybrid Systems IV, LNCS, Springer-Verlag, 1997.

Intuitionistic Logic and Hybrid Systems (with S. Artemov and J. Davoren); in Logical Foundations of Computer Science: 4th Int'l Symp., Proc., LNCS, Springer-Verlag, 1997.

Scalable Data and Sensor Fusion via Multiple Agent Hybrid Systems (with W. Kohn and J. B. Remmel), IEEE Trans., special issue on Hybrid Systems (1997), to appear.

Automata Theory and Computer Science (with B. Khoussainov), in preparation.

Constructive Logics and Lambda Calculi (with G. Odifreddi), in preparation.

Lawrence Payne

Professor Emeritus of Mathematics

My research interests lie in several areas of partial differential equations: Isoperimetric Inequalities, Ill-Posed and Non-Standard Problems, Growth Decay and/or Blowup of Solutions, and applications to various problems in Solid and Fluid Mechanics. My most recent interests have been in the study of Overdetermined Systems and Saint Venant type problems for nonlinear equations.

Awards and Honors: Steele Prize in mathematics (1972). Honorary D.Sc. from the National University of Ireland (1990). Honorary Fellow of the Royal Society of Edinburgh (1991). Citation of Merit, Iowa State University (1992).

Professional Activities: Editorial board member of Math. Methods in Appl. Sci., Glasgow Mathematical

Journal and Journal of Elasticity. Advisor for Pitman Monographs.

Selected Publications:

Asymptotic Behavior for Two Regularizations of the Cauchy Problem for the Backward Heat Equation (with K. A. Ames), Math. Methods and Models in Appl. Sci. **8** (1998), 187–202.

Growth and Decay Results in Heat Conduction Problems with Nonlinear Boundary Conditions (with P. W. Schaefer and J. C. Song), Nonlinear Analysis **35** (1998), 269–286.

Analysis of the Boundary Condition at the Interface Between a Viscous Fluid and a Porous Medium and Related Modeling Questions (with B. Straughan), J. Math. Pure Appl. **77** (1998), 317–354.

Structural Stability for the Darcy Equations of Flow in Porous Media (with B. Straughan), Proc. Roy. Soc. London A **454** (1998), 1691–1698.

Convergence and Continuous Dependence for the Brinkman-Forchheimer Equations (with B. Straughan), Studies in Applied Math. **102** (1999), 419–439.

Irena Peeva

Assistant Professor of Mathematics

My work is in commutative algebra. I am especially interested in problems which are at the interface between commutative algebra, algebraic geometry, combinatorics and non-commutative algebra.

Awards and Honors: Alfred P. Sloan Doctoral Dissertation Fellowship (1994–1995). Alfred P. Sloan Research Fellowship (1999–2001)

Professional Activities: (Co)organizer of the following conferences: Workshop on Regularity of Toric Varieties at the University of California at Berkeley (1996); The Sixth Route 81 Conference on Algebraic Geometry and Commutative Algebra at SUNY at Albany (1996); Special Session in Commutative Algebra at the AMS Meeting in Montreal (1997); Special Session in Commutative Algebra at the AMS Meeting in Chicago (1998).

Selected Publications:

Complete Intersection Dimension (with L. Avramov and V. Gasharov), Publications Mathématiques IHES **86** (1997).

Generic Lattice Ideals (with B. Sturmfels), JAMS **11** (1998), 363–373.

Rationality for Generic Toric Rings (with V. Gasharov and V. Welker), Mathematische Zeitschrift, to appear.

Monomial Resolutions (with D. Bayer and B. Sturmfels), Mathematical Research Letters **5** (1998), 31–46.

Cohomology of Real Diagonal Subspace Arrangements Via Resolutions (with V. Reiner and V. Welker), Compositio Mathematica **117** (1999), 107–123.

How to Shell a Monoid (with V. Reiner and B. Sturmfels), Mathematische Annalen **310** (1998).

Hyperplane Arrangements and Linear Strands in Resolutions, Trans. AMS, to appear.

Syzygies of Codimension 2 Lattice Ideals (with B. Sturmfels), Mathematische Zeitschrift **229** (1998).

Richard A. Platek

Associate Professor of Mathematics

Professor Platek founded Odyssey Research Associates (ORA), Inc., an Ithaca based private research and development organization, in 1982 and currently serves as CEO. ORA is primarily concerned with applying the techniques of mathematical logic to software development in order to increase assurance that resulting systems are correct. These techniques include: the development of formal specification languages; the development of formal semantics for requirements, specifications, and implementations of languages; the development of sound logics for these semantics; and the implementation of these concepts in software tools and verification environments. ORA is particularly concerned with hardware/software system safety and security. ORA's personnel is largely drawn from the academic community with a strong logic contingent. ORA tools are based on a variety of ideas in the forefront of applied logic.

Professor Platek is the senior technical advisor on all projects at ORA. As such he frequently presents the results and current status of projects at numerous meetings, symposiums, etc. Most recently, he is an invited speaker at the 12th International Conference on Automated Deduction, CADE-12, in the summer of 1994.

Professor Platek and ORA are recognized in technology policy making circles as leading advocates for increased rigor in software engineering with mathematical logic playing the primary role as the underlying scientific discipline.

Richard H. Rand

Professor of Theoretical and Applied Mechanics

Current research work involves the application of perturbation methods and computer algebra to problems in nonlinear dynamics. In particular, we are using the computer algebra system MACSYMA to perform the lengthy algebraic manipulations associated with a variety of approximate methods for treating systems of nonlinear differential equations, such as the method of normal forms and center manifolds, Lie transforms, and averaging.

We have applied this approach to such problems as the dynamics of resonant capture, coupled limit-cycle oscillators, the parametric stability of a rotating rigid body, parametric stiffness control of flexible structures, the behavior of van der Pol's equation at infinity, the determinancy of degenerate equilibria, the nonlinear stability of L_4 in the three-body problem, and Hilbert's 16th problem.

These mathematical studies have been applied to a number of biomathematical problems in collaborative work with biologists. These problems have included the fluid dynamics of green plants, the neurobiology of swimming in fish, the dynamics of retinal chemistry in the human eye, and the mechanics of the cornea.

Awards and Honors: Amer. Soc. Agricultural Eng. Best Paper Award (1982). Dean's Prize for Innovation in Undergraduate Teaching, Cornell University (1986). Dean's Prize for Excellence and Innovation in Teaching, Cornell University (1993). Dean's Prize for Excellence in Teaching, Cornell University (1995). Elected a Fellow of the American Society of Mechanical Engineers (1995).

Professional Activities: Member of Soc. Industrial and Applied Math (SIAM). Editorial Board of the *Journal of Vibration and Control* (1995–present).

Selected Publications:

Computer Algebra in Applied Mathematics: An Introduction to MACSYMA, Research Notes in Mathematics, no. 94., Pitman, Boston, 1984, 181 pp.

Perturbation Methods, Bifurcation Theory, and Computer Algebra (with D. Armbruster), Applied Mathematical Sciences, no. 65, Springer-Verlag, New York, 1987, 243 pp.

Topics in Nonlinear Dynamics With Computer Algebra, Computation in Education, vol. 1, Gordon and Breach Science Publishers, Langhorne, PA, 1994, 229 pp.

Dynamics of a Nonlinear Parametrically-Excited Partial Differential Equation (with W. I. Newman and A. L. Newman), Chaos **9** (1999), 242–253.

Resonant Capture and Separatrix Crossing in Dual-Spin Spacecraft (with R. Haberman and T. Yuster), Nonlinear Dynamics **18** (1999), 159–184.

Transition Curves in the Quasiperiodic Mathieu Equation (with R. S. Zounes), SIAM J. Appl. Math. **58** (1998), 1094–1115.

Modeling the Pumping of a Swing (with S. Wirkus and A. Ruina), The College Mathematics Journal **29** (1998), 266–275.

Relaxation Oscillations in Tidally Evolving Satellites (with D. Quinn, B. Gladman and P. Nicholson), Celestial Mechanics and Dynamical Astronomy **67** (1997), 111–130.

A Mathematical Model of a Placido Disk Keratometer and its Implications for Recovery of Corneal Topography (with R. A. Applegate and H. C. Howland), Optometry and Vision Science **74** (1997), 926–930.

Nonlinear Modal Analysis of a Cracked Beam (with M. Chati and S. Mukherjee), J. Sound and Vibration **207** (1997), 249–270.

Fluid Mechanics in Plant Biology (with J. R. Cooke); in Handbook of Fluid Dynamics and Fluid Machinery, vol. III: Application of Fluid Dynamics, (J. A. Schetz, A. E. Fuhs, eds.), John Wiley & Sons (1996), pp.1921–1938.

