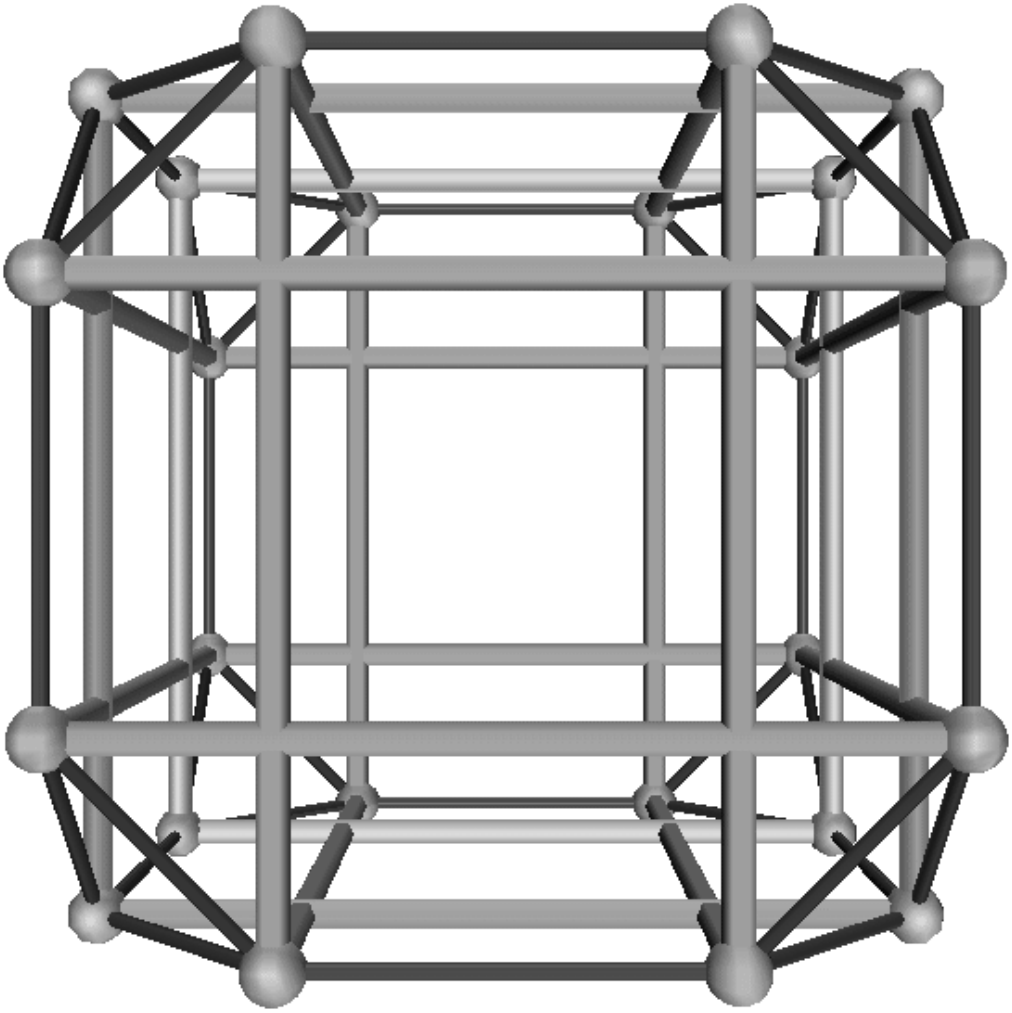
Department of Mathematics

Cornell University

Annual Report 1997–98



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 24 balls represent points in space placed at the vertices of a truncated 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 that lie in the faces of the truncated cube represent "struts." If two vertices are connected by a strut, then they are not permitted to get closer together. In this example the struts happen to intersect, which is allowed for cables and struts.

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. (It turns out that for this structure, each of the six octagonal faces is super stable also.) 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 1997–98

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.

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The Year in Review 1997–98

The 1997–98 academic year seemed to pass in the blink of an eye. Beginning as early as possible, we conducted searches for new tenure-track faculty, and we are very pleased with our success. Irena Peeva turned down three competing offers to be one of our new assistant professors. Ravi Ramakrishna, whom many will remember as an undergraduate here in Mathematics, will also be a new assistant professor. As an undergraduate Ravi competed in a Putnam Mathematics Competition as one of our team "stars."

We also welcome Vesselin Gasharov, Anthony Kable, Adam Epstein, and Gregery Buzzard who will join the department as H. C. Wang Assistant Professors in the coming year. In addition, Peter Topping and Vlada Limic have accepted H. C. Wang Assistant Professorships effective July 1999. We will all benefit when these bright and exciting colleagues join our faculty, and we consider ourselves fortunate that they have decided to come to Cornell. We extend a special welcome to all the new members of our department.

We will continue searching for a senior person in mathematical statistics. We may broaden the search to include other areas but plan to fill this position in the 1998–99 academic year. We feel it is important to find a top person to help lead us into the twenty-first century.

Chairman Connelly was assisted this year by Stephen Chase as associate chairman, Dan Barbasch as director of graduate studies, Tom Rishel as director of undergraduate teaching, and Oscar Rothaus as director of math majors. Ken Brown directed the department computer facilities, while Allen Back directed the instructional computer lab. John Smillie continues to oversee preparations for the department's upcoming move to Malott Hall, which is proceeding on schedule (see p. 9). Steve Chase has agreed to serve as associate chairman for another two year term.

We are happy to announce that Professor Lou Billera will become a full-time member of our department on July 1, 1998. In the past, Lou has held a joint appointment in the departments of Operations Research and Industrial Engineering (OR&IE) and Mathematics, but he decided that he would like to change this appointment to full-time in Mathematics. We are all very pleased that the change was approved and look forward to having Lou in the department on a full-time basis.

Meanwhile, Professor Cliff Earle has decided on a program of phased retirement at half-time starting July 1, 1998. Cliff will be teaching fewer courses each year but will continue full-time in his work in mathematics.

Two of our faculty, Professors John Guckenheimer and Keith Dennis, are ending leaves of absence involving very distinguished service to mathematics. John is finishing his term as president of the Society of Industrial and Applied Mathematics (SIAM), and Keith is finishing his term as executive editor of *Mathematical Reviews*. Their excellent accomplishments will benefit us all in Mathematics.

The first year of our experiment with restructuring freshman engineering calculus has been completed. The primary aim of the experiment is to offer Math 192 during the fall semesters in small classes of approximately 25 students. The additional teaching power needed to change this course from the large lecture system to the small class system was provided from a variety of sources. In particular, we received funding for another H. C. Wang position, four one-semester instructional teaching assistants and additional Cornell faculty to be hired on a per course basis. The faculty recruited for this purpose were: Professor Hans Fleischmann from Applied and Engineering Physics, Professor Christine Shoemaker from Civil and Environmental Engineering, Professor Peter Stein from Physics (also dean of faculty), Professor Leigh Phoenix from Theoretical and Applied Mechanics, and Professor Paul McIsaac from Electrical Engineering. All involved, but especially the students, have benefited from the dedication and varied experience of these outstanding participants.

Mark Gross took a leave of absence for the spring 1998 semester to work with colleagues in mathematics at the University of Warwick. He requested an extension for this leave through June 30, 1999, which has been approved. Persi Diaconis also requested and received approval to take a leave of absence for the 1998–99 academic year. He will be in residence at Stanford University.

Mike Stillman received faculty endorsement this year for promotion to full professor. The tenured faculty also voted in favor of reappointing Avery Solomon for another 5 year term as senior lecturer. (See *Faculty Changes*, page 5.)

Sadly, the department suffered the tragic loss of a talented graduate student this year. Robert Battig died suddenly in December 1997. A memorial service was held by the department on December 10, 1997, in Anabel Taylor Hall, and a memorial endowment has been established in his name to honor an outstanding graduate student in mathematics each year. We all extend our heartfelt condolences to Robert's mother, father and many wonderful friends. Robert was awarded his Ph.D. posthumously on May 23, 1998.

Faculty and graduate students continued to heighten our profile this year through special awards and honors (see pages 6–7). Xavier Buff and Leonard Gross each gave a prestigious Bourbaki Lecture at the Institut Henri Poincaré in Paris, France. Several graduate students received awards this year: Robert Battig received a Sloan Doctoral Dissertation Fellowship; Ferenc Gerlits received a Hutchinson Fellowship; and Reed Solomon received a Clark Distinguished Teaching Award.

This year's Visiting Faculty Program participants were: Professor Richard Cleary, St. Michael's College in Colchester, Vermont; Professor Kenneth Constantine, Eastern Nazarene College in Quincy, Massachusetts; Professor Karl David, Wells College in Aurora, New York; Professor Kenneth Ross, University of Oregon in Eugene, Oregon; Professor Henry Schenck, Ph.D. Cornell University, May 1997. (For information about their experiences at Cornell, see pages 73–76.) Recruitment efforts have produced five participants for the 1998–99 academic year.

Graduate student recruitment yielded 18 new graduate students plus one nondegree student for the 1998–99 academic year, increasing the program from 57 to 62 students. Applications numbered 172 while inquiries totaled nearly 900.

Support Staff

For a variety of reasons, this has been a year of significant change regarding staff turnover in the department. The undergraduate coordinator position, vacant for over a year, was filled in November 1997 by Cheri Farnsworth. Cheri comes to Mathematics from the College of Arts & Sciences Academic Advising Center, where she worked closely with undergraduate students. We welcome her gracious manners and good humor, and are confident our math majors are well taken care of.

Shirley Allen retired on January 2, 1998, with 12 years of experience as graduate field coordinator. Shirley cared deeply about graduate students, often acting as their fearless advocate. Consequently, she has been well loved in return, and she will be missed by all. Shirley and her husband, Jay, are in the process of moving to North Carolina, where they are building a new home.

Donna Smith was hired effective December 2, 1997, as the new graduate field coordinator. Donna spent the last 11 years at the Theory Center prior to its downsizing and reorganization last fall. She was hired there in 1986 as a secretary and was promoted to conference coordinator in 1988. Donna was first hired at Cornell in 1979 as a secretary in the Department of Theater Arts. She comes to us with excellent organizational and interpersonal skills.

Rachel Engler resigned effective January 2, 1998, as computer support and network coordinator. She is now the system administrator for the Department of Mathematics at the University of Warwick. Rachel was a trusted and able systems administrator, and we were sorry to see her go.

Rachel's position was divided into two part-time positions. Bob Terrell was hired as a half-time computer consultant/advisor in December 1997. His primary responsibility is to maintain the department's computer network. Bob had to "hit the ground running" and has done an admirable job of heading up our complex UNIX system. Bob also has a half-time adjunct professor position with the department. The other half of the computer support line was filled in late May 1998 by Doug Alfors, who also works in the department as the director of the Mathematics Support Center. Doug provides primary computer support, diagnostics and troubleshooting for the departmental administrative staff and faculty. He assists Bob Terrell with the computer network. Doug has already earned the confidence of the office staff by virtue of his commitment to creative problem solving.

In April 1998, our long term accounts coordinator, Terri Denman, left to take the administrative manager position in the Department of Rural Sociology at Cornell. Terri was first hired in the department in September 1985. In June 1989 she was promoted into the accountant position to replace Tony Augustine. Terri will be missed for her dry wit and exemplary skills. We thank her for her many years of good service to the department, and wish her the best of luck in her career at Cornell.

Gayle Davis accepted the position of accounts coordinator effective April 13, 1998. She has worked at Cornell for over 20 years. Starting in 1991, she worked for the College of Industrial and Labor Relations in budget, fiscal management and general operation areas. Prior to

working for ILR, she held accounting positions at the Biotechnology Program, the Department of Biochemistry, and Statutory Finance and Business Services. We felt comfortable with her immediately and look forward to working with her.

Project 2000: Michelle Klinger was chosen to participate in PeopleSoft's Project 2000 (P2K) Course Conversion Project. She has been performing data entry of course descriptions and offering information for a five year period into the new system. Mikki's involvement provides her with valuable knowledge and experience prior to the implementation of this P2K system.

Colette Walls has been appointed to the Arts College's P2K implementation team. Each college has been asked to establish a core oversight team, which will handle general strategy, planning and communication needed to prepare each departmental administrative office for the many changes forthcoming with the advent of Project 2000.

In addition, Colette and Gayle Davis have been asked to serve on the university's Project 2000 Pilot Effort program during summer 1998. As a result of their involvement in this program, the staff will be involved in testing and providing user feedback for P2K modules prior to general dissemination.

Gayle Davis has agreed to participate with the college's implementation of COLTS II, the university's next online time collection system, which is scheduled to be released to the general public in January 1999.

Graduate Program

The Cornell Mathematics Department is rated among the top in the country by the American Mathematical Society. It is typically ranked somewhere between 10th and 15th in various *by reputation* surveys; for example, the *U.S. News and World Report* placed Cornell 12th in the nation in its 1996 national ranking of graduate mathematics programs.

The graduate program included 57 graduate students during the 1997–98 academic year. We received 9 outside fellowships in 1997–98 and were awarded 11 (one partial and 10 full) summer 1997 fellowships from Cornell's graduate school. Ph.D.s were awarded to 10 students, while seven earned master of science special degrees. (See the degree lists on pages 24–27.) The entering class for 1998–99 is larger than usual to offset the 17 graduate students who are expected to receive their Ph.D.s through August 1998. The total number is expected to be 62 (one non-degree) for the academic year of 1998–99.

Our incoming class consists of twenty students from many different countries including Israel, Romania, China and, of course, the United States. Two of our students — Noam Greenberg and Lin Yi — were awarded graduate school fellowships. Another — Chow Ying Lee — will use her fellowship from the government of Singapore to work toward a Master's degree. She finished undergraduate work at Cornell in three years (rather than four) and was written up in the *Cornell Chronicle*. Rebecca Schuller was awarded a four year Lucent Technologies fellowship.

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.

The research conducted by our graduate students is of the highest caliber. Robert Battig held one of the highly competitive Sloan Doctoral Dissertation fellowships during the 1997–98 academic year in recognition of his research towards his thesis; Denis Hirschfeldt was awarded a Sloan fellowship for the 1998–99 academic year. Our advanced students are often invited to give talks at national and international conferences. This year, Maria Gordina, Shu-Yen Pan, Wicharn Lewkeeratiyutkul, Debra Boutin and Jeff Mitchell spoke at various AMS meetings on topics related to their theses.

The Olivetti Club is devoted to expository talks on current research areas and is run entirely by graduate students. The representatives and organizers were Alan Demlow and David Revelle in the fall semester, and Chris Hruska and Suzanne Lynch in the spring semester. In addition, many of the Analysis, Lie Groups, Dynamical Systems and Topology seminar talks were given by graduate students.

Graduate student teaching assistants are one of our most valuable teaching resources. This year Reed Solomon was recognized by the university with the Clark Distinguished Teaching Award.

Over the years, several students have played a crucial role in the introduction and maintenance of the innovative project-oriented sections in one of our core calculus courses. The graduate students discuss their teaching

experiences in the Occasional Seminar and sometimes lecture at meetings elsewhere. As part of the Graduate Student Outreach Project offered through Cornell, David Brown taught a 6th grade class in Newfield, NY, about fractals, minimum distances and symmetry.

Class representatives were: Debra Boutin (6th year), Luis O'Shea (5th year), Walker White (4th year), Joe Miller (3rd year), Alan Demlow (2nd year) and Suzanne Lynch (1st year). The Graudate and Professional Student Representative was Leah Gold.

Undergraduate Program

The undergraduate program in mathematics included 90 majors this year. Among these students were 39 double majors and one triple major in programs with sister departments: Asian Studies, Computer Science, Economics, English, Linguistics and Physics. Bachelor degrees were awarded to 24 students (p. 27). In spite of a slight decrease in the number of majors in 1997–98, the year was a highly successful and exciting one for undergraduates in the department.

The Math Club's fall semester began with enthusiasm and excellent leadership provided by President Caroline Klivans (May 1999) and Secretary Michael LaRocque (May 1998). Many goals were realized this year. Among them were an increase in club meetings from biweekly to weekly and attendance at two prestigious mathematics conferences (international and national).

Math Club meetings were held each Wednesday afternoon during the fall and spring semesters. The students themselves were responsible for inviting speakers, coordinating topics of discussion and providing refreshments. (See *Department Colloquia*, pp. 28-34, for a list of talks.) As in the past, Professor Graeme Bailey provided expert assistance and guidance as the Math Club's advisor, developing longe-range goals, with Professor Richard Ehrenborg giving invaluable assistance.

The crowning achievement of the year was the successful petitioning of the SAFC (Student Activities Finance Committee) for funding to attend two mathematical conferences. The first of the conferences — the AMS South Eastern Sectional Conference — was held in Atlanta, Georgia, in October 1997. In attendance were Michael LaRocque, Caroline Klivans and graduate student Joe Miller. Michael commented upon their return that "exposure to such active branches of research mathematics was both invigorating and enticing."

The second conference was the prestigious Bourbaki Seminar, held in Paris in March. This trip was a "whirlwind excursion" because funding was not granted until one week before it was to begin. Although funding was granted for four math club students, due to short notice only three were able to retrieve their passports and make the trip. President Caroline Klivans, Secretary Michael LaRocque, and new club member (and math major) Anthony Pulido attended. Professors John Hubbard and Xavier Buff were of invaluable assistance in providing housing for the trio with a mutual friend in Paris, Professor Adrien Douady. Caroline and Mike both agreed that "the beauty of Paris in the Spring was the *icing on the cake* of a prestigious and exciting math conference." The conference provided an opportunity to rub elbows with the most important members of the European mathematical community. Time was also found to take in a number of the more famous sights of Paris: the Louvre, la Musée d'Orsay, L'Arc de Triomphe and the famous Champs Elysées. Hopes are high that future members of the Math Club will be able to attend conferences in years to come.

With the assistance of Graeme Bailey, graduate student Bob Milnikel and other department faculty and graduate students, *Math Table* became a weekly event this year. *Math Table* was held each Friday evening in Risley Dining Hall, where a table was reserved for interested undergraduate students — as well as graduate students and faculty — to meet and eat together and, of course, discuss mathematics on a purely informal basis. Attendance started out light, but picked up rapidly during the semester, including a group of about twenty. Topics were broad and interesting; and, according to Bob Milnikel, "one memorable Friday found the group clustered around the *Irish Times* crossword for an extra-mathematical challenge." The focus of *Math Table* was to reach out to the undergraduate community and increase awareness of mathematics and the math major. A rewarding side benefit was the interaction among undergraduates, faculty and graduate students. This highly successful activity will be continued, and perhaps expanded, in the future.

Research and Professional Activities

Department sponsored research expenditures totaled $1,481,000 for the 1997–98 fiscal year. This included 36 grants and contracts from federal, state and private agencies awarded to 27 faculty. Faculty submitted 21 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 40–72.