James Renegar

Professor of Operations Research and Industrial Engineering

My research relates to the computational complexity of problems arising in numerical analysis and mathematical programming. I have been especially interested in linear programming, solution procedures for systems of polynomial equations, and decision methods for the first order theory of the reals. Recently, I have been attempting to tie the theory of linear programming more closely to functional analysis and numerical analysis. For example, I have introduced quantities akin to condition numbers into the analysis of contemporary linear programming algorithms (i.e., interior-point methods).

Professional Activities: Associate editor of the SIAM Journal on Optimization and the Journal of Complexity.

Administrative Activities: Director of Graduate Studies for the field of Operations Research.

Selected Publications:

A Polynomial Time Algorithm, Based on Newton's Method for Linear Programming, Mathematical Programming **40** (1988), 59–93.

On the Computational Complexity and Geometry of the First-Order Theory of the Reals, Journal of Symbolic Computation **13** (1992), 255–352.

Linear Programming, Complexity Theory and Elementary Functional Analysis, Mathematical Programming **70** (1995), 279–351.

Thomas Rishel

Senior Lecturer of Mathematics

My research area is topology. I have written on generalizations of metric spaces and on conditions for topological spaces to preserve products.

As Director of Undergraduate Teaching, I am interested in curriculum and course design. These interests led to the organization of the Occasional Seminar on Undergraduate Education, as well as the design of four new courses in teaching, algebra and geometry which make substantial use of writing assignments. I have given numerous talks and written some papers on these courses.

My other responsibilities include: supervising and training teaching assistants, scheduling, budgeting and evaluation. I perform a similar service for part-time and visiting faculty. These activities have led to my being on a number of national and regional committees on graduate education, teaching and employment.

Awards and Honors: Professors for the Future Award, Pew Foundation (1994–98). MAA Seaway Section Distinguished Teaching Award (1995). Clark Teaching Award, Cornell University (1981).

Professional Activities: Reviewer for Math Reviews. Referee for the Proceedings of the AMS and PRIMUS. Member of the AMS and MAA. Chair of the MAA Task Force on Graduate Study. FIPSE grant for Future Professors' Program (1995–). Chair of the AMS-MAA Committee on Employment. External evaluator, SUNY at Oswego (1998). Chair of the AMS-MAA Professors for the Future Committee (1998–2001).

Administrative Activities: Executive committee of ALCU (1993–). Curriculum Committee. Organizer of the Occasional Seminar on Undergraduate Education (1991–). Johnson Museum Committee on Education. Cornell Arts College Bylaws Committee.

Invited Lectures and Workshops:

A freshman-level geometry curriculum, UFE Workshop, Cornell University (May 1998).

Professors for the future programs in mathematics, NSF Graduate Initiatives Conference, Washington (June 1998).

Teaching initiatives for graduate students, Canadian Math Congress, Kingston, Ontario (Dec. 1998).

Writing in the teaching and learning of mathematics (6 hour minicourse), AMS-MAA Joint Meetings, San Antonio (Jan. 1999).

Using writing in teaching mathematics, MAA Oklahoma Section Meeting (Mar. 1999).

Advice from a teaching award winner, MAA Seaway Section Meeting (Apr. 1999).

Finding voice amid the rigor of mathematics, Fourth National Writing Across the Curriculum Conference, Cornell University (June 1999).

Teaching workshop for graduate students and new faculty (4 hour workshop), MAA Mathfest, Providence (July 1999).

Selected Publications:

Products in Countably Compact and M-Spaces, Y. Kodama Festschrift (1991).

Geometry as Metaphor: Writing in the Math Classroom; in Teaching Critical Thinking (Clark and Biddle, eds.), Prentice-Hall, 1993, pp. 124–136.

Support Systems in Beginning Calculus (with M. Lewin), PRIMUS (1995), 275–285.

Writing in the Teaching and Learning of Mathematics (with J. Meier), MAA Math Notes **48** (1998).

The Academic Job Search in Mathematics, AMS Publications (1998).

Oscar Rothaus

Professor of Mathematics

My principal mathematical interest in the last 10 years or so has been logarithmic Sobolev inequalities and Spectral Geometry. I was drawn to log-Sobolev inequalities because of their connection with ground state for Schrödinger and other operators.

During my most recent sabbatic in London, I worked with Professor E. B. Davies on the problem of estimating ground state for Bochner Laplacian on Euclidean vector bundles. We hoped to generalize to this setting the mechanism of Bochner-Lichnerowicz-Weitzenbock

inequalities, and their use by Li and Yau particularly. To a degree we succeeded; our results are contained in two papers published recently in the Journal of Functional Analysis.

Most recently, I am returning to combinatorial problems in coding theory and to new questions in logarithmic Sobolev inequalities.

Professional Activities: Member of the Corporate Relations Committee and the Reprinted Books Committee of the AMS. Consultant for the Inst. Def. Analysis and the MITRE Corporation. Consultant to SAIC.

Invited Lectures: Paris, I.H.P (May 1998). *Log-Sobolev Inequalities* conference, Paris (May–June 1998)

Selected Publications:

Analytic Inversion of SAR Signal, Proc. Natl. Acad. Sci. USA **91** (1994), 7032–7035.

Semi-Groups of Finite Matrices, Semi-Group Forum **49** (1994), 59–65.

Inequalities Derived from Log-Sobolev, PAMS (1996).

Growth of LP Norms, PAMS (1997).

Sharp Log-Sobolev Inequalities, PAMS (1997).

Herbst Inequalities (with L. Gross), Kyoto Math J. (1998).

Laurent Saloff-Coste

Professor of Mathematics

I am an analyst who enjoys touching on other areas including probability theory and geometric group theory. I study different aspects of heat diffusion on manifolds from the point of view of both partial differential equations and stochastic processes. I am mainly interested in those properties that relate to the large scale geometry of the underlying space. For instance, I have recently been trying to understand how heat diffusion is affected by the existence of more than one end on a manifold. Potential theory and functional analysis often provide the framework and tools to study these properties.

I also work on random walks on groups. A random walk is a Markov process (g_n) on a group G where g_n is obtained from g_{n-1} by left multiplication by a random element of a fixed finite generating set of G. For instance, card shuffling methods can be modelized as random walks on the symmetric group S_{52}. In this example, G is finite but G can be infinite. What interests me most in this subject is relating the behavior of random walks to the algebraic structure of the group and to the geometry of its Cayley graphs.

Random walks on finite groups are special examples of finite Markov chains. In the past 10 years, I have worked on quantitative estimates for ergodic finite Markov chains. Some of the most interesting examples of such chains are connected to combinatorial problems that are not tractable by deterministic algorithms but for which a reasonable stochastic algorithm exists. These stochastic algorithms often involve a finite Markov chain as one of the main building blocks. In this context, obtaining quantitative estimates is essential.

Awards and Honors: Rollo Davidson Award (1994).

Professional Activities: Associate editor for Annals of Probability (1994–) and for Annales de la Faculté des Sciences de Toulouse (1996–).

Invited Lectures:

Examples of random walks on finite groups, Math. Phys. Colloquium, Milan, Italy (1995).

Comparisons of finite Markov chains, Helvetic Probability Seminar, Berne, Switzerland (1996).

Parabolic Harnack inequality and geometry, Technion Math. Colloquium, Haifa, Israel (1997).

Ultracontractivity and off-diagonal estimates in infinite dimension, Stochastic Analysis conf., Paris (1998).

Selected Publications:

A Note on Poincaré, Sobolev, and Harnack Inequalities, Duke J. Math. **65** IMRN 2 (1992), 27–38.

Analysis and Geometry on Groups (with T. Coulhon and N. Varopoulos), Cambridge Tracts in Mathematics 100, Cambridge University Press, 1993.

Gaussian Estimates for Markov Chains and Random Walks on Groups (with W. Hebisch), Ann. Prob. **21** (1993), 673–709.

Comparison Techniques for Random Walk on Finite Groups (with P. Diaconis), Ann. Prob. **21** (1993), 2131–2156.

Sobolev Inequalities in Disguise (with D. Bakry, T. Coulhon and M. Ledoux), Indiana Univ. Math. J. **44** (1995), 1033–1074.

Elliptic Diffusions on Infinite Products (with A. Bendikov), J. Reine Angew. Math. **493** (1997), 171–220.

Lectures on Finite Markov Chains, Ecole d'été de probabilités de Saint Flour 1996, Lect. Notes Math. 1665, Springer, 1997, 301–413.

Walks on Generating Sets of Groups (with P. Diaconis), Invent. Math. **134** (1998), 251–299.

Amenable Groups, Isoperimetric Profiles and Random Walks (with C. Pittet); in Geometric Group Theory Down Under (J. Cossey et. al., eds.), W. de Gruyter, 1999, 293–316.

Alfred H. Schatz

Professor of Mathematics

My field of research is numerical analysis. I have been principally involved in the analysis and construction of finite element methods for the approximate solution of partial differential equations. In particular I have been investigating both the local behavior of such matters and another phenomena associated with them called superconvergence. Many physical problems have solutions that are smooth in some places and are nonsmooth (having singularities) in others. In the numerical solution of these problems, the singular part of the solution is not only difficult to approximate but often lowers the quality of (pollutes) the approximation even where the solution is nice. I have been involved in understanding this phenomena and finding a way to improve the approximations.

Another facet of the research is to find properties of the computed approximate solutions which, when taken into account, can be used to produce better approximations than one has before. These are so called superconvergent approximations and their importance resides in the fact that the original approximations are usually difficult to obtain but usually the new approximates may be orders of magnitude better and easily computed from them.

Selected Publications:

Superconvergence in Finite Element Methods & Meshes Which are Locally Symmetric with Respect to a Point (with I. Sloan and L. Wahlbin), SIAM Journal of Numerical Analysis, to appear.

Interior Maximum Norm Estimates for Ritz Galerkin Methods Part II (with L. Wahlbin), Mathematics of Computation, to appear.

Some New Error Estimates for Ritz Galerkin Methods with Minimal Regularity Assumptions (with J. Wang), Mathematics of Computation, submitted.

Shankar Sen

Professor of Mathematics

Most of my research concerns invariants associated with representations of Galois groups of p-adic fields and algebraic number fields. These invariants, though of an arithmetic nature, are related to classical invariants arising in complex algebraic geometry; their study should shed light on geometric aspects of equations over number fields or p-adic fields. Recently, I have studied families of Galois representations depending analytically on p-adic parameters, and how the invariants for such families change with the parameters. Techniques from p-adic analytic function theory and functional analysis have proved useful in this connection.

Invited Lectures: Nottingham conference on Number Theory (1996). Cambridge University, England (1996). Conference on Arithmetic, Algebra, Geometry; Braga, Portugal (1997). Durham conference on Group Theory and Number Theory (3 lectures, 1997).

Selected Publications:

Lie Algebras of Galois Groups Arising from Hodge-Tate Modules, Annals of Math. (1973).

On Explicit Reciprocity Laws, J. Reine Angew Math. (1980 & 1981).

Continuous Cohomology and p-adic Galois Representations, Inventiones Math. (1980).

Integral Representations Associated with p-adic Field Extensions, Inventiones Math. (1988).

The Analytic Variation of p-adic Hodge Structure, Annals of Math. (1988).

An Infinite-Dimensional Hodge-Tate Theory, Bulletin Math. Soc. France (1992).

Galois Cohomology and Galois Representations, Inventiones Math. (1993).

Richard A. Shore

Professor of Mathematics

My major research interests have centered around analyzing the structures of relative complexity of computation of functions on the natural numbers. The primary measure of such complexity is given by Turing reducibility: f is easier to compute than g, $f \leq_T g$, if there is a (Turing) machine which can compute f if it is given access to the values of g. I have also worked with various other interesting measures of such complexity that are defined by restricting the resources available primarily in terms of access to g. The general thrust of my work has been to show that these structures are as complicated as possible both algebraically and logically (in terms of

the complexity of the decision problems for their theories). These results also allow one to differentiate among different notions of relative complexity in terms of the orderings they define. Another major theme in my work has been the relationship between these notions of computational complexity and ones based on the difficulty of defining functions in arithmetic. Restricting the computational resources more directly in terms of time or space leads out of recursion theory and into complexity theory. Relaxing the restrictions by allowing various infinitary procedures leads instead into generalized recursion theory or set theory. The methods developed in these investigations are also useful in determining the effective content of standard mathematical theorems (when can existence proofs be made effective) and the inherent difficulty of combinatorial theorems in proof theoretic terms. Recently, I have also been working on issues in effective model theory and algebra connected with the problem of how the computational properties of algebraic structures can vary with different (but always computable) presentations of the models.

Professional Activities: Member of the AMS, ASL, ACM and SIGACT. Referee and reviewer for the NSF, the Natural Sciences and Engineering Research Council of Canada, the US-Israeli Bi-National Science Foundation, the New Zealand Mathematical Society Research Awards and many journals.

Editor of the Journal of Symbolic Logic (1984–93). Nominating committee and publications committee of the Association of Symbolic Logic (1993–94). Managing editor for the Bull. Symbolic Logic (1993–). Council member of the Assn. Symbolic Logic (1984–). Editor of Studies in Logic and the Foundations of Mathematics, North-Holland (1996–).

Selected Publications:

α-Recursion Theory; in Handbook of Mathematical Logic (J. Barwise, ed.), North-Holland, 1977, pp. 653–680.

The Homogeneity Conjecture, Proceedings of the National Academy of Sciences **76** (1979), 4218–4219.

Definable Degrees and Automorphisms of $\mathcal{D}$ (with L. Harrington), Bull. Amer. Math. Soc. (NS) **4** (1981), 97–100.

The Degrees of Unsolvability: The Ordering of Functions by Relative Computability; in Proc. Inter. Congress of Mathematicians (Warsaw) (1983) PWN-Polish Scientific Publishers, Warsaw 1984, Vol. 1: 337–346.

The Structure of the Degrees of Unsolvability; in Recursion Theory (A. Nerode and R. A. Shore, eds.), Proceedings of The Symposia in Pure Mathematics **42**, AMS, Providence, R. I. (1985), 33–51.

Recursive Limits on the Hahn-Banach Theorem (with A. Nerode and G. Metakides), Contemporary Mathematics **39** (1985), 85–91.

On the Strength of König's Theorem for Infinite Bipartite Graphs (with R. Aharoni and M. Magidor), J. Comb. Theory (B) **54**, (1992), 257–290.

The p-T-degrees of the Recursive Sets: Lattice Embeddings, Extension of Embeddings and the Two Quantifier Theory (with T. Slaman), Theoretical Computer Science **92** (1992), 263–284.

Logic for Applications (with A. Nerode), Texts and Monographs in Computer Science, Springer-Verlag, New York, 1993; second edition, Graduate Texts in Computer Science, Springer-Verlag, New York, 1997.

Definability in the Recursively Enumerable Degrees (with A. Nies and T. Slaman), Bull. Symb. Logic **2** (1996), 392–404.

Computable Isomorphisms, Degree Spectra of Relations and Scott Families (with B. Khoussainov), Ann. Pure and Applied Logic **93** (1998), 153–193.

Reyer Sjamaar

Assistant Professor of Mathematics

My research area is symplectic geometry. In most of my work I apply methods developed in singularity theory, invariant theory and representation theory to the study of Lie group actions on symplectic manifolds.

Awards and Honors: Sloan Fellow (1996).

Selected Publications:

Holomorphic Slices, Symplectic Reduction and Multiplicities of Representations, Ann. Math. (2) **141** (1995), 87–129.

Symplectic Reduction and Riemann-Roch Formulas for Multiplicities, Bull. Amer. Math. Soc. (new series) **33** (1996), 327–338.

Convexity Properties of the Moment Map Re-examined, Adv. Math. **138** (1998), 46–91.

Singular Reduction and Quantization (with E. Meinrenken), Topology **38** (1998), 699–762.

Projections of Coadjoint Orbits, Moment Polytopes and the Hilbert-Mumford Criterion (with A. Berenstein), preprint.

John Smillie

Professor of Mathematics

My area of interest is dynamical systems. I have done work on polygonal billiards and dynamics of flows on Teichmüller space; analysis of algorithms; and diffeomorphisms of surfaces. I am currently working on complex dynamics in two dimensions.

Selected Publications:

Flat Manifolds with Non-zero Euler Characteristic, Comm. Math. Helv. **52** (1977), 453–455.

Periodic Points of Surface Homeomorphisms with Zero Entropy, Ergodic Theory and Dynamical Systems **3** (1983), 315–334.

Ergodicity of Billiard Flows and Quadratic Differentials (with S. Kerckhoff and H. Masur), Annals of Mathematics **124** (1986), 293–311.

The Euler Characteristic of the Group of Outer Automorphisms of a Free Group (with K. Vogtmann), Journal of Pure and Applied Algebra **44** (1987), 329–348.

Rayleigh Quotient Iteration for Non Symmetric Matrices (with S. Batterson), Mathematics of Computation **55** no. 191 (1990), 169–178.

Polynomial Diffeomorphisms of $\mathbf{C}^2$*: Currents, Equilibrium Measures and Hyperbolicity* (with E. Bedford), Inventiones Math. **103** (1991), 69–99.

Complex Dynamics in Several Variables (with G. Buzzard); in Flavors of Geometry, Mathematical Sciences Research Institute Publication 31 (S. Levy, ed.), Cambridge University Press, 1997.

Polynomial Diffeomorphisms of $\mathbf{C}^2$ *VI: Connectivity of J* (with E. Bedford), Annals of Mathematics, to appear.