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*; Keith Dennis as editor of *Mathematical Reviews*; 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*; Gene Hwang as associate editor of *Annals of Statistics*; 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*; 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 Faculté 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 managing 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

Cliff Earle has decided to go on phased retirement beginning July 1, 1998. As per arrangements negotiated with the College of Arts and Sciences, his academic appointment will now be at 50% effort until he officially retires in June 2005.

In mid-April, Lou Billera asked to have his appointment changed to full time in the Department of Mathematics effective July 1, 1998. Previously, he has been 50% in Mathematics and 50% in OR&IE. The faculty discussed and quickly approved this request, which was then forwarded to the College of Arts and Sciences. The college accepted our recommendation, which goes into effect with the 1998–99 academic year.

In February, Mike Stillman received enthusiastic endorsement from the tenured faculty for promotion to full professor. Although all parts of his dossier were strong, special note must be made of the extraordinarily powerful letters from former students. We are delighted to have the opportunity to recognize Mike for his many contributions to the department.

Steve Chase has agreed to remain associate chair for an additional two years. His term will now run through 1999–00. Steve has been an effective and industrious associate chair, and we appreciate his decision to continue in this role for an additional term.

In April, the tenured faculty voted unanimously in favor of reappointing Avery Solomon for another 5 year term as senior lecturer in the field of mathematics education. Avery's duties will also be changed somewhat to include more involvement with students in the Teachers Education in Agriculture, Mathematics and Science (TEAMS) program, as well as with other Cornell students interested in educational issues in school mathematics.

On leave for 1996–97:
Louis Billera, sabbatical leave, academic year
Jianguo Cao, leave, academic year
R. Keith Dennis, administrative leave, academic year
Eugene Dynkin, sabbatical leave, fall 1996
Jose Escobar, sabbatical leave, academic year
Harry Kesten, sabbatical leave, spring 1997
Kakhadyr Khoussainov, leave, academic year
Michael Morley, sabbatical leave, fall 1996
Anil Nerode, administrative leave, academic year
Richard Shore, sabbatical leave, spring 1997
Moss Sweedler, sabbatical leave, fall 1996
Beverly West, leave, academic year
James West, sabbatical leave, spring 1997

On leave for 1997–98:
Marshall Cohen, sabbatical leave, spring 1998
R. Keith Dennis, administrative leave, academic year
Mark Gross, leave, spring 1998
John Guckenheimer, leave, academic year
Peter Kahn, sabbatical/admin. leave, academic year
Harry Kesten, sabbatical leave, fall 1997
Laurent Saloff-Coste, leave, academic year

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
Moss Sweedler, leave, academic year

Other department personnel changes are noted in the *Department Directory*, pages 14–15.

New Faculty for 1998–99

Gregery Buzzard, H. C. Wang Assistant Professor, received his Ph.D. in mathematics from the University of Michigan in 1995. During the 1997–98 academic year, he finished up a three year Max Zorn Instructorship at Indiana University. His area of expertise is in dynamical systems. Recently, he has been working mainly in several complex variables dynamics, with an emphasis on iteration of holomorphic maps of two variables.

Adam Epstein, H. C. Wang Assistant Professor, received his Ph.D. in mathematics in 1993 from the City University Graduate Center. Since August 1995, he has been an assistant professor at the Institute for Mathematical Sciences at the State University of New York at Stony Brook. His research interests are in complex analytic dynamics, Riemann surfaces, and Teichmüller spaces.

Vesselin Gasharov, H. C. Wang Assistant Professor, received his Ph.D. in mathematics in 1994 from Brandeis University. From July 1994 through July 1997 he was an assistant professor at the University of Michigan at Ann Arbor. He held a visiting position at MIT during the 1997–98 academic year. His research interests are combinatorics and commutative algebra.

Anthony Kable, H. C. Wang Assistant Professor, received his Ph.D. in mathematics from Oklahoma State University in May 1997, where he also worked as a visiting assistant professor during the 1997–98 academic year. His area of expertise is in Lie theory, including automorphic L-functions, algebraic number theory and prehomogeneous vector spaces.

Irena Peeva, Assistant Professor, received her Ph.D. in mathematics in 1995 from Brandeis University. Her expertise lies in the areas of commutative algebra and algebraic geometry and combinatorics. She was the C.L.E. Moore Instructor at MIT from 1995 through 1998.

Ravi Ramakrishna, Assistant Professor, received his Ph.D. in mathematics from Princeton University in June 1992. He was the J. W. Gibbs Assistant Professor at Yale from July 1994 through June 1998. Prior to that he was employed as an L. E. Dickson Instructor at the University of Chicago from October 1992 through September 1994. Ravi is an algebraist whose current research interests include the deformation theory of Galois representations.

Gifts

We continue to appreciate the kindness and generosity of alumni and other friends of mathematics. During the 1997–98 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

Bourbaki Lectures: Professors Xavier Buff and Leonard Gross each gave a Bourbaki Lecture this year at one of the triannual Bourbaki Seminars held at the Institut Henri Poincaré in Paris, France. Bourbaki, named after an obscure nineteenth century French general, is a semi-secret group of mathematicians that was initially organized following World War II to promote mathematics. It is a considerable honor to be chosen to speak about someone's work, and it is a greater honor to have someone speak about your work. Literally all of the most important recent mathematics has been the subject of at least one of the talks at a Bourbaki seminar. Scholars are not usually invited to speak about their own work, but in the case of Professor Gross, an exception was made. Professor Gross gave a talk about his own work (Harmonic Functions on Loop Groups) in english, and Professor Buff spoke about the work of Van Strien.

Clark Distinguished Teaching Award: Recipients of the Clark Award have demonstrated their devotion to teaching, student counseling and development of new courses and new methods of student instruction. Among the very best teaching assistants in the college, David Reed Solomon was presented with the Clark Award at a College of Arts and Sciences convocation honoring distinguished faculty and students. The award was accepted for Reed by Leah Gold; Reed is presently in New Zealand doing research.

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 1997–98 was awarded to James Lombardi in Astronomy and will be presented to a Mathematics graduate student at the Fall Reception to be held August 27, 1998.

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 recipient was Ferenc Gerlits.

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 Conrad Coleman. Conrad will be attending Cornell for undergraduate study in the College of Engineering.

Kieval Prize: The Kieval Prize was established in 1934 by Harry S. Kieval '36, a long-time benefactor of the Mathematics Department. Dr. Kieval left an endowment, upon his death in 1994, to continue the Kieval Prize, as well as an honorarium for visiting lecturers and an additional endowment to provide financial aid for undergraduate scholarships in mathematics. The Kieval Prize provides an annual award to an outstanding graduating senior mathematics major. The recipient of this award is selected by the Mathematics Department's Honors Committee on the basis of academic performance, the quality and variety of mathematics courses taken and faculty recommendations. The co-winners of the 1997–98 prize were Daniel Klein and Chow Ying Lee.

Daniel Klein graduated with a triple major in mathematics, computer science and linguistics and has been awarded *magna cum laude* honors in mathematics. For the next two years he will be studying linguistics at Oxford on a Marshal Scholarship. After that, he will return to the U.S. to pursue a Ph.D. in computer science.

Chow Ying Lee finished her bachelor's degree at Cornell with *magna cum laude* honors in just three years. Chow has been accepted into the graduate program and will remain at Cornell for one more year before returning to Singapore.

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. Robert Battig was the recipient of a fellowship this year.

Instructional Activities

The faculty taught 120 courses in 208 lectures during the 1997–98 academic year, generating 21,516 credit hours. They taught 5,511 students aided by 87 teaching assistants and associates. The enrollment figures are reflected in the table on pages 12–13. The Department of Theoretical and Applied Mechanics shares the teaching of Math 191 and 193 in the fall and Math 293 and 294 in the fall and spring. Fifty percent of the credit hours for these courses are accredited to T&AM, while the remaining 17,664 credit hours are accredited to Mathematics.

Summer Program

During the summer of 1997, we offered 15 courses covering areas such as History of Mathematics, Calculus, Statistics, and Engineering Mathematics in the 3-, 6- and 8-week sessions. Offering a variety of summer courses allows students to take classes needed to fulfill their graduation requirements or just to get ahead. We also offer special courses, such as Math 103 in the 6-week session, which was an introduction to knot theory and its many exciting applications: medicine, textiles, scheduling, etc. There were a total of 254 students enrolled in these courses, which included students from Cornell, other colleges and high schools. One of the major attractions for high school students, in particular, is that they get an opportunity to experience the vitality of math-

ematical life at Cornell; indeed many of these students apply for undergraduate study the following year with Cornell as their first choice.

This summer six courses were taught by members of the department, while the other courses were taught by visiting faculty. Mathematics graduate students provided TA support for the instructors in the 6-week session, and an undergraduate graded for Math 171. One graduate student from Theoretical and Applied Mechanics served as a TA for the two 8-week courses.

3-Week Session (June 4–June 27, 1997):

103 Mathematical Explorations
M. Terrell
109 Precalculus Mathematics
R. Terrell

8-Week Session (June 16–August 12, 1997):

293 Engineering Mathematics
H. Rosenzweig; Y. Potdar, TA
294 Engineering Mathematics
R. Harrell; Y. Potdar, TA (2 lectures)

6-Week Session (June 30–August 12, 1997):

101 History of Mathematics
G. Cochell
103 Mathematical Explorations
G. Bailey
105 Finite Mathematics for Biologists
D. Alfors; K. Nyman, TA
106 Calculus for Biologists
V. L. Turner; K. Nyman, $\frac{1}{2}$TA
109 Precalculus Mathematics
A. Roy; D. Brown, TA
K. Bezdek; A. Zherebtsov, TA
111 Calculus
T. Stiadle, Czar; S. Mahajan, TA
C. DeSilva; S. Ganguli, TA
G. Odifreddi; S. Crowe, TA
112 Calculus
M. White; S. Ganguli, $\frac{1}{2}$TA
171 Statistical Theory and Appl. in the Real World
A. Back; L. DeCandia, grader
192 Calculus for Engineers
J. Meier; A. Zherebtsov, $\frac{1}{2}$TA
193 Calculus for Engineers
T. Rishel; S. Mahajan, $\frac{1}{2}$TA

Curriculum Changes

The academic year 1997–98 was devoted largely to carrying through and building upon several rather sweeping curricular changes and initiatives in the calculus sequences developed during the preceding year. The new sequence Math 223–224 and the revisions in the syllabi of the 3-semester sequence 111–112–213 are described below. The change in the format of Math 192, arising from a restructuring of the first-year engineering calculus sequence, is discussed in the next section on Interdisciplinary Instructional Activity.

A curricular change of a technical administrative nature was introduced in Fall 1997: The numbering of the graduate level courses was revised in order to bring the department's numbering system into conformity with the official Cornell system. The primary results of this change is that the numbers 500-599 will henceforth be reserved for professional-level courses in mathematics education, and the numbering of all other graduate courses were increased by 100.

The following courses and sequences were added to the department's curriculum in 1997-98:

Math 223–224, *Honors Linear Algebra and Calculus*, provides an integrated treatment of linear algebra and multivariable calculus at a somewhat higher mathematical level than the other 2nd-year calculus sequences, Math 221–222 and 293–294. "Integrated" means simply that both linear algebra and calculus are taught in each semester, instead of separated into different semesters as in Math 221–222. The sequence is designed for students who expect to major in mathematics or in a strongly mathematics-related field such as physics, and who have been extremely successful in their previous calculus courses. Math 223–224 was developed and taught in 1997–98 by Professor John Hubbard; he will teach this sequence again in 1998–99.

Math 441–442, *Introduction to Combinatorics*, is an upper-level undergraduate sequence in combinatorics designed by Professors Persi Diaconis and Louis Billera. The sequence covers a wide variety of topics in the subject; however, these topics are arranged so that Math 441 is not a prerequisite for Math 442. Math 441 was taught in fall 1997 by Professor Diaconis, and Math 442 in spring 1998 by Professor Billera. Since the Mathematics Department has not offered courses in combinatorics for many years, this sequence is a most welcome addition to our curriculum. It is expected that at least one of these courses will be offered approximately every other academic year.

Math 628, *Complex Dynamical Systems*, is a first-year graduate course that treats various topics in the dy-

namics of analytical mappings of one complex variable. The course was designed by Professor John Hubbard and H. C. Wang Assistant Professor Xavier Buff as a sequel to Math 617, the department's long-standing fall semester introductory graduate course in dynamical systems. It is expected that Math 628 will be offered approximately every other spring semester, alternating with Math 618, *Smooth Ergodic Theory*.

Math 785, *Automata Theory*, is an advanced graduate topics course that discusses a variety of types of automata and their applications in mathematical logic and theoretical computer science. The course was designed and taught by H. C. Wang Assistant Professor Bakhadyr Khoussainov.

In fall 1997 Math 111–112, the department's largest first-year calculus sequence, began to use new syllabi that had been prepared during the preceding year by a subcommittee of the Curriculum Committee. This Calculus Committee, chaired by Professor Marshall Cohen, also selected a new text for the sequence. The revisions in syllabi affected primarily Math 112, in which a unit on vectors was dropped and an increased emphasis on differential equations supplied. In the fall the Curriculum Committee revised slightly the syllabus of Math 213, the third semester of this calculus sequence, so that course could accommodate the material on vectors that was no longer in Math 112; this new syllabus was introduced into the course in spring 1998. Beginning in fall 1998, Math 213, as well as the first-year honors calculus sequence Math 121–122, will also use new texts.

A comprehensive evaluation of the new fall 1997 version of Math 111 was prepared during that semester for the Calculus Committee by Visiting Professor Daina Taimina. Her report, consisting primarily of the responses of students in the course to several detailed questionnaires, contains much information and analysis that is extremely useful to the department, and we are most grateful to Professor Taimina for her efforts.

Math 503, *History of Modern Mathematics*, a new professional-level course in the history of mathematics of the 18th and 19th centuries, will be introduced and offered in spring 1999. Moreover, in that semester the Mathematics Department will, for the first time in many years, offer a course in the John S. Knight Freshman Writing Seminar program; namely, Math 189, *Reasoning About Reasoning*. This seminar is designed to increase and focus the student's abilities in both expository writing and logical and mathematical reasoning.

Interdisciplinary Instructional Activity

Mathematics/Engineering Liaison: We have recently completed the first year of the new engineering restructuring plan. The most significant effect has been that all freshmen-level engineering calculus in the fall 1997 semester was taught in small sections, with no lectures larger than 30 students. Twelve additional lectures needed for this new program were supplied for the second-level calculus course, Math 192. Additional teachers for these courses came from a new H. C. Wang Assistant Professorship in our department, four instructional teaching assistants and five additional faculty recruited from other departments at Cornell, mostly from the Engineering School. The monetary resources for this experiment (which will continue for two more years) has come from a very generous initiative from the Provost and the President.

Meanwhile, Joseph Ingoglia has performed an initial evaluation — sponsored by the Engineering School under the direction of the Mathematics Department — to see what the effects of this restructuring have been. The preliminary reports, from the students and instructors in the course, are essentially positive, but we have two more years to evaluate and compare data. One of the most difficult aspects of implementing the restructuring has been recruiting enough faculty from outside the departments of Mathematics and Theoretical & Applied Mechanics. Both of these departments have traditionally supplied instructors for engineering calculus. This problem remains, despite the monetary reimbursement that outside departments receive as an incentive to release faculty to teach Freshmen Engineering Calculus.

Teaching Exchange: Lou Billera, who would have taught two courses in Operations Research & Industrial Engineering and one course in Mathematics, taught only one course in OR&IE and two courses in Mathematics, while Richard Durrett taught a course in OR&IE.

Relocation Preparations

The Mathematics Department's move to Malott Hall is proceeding on schedule. The move will give the department the additional space needed to house all our members in one building. Another critical problem with White Hall is that the library's current collection is quite cramped. Moving to Malott will more than double the space available to the library. This will make the library a more comfortable place to work and it will also mean

that we will not have to send books to off-campus storage as the size of our collection increases. The move to a larger building will improve the working conditions for the staff. In addition, more logically designed administrative and reception areas will allow us to present a more welcoming face to our students, faculty, and visitors. On the other hand the move to Malott means leaving White Hall, to which many of us are quite attached.

Mathematics at Cornell originated, in 1868, as a part of the College of Mathematics and Engineering, and was originally housed in Sibley Hall. By 1880 it had separated from the engineering department and had joined with astronomy to form the Department of Mathematics and Astronomy (not breaking away from Astronomy and becoming a separate entity until the 1930's). Mathematics moved to White Hall in the 1880's, where we've happily existed ever since. Unfortunately, the department has long since outgrown White Hall, and for the past couple of years we've been preparing to move to Malott Hall once the Johnson Graduate School of Management moves out of Malott and into their new facilities in the recently refurbished Sage Hall.

The Sage renovation is close to being on schedule and the business school should be in their new quarters by August '98 so that renovation work in Malott can begin. The department will move at the end of the next academic year (tentatively June '99). After the Mathematics Department leaves, White Hall will be used to temporarily house the Music Department for one year (1999–00) while their building is being renovated. As far as we know the next long term tenant for White Hall has not yet been selected.

The Malott renovation involves a number of changes to the building. We will create new offices out of a small amount of the current library space and convert a cafeteria into classrooms. The heating, ventilation and air conditioning systems in the building will be renovated. Renovation work will also bring the building up to current standards for wheelchair access and fire safety. New carpeting and painting will change the color scheme. Malott has a very nice department lounge which will be renovated.

A set of drawings for the Malott renovation project have been completed and are now in the hands of contractors who will be bidding on the project. These bids are expected back soon. If the bids we receive are not too high we will proceed with the project as currently planned. The budget for the project is about four and a half million dollars with the heating and ventilation renovation being the most expensive single piece.

Department Needs

Support Staff: We're in the midst of upgrading staff computers for P2K (Project 2000) and COLTS II (Cornell On Line Time System) implementation scheduled for 1998–99. With the generous computer allotment program funded by the college in July 1997, we were able to begin a systematic replacement of outdated staff computer equipment. Although it will take a few years to accumulate funds sufficient to replace all of our outdated computer equipment, memory can be added to remaining workstations to enable all applicable employees to access the new generation of time collection technology slated for January 1999.

We are hoping funds will be identified to provide new furniture for the staff when we move to Malott Hall, although there are not currently plans to do so. One of the benefits of this move is the newly designed central administrative area. Having all the staff together in a third floor administrative area will enable us to provide a more welcoming presence to faculty, staff and students. The staff in White Hall have made do with less for many years, and modern office furniture would be a helpful change.

Operating Budget: We started the year with new general expense and teaching assistant budgets. Upon review at the end of the 1997–98 fiscal year, it appears that these changes have served us well. A special thanks to the college for recognizing our needs and providing much appreciated help.