Avery Solomon

Senior Lecturer of Mathematics

My position involves me in mathematics, math education, and outreach programs in several area schools. I teach courses in mathematics at Cornell and teach a variety of sections of the special course Math 508 — Mathematics for Secondary Teachers — both at Cornell and at local sites within a 50 mile radius of Ithaca. My position in the Teacher Education in Science, Mathematics and Agri-science program in the Department of Education has involved me in supervising student teachers and co-teaching the math/science methods course Education 602.

In addition to these courses, I am the director of the Cornell/Schools Mathematics Resource Program (CSMRP). Through this program I organize and co-teach Saturday workshops and summer programs, consult with school districts, work with teachers directly to develop curriculum and programs, visit classrooms and occasionally teach classes in middle schools or high schools, teach workshops in schools and at BOCES.

For the past eight years the CSMRP has held teacher workshops meeting four Saturdays a year. These workshops focus on both content and pedagogy, giving teachers a chance to immerse themselves for a time in mathematical problems, share ideas, and get inspiration for their classes. We often examine basic mathematics concepts from a more mature standpoint, and also present interesting and relevant topics to get teachers interested in their own mathematical explorations, as well as presenting new curricula and introducing software environments as teaching tools. We now have a core group of about 25 teachers, and a larger group of about 50 others who are part of our e-mail list and occasionally attend.

Our week long summer institute for mathematics teachers, given for the past eleven years, has recently focused on teaching geometry, especially exploring geometry on spheres and other surfaces, and Geometer's Sketchpad software.

Our program in the classrooms focuses on a few exemplary teachers, supporting their efforts to develop modules and activities in the classroom, and share these with other teachers through visits, workshops, and actual classroom intervention. One of our middle school teachers taught a model two-week unit at two different middle schools while the 7th and 8th grade teachers watched, and then they taught the lessons to their other sections. Math lab activities and structure developed with high school teachers is being used in classrooms in several districts.

My current interests include developing exploratory units for high school mathematics, the use of Sketchpad as an environment for learning geometry, and integrating mathematics and philosophy in a humanist context. A long range plan is to produce materials for a manual for 6-12 mathematics teachers which would provide essential insights into selected topics, interrelations and meanings. This text would also serve pre-service teachers of mathematics, helping them to look back at their own pre-college experiences from a more mature standpoint. I am interested in studying the role of intuition in mathematical exploration, and in continuing to pursue the relation of philosophy and mathematics as a route to self-knowledge.

Grants: Twelve DDE Title IIA grants awarded by the New York State Department of Education to support in-service programs for teachers, 1986–present. Participant in UFE grant through NSF for enhancement of college teaching, with David Henderson, 1995–present.

Articles/Videos:

A manual of mathematics labs to accompany Course I mathematics (with Amy Davis of Moravia High School), self published.

Puppies Pen, a video of a pilot intervention program for Middle School Mathematics.

Levels of Knowledge submitted for publication in Parabola, 1997.

A Constructivist Dilema: an Episode from Middle School Mathematics.

Geometric Patterns in Nature, being prepared for publication.

Proportions and Levels of Meaning in Mathematics; in For the Learning of Mathematics, 1991.

What is a Line?; in For the Learning of Mathematics, 1991.

A Fractal Outline of a Fractal Course, AMTYS journal, 1989.

Birgit Speh

Professor of Mathematics

I am interested in representation theory of semisimple Lie groups as well as in arithmetic groups and analytic number theory. In the last few years most of my work concerned around the cohomology of arithmetic groups, in particular Lefschetz numbers of automorphisms of finite order and the application to problems in automorphic forms and number theory.

Awards and Honors: Humboldt Prize (1995). Sloan Fellowship (1983).

Professional Activities: Reviewer for the NSF. Editor of the New York Journal of Mathematics and the Journal of Representation Theory.

Selected Publications:

Unitary Representations of $GL(n, R)$ with Non-trivial (g, K)-Cohomology, Inv. Math. **71** (1983), 443–465.

A Cohomological Method for the Determination of Limit Multiplicities of Representations with Cohomology in the Cuspidal Spectrum (with J. Rohlfs), Duke Mathematical Journal **55** (1987), 199–211.

Representations with Cohomology in the Discrete Spectrum of Subgroups of $SO(n, 1)(Z)$ and Lefschetz Numbers (with J. Rohlfs), Annales Scientifiques d'Ecole Normale Sup. (1987), 89–136.

Automorphic Representations and Lefschetz Numbers (with J. Rohlfs), Annales Scientifiques d'Ecole Normale Sup. (1989).

Lefschetz Numbers and Twisted Stabilized Orbital Integrals (with J. Rohlfs), Math. Annalen **296** (1993).

Seiberg Witten Equations on Locally Symmetric Space (1998).

Michael Stillman

Professor of Mathematics

My main areas of interest are computational algebra and algebraic geometry, commutative algebra, and algebraic geometry. My original interest in computational methods was their application to problems in algebraic geometry. Since then, my work has proceeded in several related directions. I have studied the complexity of the algorithms (mainly Gröbner bases). I have been developing algorithms for computing in commutative algebra and algebraic geometry. For example, I have developed algorithms for manipulating line bundles in algebraic geometry (with M. Brundu), computing Hilbert functions (with D. Bayer), and finding integral closures of polynomial rings.

My original interest in these methods was to actually use them in my research in algebraic geometry. D. Bayer (of Columbia) and I have designed and implemented a specialized computer algebra system, which we call "Macaulay", which includes many of these algorithms. Hundreds of researchers use this system. The latest version includes algorithms for a large number of useful operations in algebraic geometry (written with D. Eisenbud).

Selected Publications:

A Criterion for Detecting m-regularity (with D. Bayer), Invent. Math. **87** (1987), 1–11.

A Theorem on Refining Division Orders by the Reverse Lexicographic Order (with D. Bayer), Duke Math. J. **55** (1987), 321–328.

Determinantal Equations for Algebraic Curves of High Degree (with D. Eisenbud and J. Koh), Amer. J. Math. **110** (1988), 135–147.

On the Complexity of Computing Syzygies (with D. Bayer), J. Symbolic Comp. **6** (1988), 135–147.

Computing the Equations of a Variety (with M. Brundu), Trans. AMS (1991), to appear.

Some Matrices Related to Green's Conjecture (with D. Bayer), Sundance Conference Proceedings on Free Resolutions (1991), to appear.

Robert S. Strichartz

Professor of Mathematics

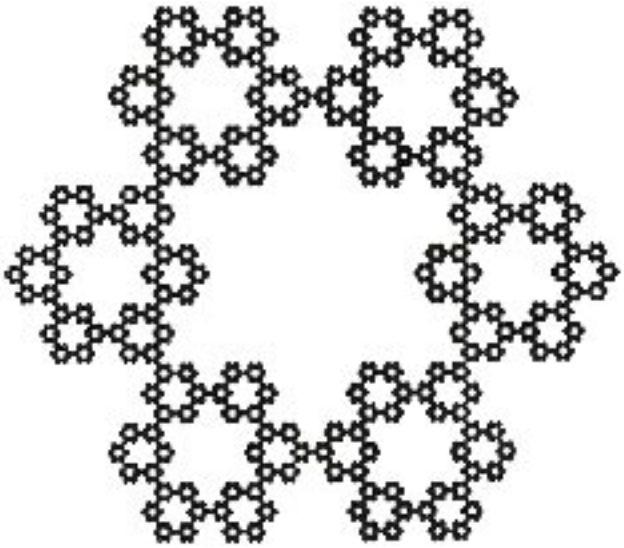
Mathematics is an adventure. As a research mathematician, I have wandered along many paths, always enjoying the discoveries that have come my way and never knowing exactly where I might be heading next. I have certainly not been following a geodesic! Perhaps its has been just a random walk. Yet sometimes I think there has been some purpose behind it, to bring me to the work I am doing today. So here is a synopsis of where I have been and what it might add up to.

In my thesis I studied Sobolev spaces, an important class of function spaces useful in the theory of partial differential equations, and gave an important characterization of Sobolev spaces with smoothness coefficient not equal to an integer. (*Multipliers on Fractional Sobolev Spaces*, J. of Math Mech. **16** (1967), 1031–1060)

In my early work I studied applications of harmonic analysis to wave equations (*Convolutions with Kernels Having Singularities on Spheres*, Trans. Amer. Math. Soc. **148** (1970), 461–478; *A Priori Estimates for the Wave Equation and Some Applications*, J. Func. Anal. **5** (1970) 218–235; and *Restrictions of Fourier Transforms to Quadratic Surfaces and Decay of Solutions of Wave Equations*, Duke Math J. **44** (1977), 705–714) and made contributions to the theory of pseudo-differential operators (*A Functional Calculus for Elliptic Pseudo-Differential Operators*, Amer. J. Math. **94** (1972), 711–722) and harmonic analysis on semi-simple symmetric spaces (*Harmonic Analysis on Hyperboloids*, J. Func. Anal. **12** (1973), 341–383).

Beginning in the 1980s, my work became more geometric. I applied harmonic analysis to integral geometry (L^P *Estimates for Radon Transforms on Euclidean and Non-Euclidean Spaces*, Duke Math J. **48** (1981), 699–727), in which the central problem is to reconstruct a function from its integrals over geometrically simple sets such as straight lines or planes. This is the mathematical theory that underlies the modern advances in X-ray diagnoses. I used Riemannian geometry as a kind of metaphoric prism to understand the significance and relationships among the basic concepts and constructions of harmonic analysis (*Analysis of the Laplacian on a Complete Riemannian Manifold*, J. Functional Anal. **52** (1983), 48–79, and *Harmonic Analysis a Spectral Theory of Laplacians*, J. Func. Anal. **87** (1989), 51–148). I also studied a generalization of Riemannian geometry which I am trying to call "Sub-Riemannian" (as opposed to the unwieldy name "Carnot-Caratheodory"). This geometry is related to sub-elliptic differential equations, and arises naturally in the theory of nilpotent Lie groups (*Sub-Riemannian Geometry*, J. Diff. Geom. **24** (1986), 221–263).

In the 1990s I began working on fractal geometry and the theory of wavelets. The underlying theme in both these areas is the idea of *self-similarity*, in which the whole is written as a sum of parts, each of which is similar to the whole. A simple example is an interval, which can be broken into two pieces, and each piece expands to recover the original interval. More interesting examples include the von Koch snowflake, the Sierpinski gasket, or the hexagasket, or "fractal Star of David," shown here.



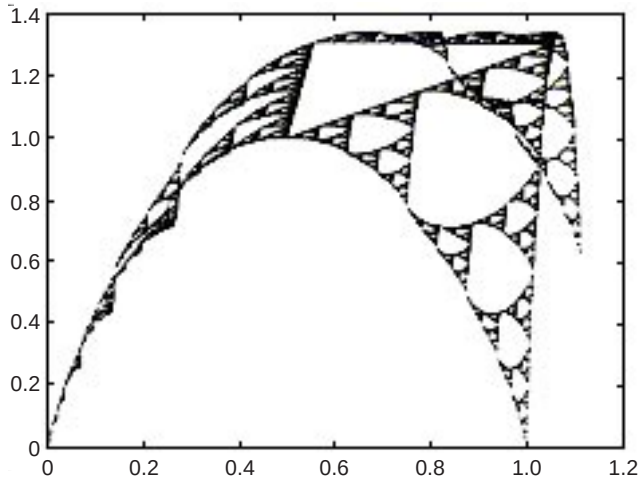
I have developed the idea of a Fractal Plancherel Theorem, both in the general case (*Fourier Asymptotics of Fractal Measures*, J. Func. Anal. **89** (1990), 154–187) and for self-similar measures (*Self-Similar Measures and their Fourier Transforms I, II, III*, Indiana U. Math. J. **39** (1990), 797–817; **42** (1993), 367–411; Trans. Amer. Math. Soc. **336** (1993), 335–361), in which I showed how the fractal properties of a measure show up in the asymptotic behavior of its Fourier transform.

In connection with this work I have become involved with what might be called "experimental mathematics." The idea is to use computer experiments to explore mathematical problems, with the goal of gener-

ating interesting conjectures that can then be proven using conventional mathematical reasoning. This has already led to a number of interesting results (*Numerical Experiments in Fourier Asymptotics of Cantor Measures and Wavelets* (with Prem Janardhan and David Rosenblum), Exper. Math. **1** (1992), 249–273; *Densities of Self-Similar Measures* (with Arthur Taylor and Tong Zhang), Exper. Math. **4** (1995), 101–128; *Exact Hausdorff Measure and Intervals of Maximum Density for Cantor Measures* (with E. Ayer), Trans. AMS, to appear; and *Nonlinear Self-Similar Measures and their Fourier Transforms* (with D. Glickenstein), Indiana U. Math. J. **45** (1996), 205–220.).

For the past three years I have been working on analysis on fractals. The idea is to develop the analog of calculus for functions defined on fractals and to study the resulting fractal differential equations that might be used to model physical processes taking place in fractal objects. Through the work of Jun Kigami, it is possible to define the analog of a Laplacian on some fractals, including the hexagasket shown above, as a limit of difference quotients. This Laplacian has some strange properties, such as: 1) there exist localized eigenfunctions; 2) there exist harmonic functions locally constant, but not globally constant; 3) if the Laplacian of u is defined, then the Laplacian of u^2 is not defined (unless u is constant); 4) the associated wave equation does not have a finite propogation speed. I have been working on learning more about this Laplacian, and I have developed tools of numerical analysis to approximate solutions to various fractal differential equations. The graph of the ground state eigenfunction on the Sierpinski gasket is shown below.

Since the Laplacian is a second order differential operator, it seems natural to look for analogs of first order operators, such as the gradient. I have begun to study these, but the story turns out to be more complicated. I am also beginning to study questions that are suggested by ideas coming from partial differential equations, analysis on manifolds and harmonic analysis. I see this area as a rapidly developing field with many connections to other areas of mathematics, and I am pleased to be able to bring my own perspective, based on my past experience, to help its development. Perhaps this is my mathematical destiny. My experimental research has been done in collaboration with undergraduate students, with the support of the REU (Research Experiences for Undergraduates) Program sponsored by the NSF. Starting in the summer of 1994, I have directed an REU site program at Cornell that involves 10 undergraduate students and 3 faculty members.



In addition to my research, I have maintained an interest in mathematical exposition. I received a Lester Ford Award from the Mathematical Association of America in 1983 for expository writing, and in 1982 I won the first prize in the French Museum Competition sponsored by the Mathematical Intelligencer. I have recently published two textbooks. *A Guide to Distribution Theory and Fourier Transforms*, CRC Press, 1993 and *The Way of Analysis*, Jones and Bartlett, 1995, based on course notes that have been used at Cornell for many years in Math 413, 414, 422 and 515.

Moss Sweedler

Professor of Mathematics

First I worked in the area of Hopf algebras and wrote *Hopf Algebras*, which came to be the standard reference book on the subject. H. Allen and I used Hopf algebras to prove a 25 year old conjecture of Jacobson. Over the ensuing years until about the mid eighties, I worked and published in the areas of commutative algebra and algebraic geometry, real-algebraic geometry, homological algebra, algebraic groups, purely inseparable field extensions and general positive characteristic phenomena, simple algebras and generalizations of the Brauer group, and differential algebra. Since the mid eighties I have primarily worked in the area of computer algebra, especially computational commutative algebra. This has produced both theoretical and applied results with applications beyond mathematics, such as to error control codes and resulted in my position as Director of the Army Center of Excellence for computer algebra.

Professional Activities: Member of ACM/SIGSAM, AMS and SIAM/AG on Discrete Mathematics. Served

on the program committee for *33 Years of Groebner Bases* conference held in Linz, Austria (1998).

Invited Lectures:
Computational commutative algebra, NSA.

Selected Publications:
Remarks on Automatic Algorithm Stabilization (with K. Shirayanagi), invited contribution to (fourth) IMACS Conf. on Appl. of Computer Algebra (1998).
Ideal and Subalgebra Coefficients (with L. Robbiano), Proceedings of the AMS (1998), to appear.
Gröbner Bases for Linear Recursion Relations on m-D Arrays and Applications to Decoding (with I. Rubio and C. Heegard), Proc. IEEE Int'l Symp. on Information Theory, June 29–July 4, 1997, Ulm, Germany.
A New Invariant for the Complex Numbers over the Real Numbers (with D. Haile and R. Larson), American Journal of Mathematics **105** (1983), 689–814.
Groups of Simple Algebras, Institut des Hautes Etudes Scientifiques **44** (1975), 79–189.
A Theory of Linear Descent Based upon Hopf Algebraic Techniques (with H. P. Allen), Journal of Algebra **12** (1969), 242–294.
Hopf Algebras, W.A. Benjamin, Inc., 1969.
Integrals for Hopf Algebras, Annals of Mathematics **89** (1969), 323–335.
Structure of Inseparable Extensions, Annals of Mathematics **87** (1968), 401–410.

Maria S. Terrell

Adjunct Associate Professor of Mathematics
Assistant Dean for Advising in the College of Arts and Sciences

Maria Terrell's recent interests have included tensegrities, the history of Mathematics, and Mathematics education. With the help of an NSF curriculum development grant she has developed an introductory level course which explores geometry, optics and perspective.

Robert E. Terrell

Adjunct Associate Professor of Mathematics
http://math.cornell.edu/~bterrell/bterrell.html

Bob Terrell enjoys teaching mathematics and has written software for teaching partial differential equations. He was once an engineer, and might be the only member of the department with patents on machinery.