In the beginning — with the help and creativity of our old computer-guru, Rich Jaenson — the department was able to network White Hall by essentially wiring the building ourselves. By doing so, we were able to avoid costly CIT networking installation fees and monthly access charges. This approach is no longer an option at Cornell. When we move to Malott, the operating budget will need to be increased to accommodate monthly networking charges for all of our faculty, staff and graduate student computers. In addition, initial installation charges for all these departmental workstations in Malott represent a costly one-time charge.

Equipment: A significant equipment need coincides with our forthcoming move to Malott Hall in summer 1999. At that time, long obsolete computer equipment will need to be upgraded and/or replaced in the graduate

computer room and in the Mathematics Support Center. A preliminary budget for these expenditures was submitted as a special request to the college in April 1998. We are hopeful that solutions can be found to fund this essential equipment request prior to June 1999.

Mathematics Course Enrollment Statistics

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
103	Mathematical Explorations	Lecture	Bailey, Cohen	38	114	Fall 1997
103	Mathematical Explorations	Lecture	B. West	34	102	Spring 1998
105	Finite Mathematics for Biologists	Lec/Sec	M. Terrell	255	765	Fall 1997
106	Calculus for Biologists	Lec/Sec	Durrett	153	459	Spring 1998
111	Calculus	Lecture	Cleary, Constantine, David, Henderson, Lakic, Schenck, Taimina, J. West	434	1736	Fall 1997
111	Calculus	Lecture	Cleary, Morley, Ross	169	676	Spring 1998
112	Calculus	Lecture	Berenstein, Wahlbin	213	852	Fall 1997
112	Calculus	Lecture	Constantine, David, Earle, Sen	237	948	Spring 1998
121	Modern Calculus	Lecture	Brady, Diller	32	128	Fall 1997
122	Calculus	Lec/Sec	Chase, Pilgrim	42	168	Fall 1997
122	Calculus	Lec/Sec	Kuznetsov, Pilgrim	22	88	Spring 1998
150	From Space to Geometry	Lecture	Rishel	24	72	Spring 1998
171	Statistical Theory and Applications	Lec/Sec	Back, Hwang	33	132	Fall 1997
171	Statistical Theory and Applications	Lec/Sec	Back, Farrell	44	176	Spring 1998
181	Elementary Logic & Formal Proof	Lecture	Morley	19	57	Fall 1997
191	Calculus for Engineers	Lec/Sec	Ehrenborg, Phoenix (T&AM)*, Readdy	56	224	Fall 1997
192	Calculus for Engineers	Lec/Sec	Earle, Fleischmann (A&EP), Hatcher, Kuznetsov, McIsaac (EE)*, Nag, Seyler (EE), Veselov, J. Wang	373	1492	Fall 1997
192	Calculus for Engineers	Lec/Sec	R. Terrell	312	1248	Spring 1998
193	Calculus for Engineers	Lec/Sec	Cady (T&AM)*, Erdelyi-Szabo, Rand (T&AM)*, Shoemaker (CEE), P. Stein (Physics), Strichartz	235	940	Fall 1997
193	Calculus for Engineers	Lec/Sec	Schatz	13	52	Spring 1998
213	Calculus	Lec/Sec	Khoussainov	19	76	Fall 1997
213	Calculus	Lec/Sec	Lakic	24	96	Spring 1998
221	Linear Algebra & Calculus	Lec/Sec	L. Gross, Nerode, Vogtmann	74	296	Fall 1997
221	Linear Algebra & Calculus	Lec/Sec	Chase, Wise	62	248	Spring 1998
222	Calculus	Lec/Sec	Sjamaar, Speh	30	120	Fall 1997
222	Calculus	Lec/Sec	Ehrenborg, Ngai, Veselov	54	216	Spring 1998
223	Honors Linear Algebra and Calculus	Lec/Sec	Hubbard	18	72	Fall 1997
224	Honors Linear Algebra and Calculus	Lec/Sec	Hubbard	18	72	Spring 1998
231	Linear Algebra	Lecture	Stillman	11	33	Spring 1998
281	Formal Logic	Lecture	H. Hodes (Phil)	1	4	Fall 1997
293	Engineering Mathematics	Lec/Sec	Schatz, R. Terrell	492	1968	Fall 1997
293	Engineering Mathematics	Lec/Sec	Smillie	375	1500	Spring 1998
294	Engineering Mathematics	Lec/Sec	Mukherjee (T&AM)*, Stillman	316	1264	Fall 1997
294	Engineering Mathematics	Lec/Sec	Jenkins (T&AM)*, Zehnder (T&AM)*	452	1808	Spring 1998
321	Applicable Analysis	Lec/Sec	Lakic	11	44	Fall 1997
332	Algebra and Number Theory	Lecture	Ehrenborg	22	88	Fall 1997
336	Applicable Algebra	Lecture	Readdy	51	204	Spring 1998
356	Groups and Geometry	Lecture	Pilgrim	15	60	Spring 1998
401	Honors Seminar: Topics in Modern Math.	Lecture	Brown	12	48	Spring 1998
403	History of Mathematics	Lecture	Strichartz	12	48	Spring 1998
405	Mathematical Exposition	Lecture	Rishel	4	12	Fall 1997
408	Mathematics in Perspective	Lecture	Solomon	5	20	Spring 1998
411	Introduction to Analysis	Lecture	Bailey	22	88	Fall 1997
413	Introduction to Analysis	Lecture	Chen, Escobar	34	136	Fall 1997
414	Introduction to Analysis	Lecture	Escobar, Kuznetsov	16	64	Spring 1998
418	Function Theory of One Complex Var.	Lecture	Speh	8	32	Spring 1998
420	Applicable Analysis	Lecture	Veselov	12	48	Fall 1997
420	Applicable Analysis	Lecture	Veselov	18	72	Spring 1998
422	Applicable Analysis	Lecture	Rothaus	10	40	Fall 1997
422	Applicable Analysis	Lecture	Buff	12	48	Spring 1998
427	Intro. to Ordinary Differential Equations	Lecture	Rothaus	6	24	Fall 1997
428	Intro. to Partial Differential Equations	Lecture	Rothaus	8	32	Spring 1998
431	Introduction to Algebra	Lecture	Readdy	19	76	Fall 1997
432	Introduction to Algebra	Lecture	Speh	6	24	Spring 1998
433	Introduction to Algebra	Lecture	Sjamaar	14	56	Fall 1997
434	Introduction to Algebra	Lecture	Vogtmann	14	56	Spring 1998
441	Introduction to Combinatorics	Lecture	Diaconis	17	68	Fall 1997
442	Introduction to Combinatorics	Lecture	Billera	9	36	Spring 1998
451	Euclidean and Spherical Geometry	Lecture	Solomon	6	24	Fall 1997
452	Classical Geometries	Lecture	Connelly	16	64	Spring 1998
453	Introduction to Topology	Lecture	Brown	13	52	Fall 1997
454	Introduction to Differential Geometry	Lecture	Henderson	16	64	Spring 1998

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
455	Applicable Geometry	Lecture	Billera	3	12	Fall 1997
471	Basic Probability	Lecture	Farrell	26	104	Fall 1997
472	Statistics	Lecture	Hwang	16	64	Spring 1998
474	Basic Stochastic Processes	Lecture	Chen	7	28	Spring 1998
482	Topics in Logic	Lecture	H. Hodes (Phil)	0	0	Spring 1998
483	Intensional Logic	Lecture	Stanley (Phil)	1	4	Fall 1997
486	Applied Logic	Lecture	Erdelyi-Szabo	3	12	Spring 1998
490	Supervised Reading and Research	Ind Stud	Faculty	4	12	Fall 1997
490	Supervised Reading and Research	Ind Stud	Faculty	7	21	Spring 1998
500	College Teaching	Lecture	Rishel	5	5	Fall 1997
508	Mathematics for Secondary School Teachers	Lecture	Solomon	14	24	Spring 1998
611	Real and Complex Analysis	Lecture	Dynkin	18	72	Fall 1997
612	Real and Complex Analysis	Lecture	Earle	13	52	Spring 1998
613	Topics in Analysis	Lecture	M. Gross	6	24	Fall 1997
614	Topics in Analysis	Lecture	Diller	3	12	Spring 1998
615	Mathematical Methods in Physics	Lecture	Nag	3	12	Fall 1997
617	Dynamical Systems	Lecture	Ilyashenko	12	48	Fall 1997
621	Measure Theory & Lebesgue Integration	Lecture	Ilyashenko	8	32	Fall 1997
622	Applied Functional Analysis	Lecture	Kesten	3	12	Spring 1998
628	Complex Dynamical Systems	Lecture	Buff	3	12	Spring 1998
631	Algebra	Lecture	Sen	18	72	Fall 1997
634	Algebra	Lecture	Stillman	6	24	Spring 1998
650	Lie Groups	Lecture	Berenstein	6	24	Spring 1998
651	Introductory Algebraic Topology	Lecture	Vogtmann	15	60	Spring 1998
652	Differentiable Manifolds	Lecture	Buff	7	28	Fall 1997
661	Geometric Topology	Lecture	Cohen	3	12	Fall 1997
662	Riemannian Geometry	Lecture	Hubbard	5	20	Spring 1998
671	Probability Theory	Lecture	Dynkin	19	76	Fall 1997
672	Probability Theory	Lecture	Dynkin	11	44	Spring 1998
674	Introduction to Mathematical Statistics	Lecture	Hwang	10	40	Spring 1998
681	Logic	Lecture	Nerode	3	12	Spring 1998
711	Seminar in Analysis	Seminar	Kigami	2	8	Fall 1997
712	Seminar in Analysis	Seminar	J. Wang	3	12	Spring 1998
713	Functional Analysis	Lecture	L. Gross	14	56	Spring 1998
715	Fourier Analysis	Lecture	Strichartz	6	24	Spring 1998
728	Seminar in Partial Differential Equations	Seminar	Wahlbin	7	28	Spring 1998
731	Seminar in Algebra	Seminar	Sweedler	6	24	Fall 1997
732	Seminar in Algebra	Seminar	Berenstein	1	4	Spring 1998
735	Topics in Algebra	Lecture	Barbasch	4	16	Fall 1997
737	Algebraic Number Theory	Lecture	M. Gross	4	16	Fall 1997
739	Topics in Algebra II	Lecture	Barbasch	4	16	Spring 1998
751	Seminar in Topology	Seminar	Brady	2	8	Fall 1997
752	Seminar in Topology	Seminar	Hatcher	4	16	Spring 1998
753	Algebraic Topology	Lecture	J. West	1	4	Fall 1997
757	Topics in Topology	Lecture	Brown	8	32	Fall 1997
758	Topics in Topology	Lecture	Brady	3	12	Spring 1998
761	Seminar in Geometry	Seminar	J. Wang	4	16	Fall 1997
771	Seminar in Probability and Statistics	Seminar	Seminar	0	0	Fall 1997
772	Seminar in Probability and Statistics	Seminar	Seminar	0	0	Spring 1998
777	Stochastic Processes	Lecture	Durrett	6	24	Fall 1997
778	Stochastic Processes	Lecture	Chen	6	24	Spring 1998
781	Seminar in Logic	Seminar	Shore	5	20	Fall 1997
782	Seminar in Logic	Seminar	Shore	5	20	Spring 1998
784	Recursion Theory	Lecture	Shore	3	12	Spring 1998
785	Automata Theory	Lecture	Khoussainov	6	24	Fall 1997
788	Topics in Applied Logic	Lecture	Platek	2	8	Fall 1997
790	Supervised Reading and Research	Ind Stud	Faculty	27	160	Fall 1997
790	Supervised Reading and Research	Ind Stud	Faculty	28	128	Spring 1998

TOTALS	Courses	Lectures	Enroll	Dept* Cr Hrs	Total Cr Hrs
Academic Year	120	208	5,511	17,664	21,516
Fall Semester	59	119	3,080	9,839	12,037
Spring Semester	61	89	2,431	7,825	9,479

* The Department of Theoretical and Applied Mechanics shares the teaching of Math 191 and 193 in the fall and Math 293 and 294 in the fall and spring; 50% of the credit hours for these courses are accredited to T&AM, while 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

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
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
Michael Stillman

Assistant Professors:
Zhen-Qing Chen
Reyer Sjamaar

Adjunct Professors:
Graeme Bailey

Adjunct Associate Professors:
Maria Terrell
Robert Terrell

H.C. Wang Assistant Professors:
Arkady Berenstein
Noel Brady
Xavier Buff
Jeffrey Diller
Richard Ehrenborg
Miklós Erdélyi-Szabó
Bakhadyr Khoussainov
Nikola Lakic
Kevin Pilgrim
Jiaping Wang
Daniel Wise

Senior Lecturers:
Thomas Rishel
Avery Solomon
Beverly West

Visiting Faculty:
Jun Kigami
Sergei Kuznetsov
Subhashis Nag
Sze-Man Ngai
Margaret Readdy
Daina Taimina
Vladimir Veselov

Visiting Program Participants:
Richard Cleary
Kenneth Constantine
Karl David
Kenneth Ross
Henry Schenck

Visiting Scholars:
Christian Bluhm
Jane-Jane Lo
Zhonggen Su

Teaching Associates:
Moon Duchin
Richard Furnas

Graduate Students:
Henrique Araujo
Robert Battig
Eknath Belbase
Debra Lynn Boutin
David Brown
Ryan Budney
Stephen Bullock
Andrei H. Caldararu
Sean Michael Crowe
Alan Robert Demlow
Vincent Thomas Frisina
Maria G. Fung
Suman Ganguli
Gonzalo Garcia
Ferenc Gerlits
Illya German
Leah Gold
Maria M. Gordina
Denis Roman Hirschfeldt
Matthew Horak
Geoffrey Hruska
Haiying Huang
Antal Jarai
Craig A. Jensen
Min Jeong Kang
Shannon Kelly
Wicharn Lewkeeratiyutkul
Qi Lu
Jennifer Lynch
Swapneel Mahajan
Brian A. Meloon
Joseph Stephen Miller
Nathaniel G. Miller
Robert Saxon Milnikel
Jeffrey Mitchell
Sudeb Mitra
Kathryn Louise Nyman
Luis O'Shea
Lisa A. Orlandi
Wei Ouyang
Shu-Yen Pan
Ofer Porat
David Robert Revelle
Shayan Sen

David Reed Solomon
Sarah Spence
Catherine Anne Stenson
David Stephenson
Alexander Teplyaev
Jonathan Todd
Juan Carlos Uribe
Anke B. Walz
Walker McMillan White
Bernd Wuebben
Yongjian Xiang
Wenhuan Zhao
Andrei Zherebtsov

Visiting Graduate Students:
Erdal Emsiz
Christian Henriksen
Asya Rabinovich

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

Computer Consultants:
Douglas Alfors
Robert Terrell

Instructional Computer Lab:
Allen Back, director
Douglas Alfors, associate director

Mathematics Support Center:
Douglas Alfors, director
Richard Furnas

Library Staff:
Michelle Paolillo
Steven Rockey, librarian
Stace Sisco
Raj Smith

Changes for 1998–99

Promotion:
Michael Stillman to professor

New Assistant Professors:
Irena Peeva
Ravi Ramakrishna

New H.C. Wang Asst. Professors:
Gregery Buzzard
Adam Epstein
Vesselin Gasharov
Anthony Kable

New Graduate Students:
Nelia Charalambous
Dan Ciubotaru
Yuval Gabay
Noam Greenberg
Samuel Hsiao
Chow Ying Lee
Dmitriy Leykekhman
Lekheng Lim
Yi Lin
Steven Morris
Maria-Christina Patron
Rajmohan Rajagopalan
Rebecca Schuller
Steven Sinnott
Roman Tymkiv
Russell Woodroofe
Yan Zhang
Huibin Zhou

Faculty Departures:
Noel Brady
Xavier Buff
Zhen-Qing Chen
Jeffrey Diller
Richard Ehrenborg
Bakhadyr Khoussainov
Nikola Lakic
Kevin Pilgrim

Faculty Leaves:
Ken Brown, spring 1999
Persi Diaconis, academic year
Richard Durrett, spring 1999
Mark Gross, academic year
Allen Hatcher, fall 1998
Moss Sweedler, academic year

Special Programs and Activities

Spring Concert Series

On the evening of Tuesday, May 5, 1998, 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 eighth 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 a dance exhibition.

Three Songs from Dichterliebe, opus 48, Robert Schumann: 1. Im wunderschönen Monat Mai; 2. Aus meinen Tränen sprießen; 3. Die Rose, die Lilie, die Taube, die Sonne; Douglas Alfors — tenor; Clifford Earle — piano.

Spring, David Henderson: David Henderson — piano.

Walk Right In, Gus Cannon: Jon Rosenberger — jug; Michael Gray — banjo; Roman Koshykar — guitar.

Minuet from Quartet in D Minor, W. A. Mozart: Brian Hwang — violin; Graeme Bailey — piano.

Duet for Flute and Violin, Carl Philipp Emmanuel Bach: Brenda Posipanko and Nina Tillman — flutes.

Charlie Rutlage, Charles Ives: Clifford Earle — voice; Graeme Bailey — piano.

Diamonds Are a Girl's Best Friend, Lyrics — Leo Robin (additional lyrics by Margaret Readdy); Music — Jules Styne: Kathryn Nyman, Peter Haberlandt, Joshua Thorp — singers.

If Beethoven Wrote Waltzes, If Chopin Wrote Fugues, deconstructed by Robert Strichartz: Jon Rosenberger — flute; Bob Milnikel — clarinet; Brian Hwang — violin; Graeme Bailey — cello; Clifford Earle — piano; Robert Strichartz — conductor.

A Moving Experience, original skit: Moss Sweedler, Richard Ehrenborg, Margaret Readdy (lyricist).

Ariel's Song (from Shakespeare's *The Tempest*), Music — Robert Strichartz: Kathryn Nyman — soprano; Douglas Alfors — tenor.

Five Easy Pieces, Karl David: 1. Simple Song; 2. Two-hand Swing; 3. "Happy Anniversary, Franz" waltz; 4. 3/2 Tango; 5. Andante con moto; Karl David — piano.

Sonata for bassoon and piano, Paul Hindemith; Bob Milnikel — bass clarinet; Graeme Bailey — piano.

Lazy Sunday Rag, Denis Hirschfeldt: Denis Hirschfeldt — guitar; Bob Milnikel — clarinet; Graeme Bailey — cello.

A Swing Dance Exhibition: Suzanne Lynch, Chris Hruska, Joe Miller, Kathryn Nyman, Nat Miller, Leah Gold — dancers

Shut de Do', Randy Stonehill, arranged by Mark Hayes: Cathy Stenson, Nat Miller, Bob Milnikel, Min Kang, Suzanne Lynch — singers; impromptu appearance by Diane Downing.

Topology Festival

The topology/geometry group of the Mathematics Department hosted the thirty-sixth annual Topology Festival on May 1–3 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:

Daryl Cooper, University of California at Santa Barbara: *Some Surface Subgroups Survive Surgery*

James Stasheff, University of North Carolina: *From Operands to String Theory*

Jon McCammond, Texas A & M University: *General Versions of Small Cancellation Theory*

William P. Thurston, University of California at Davis: *Analyzing 3-Manifolds with Snappea,* an informal computer demonstration

Michael Hutchings, Harvard University: *Reidemeister Torsion in Generalized Morse Theory (with an Application to Seiberg-Witten Theory)*

Alan Reid, University of Texas: *Thue Equations and Dehn Surgery*

Michael Handel, Lehman College and Graduate Center, CUNY: *The Mapping Torus of a Free Group Automorphism is Coherent*

William P. Thurston, University of California at Davis: *Three-Manifolds that Slither around the Circle*

The 37th Cornell Topology Festival will be held during the first week of May 1999.

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.

Eleven Cornell graduate students gave ten talks on such topics as *Origami and mathematics* and *The history of the number pi* to a mixed audience of faculty and graduate 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 and Catherine Stenson coordinated these talks. In April, Robert Milnikel and Maria Fung were invited through the program to speak at the MAA sectional meeting in Toronto.

During the 1998 joint meetings of the MAA and AMS, Tom Rishel moderated an MAA Panel Discussion about university teaching. Richard Cleary of St. Michael's College, John Meier of Lafayette College (formerly a Cornell graduate student), Teresa Moore of Ithaca College and Dennis Luciano of Western Massachusetts formed the panel, which discussed the job interview process, teaching, the ingredients of a good vita and cover letter and programs on teaching designed for graduate students. Rishel talked about preparing CVs and cover letters and spoke on the special programs for graduate students to interact with students and faculty at traditionally four-year colleges. Cleary and his current chair, Zsuzsanna Kadas conducted a mock interview, using questions that can be expected in an employment register interview. Cleary, Meier, Moore and Rishel gave similar job market seminars at SUNY at Binghamton, Syracuse University and Cornell University. They will also conduct the Panel Discussion at the 1999 joint meetings to be held in San Antonio.

The final meeting of the Preparing Future Professors program was held in the Adirondacks in May. Tom Rishel and graduate students Maria Fung and Catherine Stenson gave presentations to assembled faculty from Syracuse University, SUNY at Binghamton, New York University and SUNY at Stony Brook on what they learned from the their involvement with the program.

The National Research Council asked Prof. Rishel to present a panel at a meeting of Mathematics Department chairs last November in Washington, DC, in hopes that more graduate departments will consider giving their students the opportunity to learn more about the professorate in the hands-on way Cornell has developed. Rishel will also chair a national PFP committee for the MAA next year.

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. Congratulations go to Steve Hedge on the winning design! 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

During the summer of 1997, the department held its fourth Research Experiences for Undergraduates (REU) program. Sponsored by the National Science Foundation, this program brings talented under-graduates from across the nation to work on research projects directed by Cornell faculty and visitors. This year the department was fortunate to have an additional Cornell grant (President's discretionary funding), which enabled an unusually large number of visitors to assist the program. The eleven student participants came from a variety of universities (Harvard, Yale, University of Missouri at St. Louis) and included two from Cornell — Harold Fox and Jonathan Rynd. The Cornell faculty who directed projects were Richard Ehrenborg, John Hubbard, Kevin Pilgrim, Margaret Readdy and Robert Strichartz. Cornell graduate student Alexander Teplyaev and visitors Adam Epstein (SUNY at Stony Brook), Rick Kenyon (Université de Lyons) and Yang Wang (Georgia Tech) also participated. Several research papers are in the process of being written based on the work accomplished, co-authored by student and faculty participants.

The students in the program devoted most of their time to individual research problems, but they also experienced giving talks based on their research to each other, the public, and the press. (Articles about the program were published in both the *Ithaca Journal* and the *Cornell Chronicle*.) The program also included a lecture series, the Smorgasbord Seminar (open to the public), in which the broad spectrum of research interests of the depart-ment's faculty were showcased. True to the name, the talks were followed by gourmet refreshments, including fresh locally grown strawberries.

The student research projects fell into three general areas: (1) analysis on fractals; (2) dynamics of analytic mappings; and (3) combinatorics of polytopes. Within these areas, students worked either individually or in small groups. Some of the work involved a lot of computer programming, either to implement known algorithms or to explore complex examples in order to generate and test conjectures. Many of the students also participated in the more traditional research activities of finding proofs. The students working on analysis on fractals were directed by Robert Strichartz, but often found that graduate student Sasha Teplyaev and visitors Rick Kenyon and Yang Wang gave the best advice. They studied the analog of differential equations on a class of fractals, including the pentagasket (Fig. 1). This theory, originated by Jun Kigami (currently a visiting professor in the department), has the advantage of allowing very explicit calculations to be made. The students worked out the details of this theory for a large class of new examples

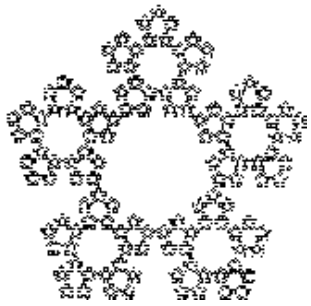


Figure 1

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

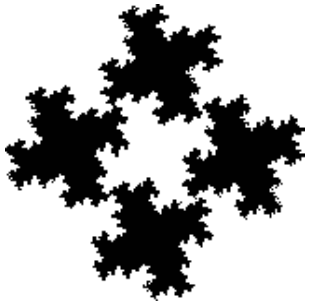


Figure 2

Students working on dynamics of analytic mappings were directed by Kevin Pilgrim, Adam Epstein and John Hubbard. One project involved a census of dynamically interesting rational maps, which had been begun the previous summer by other students of Kevin Pilgrim. This summer's work involved finding all conjugacies between maps on the list. The completed census has no duplications and will soon be available on a web site. Another project involved studying universal relationships between derivatives at periodic points for quadratic rational maps $\left(\frac{az^2+bz+c}{ez^2+fz+g}\right)$ on the Riemann sphere, generalizing results of John Milnor. The project directed by John Hubbard involved an ambitious attempt to find the analog of the Mandelbrot set for a class of mappings

(Henon maps) in two complex variables. The computational approach requires the ability to find all roots of certain polynomial equations of very high degree.

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

Jade Vinson, who participated in the REU program in 1996, working with Robert Strichartz and Karoly Bezdek, was the 1997 recipient of the Morgan Prize for undergraduate research. This is a national prize, administered jointly by the AMS, MAA and SIAM. Much of the research for which he received the award was done at Cornell. The summer of 1998 brings another group of students to Cornell, for our fifth REU program, to work on projects directed by John Hubbard, Jun Kigami and Robert Strichartz.

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. Thomas Coleman was the Director of CAM this year and Stephen Vavasis served as Director of Graduate Stuides. 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 75 center faculty are drawn from the Department of Mathematics and thirteen other departments in engineering and the sciences.

Mathematics Professors: L. Billera, R. Connelly, R. Durrett, E. B. Dynkin, 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 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 Sciences was formed effective July 1, 1997, by the combined efforts of the affiliated faculty, college deans and university administration. At the outset, the department will have 29 faculty with primary and joint appointments in other departments. This new organizational structure will allow better coordination of teaching, consulting, research and computing. It will also make it possible to offer a university-wide undergraduate degree and an applied masters program. The Department of Statistical Sciences will move into Malott Hall in June 1999, along with the Department of Mathematics.

Mathematics Library

The Mathematics Library is Cornell University's prestigious collection of source materials for mathematical research. Under the direction of Mathematics Librarian Steven Rockey, the research collection consists of works on mathematics, statistics, applied mathematics and the history of mathematics. For undergraduates with an interest in mathematics the library is a wonderful resource, which also includes materials to support instructional and career needs as well as expository and recreational reading. The library has great historic depth and breadth, with 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 mathe-

matical 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 Mathematics Library has a staff of three — Steve Rockey, Stace Sisco, Raj Smith — 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 of the library is to make the experience of the staff and patrons interesting, productive and enriching in a small and personal environment.

The Mathematics Library has almost 50,000 books and bound journal volumes, and an average of 1,200 new volumes are added each year. There are 540 current journal subscriptions. In addition, the library has a collection of video tapes and a TV-VCR unit available in the library or for use on loan. The library stacks are extremely overcrowded, but the library will move into a new facility in Malott Hall with plenty of room for growth in 1999. The 1997–98 budget base for acquisitions is $186,500, not including income from endowments. The total endowment earning available for book purchases next year will be in excess of $27,000.

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 interested in adding new and relevant links to their 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.

Special Projects

Almost 600 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. You can view the books remotely by going to the Cornell Digital Library at: http://moa.cit.cornell.edu/ and selecting the link for "Cornell Library Math Book Collection."

Special Instructional Support

Computer Lab

Regular users of the lab at least one semester this year included Statistics (171), Multivariable Calculus (222), Mathematical Explorations (103), Applicable Analysis (420), and some of the courses where geometry arises (408, 451 and 508). Semi-regular users at least one semester included Linear Algebra (221), Multivariable Calculus (213) and Differential Geometry (454). Occasional users included Calculus (112), Complex Variables (418), Algebra (432), Precalculus (109) and Classical Geometries (452). The lab also hosted a number of geometry conferences, movie presentations and served as a major site for teaching related courses. During the summer, the lab continues as the principal location for many REU (Research Experiences for Undergraduates) students to pursue their work.

Lab Director Allen Back has also received equipment under the Intel sponsored Tech2000 project. This was received in large part because of the lab's longstanding support of REU and other research activity relevant to Professor Bob Connelly's symmetric tensegrity catalog.

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!

Despite the obvious merits of its services, the Center has continued to suffer from lack of sufficient space and dependence on antiquated equipment. We are looking forward to our new space in Malott Hall. As use of

computers increases in the undergraduate mathematics curriculum, it is vital that antiquated computer equipment in the Center be updated with machines capable of running current mathematical software.

Learning Skills Center

The Learning Skills 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 Sundays (in mathematics) to review the week's material from the *parent* course. LSC tutors were available during regularly scheduled hours, on a walk-in basis, free of charge, for all students in the course. Prelim review sessions were given 3–7 days in advance of prelims. Academic support in the form of tutoring was given to Math 171 students at the Academic Support Center for Undergraduate Statistics (ASCUS), where students in many introductory statistics classes campus-wide can come for tutoring and help on computer-based assignments.

Academic support for all of these courses will continue in this fashion during the 1998–99 academic year. Less formal academic support will 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 fourth 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. Twenty-eight 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 and Avery Solomon.

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 other surfaces — 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 continues to assist Ithaca High School and other area schools in instituting "Math Labs" in their courses and is piloting a classroom intervention program in two middle schools.

Activities of the CSMRP in 1997–98 included: consulting for an algebra project and curriculum development at De Witt Middle School; visits to and con-

sultation with Moravia, Tully and Norwich schools; a workshop on writing in the mathematics classroom with Vestal teachers; a workshop on Geometer's Sketchpad in BCC for Binghamton teachers and BCC; work with DeWitt middle school teachers on developing units of instruction in algebra and geometry; videotape editing work to produce a video modeling constructivist teaching in the classroom; organization and co-teaching of seven workshops with Ithaca High School on integrating science, mathematics and technology for middle and high school teachers; and a five-week workshop/course on Geometer's Sketchpad in Elmira.

Geometry Workshop for Mathematics Teachers

The Geometry Workshop introduces a hands-on approach to basic concepts in the high school curriculum, giving participants an opportunity to share new ideas. This year's workshop entitled *Exploring Geometry on Sphere, Plane and Screen* was held on June 25–29, 1998.

In the mornings, *Geometry on cone, sphere and plane: developing our own proofs and understanding*, led by Avery Solomon and Steve Weissberg and Beth Porter explored the geometry of plane, sphere and cone in a physical hands-on way as a context for investigating the questions: What is geometric intuition? How does it affect and effect our understanding? Are precise definitions always desirable in geometry? Are they always possible? What use are geometric axioms? What power do they give us? Is knowledge gained without axioms inferior to knowledge from formal axiom systems?

In the afternoons, *Geometry on Geometer's Sketchpad*, led by Dr. Avery Solomon and Sarah Burnett explored problems using *Geometer's Sketchpad* and in this context continued discussion of the nature of proof, construction and discovery.

The Geometry Workshop is sponsored by a DDE title II grant from New York State and the Cornell/Schools Mathematics Resource Program.

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 1997–98

Doctoral Degrees

August 1997

Marcelo Aguiar

Internal Categories and Quantum Groups

BS, Universidad de Uruguay, 1991
Committee: Chase, Brown, Sweedler

Abstract: Let $\mathcal{S}$ be a monoidal category with equalizes that are preserved by the tensor product. The notion of *categories internal to* $\mathcal{S}$, and extending the usual notion of internal categories, which is obtained when $\mathcal{S}$ is a category with products and equalizers.

The basic theory of internal categories is developed and several applications to quantum groups are found. Delta categories are defined; these are algebraic objects that generalize groups or bialgebras, in the sense that attached to them there is a monoidal category of representations. Quantum groups are constructed from delta categories. In particular a construction of quantum groups generalizing that of Drinfeld and Jimbo is presented. An invariant of finite dimensional quasitriangular Hopf algebras is constructed.

Harel Barzilai

Finiteness Properties For Handlebody Mapping Class Groups

BS, Dartmouth College, 1988
Committee: Hatcher, Brown, Vogtmann

Abstract: We study the mapping class group of a handlebody V by introducing the notion of "patches" on V as the appropriate analogs of other "boundary objects" such as boundary circles for compact surfaces and boundary spheres of certain 3-manifolds.

We then define a 1-patched version of the handlebody mapping class group, and a *disc-arc complex* DAC upon which it acts. We show that DAC is finite dimensional, contractible, and locally finite, and that the action has finite simplex stabilizers, and is co-compact. We derive from this action that handlebody mapping class groups are finitely presented, of type VFL. We prove also that these one-patched mapping class groups are simply-connected at infinity.

We also derive substantial partial results for establishing homological stability for the 1-patched handlebody mapping class group. We note that in the rather different contexts of DAC and finiteness properties on the one hand, and the arena of homological stability on the other, the notion of "patches" is a fruitful analog allowing (modifications of) many familiar constructions to be applied, and familiar results to be established as if the handlebody had one or many localized boundary components.

Nikhil Shah

Predator Mediated Coexistence

BS, University of Waterloo, 1993
Committee: Durrett, Chen, Kesten

Abstract: Unavailable for publication.

January 1998

Robert John Battig (posthumous)

Completeness of Securities Market Models — An Operator Point of View

BS, University of California at Davis, 1991
MS Special, Cornell University, 1994
Committee: Durrett, L. Gross, Jarrow

Abstract: We propose a notion of market completeness which is invariant under change to an equivalent probability measure. Completeness means that an operator T acting on stopping time simple trading strategies has dense range in the weak* topology on bounded random variables. In our setup the claims which can be approximated by attainable ones has codimension equal to the dimension of the kernel of the adjoint operator T^* acting on signed measures, which in most cases is equal to the "dimension of the space of martingale measures." From this viewpoint the example of Arzner and Heath (1995) is no longer paradoxical since all these dimensions are 1. We also illustrate how one can check for injectivity of T^* and hence for completeness in the case of price processes on a Brownian filtration (e.g. Black-Scholes, Heath-Jarrow-Morton) and price processes driven by a multivariate point process.

Jennifer Mary Davoren

Modal Logics for Continuous Dynamics

BS, University of Melbourne, 1991
Committee: Nerode, Shore, Constable

Abstract: This work is a formal investigation of a number of bimodal and polymodal logics built on a base of propositional **S4**, and is a contribution to the theory of hybrid control systems. It is the first stage of a larger project of developing logics for the design and verification of such systems. A hybrid control system is a network of finite-state digital machines which act on and react to a dynamically changing environment, where such environments may have mixed analog and digital states. Following Nerode, I look to topology to provide a mediating link between the analog and digital worlds; **S4** is taken as a logical foundation since from Tarski and McKinsey, it is the logic of topology.

The base logic **S4F** adds to the $\Box$ (topological interior) of **S4** a modality $[a]$ for representing the effect of an action in an environment; $[a]$ is interpreted by a total function. In this logic, the continuity of a function with respect to a topology is expressible. In the second stage of this study, a fragment of deterministic propositional dynamic logic **DPDL** is overlaid on **S4F** to produce a new modal dynamic logic. In the resulting logic, called **TPDL** (topological propositional dynamic logic), atomic actions are interpreted by continuous functions, and complex actions are formed under the Kleene operations of composition, choice and iteration.

Both a Tarski-style topological semantics and a Kripke semantics are presented for the logics. Building on work of Grzegorczyk, I identify a subclass of topological structures naturally dual to Kripke frames. Topologies in this class are such that every point is contained in a smallest open set. As argued by Nerode, these are precisely the topologies needed to give an account of analog-to-digital conversion.

In addition to Hilbert-style axiomatizations, tableaux proof systems are presented for each of the logics and proved complete. The tableaux completeness proofs construct countable T_0 topologies whose elements are functional terms, in which the term constructor functions are continuous. Finite quotients of the term model are obtained, so establishing the decidability of each of the logics.

Yongjian Xiang

Computing Thom-Boardman Singularities

BS, Peking University, 1992
MS Special, Cornell University, 1996
Committee: Guckenheimer, Smillie, Vavasis

Abstract: Thom-Boardman singularities describe the hierarchical degeneracy of smooth mappings between smooth manifolds. This thesis presents a numerical method to compute a regular set of defining equations for Thom-Boardman singularities. Using an automatic differentiation package, we have written C++ and Matlab programs to test the algorithm developed in the thesis. As a byproduct of the development of the algorithm, we present algorithmic proofs of some of the theoretical results proved in Boardman [3]. Using bordering matrix

techniques, we have also derived a simpler algorithm that computes non-regular defining equations. Numerical experiments show that the algorithm that computes regular equations is much more robust than the algorithm based on bordering matrices.

May 1998

Eknath Belbase

Coexistence in a Two Species Reaction Diffusion Process Using a Hydrodynamic Limit

BA, Ohio Wesleyan College, 1992
MS Special, Cornell University, 1996
Committee: Durrett, L. Gross, Kesten

Abstract: A two-species reaction diffusion process on the scaled integer lattice with scaling ϵ, linear and quadratic birth and death rates and migration according to a random walk with rate $1/\epsilon^2$ is considered. As $\epsilon \to 0$ the density fields are shown to converge in probability to the weak solutions of a system of partial differential equations. Properties of these solutions are then shown to imply the existence of a stationary distribution for small ϵ where both species co-exist.

Ricardo Antonio Oliva

On the Combinatorics of External Rays in the Dynamics of the Complex Henon Map

BS, Cornell University, 1989
MS Special, Cornell University, 1994
Committee: Cohen, Vogtmann, Earle
Abstract: Unavailable for publication.