Karen Vogtmann

Professor of Mathematics

A fundamental technique for studying a group G is to view G as a group of automorphisms of geometric object C. Geometric and topological properties of C can then be used to study algebraic properties of G. Beautiful classical examples of this are the theory of arithmetic and S-arithmetic groups acting on homogeneous spaces and buildings, including work of Borel and Serre on cohomological properties of these classes of groups, and the theory of groups of surface homeomorphisms acting on the Teichmüller space of the surface. My main area of research interest is in developing geometric theories for other classes of groups. In particular, I have worked with orthogonal and symplectic groups, SL_2 of rings of imaginary quadratic integers, groups of automorphisms of free groups, and mapping class groups of surfaces.

Awards and Honors: NSF Visiting Professorships for Women, Cornell University (1984–85). Invited hour address, AMS Summer Meeting, Provo, Utah (1986). NSF Career Advancement Award, MSRI (1989). Research Professorship, MSRI (1995).

Professional Activities: Executive committee of the Council of the AMS. Referee for professional journals. Committee on Meetings and Conferences of the AMS. Associate Editor for Research-Expository articles, Bulletin of the AMS. Research board of the American Institute of Mathematics.

Selected Publications:
Spherical Posets and Homology Stability for $O_{n,n}$, Topology **20** (1981), 119–132.
Moduli of Graphs and Automorphisms of Free Groups (with M. Culler), Inventiones **84** (1986), 91–119.
Equivariant Outer Space and Automorphisms of Free-by-Finite Groups (with S. Krstic), Comment. Math. Helvetici **68** (1993) 216–262.
A Group-Theoretic Criterion for Property FA (with M. Culler), Proc. AMS **124** no. 3 (1996), 677–683.
Cerf Theory for Graphs (with A. Hatcher), Jour. London Math. Soc. **58** part 3 (1998), 633–655.
A Whitehead Algorithm for Surface Groups (with G. Levitt), Topology, to appear.

Lars B. Wahlbin

Professor of Mathematics

At present one can compute "solutions" to very tough nonlinear, singular problems on, say, a supercomputer. Most often, numerical analysis does not furnish theorems that cover a practical situation, but it provides insight into the behavior of the relevant numerical method on carefully chosen model problems with, at best, some of the most pertinent difficulties of the real problem present.

My work in numerical analysis is aimed at gaining a fundamental understanding of numerical methods. Such insight is also necessary for constructing better algorithms. My particular interest is in methods for partial differential equations, and lately I have been studying the precise and detailed behavior of the finite-element methods in a variety of problems; the most interesting ones contain singularities of various degrees of nastiness.

Professional Activities: Managing editor for Mathematics of Computation.

Selected Publications:

Local Behavior in Finite Element Methods; In Handbook of Numerical Analysis (P. G. Ciarlet and J. L. Lions, eds.), Vol.II (Part 1), North Holland (1991), 353–522.

Superconvergence in Galerkin Finite Element Methods, Springer Lecture Notes in Mathematics 1605, Springer-Verlag New York, 1995.

Jiaping Wang

H. C. Wang Assistant Professor of Mathematics

Most of my research concerns the solutions to second order elliptic partial differential equations and systems on a complete Riemannian manifold. I am especially interested in understanding the interaction of these analytic objects with the geometry and topology of the underlying manifold. Under suitable assumptions on the geometry and topology, one would like to obtain a good description of these analytic objects. The knowledge of these objects is then applied to deduce further geometric and topological information.

Awards and Honors: AMS Centennial Fellow (1996).

Selected Publications:

Convex Hull Properties of Harmonic Maps (with P. Li), J. Diff. Geom., to appear.

The Spectrum of the Laplacian on a Manifold of Nonnegative Ricci Curvature, Math. Res. Lett. **4** (1997), 473–479.

Sharp Bounds for the Green's Functions and the Heat Kernel (with P. Li and L. F. Tam), Math. Res. Lett. **4** (1997), 589–602.

Beverly H. West

Senior Lecturer of Mathematics

My chief interest is in mathematics teaching, using interactive computer graphics, particularly in differential equations, multivariable/vector calculus, and dynamical systems (both real and complex).

It has been a great pleasure this year to work on educational research and writing projects with Samer Habre and Jim Hall, calculus visitors from Beirut American University and Westminster College, respectively.

Awards and Honors: Invited address, *Computer graphics in mathematics education*, at the Grand Opening of Fields Institute, Waterloo, Ontario (1992). Plenary address, *Computer graphics in differential equations*, at Seventh International Congress on Mathematical Education (ICME7), Quebec (1992). Guest Editor of The College Mathematics Journal for November 1994 issue devoted to innovations in the teaching of differential equations.

Professional Activities: Member of the MAA, SIAM, AWM, NYAS, NCTM, and CODEE (NSF Differential Equations Consortium with Harvey Mudd College, Rensselaer Polytechnic Institute, St. Olaf College, Washington State University and West Valley Community College to promote computer graphics experimentation in differential equations courses and provide workshops). Software reviews editor for the College Mathematics Journal.

National Advisory Board for Silvia Heubach's California State University at Los Angeles NSF project on An Innovative Modeling Approach at the Freshman/Sophomore Level (1997–99) and for J. McDill's Cal

Poly San Luis Obispo NSF project on interactive business calculus. Committee to review the Mathematics Department, Southern Oregon State College (1995).

Invited Lectures:

The role of visualization in the teaching of multivariable mathematics (with Samer Habre), Occasional Seminar, Cornell University (Sept. 1998).

Interactive Differential Equations: a different kind of teaching tool for differential equations, Arizona State University (Oct. 1998).

New generation software for teaching differential equations: Interactive Differential Equations, ODE Architect, new MacMath, a panel at the International Conference on Technology in Collegiate Mathematics (ICTCM), New Orleans (Nov. 1998).

The importance of dynamics in interactive graphics, part of a panel by Frank Wattenburg of the NSF on Choosing the Right Tools for Student Exploration, International Conference on Technology in Collegiate Mathematics (ICTCM), New Orleans (Nov. 1998).

Pensacola Junior College, Department Colloquium (Jan. 1999).

Successful take-home exams in multivariable calculus and differential equations, where students show what they can do rather than what they can not, Educational Issues in Undergraduate Mathematics seminar, Cornell University (Apr. 1999).

MAA Short Course on Teaching Differential Equations (with Paul Blanchard et. al.; July 1999).

Real time dynamics: why it makes a difference and *Ideas for take-home examinations*, International Conference on Technology in Mathematics Teaching (ICTMT), Plymouth, England (Aug. 1999).

Successful take-home examinations: multivariable calculus and differential equations, International Conference on Technology in Collegiate Mathematics (ICTCM), San Francisco (Nov. 1999).

Selected Publications:

*Analyzer** (with D. Alfors), an exhaustive software package for studying functions of a single variable (1990 EDUCOM/NCRIPTAL Distinguished Mathematics Software Award), Addison Wesley, 1992.

MacMath (with J. Hubbard), 12 interactive graphics programs for the Macintosh, to accompany the Differential Equations texts, second edition, Springer-Verlag, 1994; new expanded version in progress.

A New Look at the Airy Equation with Fences and Funnels (with J. Hubbard, J. McDill and A. Noonburg), College Mathematics Journal (1994); Proceedings of the Organic Mathematics Project (1996); CECM at Simon Fraser University (1997).

Differential Equations: A Dynamical Systems Approach (with J. Hubbard), Springer-Verlag; Part I: One-Dimensional Equations, 1991, 1997; Part II: Higher-Dimensional Equations, 1995.

Interactive Differential Equations (with S. Strogatz, J. M. McDill, J. Cantwell and H. Hohn), a CD-ROM with laboratory workbook, Addison Wesley Interactive, 1996, 1.1 for Mac and 2.0 for Windows, 1997.

ODE Architect (with C•ODE•E, NSF Consortium for ODE Experiments), John Wiley and Sons, 1998. An interactive teaching, learning and research environment on CD Rom with Companion Book of 269 pages. This package won an Invision '98 award as one of "The 9 Best CD-Roms on the Planet" (against all sorts of nonmathematics competitors)!

Technology in Differential Equations Courses: My Experiences, Student Reactions, a chapter for an MAA volume on teaching differential equations "in the new millenium" (M. Kallaher, ed.), in press.

Dynamic Duo: Differential Equations and Linear Algebra (with J. Stanley Farlow, James E. Hall and Jean Marie McDill), Prentice Hall, 2000, 600 pages.

James West

Professor of Mathematics

My research has focused on the topology and symmetries of manifolds of finite and infinite dimensions, and on the related topics of polyhedra, absolute neighborhood retracts, function spaces and spaces of sets.