David Reed Solomon

Reverse Mathematics and Ordered Groups

BS, Notre Dame University, 1992
MS Special, Cornell University, 1997
Committee: Shore, Nerode, Kozen
Abstract: Unavailable for publication.

Alexander Vyacheslav Teplyaev

Spectral Analysis on Infinite Sierpinski Gaskets

MS, Leningrad State University, 1990
Committee: Strichartz, Dynkin, L. Gross

Abstract: We study the spectral properties of the Laplacian on infinite Sierpinski gaskets. We prove that the Laplacian with the Neumann boundary condition has pure point spectrum. Moreover, the set of eigenfunctions with compact support is complete. The same is true if the infinite Sierpinski gasket has no boundary, but is false for the Laplacian with the Dirichlet boundary condition. In all these cases we describe the spectrum of the Laplacian and all the eigenfunctions with compact support.

To obtain these results, first we prove certain new formulae for eigenprojectors of the Laplacian on finite Sierpinski pre-gaskets. Then we prove that the spectrum of the discrete Laplacian on a Sierpinski lattice is pure point, and the eigenfunctions are localized.

Master of Science Special

(No Thesis Required)

August 1997

Turkmen Ornek, Mathematics
BS, Middle East Technical University, 1992
Committee: Durrett, Wahlbin, Vogtmann

David Eugene Tang, Mathematics
BS, MIT, 1994
Committee: Hubbard, Morley, Smillie

Juan Uribe, Mathematics
BS, Universidad de Los Andes, 1992
Committee: Sweedler, Cohen, Stillman

January 1998

Catherine Anne Stenson, Mathematics
BS, Brown University, 1994
Committee: Billera, Connelly, Helmann, Diaconis

David Mark Stephenson, Computer Science
BS, Pennsylvania State University, 1992
Committee: Kesten, Tardos, Durrett

May 1998

Sean M. Crowe, Mathematics
BS, University of California at Davis, 1993
Committee: Barbasch, Cao, L. Gross

Ilya German, Computer Science
BS, Tel-Aviv University, 1993
Committee: Durrett, Swindle, Chen, Zabih

Bachelor of Arts

August 1997

Igor Tsukerman

January 1998

Grainne E. O'Neill
Yevgeniy Rozenfeld †
Summa Cum Laude in Computer Science
Cum Laude in Mathematics

May 1998

Scott Allan Carter †
Stephen H. Chan
Akhil Dhawan †
Cum Laude in Economics
Maurice Avrum Garfinkel
Dimitre N. Germanov
Michael J. Inguagiato
Michael David Kassatly
Daniel Louis Klein †
Summa Cum Laude in Linguistics
Summa Cum Laude in Computer Science
Magna Cum Laude in Mathematics
Yishen Kuik †
Michael Gregory Larocque
Cum Laude in Mathematics
Chow Ying Lee †
Magna Cum Laude in Mathematics
Frank David McSherry †
Cum Laude in Computer Science
Rahul Mehta †
Cum Laude in Economics
Kenneth Jarrod Millman
Paul Edgar Owens
Mark Andrew Paskin †
Cum Laude in Computer Science
Kyle R. Rose †
Magna Cum Laude in Computer Science
Cum Laude in Mathematics
Jon Lin Rosenberger †
Michael Brandon Silverstein
Cum Laude in Mathematics
Seth Erickson Walters †
Cum Laude in Mathematics
Joyce Jeanpin Wang

† **Distinction in all subjects**

Department Colloquia

Analysis Seminar

September 97

Lucio Rodriguez, IMPA (Rio, Brazil): *Minimal surfaces in $\mathbb{R}^3$ with one end and bounded curvature*

Eugene Dynkin, Cornell University: *Positive solutions of a class of semilinear elliptic equations*

Jun Kigami, Kyoto University and Cornell University: *Counting localized eigenvalues of the Laplacian on fractals*

Sergei Kuznetsov, Cornell University: *Fine trace on the boundary for solutions of semilinear elliptic PDEs*

Kenneth Ross, University of Oregon and Cornell University: *Riemann sums on locally compact groups*

October 97

Jeff Mitchell, Cornell University: *Hermite functions on compact Lie groups*

William Minicozzi, John Hopkins University: *Weyl type bounds for harmonic functions*

Robert Strichartz, Cornell University: *Geometry of self-similar tiles*

January 98

Jeff VanderKam, Princeton University: *L^∞ norms of spherical harmonics and eigenfunctions on arithmetic surfaces*

February 98

Yuan Lou, University of Chicago: *Diffusion vs. cross diffusion: an elliptic approach*

Gang Liu, Massachusetts Institute of Technology: *Floer homology*

Sze-Man Ngai, Chinese University of Hong Kong and Cornell University: *Multifractal formalism for overlapping self-similar measures*

Joseph Fu, University of Georgia: *Geometric measure theory and the Riemannian geometry of singular spaces*

March 98

Jiaping Wang, Cornell University: *Analytical aspects of nonnegative Ricci curvature*

Jianguo Cao, University of Notre Dame: *Gromov's minimal volume gap conjecture for nonpositively curved manifolds*

Wicharn Lewkeeratiyutkul, Cornell University: *Perturbation theorems for supercontractive semigroups*

Leonard Gross, Cornell University: *Hypercontractivity over complex manifolds*

April 98

Nat Smale, University of Utah: *Singular area minimizing surfaces in a homology class*

Gonzalo Garcia, Cornell University: *Conformal deformation of metrics on the n-ball*

Combinatorial and Algebraic Geometry Seminar

September 97

Richard Ehrenborg, Cornell University: *Valuations and the characteristic polynomial*

Louis Billera, Cornell University: *Linear inequalities for graded posets*

Margaret Readdy, Cornell University: *Mixed volumes of slices of the unit cube*

Arkady Berenstein, Cornell University: *Products of Schur polynomials, sums of Hermitian matrices and piecewise linear combinatorics*

October 97

Oscar Rothaus, Cornell University: *Polytopal approximations to convex sets*

Persi Diaconis, Cornell University: *Threshold graphs*

Moss Sweedler, Cornell University: *Intimations of generality*

November 97

Lisa Jeffrey, McGill University: *Holomorphic bundles on Riemann surfaces and the Verlinde formula*

Kelly Wieand, Harvard University: *Superuniform distributions for random permutations*

Louis Billera, Cornell University: *Enumeration in graded posets*

Yasuyuki Kachi, Johns Hopkins University: *Characterization of projective spaces and hyperquadrics in terms of the minimal degree of rational curves connecting points*

Lars Ernström, Royal Institute of Technology (Stockholm): *Quantum products*

Hal Schenck, Cornell University: *Free arrangements*

December 97

Bob Connelly, Cornell University: *Symmetric tensegrities*

January 98

Mike Stillman, Cornell University: *Primary decomposition of some ideals in statistics*

February 98

Ken Brown, Cornell University: *Combinatorial topology and eigenvalues*

Eric Babson, Institute for Advanced Study: *Counting faces of cubical spheres*

Louis Billera, Cornell University: *The geometry of products of minors*

Veit Elser, Cornell University: *Mathematical problems generated by the study of quasicrystals*

March 98

Thomas Zaslavsky, Binghamton University: *Supersolvable matroids of signed and biased graphs*

Steve Pagano, Binghamton University: *Vector representation of matroids of signed graphs*

Louis Billera, Cornell University: *The geometry of products of minors*

Karen Vogtmann, Cornell University: *Forests and partitions in outer space*

April 98

Persi Diaconis, Cornell University: *Counting lattice points in polytopes*

Rachel Hastings, Cornell University: *Products of simplices and compositions; or How to find a triangle in a tree*

Moon Duchin, Harvard University and Cornell University: *The Colin de Verdiere graph parameter*

Mehrdad Shahshahani, University of Wisconsin: *Morse theory for finite combinatorial structures*

Dynamics and Geometry Seminar

September 97

Yulij Ilyashenko, Moscow State University and Cornell University: *Generic foliations in* $\mathbb{C}^2$

Subhashis Nag, Institute of Mathematical Sciences (Madras, India) and Cornell University: *Teichmüller space of the universal solenoid and a new modular group*

Xavier Buff, Cornell University: *Baby Mandelbrot sets in the universal elephant* (in two parts)

October 97

John Hubbard, Cornell University: *Shishikura's proof that the Mandelbrot set has dimension two*

Yulij Ilyashenko, Moscow State University and Cornell University: *Generic foliations in* $\mathbb{C}^2$

Dante Giarrusso, St. Lawrence University: *The Galois group of the Mandelbrot set*

Yulij Ilyashenko, Moscow State University and Cornell University: *Generic foliations in* $\mathbb{C}^n$

Mikhail Lyubich, SUNY at Stony Brook: *Dynamics of quadratic polynomials*

November 97

John Hubbard, Cornell University: *Hilbert modular surfaces and sequence spaces*

Vadim Kaloshin, Princeton University: *Growth of periodic orbits: expected and unexpected results*

Vadim Kaloshin, Princeton University: *Bifurcation of separatrix polygons and Hilbert's 16th problem*

December 97

A. Gorodetskii, Moscow State University, and Yulij Ilyashenko, Moscow State University and Cornell University: *Random dynamical systems as subsystems of the smooth ones*

January 98

Curt McMullen, University of California at Berkeley and Harvard University: *Hausdorff dimension and conformal dynamics*

Mattias Jonsson, Yale University: *Dynamics of polynomial skew products on* $\mathbb{C}^2$

March 98

Linda Keen, CUNY: *Pleating invariants for quasifuchsian punctured tori*

Christian Henriksen, Technical University of Denmark and Cornell University: *Herman rings in a certain family of Blashke fractions*

April 98

Xavier Buff, Cornell University: *Scaling ratios and triangles in Siegel disks*

Kevin Pilgrim, Cornell University: *Dessins d'enfant and Hubbard trees*

Mitsuhiro Shishikura, Johns Hopkins University: *Rigidity of real quadratic polynomials and the universal Teichmüller space*

Educational Issues Seminar

January 98

David Henderson, Cornell University: *Does there exist an accessible theory of calculus?*

February 98

David Henderson, Cornell University: *An accessible theory of calculus*

April 98

Jane-Jane Lo, Cornell University and SUNY at Cortland: *Is this a calculus problem? There is no forumula nor correct answer for it*

Lie Group Seminar

September 97

Peter Heinzner, Brandeis University: *A proof of the extended future tube conjecture*

October 97

Roger Howe, Yale University: *Symmetric spaces and multiplicity free actions on flag manifolds — classification, examples and applications*

March 98

Hongyu He, Massachusetts Institute of Technology: *Rank and associated varieties of unitary representation*

Francois Ziegler, Pennsylvania State University: *Symplectic Mackey theory*

Logic Seminar

September 97

Suman Ganguli, Cornell University: *Effective completeness theorem; model completeness and decidability*

Reed Solomon, Cornell University: *Computable presentations of structures of low degree*

Robert Milnikel, Cornell University: *Omitting types and decidability* (in four parts)

Joe Miller, Cornell University: *Avoidable algebraic sets in Euclidean space* (in two parts)

Denis Hirschfeldt, Cornell University: *The Baldwin-Lachlan theorem* (in two parts)

October 97

Richard Shore, Cornell University: *Decidable prime models* (in two parts)

Bakhadyr Khoussainov, Cornell University: *Randomness, computability and finitely presented algebras*

Walker White, Cornell University: *Homogeneity and computability* (in two parts)

November 97

Reed Solomon, Cornell University: *Saturation and computability*

Andrea Sorbi, University of Siena (Italy): *The problem of embedding finite lattices into the Σ_2^0 e-degrees*

Bakhadyr Khoussainov, Cornell University: *Effective intuitionistic model theory* (in two parts)

Joseph Halpern, Cornell University: *Degrees of belief, random worlds and maximum entropy*

Geoffrey LaForte, Wellington, New Zealand: *A Δ_2 set which is barely Σ_2*

Joseph Halpern, Cornell University: *Plausibility measures and default reasoning*

December 97

Vivian Morley, Cornell University: *Finitely axiomatizable theories* (in two parts)

January 98

Sergei Artemov, Cornell University and Steklov Institute: *Logic of proofs vs. typed lambda calculi* (in two parts)

Richard Shore, Cornell University: *Computable categoricity and degree spectra*

February 98

Walker White, Cornell University: *Computable categoricity and Scott families*

Miklós Erdélyi-Szabó, Cornell University: *Randomized Kripke schema and undecidability in the intuitionistic reals*

Denis Hirschfeldt, Cornell University: *Persistence of computable categoricity*

Dexter Kozen, Cornell University: *Hopkins's proof of Parikh's theorem*

Robert Milnikel, Cornell University: *Intrinsic and formally computable relations*

William Calhoun, Bloomsburg University of Pennsylvania: *The Π^0_2 enumeration degrees are not dense*

Vivian Morley, Cornell University: *Turing machine computations and finitely axiomatizable theories* (in two parts)

Denis Hirschfeldt, Cornell University: *A basis theorem for perfect sets*

March 98

Reed Solomon, Cornell University: *On degrees of models of arithmetic*

Jeniffer Seitzer, College of Mt. St. Joseph: *Knowledge representation using normal logic programs*

Suman Ganguli, Cornell University: *Relatively intrinsically recursive relations*

Sergei Artemov, Cornell University and Steklov Institute: *Proof polynomials vs. lambda terms*

Walker White, Cornell University: *Metatheorems for priority arguments* (in three parts)

April 98

Suman Ganguli, Cornell University: *Degrees of models of arithmetic* (in two parts)

Joe Miller, Cornell University: *The Krohn-Rhodes decomposition theorem for automata*

Richard Shore, Cornell University: *Degree spectra*

Valentina Harizanov, George Washington University: *Computability-theoretic properties of relations on computable models*

J. M. Davoren, Cornell University: *On continuous dynamics and modal logics*

Julia Knight, Notre Dame University: *Ash's program in computable structure theory*

Occasional Seminar on Undergraduate Education

September 97

Tom Rishel, Cornell University: *Some educational models for the teaching of mathematics*

Jeffrey Mitchell, Eknath Belbase and others, Cornell University: *A job forum*

October 97

Allen Back, Cornell University: *What makes a good computer or graphing calculator assignment?*

November 97

Rick Cleary, Ken Constantine, Jeff Diller and Ken Ross, Cornell University: *More on the job market: what we look for*

Tom Rishel, Cornell University: *Preliminary results of an NSF study of calculus reform efforts*

December 97

Kenneth Ross, University of Oregon and Cornell University: *What do we all need to know about the NCTM standards*

January 98

Tom Rishel, Cornell University: *Preliminary results of an NSF study of calculus reform efforts*

February 98

David Cohen, Smith College: *Conversational calculus — a successful approach at Smith College*

March 98

Tom Rishel, Cornell University: *Writing toward proof: from 'playing around' to precision*

Rick Cleary, St. Michael's College and Cornell University: *The clever or the beautiful*

Beverly West, Cornell University: *A judge's perspective: the fascination of COMAP's annual and international Modeling Contest — should Cornell keep missing out?*

April 98

Ken Constantine, Eastern Nazarine College and Cornell University: *Divulging rhyme, rhythm and reason to students*

Bob Connelly, Cornell University: *The mathematical job market from the employer's viewpoint*

Karl David, Wells College and Cornell University: *Designing fair tests and grading them fairly*

Tom Rishel, Cornell University: *Let's make a devilishly clever exam*

Oliver Club

September 97

Louis Billera, Cornell University: *Counting faces in polytopes, spheres and hyperplane arrangements*

Peter Heinzner, Brandeis University: *Complex geometry of proper actions*

Laurent Saloff-Coste, CNRS and Cornell University: *Harnack inequalities and geometric applications*

October 97

Peter Li, University of California at Irvine: *Polynomial growth harmonic functions and harmonic maps*

Sergei Artemov, Cornell University and Steklov Institute: *Proof polynomials*

Anil Nerode, Cornell University: *Hybrid systems and distributed autonomous control*

Mikhail Lyubich, SUNY at Stony Brook: *Proof of the renormalization conjecture*

John Hubbard, Cornell University: *Geometric limits of polynomials*

November 97

Xavier Buff, Cornell University: *Holomorphic motions in dynamical systems*

John Franks, Northwestern University: *Area preserving surface homeomorphisms and rotation vectors*

José F. Escobar, Cornell University: *Some isoperimetric problems*

January 98

Curt McMullen, University of California at Berkeley and Harvard University: *Exotic hyperbolic 3-manifolds*

Nikola Lakic, Cornell University: *Substantial boundary points of plane domains*

February 98

Irena Peeva, Massachusetts Institute of Technology: *Free resolutions*

Adrian Lewis, University of Waterloo: *Eigenvalues, hyperbolic polynomials and the Kostant convexity theorem*

Rick Durrett, Cornell University: *When is space important in ecological modeling?*

Richard Shore, Cornell University: *Computable structures: presentations matter*

March 98

Ken Brown, Cornell University: *Geometry and probability in three dimensions*

Barbara Shipman, University of Rochester: *The geometry of momentum mappings on generalized flag manifolds: connections with a dynamical system, quantum mechanics and the dance of the honeybee*

Richard Schoen, Stanford University: *A plateau problem in complex geometry*

April 98

Paul Sally, University of Chicago: *Harmonic analysis on p-adic general linear groups*

James Renegar, Cornell University: *How to explain the efficiency of root-finding algorithms?*

Richard Stanley, Massachusetts Institute of Technology: *Spanning trees and a conjecture of Kontsevich*

Phil Hanlon, University of Michigan: *Combinatorics and Lie theory*

May 98

Daryl Cooper, University of California at Santa Barbara: *Some surface subgroups survive surgery*

Olivetti Club

September 97

David Revelle, Cornell University: *Kolmogorov's solution to Hilbert's 13th problem*

Christian Bluhm, Cornell University: *Fourier asymptotics of fractal measures*

Richard Durrett, Cornell University: *Subadditivity: a super idea*

Ferenc Gerlits, Cornell University: *Electronic money*

October 97

Moon Duchin, Harvard University and Cornell University: *Geometry of numbers*

Swapneel Mahajan, Cornell University: *Descent classes of permutations and Gessel's conjecture*

David Brown, Cornell University: *Complex prime producing quadratics*

November 97

Andrei Caldararu, Cornell University: *Blow-ups, birational geometry and Mori's conjecture*

Hal Schenck, Cornell University: *Introduction to hyperplane arrangements*

Maria Fung, Cornell University: *Unitary matrices, the Riemann sphere and the Borel-Weil theorem*

Shannon Kelly, Cornell University: *Problems in the estimation of drift and volatility from a sample path of a stochastic differential equation*

February 98

Debra Boutin, Cornell University: *Visualizing in* $Aut(F_n)$

Fermat's last theorem: the proof (NOVA Adventures in Science Video)

Henry Matzinger, Cornell University: *Cool reconstructions*

Rick Cleary, St. Michael's College and Cornell University: *The file drawer problem and the strength of scientific evidence*

March 98

Sze-Man Ngai, Chinese University of Hong Kong and Cornell University: *Self-similarity in fractals, wavelets and tilings*

Shu-Yen Pan, Cornell University: *Buildings and classical groups*

Shayan Sen, Cornell University: *Representations of semisimple Lie groups*

Ed Bueler, MSRI: *Old and newer quantum mechanics*

April 98

Cathy Stenson, Cornell University: *Mathematics and drug design*

Chris Hruska, Cornell University: *The geometry of surfaces and three-manifolds*

Probability Seminar

September 97

Persi Diaconis, Cornell University: *Random iterations: a simple idea in Markov chain theory*

Rinaldo Schinazi, University of Colorado: *A spatial stochastic model for sickle cell disease*

Persi Diaconis, Cornell University: *Random iterations: examples of a simple principle in Markov chain theory*

Ken Brown, Cornell University: *Random walk and hyperplane arrangement* (in two parts)

October 97

David Steinsaltz, University of Berlin: *Zenos walk and iterated function systems*

Thomas Yan, Cornell University: *Demonic algorithms for efficient simulation of complex Markov chains*

Ed Weymeier, Oregon State University: *Multiplicative cascades*

November 97

Divakar Viswanath, Cornell University: *Random Fibonacci sequences and the number 1.3198824...*

Zhen-Qing Chen, Cornell University: *Weak convergence of reversible diffusions* (in two parts)

Kris Burdzey, University of Washington: *Hot bodies*

December 97

Gennady Samorodnitsky, Cornell University: *Large deviations explain how system performance is affected by the interplay of averages in a fluid queue with long range dependence induced by heavy tails*

January 98

Zhen-Qing Chen, Cornell University: *First passage distributions and reflected Dirichlet spaces*

February 98

H. Matzinger, Cornell University: *Reconstruction of a 3 color random scenery on Z, seen along the path of a symmetric random walk*

T. Povel, ETH Zurich and Massachusetts Institute of Technology: *Large deviation principle for random walk in a quenched random environment in the low speed regime*

Min Kang, Cornell University: *Weak convergence of solution for a parabolic stochastic PDE with boundary condition*

Leonid Mytnik, University of British Columbia: *A duality approach to proving uniqueness*

March 98

Richard Durrett, Cornell University: *Scaling limits of particle systems*

Christian Meise, University of Bielefeld: *Parallel simulated annealing and genetic algorithms*

E. B. Dynkin, Cornell University: *Positive solutions of nonlinear PDEs: history and recent developments*

April 98

Sergei Kuznetsov, Cornell University: *Fine trace on the boundary for solutions of nonlinear PDEs*

Eknath Belbase, Cornell University: *Existence of stationary distributions in reaction-diffusion processes via a hydrodynamic limit*

Ronitt Rubinfeld, Cornell University: *Testing 'properties' using probability*

Harry Kesten, Cornell University: *How far apart are the trees in a uniform spanning forest?*

Topology and Geometric Group Theory Seminar

September 97

Karen Vogtmann, Cornell University: *Connectivity at infinity of outer space I*

Dani Wise, Cornell University: *The finitely presented subgroups of the direct product of free groups*

Noel Brady, Cornell University: *Connectivity at infinity for right-angled Artin groups*

Noel Brady, Cornell University: *Connectivity at infinity for $Out(F_n)$ II and III*

October 97

Marshall Cohen, Cornell University: *Connectivity at infinity of $Out(F_n)$, IV and V*

November 97

Lisa Orlandi, Cornell University: *Group actions on R-trees and finiteness properties*

Dani Wise, Cornell University: *Coherent groups and the perimeter of 2-complexes*

December 97

Rob Ghrist, University of Texas: *Plane field flows*

February 98

Ferenc Gerlits, Cornell University: *Divergence of geodesics as a quasi-isometry invariant* (in two parts)

Martin Bridson, Oxford University: *Finitely presented subgroups of semihyperbolic groups*

Mladen Bestvina, University of Utah: *Artin groups of finite type*

March 98

Dani Wise, Cornell University: *3-manifold groups that are not subgroup separable*

Eugene Lerman, University of Illinois: *Symplectic orbifolds and projective toric varieties*

April 98

Noel Brady, Cornell University: *Geometry and logical complexity of HNN extensions of $Z + Z$* (in two parts)

Undergraduate Math Club

Fall 97

Persi Diaconis, Cornell University: *The birthday problem writ large*

Graeme Bailey, Cornell University: *The shape and size of the universe in 40 minutes*

Joe Miller, Cornell University: *An exotic view of plane old geometry (exploring the duality between points and lines)*

Reed Solomon, Cornell University: *Paradoxes in set theory*

David Henderson, Cornell University: *Proof as a convincing communication that answers "Why?"*

Hal Schenck, Cornell University: *Splines: a practical application of abstract mathematics*

Margaret Readdy, Cornell University: *Hilbert's third problem: scissors congruence*

Michael LaRocque, Cornell University: *Troubled bubbles: minimization problems in the plane*

A special showing of *The Nature of Things* — a tribute to Martin Gardner

Richard Ehrenborg, Cornell University: *The blind bartender's problem*

Rahul Mehta, Grainne O'Neil, Lawerence Suen, Naoki Yoshihiro, Cornell University: *What do game theory, mappings, sound reception, and Godel's theorem have in common?*

Spring 98

Robert Strichartz, Cornell University: *Cornell's REU summer '98*

Bob Connelly, Cornell University: *Tensegrity*

Chris Hruska, Cornell University: *Bubbles II: the continued saga*

A special showing of *Nova: Fermat's Last Theorem*

Tom Rishel, Cornell University: *Famous impossibilities*

Francis Fung, Cornell University: *Transcendental numbers*

Maria Fung, Cornell University: *A history of pi*

Al Schatz, Cornell University: *On the numerical solution of a partial differential equation*

Richard Ehrenborg, Cornell University: *Tilings*

1997–98 Faculty Publications

Dan Barbasch and A. Moy, *Local Character Expansions*, Ann. Sci. de L'Ecole Norm. Sup. (1997).

Dan Barbasch and M. Bozicevic, *The Associated Variety of an Induced Representation*, Proc. AMS (1998).

Robert Connelly , I. Sabitov and A. Walz, *The Bellows Conjecture*, Contributions to Algebra and Geometry **38** no. 1 (1997), 1–10.

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

Cliff Earle and F. P. Gardiner, *Teichmüller Disks and Veech's $\mathcal{F}$-Structures*, Contemporary Mathematics **201** (1997), 165–189.

Cliff Earle, *Some Maximal Holomorphic Motions*, Contemporary Mathematics **211** (1997), 183–192.

Cliff Earle, F. P. Gardiner and **Nikola Lakic**, *Vector Fields for Holomorphic Motions of Closed Sets*, Contemporary Mathematics **211** (1997), 193–225.

Cliff Earle and Li Zhong, *Extremal Quasiconformal Mappings in Plane Domains*; in Quasi-conformal Mappings and Anaylsis, Springer-Verlag, 1998, pp. 141–157.

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

José F. Escobar and Jaime Lesmes, *Proceedings of the III Summer School in Differential Geometry, Partial Differential Equations and Numerical Analysis, Communications*, Department of Mathematics, Universidad de los Andes and the Colombian Mathematical Society, 1997.

José F. Escobar, *The Geometry of the First Non-zero Steklov Eigenvalue*, Journal of Functional Analysis **150** No. 2 (1997), 544–556.

Leonard Gross and **Oscar Rothaus**, *Herbst Inequalities*, Kyoto Math J. (1998).

John Guckenheimer, *Complexity of Hybrid Switching Models*; in Control using Logic-based Switching (A. Morse, ed.), Lecture Notes in Control and Information Sciences, Springer-Verlag, 1997, 13–16.

John Guckenheimer and P. Rowat, *Dynamical Systems Analyses of Real Neuronal Networks*; in Neurons, Networks and Motor Behavior (P. Stein, S. Grillner and A. Seleverston, eds.), MIT Press, 1997, 151–163.

John Guckenheimer, R. Harris-Warrick, J. Peck and A. Willms, *Bifurcation, Bursting and Spike Frequency Adaptation*, J. Computational Neuroscience **4** (1997), 257–277.

W. Govaerts, **John Guckenheimer** and A. Khibnik, *Defining Functions for Multiple Hopf Bifurcations*, SIAM J. Num. Anal. **34** (1997), 1269–1288.

John Guckenheimer, M. Myers and B. Sturmfels, *Computing Hopf Bifurcations I*, SIAM J. Num. Anal. **34** (1997), 1–21.

Allen Hatcher and Darryl McCullough, *Finiteness of Classifying Spaces of Relative Diffeomorphism Groups of 3-Manifolds*, Geometry and Topology **1** (1997), 91–109.

David Henderson, *Differential Geometry: A Geometric Introduction*, Prentice-Hall, 1998.

Harry Kesten and Y. Zhang, *A Central Limit Theorem for "Critical" First-Passage Percolation in Two Dimensions*, Prob. Theory and Rel. Fields **107** (1997), 137–160.

Harry Kesten and R. A. Maller, *Divergence of a Random Walk Through Deterministic and Random Subsequences*, J. Theor. Probab. **10** (1997), 395–427.

Harry Kesten and R. A. Maller, *Random Deletion Does Not Affect Asymptotic Normality or Quadratic Negligibility*, J. Multivariate Anal. **63** (1997), 136–179.

Anil Nerode and **Richard Shore**, *Logic for Applications*, second edition, Springer-Verlag Computer Science Series, 1997.

P. Antsaklis, W. Kohn, **Anil Nerode** and S. Sastry, *Hybrid Systems IV*, Springer-Verlag, 1997.

Lawrence Payne and J. C. Song, *Continuous Dependence on Initial-Time and Spatial Geometry in Generalized Heat Conduction*, JMAA **214** (1997), 173–190.

Lawrence Payne and J. C. Song, *Spatial Decay Estimates for the Brinkman and Darcy Flows in a Semi-infinite Cylinder*, Cont. Mech. Therm. **9** (1997), 175–190.

C. O. Horgan and **Lawrence Payne**, *Spatial Decay Estimates for a Coupled System of Second-Order Quasilinear Partial Differential Equations Arising in Thermoelastic Finite Anti-Plane Shear*, J. Elasticity **47** (1997), 3–21.

K. 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.

K. Ames and **Lawrence Payne**, *Continuous Dependence Results for a Problem in Penetrative Convection*, Quant. Appl. Math. **55** (1997), 769–790.

John Meier and **Thomas Rishel**, *Writing in the Teaching and Learning of Mathematics*, Mathematical Association of America, 1998.

Oscar Rothaus, *Growth of LP Norms*, Proc. AMS (1997).

Oscar Rothaus, *Sharp Log-Sobolev Inequalities*, Proc. AMS (1997).

Laurent Saloff-Coste, *Lectures on Finite Markov Chains*; in Ecole d'été de probabilités de Saint Flour 1996, Lecture Notes in Math. 1665, Springer-Verlag, 1997, 301–413.

A. Bendikov and **Laurent Saloff-Coste**, *Elliptic Diffusions on Infinite Products*, J. reine angew. Math. **493** (1997), 171–220.

Richard Shore, *Conjectures and Questions from Gerald Sacks's Degrees of Unsolvability*, Archive for Mathematical Logic **36** (1997), 233–253.

P. Cholak, R. Downey and **Richard Shore**, *Intervals Without Critical Triples*; in Logic Colloquium '95 (J. A. Makowsky and E. V. Ravve, eds.), Lecture Notes in Logic **11**, Springer-Verlag, Heidelberg, 1998, 17–43.

B. Khoussainov, A. Nies and **Richard Shore**, *Recursive Models of Theories with Few Models*, Notre Dame Journal of Formal Logic **38** (1997), 165–178.

R. Downey and **Richard Shore**, *There Is No Degree Invariant Half Jump*, Proc. AMS **125** (1997), 3033–3037.

B. Khoussainov and **Richard Shore**, *Categoricity and Scott Families* (extended abstract), Combinatorics, Complexity and Logic, Proceedings of DMTCS '96 (D. Bridges, et al., eds.), Springer-Verlag, Singapore, 1997, 299–308.

G. Buzzard and **John Smillie**, *Complex Dynamics in Several Variables*, a chapter in Flavors of Geometry, Mathematical Sciences Research Institute Publication 31 (S. Levy, ed.), Cambridge University Press, 1997.

Robert Strichartz, *Piecewise Linear Wavelets on Sierpinski Gasket Type Fractals*, Journal of Fourier Analysis and Applications **3** (1997), 387–416.

A. N. Dranishnikov and **James West**, *Compact Group Actions that Raise Dimension to Infinity*, Top. and Appl. **80** (1997), 101–114.

Research Grant Activity

Funded and Continuing Grants

Source	Amount	Starts	Ends	Title
AMS	$427,725	1/1/95	12/31/97	Editor — *Mathematical Reviews*
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	$221,722	7/1/97	6/30/00	Algorithms and Numerical Analysis for Partial Differential and Integral Equations
NSF	$60,000	6/1/94	11/30/97	Algorithms and Numerical Analysis for Partial Differential 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 & Related Nonlinear Partial Diff. 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	$219,800	7/1/96	6/30/99	Geometric and Algebraic Topology
NSF	$82,710	4/1/96	3/31/99	Harmonic Analysis and Self-Similarity
NSF	$122,190	7/1/95	6/30/98	Logic and Computability
NSF	$216,000	7/1/96	6/30/99	Particle Systems: Theory for Applications to Biology
NSF	$113,000	6/1/95	5/31/98	Polytopes, Subdivisions and Piecewise Polynomial Functions
NSF	$363,000	9/1/94	2/28/99	Presidential Faculty Fellow: Linear and Nonlinear Analysis in Geometry
NSF	$180,684	6/1/94	11/30/97	Representation Theory and Automorphic Forms
NSF	$225,000	6/1/97	5/31/00	Representation Theory and Automorphic Forms
NSF	$172,796	7/1/96	6/30/99	Some Problems in Probability Theory
NSF	$150,000	6/15/97	5/31/00	Some Variational Problems in Differential Geometry
NSF	$60,000	8/1/93	7/31/97	Statistical Intervals
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	$80,000	1/1/96	6/30/98	Undergraduate Faculty Enhancement in Mathematics
NSF	$100,000	1/1/98	12/31/99	Undergraduate Faculty Enhancement in Mathematics
NYS	$25,000	7/1/97	6/30/98	CSMRP/Ithaca Schools Project
Sloan	$35,000	9/16/96	9/15/98	Alfred P. Sloan Research Fellowship for Dr. Reyer Sjamaar in Mathematics

Total Sponsored Research Expenditures for the 1997–98 Fiscal Year=$1,481,000

Submitted Grants

Source	Amount	Starts	Ends	Title
NSF	$27,661	7/1/97	6/30/98	Computational and Theoretical Aspects of the **cd**-Indexes
NSF	$297,451	7/1/98	6/30/01	Differential Equations with Real and Complex Time
NSF	$43,500	6/1/97	5/31/00	Dynamics of Birational Maps/Green's Functions of Hyperbolic Surfaces
NSF	$191,360	6/1/98	5/31/01	Enumeration and Subdivision in Polytopes and Arrangements
NSF	$224,061	6/1/97	5/31/00	High-Dimensional Empirical Linear Prediction
NSF	$79,745	6/1/98	5/31/01	Hyperbolicity in Holomorphic Dynamics
NSF	$171,395	5/1/98	4/30/01	Hypercontractivity Over Complex Manifolds
NSF	$149,230	7/1/98	6/30/01	Logic and Computability
NSF	$85,080	6/1/96	5/31/99	Markov Processes, Stochastic Analysis and Related Problems
NSF	$20,949	7/1/97	6/30/98	On Determining New Eulerian Posets and their **cd**-Indexes
NSF	$67,875	6/1/98	5/31/01	Representation Theory, Quantum Groups and Piecewise-Linear Combinatorics
NSF	$120,722	7/1/97	9/30/00	Software for Simulating Stochastic Spatial Models
NSF	$60,683	6/1/98	5/31/01	Three Problems in Algebraic Combinatorics
NSF	$156,862	1/1/98	12/31/01	Using Writing and Cognitive Strategies in Teaching Undergraduate Mathematics and Mathematics Education
NYS	$26,250	9/1/98	8/31/99	Cornell Mathematics Inservice Project

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.

Zhen-Qing Chen, Assistant Professor; Ph.D. (1992) Washington University; Probability theory and partial differential equations.

•**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, Associate 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.

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

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, Associate 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.

Glen Swindle, Associate Professor of OR&IE; Ph.D. (1988) Cornell University; Stochastic processes, mathematical finance.

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 1997–98 academic year.*

Faculty Profiles

Graeme Bailey

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. 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, including one in mathematics and one in structural pharmacology — was involved in continuing university discussions on developing more vital faculty/student interactions, was the faculty advisor for the Math Club and the Judo Club, became involved with Cornell EMS and enjoyed my ninth year as a Faculty Fellow at Risley.

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 construc-

tion 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).

Organizing committee for year-long program in combinatorics at MSRI (1996–97). Chair of organizing committee for workshop in Geometric Combinatorics (Feb. 10–14, 1997). Currently involved with co-editing a book consisting of selected survey talks given during this program.

Co-edited the book *Formal Power Series and Algebraic Combinatorics* (with C. Greene, R. Simion and R. Stanley), DIMACS Series in Discrete Mathematics and Theoretical Computer Science, vol. 24, American Mathematical Society, 1995. This consists of invited lectures given at a conference we organized at DIMACS in May 1994.

Invited Lectures:

Witnessing irregularity and incoherence, Mathematisches Forschungsinstitute Oberwolfach (Oct. 1997).

Enumeration of faces in convex polytopes, spheres and hyperplane arrangements, Mathematics Department Colloquium, University of Michigan, Ann Arbor (Apr. 1998).

Linear inequalities for graded posets, Combinatorics Seminar, Univ. of Michigan, Ann Arbor (Apr. 1998).

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.

Noel Brady

H. C. Wang Assistant Professor of Mathematics

My research interests are in geometric group theory. This involves using geometric and topological techniques to study infinite discrete groups. One thinks of groups as geometric objects, rather like a lattice in a Lie group. A very interesting question to ask is to what extent the geometry of a group is inherited by its subgroups. If the subgroup is distorted in the ambient group, then its geometry, finiteness properties, and algebraic properties may be very different from those of the parent group. I have been studying the kernels of epimorphisms to $\mathbf{Z}$ in the case where the ambient group acts nicely on a CAT(0) cube complex.

In joint work with Mladen Bestvina, I have used topological and geometric tools to produce examples of groups which distinguish between the finiteness properties F_n and FP_n for $n \geq 2$. Our examples are kernel subgroups of certain right-angled Artin groups. These Artin groups have $K(\pi, 1)$ spaces which are finite, non-positively curved, piecewise euclidean cubical complexes. This family of kernels also contains likely candidates to distinguish between geometric and cohomological dimension, and between automatic and combable groups.