An example of the interplay between these theories is that manifolds modeled on the Hilbert cube appear naturally in several ways as limits of stabilization processes for finite-dimensional objects, and, unlike standard function space stabilization, retain more of their important properties, e.g., simple homotopy type. Study of the Hilbert cube manifolds has produced several of the initial breakthroughs in introducing control into the homeomorphism theory of finite-dimensional manifolds. This in turn, has been useful in analyzing the failure of the classical matrix algebra to describe equivariant homeomorphisms and homotopy types of manifolds with locally linearizable transformation groups, which in turn has led to new results on the topological classification of linear representations of finite groups. I have been involved in these studies.

Awards and Honors: Invited Address, AMS Summer School on Algebraic and Geometric Topology, Stanford (1976). Invited Address, Moscow Mathematical Society

(1978). Invited Address, Inter. Congress of Mathematicians, Helsinki (1978). Karcher Lectures, University of Oklahoma at Norman (1979).

Professional Activities: Editorial board member of Fundamenta Mathematicae.

Selected Publications:

Infinite Products Which are Hilbert Cubes, Trans. AMS **150** (1970), 1–25.

The Hyperspace of the Closed Unit Interval is a Hilbert Cube (with R. M. Schori), Trans. AMS **213** (1975), 217–235.

Mapping Hilbert Cube Manifolds to ANR's, Ann. Math. **106** (1977), 1–18.

Equivariant h-cobordisms and Finiteness Obstructions (with M. Steinberger), Bull. AMS (NS) **12** (1985), 217–220.

Non-linear Similarity Begins in Dimension 6 (with S. Cappell, J. Shaneson and M. Steinberger), Amer. J. Math. **111** (1989), 717–752.

Fibrations and Bundles with Hilbert Cube Manifold Fibers (with H. Torunczyk), Memoirs of the AMS **406** (1989), iv + 75 pp.

Compact Group Actions that Raise Dimension to Infinity (with A. N. Dranishnikov), Topology and its Applications **80** (1997), 101–114.

Visiting Faculty Program Participants

Karl David

Wells College

After an enjoyable year in the Visiting Program for 1997–98, and the securing of a leave of absence from Wells College for 1998–99, I had to decide between joining my wife in Wisconsin (where she is an Assistant Professor of Biology at Carthage College in Kenosha) or accepting the department's offer of a visiting professorship for the fall. The second-best reason for choosing the first option would be that I would be physically present while searching for a position for myself. But, I might well be unemployed for an entire year, so I decided to accept the offer and hope I could find something in the spring. In any event, it worked out well: I got to spend a final semester at Cornell, teaching two sections of Math 111, and a few months after moving to Wisconsin, I was offered and accepted a full-time, three-year position at the Milwaukee School of Engineering starting fall 1999.

As had been the case the year before, my semester at Cornell was a thoroughly enjoyable one. Marshall Cohen was an engaged, conscientious "czar" for 111, and the group of faculty, graduate students and visitors teaching the sections was most congenial to work with. The Undergraduate Math Club asked me early in the semester if I would give a talk for them, and as the date approached I found I still had a lot more work to do on the subject than I had initially believed would be necessary. Perhaps because the resulting talk clearly reflected work very much still in progress, *A Combinatorial Problem for the Game of Dots* was (or so I was kindly told) well received. Moreover, it inspired graduate student Joe Miller to work on some of the unanswered questions, and his contribution pushed us to the brink of final proof of one of the main conjectures.

Final exam time also marked my final days in Ithaca in particular and the Finger Lakes in general, where we had lived since 1984. I took final advantage of all Ithaca has to offer and sang with the Community Chorus in their fall concert. Then the time came to write the official letter of resignation from Wells College, say good-bye to friends and pack for the move to Wisconsin. And prominent among the memories I took with me were many of my wonderful times at Cornell. Good luck to you all in your new home in Malott Hall!

Samer Habre

Lebanese American University

I have been very fortunate to be able to spend a whole year at Cornell University as a Fulbright Scholar. As I was expecting, Cornell has a lot to offer for the kind of research I came to conduct. Since my interest is in the teaching of differential equations, being with Beverly West and John Hubbard provided me with a first-hand experience on all the developments that have taken place in this field. West and Hubbard pioneered this change in 1992 with the development of interactive computer software that changed the differential equations curriculum forever.

To increase my knowledge in differential equations, I sat in John Hubbard's *Applicable Analysis* (Math 420). Hubbard is an exceptional instructor and an excellent researcher. As a result of this interaction, I collaborated with Hubbard and West on a paper (tentative title: *ON the Convergence of Euler Approximations*). It is now in its final stages, and we hope to be able to publish it soon.

Beverly West, on the other hand, teaches Math 213, a course that combines multivariable calculus and differential equations. I sat in the course and observed how interactive computer software programs are integrated in the teaching process. Furthermore, I collected data, conducted interviews with some students of the course, and consequently, was able to write two papers: *Visualization in Multivariable Calculus: The Case of 3D-Surfaces* and *Examining Students' Strategies to Solve Ordinary Differential Equations in a Reformed Setting*.

In the spring semester, my learning experience at Cornell University wsa furthered by sitting in a class offered by Steven Strogatz and dealing with nonlinear dynamics and chaos. Strogatz had previously collaborated with Bev West on a book/software package called *Interactive Differential Equations* that I hope to use back home when I teach differential equations. He is also an exceptional teacher, and I enjoyed his lectures very much.

Also, in the spring, I taught two sections of Math 112 (Calculus II). It was definitely a challenge teaching students at an Ivy League University; but it was also a joy. Stewart's reformed calculus book was used, and I was very pleased with it. I specifically enjoyed the integration of differential equations in the course and the

emphasis on the qualitative as well as the quantitative approach.

During the past year, I attended the annual meeting on the Psychology in Mathematics Education. Together with Beverly West and Jeanne McDill, we gave a talk entitled *New Generations of ODE Software* at the annual International Conference on Technology in Collegiate Mathematics. Furthermore, at the annual Graduate Mathematics Conference organized by the mathematics graduate students of Syracuse University (my alma mater), I gave a presentation entitled *The Convergence of an Euler Approximation of an Initial Value Problem Is Not Always Obvious*. As a result of my research at Cornell, I gave three talks at the Occasional Seminar and/or Educational Issues Seminar; later this summer, I am giving a talk at the International Conference on Technology in Mathematics Teaching in Plymouth, UK; then in November, I will visit the U.S. again to present a paper at the next International Conference on Technology in Collegiate Mathematics.

I was a regular at the Occasional Seminar as well as the Educational Issues Seminar. Chats with David Henderson, Tom Rishel, Allen Back, Avery Solomon, Beverly West, Doug Alfors, Jim Hall (another visitor) and other regulars were fruitful and very stimulating. I am grateful to all of them for their valuable input on the research I conducted while visiting Cornell. I also had the good fortune to meet Thomas Deck, a visitor and my officemate for one semester. Discussions with him were mathematically enlightening.

My experience at Cornell will certainly benefit my home institution (LAU). I am planning to use a reformed book in my next differential equations class and will be using *Interactive Differential Equations* in the computer laboratory. Having LAU in mind also, I attended a workshop at Cornell during the month of June, which focused on the new curriculum in geometry. This topic is especially important for future teachers of mathematics. Since at the Lebanese American University we only offer a bachelor's degree in mathematics education, I thought it was an opportunity for me to learn more about geometry and share that knowledge with my other colleagues in Beirut.

In the end, I would like to thank all the people that made this year memorable (for my family and me). Special thanks to J. Hubbard and S. Strogatz for letting me sit in their classes. Thanks are extended to all the staff of the Mathematics Department. Very special thanks go to Beverly and Jim West. Beverly, you helped create this opportunity for me and you provided me with many means to develop professionally. Thank you. Thank you also and thanks to Jim for helping my family and me settle down easily upon our arrival in Ithaca. You have become an extended family for us, and we are waiting for you to visit us in Beirut.

Finally, my family and I think that Cornellians are very fortunate to be living in this beautiful region. The campus is marvelous; every season has its charm, and the gorges all around make this place truly exceptional. (And perfect for creativity!)

James Hall

Westminster College

Cornell and its Mathematics Department offered me a variety of opportunities during the 1998–99 academic year of which I partook sporadically and idiosyncratically. I am grateful to all for a worthwhile sabbatical year.

Since I enjoy teaching, and in particular, teaching calculus, my assignment to teach two sections of Math 111 in the fall and two sections of Math 112 in the spring was welcome. The students were generally able and responsive. (Working under the direction of a czar each term reminded me why I have chosen to teach for the past 15 years at a small liberal arts college.)

Opportunities to attend Oliver and Olivetti Club talks and to interact informally with colleagues in corridor and lounge, as well as such extras as the spring concert, were valuable and worthwhile. Auditing courses from John Hubbard and Yulij Ilyashenko contributed to my knowledge of differential equations at two levels.