Another very intriguing direction is to inquire about the finiteness properties of subgroups of torsion free Gromov hyperbolic groups. I have been able to produce an example of such a subgroup which is finitely presented but not of type F_3. The geometry of this subgroup is rather mysterious. Are there examples of subgroups which are of type F_n but not F_{n+1} for all $n \geq 3$? All known examples of groups with the finiteness properties described above contain high rank free abelian subgroups. Requiring that the ambient group should be hyperbolic rules out such examples.

Professional Activities: Referee for a few journals.

Invited Lectures:

Morse theory and finiteness properties of groups I–II, Wasatch Topology Conf., Park City, Utah (1995).

Branched coverings of cubical complexes and subgroups of hyperbolic groups, Cornell University Topology Festival (1996).

Morse theory and finiteness properties of groups, Summer Meeting in Geometric Group Theory, Southampton, England (1996).

On the geometry of kernels of right-angled Artin groups, SUNYA Topology and Group Theory Conf. (1996).
Combing kernels of certain right-angled Artin groups, Université de Montreal (1996).
Morse theory and finiteness properties of groups, SUNY at Binghamton (1997).
On the geometry of kernels of right-angled Artin groups, SUNY at Binghamton (1997).

Selected Publications:
Asynchronous Automatic Structures on Closed Hyperbolic Surface Groups; in Geometric Group Theory, Vol. 3 (R. Charney, M. Davis, M. Shapiro, eds.), OSU Math. Research Institute Publ., de Gruyter, 1995.
Morse Theory and Finiteness Properties of Groups (with M. Bestvina), Invent. Math. (1997), to appear.
Filling Invariants at Infinity for Manifolds of Nonpositive Curvature (with B. Farb), Trans. Amer. Math. Soc., to appear.
Branched Coverings of Cubical Complexes and Subgroups of Hyperbolic Groups, Jour. London Math. Soc., submitted.
Combing Kernels of Certain Right Angled Artin Groups (with M. Bestvina), in preparation.
Higher Connectivity at Infinity for Right Angled Artin Groups (with J. Meier), in preparation.

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 Mathe-

maticians. 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, International Centre for Theoretical Physics, Trieste (1990).

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), Annals of Probability, 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.

Zhen-Qing Chen

Assistant Professor of Mathematics

My research interest is in probability theory and its applications. Most of my research centers on Dirichlet spaces, stochastic analysis and their interplay with analysis. Dirichlet space is a powerful tool which links the theory of a fairly general class of Markov processes to the analytic potential theory on the state space. Recent development has extended the theory to cover infinite-dimensional problems. The Dirichlet form methods are finding their steadily increasing use in the study of Markov processes, stochastic differential equations and in applications to analysis. My recent years' research includes the study on reflecting diffusion processes on general (non-smooth) domains, on Dirichlet forms, on weakly coupled elliptic system and its associated switched diffusion processes and their potential theory, on semilinear partial differential equations using probabilistic approach, on quantitative stability results for diffusions processes, and on fine properties of symmetric stable processes.

Professional Activities: Reviewer for Mathematical Reviews, the NSA and the NSF. Referee for Annals of Probability, Journal of Functional Analysis, Journal of Mathematical Physics, Probability Theory and Related Fields, Stochastics and Stochastics Reports, Stochastic Processes and their Applications, Studia Mathematica, and Applied Mathematics and Optimization. NSA research grant in probability.

Selected Publications:

On Reflected Dirichlet Spaces, Prob. Theory Rel. Fields **94** (1992), 135–162.

On Reflecting Diffusion Processes and Skorokhod Decompositions, Prob. Theory Rel. Fields **94** (1993), 281–316.

Reflecting Brownian Motions: Quasimartingales and Strong Caccioppoli Sets (with P. J. Fitzsimmons and R. J. Williams), Potential Analysis **2** (1993), 219–243.

Quasi-homeomorphisms of Dirichlet Forms (with Z. Ma and M. Röckner), Nagoya J. Math. **136** (1994), 1–15.

On the Existence of Positive Solutions of Semilinear Elliptic Equations with Dirichlet Boundary Conditions (with R. J. Williams and Z. Zhao), Math. Annalen. **298** (1994), 543-556.

On the Existence of Positive Solutions of Semilinear Elliptic Equations with Neumann Boundary Conditions (with R. J. Williams and Z. Zhao), Prob. Theory Rel. Fields **101** (1995), 251–276.

Reflecting Brownian Motions and a Deletion Result for Sobolev Spaces of Order $(1, 2)$, Potential Analysis **5** (1996), 383–401.

Potential Theory for Elliptic Systems (with Z. Zhao), Ann. Probab. **24** (1996), 293–319.

Harnack Principle for Elliptic Systems (with Z. Zhao), J. Diff. Equation **139** (1997), 261–282.

Holomorphic Diffusions and Boundary Behavior of Harmonic Functions (with R. Durrett and G. Ma), Ann. Probab. **25** (1997), 1103–1134.

Intrinsic Ultracontractivity and Conditional Gauge for Symmetric Stable Processes (with R. Song), J. Func. Anal. **150** (1997), 204–239.

Stability and Approximations of Symmetric Diffusion Semigroups and Kernels (with Y. Hu, Z. Qian and W. Zheng), J. Func. Anal. **152** (1998), 255–280.

Estimates on Green Functions and Poisson Kernels of Symmetric Stable Processes (with R. Song), Math. Ann., to appear.

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: An article, *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 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. Attended a meeting of Chairs in Maryland, November 1997. Attended the annual meeting of the AMS in Baltimore, January 1998. Gave an invited lecture at the University of Pennsylvania, February 19, 1998. 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), Contributions to Algebra and Geometry **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?, submitted to the proceedings of the workshop on rigidity theory and applications, June 1998.

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–). Referee 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), Technical Report BU-1385-M, Biometry, Cornell University; 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.

Jeffrey Diller

H. C. Wang Assistant Professor of Mathematics

My research interests concern two rather different sets of problems in complex analysis. My thesis work at the University of Michigan led me to study analytic objects on Riemann surfaces in terms of the underlying geometry. The starting point for such work is the so-called *thick/thin* decomposition of a hyperbolic surface into pieces where the injectivity radius is large/small, respectively. This decomposition allows one to study an analytic object—the Green's function for the Laplacian, for example — in a *piecewise* fashion on domains that are all isometric to either annuli or disks. The difficulty comes in making sure that everything agrees when the pieces are fit back together.

While a visitor at Indiana University, I grew acquainted with the new and rapidly emerging field of multi-variable complex dynamics. Pluripotential theory

has emerged as a standout tool in this field which at present, when compared with its one variable cousin, has relatively few useful techniques at its disposal. My concern thus far has been to apply pluripotential theory to study dynamics of birational maps of the complex projective plane.

Awards and Honors: National Science Foundation Postdoctoral Fellowship (1995). University of Michigan Outstanding Teaching Assistant (1993).

Selected Publications:

Poincaré Series and Holomorphic Averaging (with D. Barrett), Inventiones Mathematicae **110** (1992), 23–28.

The Failure of Weak Holomorphic Averaging, Mathematische Zeitschrift **217** (1994), 167–178.

A Canonical $\bar{\partial}$ Problem on Bordered Riemann Surfaces, Indiana University Mathematics Journal **44** (1996), 747–764.

Limits on an Extension of Carleson's $\bar{\partial}$ Theorem, Journal of Geometric Analysis, to appear.

A New Construction of Riemann Surfaces with Corona (with D. Barrett), Journal of Geometric Analysis, to appear.

Contraction Properties of the Poincaré Series Operator (with D. Barrett), Michigan Mathematics Journal, to appear.

Dynamics of Birational Maps of $\mathbf{P}^2$, preprint.

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, which change at rates that depend on the states of a finite number of neighbors. The analysis of these systems leads to some difficult mathematical problems. For the last half dozen 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 and with Chip Aquadro in Population 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.

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 nonlin-

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

Invited Lectures:

Positive solutions of a class of semilinear partial differential equations, MSRI, Berkeley (Sept. 1997).

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.

Stochastic Boundary Values and Boundary Singularities for Solutions of the Equation $Lu = u^\alpha$, J. Func. Anal. **151** (1998), 147–186.

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, Univ. 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.

Richard Ehrenborg

H. C. Wang Assistant Professor of Mathematics

My main area of interest is algebraic combinatorics. Much of my latest work has dealt with understanding flag vectors of polytopes, hyperplane arrangements and mixed volumes.

The toric h-vector is an invariant of Eulerian posets which has connections with the intersection homology of a certain toric variety associated with rational polytopes. Together with Margaret Bayer, I expressed the toric h-vector in terms of the poset's flag vector. This work used coalgebra techniques that I have developed with Margaret Readdy. I have also completed a project with Gábor Hetyei where we showed two different no-

tions of shellings, that is, the classical and the spherical, are equivalent for cubical complexes. From this we can express the **c***d*-index of a cubical complex in terms of the Ron Adin h-vector, giving further evidence that this is the right h-vector for a cubical polytope.

Margaret Readdy and I exploited the theory valuations to give a geometric interpretation for the characteristic polynomial of hyperplane arrangements over any infinite field. Previous combinatorial results have been restricted to subarrangements of the braid arrangement B_n and hyperplanes over the integers, whereas our results expand the range of study to include complex hyperplane arrangements.

Mixed volumes were originally defined by Minkowski in his study of convex sets and have applications in computational complexity, analysis and algebra. Surprisingly there are very few combinatorial interpretations for mixed volumes. Generalizing a result of Laplace which expresses the volume of the slices of the cube in terms of Eulerian numbers, Margaret Readdy, Einar Steingrímsson and I found such an interpretation of the mixed volume of adjacent slices of the cube in terms of a refinement of the Eulerian numbers.

This completes my last year at Cornell. I am looking forward to working in Princeton at the Institute for Advanced Study.

Awards and Honors: Postdoctoral fellowship from LACIM, Université du Québec à Montréal and CRM, Université de Montréal (1993–1995). Member of the Swedish team at three International Mathematical Olympiads: Finland (1985); Poland (1986), Third Prize; and Cuba (1987), Third Prize.

Professional Activities: Member of the AMS, AWM, MAA and Svenska Matematikersamfundet. General member of the Mathematical Sciences Research Institute, Special Year in Combinatorics (1996–1997). Visiting scholar at Chalmers University of Technology (summer 1997).

Invited Lectures:

Valuations and mixed volumes, Eötvös University, Budapest, Hungary (1998).

Coproducts and geometric operations, Eötvös University, Budapest, Hungary (1998).

Polytopes and hyperplane arrangements, colloquium talk, University of Washington (1998); colloquium talk, Georgia Institute of Technology (1997); Mid-Atlantic Day for Combinatorics and Probability, Johns Hopkins University, one of four invited speakers (1997).

The **cd***-index of zonotopes and hyperplane arrangements*, AMS sectional meeting, Univ. of Montréal, Canada (1997).

Generic canonical forms for polynomials and tensors, Chalmers University of Technology, Sweden (1997).

Selected Publications:

The **r***-Cubical Lattice and a Generalization of the* **cd***-Index* (with M. Readdy), European Journal of Combinatorics **17** (1996), 709-725.

On Posets and Hopf Algebras, Advances in Mathematics **119** (1996), 1–25.

The **c***-2***d***-Index of Oriented Matroids* (with L. Billera and M. Readdy), Journal of Combinatorial Theory, Series A **81** (1998), 121–126.

On Valuations, the Characteristic Polynomial and Complex Subspace Arrangements (with M. Readdy), Advances in Mathematics **134** (1998), 32–42.

Coproducts and the **cd***-Index* (with M. Readdy), Jour. Alg. Comb., to appear.

The **cd***-Index of Zonotopes and Arrangements* (with L. Billera and M. Readdy); in Mathematical essays in honor of Gian-Carlo Rota (B. E. Sagan and R. P. Stanley, eds.), Birkhäuser, Boston, 1998, pages 23–40.

On Flag Vectors, the Dowling Lattice and Braid Arrangements (with M. Readdy), Discrete and Computational Geometry, to appear.

Flags and Shellings of Eulerian Cubical Posets (with Gábor Hetyei), SIAM Journal on Discrete Mathematics, submitted.

The Toric h-Vectors of Partially Ordered Sets (with M. Bayer), Trans. AMS, submitted.

Maximizing the Descent Statistic (with S. Mahajan), preprint (1998).

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 (1992–1997), 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. Member of the New York Academy of Sciences. 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 the Mathematical Society of Japan, Duke Mathematical Journal, Communications in Partial Differential Equations, Indiana Mathematical Journal, Proceedings of the AMS, Communications in Analysis and Geometry and the NSF.

Invited Lectures:

Harmonic functions satisfying a non-linear boundary condition, Int'l meeting on Non-linear Equations and Free Boundary Problems, Buenos Aires, Argentina (1994).

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).

Selected Publications:

Conformal Metrics with Prescribed Scalar Curvature (with R. Schoen), Inv. 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.

The Spectrum of the Laplacian on Manifolds of Positive Curvature (with A. Freire), Duke Math. J. **65** no. 1 (1992), 1–21.

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.

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.

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.

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).

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), 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 Threefolds, 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:

Numerical Analysis of Dynamical Systems; in Chaotic, Fractal and Nonlinear Signal Processing (R. Katz, ed.), AIP Press, 1996, pp. 3–13.

Towards a Global Theory of Singularly Perturbed Systems, Progress in Nonlinear Differential Equations and their Applications **19** (1996), 214–225.

Computer Proofs for Bifurcations of Planar Dynamical Systems; in Computational Differentiation, Techniques, Applications and Tools (M. Berz, C. Bischof, G. Corliss and A. Griewank, eds.), SIAM, 1996.

Computing Hopf Bifurcations II (with M. Myers), SIAM J. Sci. Comp. **17** (1996), 1275–1301.

Complexity of Hybrid Switching Models; in Control Using Logic-Based Switching (A. Morse, ed.), Lecture Notes in Control and Information Sciences 222, Springer-Verlag, 1997, 13–16.

Computing Hopf Bifurcations I (with M. Myers and B. Sturmfels), SIAM J. Num. Anal. **34** (1997), 1–21.

Dynamical Systems Analyses of Real Neuronal Networks (with P. Rowat); in Neurons, Networks and Motor Behavior (P. Stein, S. Grillner and A. Seleverston, eds.), MIT Press, 1997, pages 151–163.

Bifurcation, Bursting and Spike Frequency Adaptation (with R. Harris-Warrick, J. Peck and A. Willms), Journal of Computational Neuroscience **4** (1997), 257–277.

Defining Functions for Multiple Hopf Bifurcations (with W. Govaerts and A. Khibnik), SIAM J. Num. Anal. **34** (1997), 1269–1288.

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 surfaces of a particular type in a three-dimensional manifold. More recently I have 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.

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. 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:

Global continuation via higher-gradient regularization and singular limits in one-dimensional phase transitions, Georgia Tech, Dept. Math. (fall 1997).

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, in press (1998).

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 (though I did not express it well in earlier papers) 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, published in August 1995, has been requested by faculty in 50 countries so far and is currently being translated into Portugese. My second book *Differential Geometry: A Geometric Introduction* appeared in July of 1997. 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 and the ICME Study Group on the Teaching of Geometry for the twenty-first century.

Numerous workshops (at Cornell and other places in the USA and abroad) about geometry and teaching geometry for mathematics faculty and high school teachers — in part supported by grant from NSF and Title IIA Federal grant. Coorganizer (with Colm Mulcahy) of AAAS full-day symposium *Exploring New Frontiers in Geometry: in the World Around Us and in Our Classrooms*.

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, 1995.

Differential Geometry: A Geometric Introduction, Prentice-Hall, 1997.

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.

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 5 years has been devoted to dynamics in several complex variables. I have co-authored three foundational papers in the field; a fourth, in press, establishes among other things some intriguing relations between iteration theory and complex analytic surfaces. 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.

In addition, I am currently finishing the third volume of a series of textbooks on differential equations that are designed to take advantage of computer technology (in particular, the program MacMath) in the teaching of mathematics. Because I am dissatisfied with the second-year calculus textbooks currently available, I am also writing a second-year calculus textbook that includes basics of linear algebra and topology, and a treatment of differential forms. Differential forms are important because, among other things, they allow a really coherent treatment of electromagnetism and the theory of relativity.

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: Associate editor for Ann. Stat. 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.

Monotonicity of Regression Functions in Structural Measurement Error Models (with L. A. Stefanski), Statistics and Probability Letter **20** (1994), 113–116.

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, to appear.

An Unbiased Test for the Bioequivalence Problem (with L. D. Brown and Axel Munk), Ann. Stat., 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 Applica-

tions (Nauka, Moscow); Dynamical and Control Systems (Plenum Press, New York and London); and Ergodic Theory and Dynamical Systems (Cambridge University Press, UK).

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), a monograph, to be printed.

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

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.

Awards and Honors: Correspondent, Royal Dutch Academy. Member of the National Academy of Sciences. Recipient of the Polya Prize (1994).

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.

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/Info/People/kozen/kozen.html

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, Cornell Women's Rugby Football Club and Johnson Graduate School of Management Rugby Football Club.

Selected Publications:

Automata and Computability, Springer-Verlag, New York, 1997.

Kleene Algebra with Tests, Trans. Programming Languages and Systems (1997), 427–443.

On the Complexity of Reasoning in Kleene Algebra; in Proc. IEEE 12th Symp. Logic in Comput. Sci., Los Alamitos, CA, June 1997, pp. 195–202.

Decomposition of Algebraic Functions (with S. Landau and R. Zippel), J. Symb. Comp. **22** no. 3 (1996), 235–246.

Kleene Algebra with Tests: Completeness and Decidability (with F. Smith), Cornell University Tech Report TR96-1582 (1996); in Proc. Conf. Computer Science Logic, Lecture Notes in Computer Science, Springer-Verlag, New York, 1996, to appear.

Computing the Newtonian Graph (with K. Stefansson), Jour. Symb. Comp. **23** (1997), 1–12.

Efficient Code Certification, Tech. Report 98-1661, Computer Science Department, Cornell University, January 1998.

Typed Kleene Algebra, Tech. Report 98-1669, Computer Science Department, Cornell University, March 1998.

Efficient Algorithms for Optimal Video Transmission (with Y. Minsky and B. Smith); in Proc. IEEE Data Compression Conference (J. A. Storer and M. Cohn, eds.), March 1998, pp. 229-238.

Set Constraints and Logic Programming, Information and Computation **141** no. 1 (1998), 2–25.

Interleaver Design Methods for Turbo Codes (with K. Andrews and C. Heegard); in Proc. International Symposium on Information Theory, August 1998, to appear.