Finally, the connection through Beverly West with a text-writing project in integrated linear algebra and differential equations helped fulfill a major sabbatical objective: to prepare myself better to teach such a course at Westminster (part of a new curriculum). The publication in the year 2000 of the Farlow-Hall-McDill-West book will be the chief memento of my year in Ithaca.

My thanks, then, to faculty colleagues, graduate and undergraduate students and support staff (office, library, computer) for helping to make the year successful.

Staff Profiles

Administration

Nora Balfour, Undergraduate Coordinator (1998), 100% FTE: As undergraduate coordinator, Nora is the primary resource person for the undergraduate program, which includes approximately 80 majors. She acts as liaison between faculty and their advisees, both majors and over 200 students (mostly first or second year) with undeclared majors. She hires, assigns, oversees time collection and supervises undergraduate graders. Nora coordinates the application process for the summer Research Experiences for Undergraduates (REU) program and generates a web-based newsletter for undergraduates during the fall and spring pre-enrollment periods. She is also the departmental receptionist, conducts the annual faculty recruitment effort, provides administrative support both for the undergraduate program and the administrative manager and is the editor of the department newsletter, *Math Matters*.

Gayle Davis, Accounts Coordinator (1998), 100% FTE: Gayle provides administrative, financial and personnel support for the department. In accordance with university and agency regulations, she develops research budgets and oversees proposal submissions to the Office of Sponsored Programs. She monitors account transactions, approves expenditures and maintains account information and records. She also processes nonacademic appointments, maintains nonacademic personnel records, oversees time collection, processes payroll vouchers and distributes paychecks. Gayle assists the administrative manager in the day-to-day operations of the department and serves as acting manager when the administrative manager is unavailable. She is the functional supervisor for the administrative staff.

Arletta Havlik, Department Registrar (1968), 100% FTE: Arletta provides secretarial and administrative support for the instructional and research programs of the Mathematics Department faculty. Her responsibilities include coordinating the paperwork, course enrollments and inquiries pertaining to enrollment in math courses, and she oversees the department's presence at the central course exchange each semester. In her role as department registrar, she coordinates course enrollments, evaluations and grade submissions. She is the primary technical typist for the department and prepares complex documents involving sophisticated typesetting software (TEX) which involves designing, editing and formatting.

Joy Jones, Building Coordinator (1980), 100% FTE: Joy is the building coordinator and copy room specialist for the department. She coordinates the day-to-day service operations provided to faculty, visitors, staff and students. She orders supplies, processes purchase orders and performs records and facilities maintenance, information gathering and data input. Joy assists the accounts coordinator with travel reimbursements, telephone billings, records management and accounts payable. She assists the chair's assistant with the academic appointment process and foreign nationals with housing. She oversees the mailroom operations, maintains repair and renovation records and secures the building at night. Additionally, she coordinates the refreshments for the weekly seminar series.

Michelle Klinger, Teaching Program Coordinator (1993), 100% FTE: Mikki provides administrative support for the mathematics teaching program, assisting the associate chair and the director of undergraduate teaching to generate the department course schedules. Mikki oversees room assignments and changes, course file management and textbook ordering and screens inquiries pertaining to course offerings. She also acts as back-up technical typist, processing original entry and editing of highly technical mathematical manuscripts. Mikki works with the administrative manager to compile information for the annual report. She is the back-up department receptionist, coordinates the annual capital equipment inventory, publishes a weekly seminar bulletin and maintains/generates department database directories and related reports. She also issues keys and maintains the department's access device log for all keyholders.

Donna Smith, Graduate Field Coordinator (1997), 100% FTE: Donna is responsible for the administration of the department's graduate program, beginning with the admissions process and continuing through graduation. She provides primary support to the director of graduate studies, maintains matriculated student records, processes appointments and generally oversees the administrative functions of the graduate program, consisting of about 60 graduate students. She works with the administrative manager and the director of undergraduate teaching to monitor the annual teaching assistant budget. In addition, she coordinates, schedules, plans and oversees all department social functions. Donna provides backup support to the accounts representative for the department's time collection and payroll effort.

Catherine Stevens, Assistant to the Chair (1969), 100% FTE: Cathy provides executive, administrative and secretarial support to the chair and faculty of the Mathematics Department. She assigns office space and works with the associate chair to compile teaching and committee assignments. Cathy coordinates faculty searches, processes academic personnel forms and maintains academic personnel files. She assists foreign nationals in obtaining proper visa status, arranges lectures and accommodations for prospective faculty and visitors and schedules benefits counseling for new academic employees. Cathy plays a key administrative role in overseeing the summer session course offerings, including budget development, teaching assistant assignments and grader support.

Colette Walls, Administrative Manager (1996), 100% FTE: As business manager, Colette directs the financial, personnel, facilities, communications and funds procurement operations. Her responsibilities include planning, managing and evaluating the general administrative operations and long-range aspects of the department. She assists the chair (and others) in administering selected academic activities including the course count, budget process, leave replacement funding and TA budget. She maintains, monitors and reconciles departmental appropriated, gift and endowment accounts and acts as liaison with central college and university offices. She oversees and participates in the publication of newsletters, the annual report and various external surveys and generates a variety of department, college and university reports. Colette interviews, hires, assigns workloads and supervises the administrative support staff. She is also responsible for updating and maintaining the department's web-based *Survival Manual for Faculty and Teaching Assistants* which can be found at http://math.cornell.edu/~colette/Survival/survival.toc.html.

Computer Support

Douglas Alfors, Computer Consultant and Advisor (1998), 50% FTE: Doug provides organizational and administrative computer support for the Department of Mathematics. He has primary responsibility for the administrative computer server, including backup, software and hardware installation, operations, inventory and security. He provides computer consulting, diagnostic and troubleshooting support for department members. Doug assists the network administrator in maintaining the departmental network.

Robert Terrell, Network Administrator (1997), 50% FTE: As network administrator, Bob is responsible for the departmental computer servers including networking, backup, software and hardware installation, operations and security. He maintains some of the departmental web pages, provides maintenance for the department computer systems—including UNIX, Sun, Macintosh and PC operating systems—and provides computer consulting, diagnostic and troubleshooting support for department members.

Mathematics Support Center

Douglas Alfors, Director (1983), 50% FTE: Doug directs and coordinates MSC academic support for mathematics, principally for introductory courses. Such support includes the interviewing, hiring and supervision of student tutors; the day-to-day running of the MSC office; preparation and distribution of written support capsules; and planning and conducting various workshops on topics of common interest (e.g. graphing, infinite series, integration, etc.). He also oversees the use of the computers in the MSC.

Richard Furnas, Teaching Associate (1981), 25% FTE: Richard has been a mainstay of the Mathematics Support Center since its inception in the early 1980s. He serves as a tutor, review session leader and general Macintosh guru. Graduate students from other departments often benefit from his counsel on the use of a variety of mathematical techniques in their field of research. Dick also assists in the instruction of Math 105 (*Finite Mathematics*) each fall and of Math 106 (*Calculus for Biologists*) each spring.

Mathematics Instructional Computer Lab

Allen Back, Director (1993), 50% FTE: Allen is responsible for the primary computer instruction laboratory for the teaching of mathematics. The lab is a teaching arm of the Mathematics Department, and the director addresses pedagogic issues in appropriate instructional uses of computers, acting as a resource person in all related areas. He is responsible for the installation and upkeep of hardware and software, as well as addressing all personnel issues of the lab including selection, training and supervision. Allen also contributes to the development of sample materials, assignments, and help documentation and software of interest to faculty and staff. He gives demonstrations, helps with software use, serves as an advisor on technical issues and assists in relevant grant proposals.

Mathematics Library

Michelle Paolillo, Administrative Supervisor and Network Administrator (1995): Michelle is the library's network administrator and web master. She is also responsible for personnel management and records. She deals with problems related to the library management system including bills. Michelle is an experienced professional with reference questions and interlibrary loans.

Steven Rockey, Mathematics Librarian (1972): Steve is in charge of the library and makes all policy, management and budget decisions. He is the contact for questions about book, journal or other format purchases for the library. Drawing on many years of experience in the library, he can often find an answer or solution for most any question or problem. Walk right in, send an e-mail or give him a call any time at work or at home.

Deb Gagnon, Circulation Supervisor (1998): Deb oversees the operation of the Math Library's circulation and reserve services during regular business hours. She is also responsible for the hiring, training and supervision of student employees.

Raj Smith, Evening Supervisor (1994): Through June 1999, Raj was in charge of the library in the evening hours. He was the lead person on the library's Digital Books projects and was very involved in the library's computer services. Raj was also the chief organizer of the library's popular annual book sale. His original connection to the library was back in his undergraduate days when he worked as a student assistant.