Nikola Lakic

H. C. Wang Assistant Professor of Mathematics

My area of research is the Teichmüller theory and quadratic differentials. I am especially interested in infinite dimensional Teichmüller theory and its applications in dynamics. A useful technique to study the properties of the Teichmüller's metric in an infinite dimensional Teichmüller space is to consider the trajectory structure of integrable holomorphic quadratic differentials. My current interest is in studying the connections between the analytic properties of holomorphic motions of a closed set E and the geometry of the Zygmund bounded vector fields on E.

Awards and Honors: World Olympiad in Mathematics, 3rd prize (1984). Int'l Student's Competition, 1st prize (1988). Robert Gilleece Fellowship, CUNY (1991–95).

Professional Activities: Referee for the Proceedings of the AMS and Conformal Geometry and Dynamics.

Invited Lectures:

An isometry theorem for quadratic differentials, SUNY at Stony Brook (1995).

Isomorphisms between Teichmüller spaces, AMS Conference, NYU (1996).

Asymptotic Teichmüller spaces, MSRI (1996).

Zygmund bounded functions on closed sets, CUNY (1996).

Strebel points, 17th R. Nevanlinna Colloquium, Lausanne, Switzerland (1997).

Selected Publications:

Infinitesimal Teichmüller Geometry, Complex Variables (1996).

An Isometry Theorem for Quadratic Differentials on Riemann Surfaces of Finite Genus, Transactions of AMS (1997).

Minimal Norm Property for Quadratic Differentials in the Disk, Michigan Math. Jour. (1997).

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 Mathemat-

ics 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.

Professional Activities: Editorial committee member of Applicable Analysis, J. of Elasticity, Math. Methods in Appl. Sci., and Stability and Applied Analysis of Continuous Media. Advisor for Pitman Monographs.

Invited Lectures:

On the eigenvalues and eigenfunctions of the Laplacian, University of Delaware (1995).

On the radiation problem for the backward heat equation, AMS special session on Ill Posed and Inverse Problems (1995).

Selected Publications:

Stability in the Initial-Time Geometry Problem for the Brinkman and Darcy Equations of Flow in Porous Media (with B. Straughan), J. Math. Pure Appl. **75** (1996), 225–271.

Asymptotic Behaviour of Solutions to the Equation of Constant Mean Curvature on a Three-Dimensional Region (with R. J. Knops), Meccanica **31** (1996), 597–606.

Spatial Decay Estimates for a Class of Second-Order Quasilinear Elliptic Partial Differential Equations Arising in Anisotropic Nonlinear Elasticity (with C. O. Horgan), Math. and Mech. of Solids **1** (1996), 411–423.

Phragmen-Lindelöf and Continuous Dependence Type Results in Generalized Heat Conduction (with J. C. Song), ZAMP **47** (1996), 527–538

Continuous Dependence Results for an Ill-posed Problem in Nonlinear Viscoelasticity (with K. A. Ames), ZAMP **48** (1997), 20–29.

Kevin Pilgrim

H. C. Wang Assistant Professor of Mathematics

1997–98 was my last year at Cornell. In fall of 1998 I will join the faculty at the University of Missouri at Rolla.

Following in the footsteps of my mathematical "father" (Curt McMullen) and "grandfather" (Dennis Sullivan), my research focuses on developing the growing dictionary between the theories of iterated rational maps and Kleinian groups as conformal dynamical systems on the Riemann sphere. Some relevant questions which are known in the setting of Kleinian groups include the following: How can one combine a rational map with another one, or decompose it into simpler pieces? Can one find a combinatorial object associated to a rational map which encodes dynamically interesting features? What are the topological and geometric properties possessed by the *fractal* Julia set of a rational map? Can one understand the space of all rational maps of a given degree? While much is known about these questions for polynomials, little is known in the more general setting of rational maps. The investigation of this area had been hampered by the lack of an adequate family of nice examples with which to generate conjectures and test hypotheses. In the summers of 1996 and 1997, I supervised Research Experiences for Undergraduates in mathematics. We systematically developed a *catalog* of examples of nice rational maps and investigated their combinatorics. The algebra involved in the development of this catalog suggested a connection between complex dynamics and number theory which is the subject of ongoing research.

Awards and Honors: NSF grant, DMS, 1997–2000.

Professional Activities: Referee for a few journals. Supervisor for Cornell's Research Experiences for Undergraduates program in mathematics (summers 1996–97).

Selected Publications:

Rational Maps Whose Fatou Components Are Jordan Domains, Ergodic Theory and Dynamical Systems **16** (1996), 1323–1343.

Combining Rational Maps and Controlling Obstructions (with Tan Lei), Ergodic Theory and Dynamical Systems **18** (1998), 221–245.

Rational Maps with Disconnected Julia Set (with Tan Lei), Asterisque, a volume in honor of A. Douady, to appear.

Dessins d'Enfants and Hubbard Trees, in preparation.

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 oscil-

lators, 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). The book *Nonlinear Dynamics: The Richard Rand 50th Anniversary Volume* published in my honor (1997); Editor A. Guran, World Scientific, 229 pp. (Being a collection of 9 papers on nonlinear dynamics.)

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.

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.

Dynamics of a Quasiperiodically Forced Mathieu Oscillator (with R. Zounes and R. Hastings); in Nonlinear Dynamics: The Richard Rand 50th Anniversary Volume, Chapter 9 (A. Guran, ed.), World Scientific Pub. Co. (1997), pp. 203–221.

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.

The Dynamics of Resonant Capture (with D. Quinn and J. Bridge), Nonlinear Dynamics **8** (1995), 1–20.

Oscillatory Reaction-Diffusion Equations on Rings (with S. Lubkin), J. Math. Biol. **32** (1994), 617–632.

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). NSF Grant: Geometry (1992–95). 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. Member of the MAA Task Force on Graduate Study. Organizer of the MER Forum meeting, Cornell University (Nov. 1995). Project director of Professors for the Future (1994–). FIPSE grant for Future Professors' Program (1995–). Member of the AMS-MAA Committee on Employment. External evaluator, SUNY at Oswego (1998).

Administrative Activities: Executive committee of ALCU (1993–). Curriculum Committee. Discussion leader, Faculty Training Program, John S. Knight Writing Program (1988–95). Organizer of the Occasional Seminar on Undergraduate Education (1991–). Johnson Museum Committee on Education. Cornell Arts College Bylaws Committee.

Invited Lectures:

Collaboration in writing and mathematics (with M. A. Rishel), MER Forum meeting (Nov. 1995), Suffolk University (Nov. 1996), Ithaca College (Mar. 1997).

Writing in geometry, NSF Geometry Workshop, Cornell University (June 1996).

Writing in mathematics, workshop, Hampshire College MAA meeting (June 1996).

Famous impossibilities and *Famous impossibilities: axioms that guide our teaching*, MAA Seaway meeting (Apr. 1997).

The professors for the future initiative at Cornell, NAS Chair's Meeting (Nov. 1997).

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.

Training New Graduate Students At Cornell: Ten Years of Experience (with V. M. Lew), PRIMUS (1993), 401–406.

Assessment of Writing in Mathematics, PRIMUS (1994) 39–43.

Support Systems in Beginning Calculus (with M. Lewin), PRIMUS (1995), 275–285.

Cornell: The Small-Grant Model, In Progress: the Pew Foundation Journal I, **2** (1995), 2.

Learning About Limits; Limits of Learning, CMS Notes **27** no. 6 (1995), 20–22.

Limited Resources: Enormous Change, In Progress: the Pew Foundation Journal II, **2** (1996).

Writing in the Teaching and Learning of Mathematics (with J. Meier), MAA Math Notes (1998), to appear.

The Academic Job Search in Mathematics, AMS Publications (1998), to appear.

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:

Analyse sur les Groupes de Lie à Croissance Polynômiale, Ark. för Math. **28** (1990), 315–331.

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.

Isopérimétrie pour les Groupes et les Variétés (with T. Coulhon), Rev. Mat. Iberoamericana **9** (1993), 293–314.

Moderate Growth and Random Walk on Finite Groups (with P. Diaconis), Geom. and Func. Anal. **4** (1994), 1–36.

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.

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.

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 (1989–93). 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, to appear.

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:

Stratified Symplectic Spaces and Reduction (with E. Lerman), Ann. Math. (2) **134** (1991), 375–422.

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., to appear.

Singular Reduction and Quantization, Topology, to appear.

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 ED 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 representation theory.

Awards and Honors: Humboldt Prize (1995).

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).

Michael Stillman

Associate 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

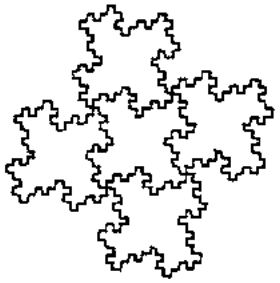
I am interested in a broad spectrum of mathematics centered around harmonic analysis. One can describe harmonic analysis roughly as the study of how complicated functions are built up by superimposing simple pieces. There are many different kinds of harmonic analysis, depending on the space on which the functions are defined, and the kind of simple pieces used. It is a very basic and fundamental process (eyes and ears have been doing it at least since the evolution of the first vertebrates) and it is very useful in studying a host of problems in a wide variety of mathematical areas, both pure and applied. I am especially interested in the interaction between harmonic analysis and geometry.

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 1980's, 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). My idea is that in order to understand a theorem in harmonic analysis on Euclidean space you have to find its proper "context," the most general class of geometric spaces for which there is an analogous theorem. 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).

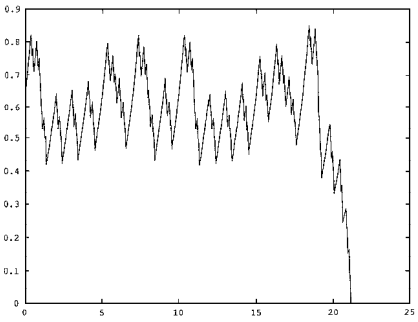
During the 1990's I have been working primarily on fractal geometry and the theory of wavelets. The underlying theme in both these areas is the idea of *self-similarity*, in which the whole is written as a sum of parts, each of which is similar to the whole. A simple example is an interval, which can 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 following self-similar tile (the decomposition into five similar pieces is indicated, and the pattern can be continued to tile the plane) that I call the "Fractal Red Cross."



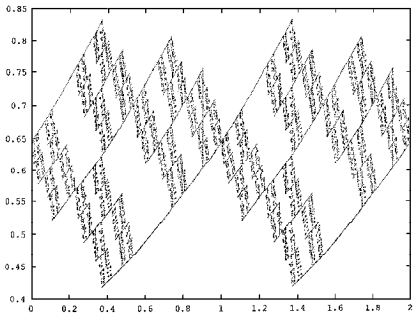
I have developed the idea of a Fractal Plancherel Theorem, both in the general case (*Fourier Asymptotics of Fractal Measures*, J. Func. Anal. **89** (1990), 154–187) and for self-similar measures (*Self-Similar Measures and their Fourier Transforms I, II, III*, Indiana U. Math. J. **39** (1990), 797–817; **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 mathemat-

ics." The idea is to use computer experiments to explore mathematical problems, with the goal of generating 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 example, the following is a graph of the density of the standard Cantor measure at a point x chosen at random, graphed on a logarithmic scale (the density is $\mu([x-r, x+r])/(zr)^\alpha$ where $\alpha = \log 2/\log 3$ is the dimension of the Cantor set, μ is the Cantor measure, and the horizontal axis variable s is related to r by $r = 3^{-s}$, so that $r \to 0$ as $s \to \infty$).



Notice the fairly regular but nevertheless non-periodic behavior of the graph (values beyond $s = 18$ show experimental error). Choosing a different random point x would yield a different graph with a similar appearance. Aside from the fact that these densities are bounded from above and below, there is little else suggested by this picture. However, look what we got when we superimposed the graphs using a large number of random points:



This *density diagram* is periodic (shown for $0 \le s \le 2$) and has a striking two-dimensional fractal structure that can be proven without reference to the computer graphics. It is unlikely that this result would ever have been discovered without the experimental input.

My experimental research has been done in collaboration with undergraduate students, with the support of the REU Program (Research Experiences for Undergraduates) 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 has also written introductory notes on differential forms, and a paper and software on stereograms. 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: Member-at-large 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., 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).

I am still coordinating, with Courtney Coleman at Harvey Mudd College, the final development stages of the *ODE Architect*, an NSF-sponsored laboratory resource package for differential equations. *ODE Architect* combines 14 multimedia modules with an open-ended solver and a companion book. Since the modules and chapters have been written by colleagues at nine different institutions in the CODEE/NSF Consortium, with a publisher in NYC and programmers in New Jersey, coordination has been a pretty demanding challenge!

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). Editor of the CODEE newsletter. 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:

Complex dynamics, Misericordia College (July 1997).

Distance learning: what works? what does not?, Educational Issues Seminar, Cornell University.

Judging the '97 international modeling contest, Occasional Seminar, Cornell University.

International Conference on Teaching Mathematics with Technology, Koblenz, Germany.

International Conference on Technology in Collegiate Mathematics, Chicago.

MAA Workshop at Winter Meetings, Baltimore.

Selected Publications:

Computer Laboratory Manuals (with B. Felsager and J. McDill) in Multivariable/Vector Calculus, Diff. Equations, Complex Dynamics, and Linear Algebra.

*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.

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.

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

Richard J. Cleary
Saint Michael's College

I have had the good fortune to spend most of my adult life living in either Burlington, Vermont or Ithaca. These two wonderful university towns are each often listed among the coolest, friendliest, prettiest, most hip places to live by various trendy magazines and I am often asked which one I like better. It's a tough question and I hoped to spend at least part of my sabbatical year thinking hard about how to research the answer.

I have also been presented with wonderful teaching and professional opportunites at both Saint Michael's College and Cornell. The difference in the students and the nature of the institutions leads to another difficult choice. Which type of teaching environment do I find best suits me and works to help students learn some mathematics or statistics? The 1997–98 school year was a very exciting one for me as a teacher and a statistician and helped me to sort out my thinking on this issue.

In the fall of 1997 I was very busy teaching at Cornell. In addition to teaching two sections of Math 111 (Calculus I), I was the instructor for Biometry 601 (Statistical Methods I). The calculus courses were my introduction to the graphing calculator as a teaching tool. I began the semester as a skeptic but by December was convinced that this technology can be very effective in helping to teach calculus. Given the choice I would rather teach using a mathematical software package such as Mathematica or Maple, largely because of the way students can expand the use of those programs in later courses. Still, the power of the calculators surprised me, and the course was certainly made more interesting by their presence. I especially thank Prof. David Henderson for his work as Czar in the fall for providing some direction for the course and its technology component.

The Biometry course was a fantastic teaching experience in a very different way. This applied course is taken by almost 200 students every fall, most of them first year doctoral students in the life sciences. Many of them see this class as a hurdle to be cleared and an obligation to get out of their way. Getting them to be excited about statistics and to see its value in their own careers is a wonderful challenge, and I am deeply grateful to the Biometrics Unit for giving me the chance to try. Anyone who enjoys diversity would enjoy this class. On a typical day my audience included the past president of the Mathematical Association of America (Prof. Ken Ross, see his note in this section), an eighteen year old first year student who is already doing research and had studied math through differential equations in high school, a fifty-something graduate student seeking a late in life career change, and students from at least twelve different countries. If anyone in the class learned as much from me as I learned from them I would consider myself a very good teacher.

In the spring semester I taught two more sections of Math 111 under the direction of Czar Michael Morley. I particularly enjoyed working with Prof. Ken Ross and our weekly chats on course progress and pedagogy were an excellent way to chart progress in the class for myself and my students. I also found time in the spring to get out and speak to the world about both my research and my teaching. I gave talks on my research area, selection bias and the file drawer problem, to the Olivetti Club at Cornell, Prof. Steve Ceci's Human Development seminar at Cornell, and at the Syracuse University Mathematics Department. I gave a talk on teaching philosophy at the Occasional Seminar and a talk on the practice of teaching statistics at BUDS, the Biometrics Unit Discussion Series. An expanded version of the BUDS talk will make up my portion of a program on teaching statistics at Monroe Community College in June.

Several personal events helped to make the year feel like a success. I was promoted from Associate to full Professor at Saint Michael's during the winter. I ran the Boston marathon in April '98 in 2:58, my first sub three hour effort in several years. I was active in my children's careers at Boynton Middle School, and my frequent drives there were a pleasant diversion from my busy schedule on campus.

Alas, I did not make much progress on my question of whether I like Burlington or Ithaca better. Fortunately, thanks to the generosity of my colleagues at Saint Michael's (who have granted me a leave of absence for 1998–99) and the hospitality of the Operations Research Department at Cornell (who have offered me a visiting position for the year) I will be able to stay in Ithaca for another twelve months or so. I hope to make substantial progress on this continuing difficult question during that time.

The staff at the Mathematics Department have done more than their share to make us feel welcome and an important part of the department. Anyone reading this far should call, email or visit Cathy Stevens, Arletta Havlik,

Joy Jones, Mikki Klinger, Cheri Farnsworth and Collette Walls and say, "Hey, I read that Rick Cleary thinks you do a great job! He's right, too!" Tom Rishel was, as always, a gracious host. The graduate students also went out of their way to not act bored while listening to my "When I was your age..." stories about teaching and Cornell. My sincere thanks to all of them.

Ken Constantine

Eastern Nazarene College

My primary professional project for this year has been to begin writing a textbook. The topic is Mathematical Statistics at the junior/senior level — with an approach that is (hopefully) innovative. The current status of this project is a first draft of one semester's worth of material. I'm grateful to Beverly West and participants in the Occasional Seminar for their advice and input on some of my ideas.

It's been stimulating to audit courses during the year. In the fall, the courses which I attended in full were Xavier Buff's *Differentiable Manifolds* and Terry Fine's *Artificial Neural Nets* (EE). In the spring, I attended Bob Connelly's *Classical Geometries* in full. All were valuable and enjoyable. My thanks to the instructors, each of whom produced a complete set of course notes. It was a nice bonus to collaborate briefly with Professor Fine on an alternative approach to one result in his monograph.

The number, quality, and diversity of talks available on campus has been delightful. I've attended a couple per week ranging from the Wednesday afternoon Statistics Seminar to the O-Clubs (Oliver and Olivetti) to the Occasional Seminar and Educational Issues Seminar. I was a speaker, a discussion leader, and a panelist at three of this last pair. Many talks' connections with other disciplines have been intriguing. A nice supplement to all these was the Deptartment of Statistical Science's Inaugural Conference in the fall.

It's been helpful to make and strengthen contacts during the year. In particular, it's been fruitful and fun to interact with my "partners in visiting crime" Rick Cleary, Karl David and Ken Ross.

My fall teaching assignment was two sections of Math 111 in which graphing calculators were used for the first time course-wide. My own experience with technology in the classroom had been with computer algebra systems so it was profitable to become acquainted with the TI-83 — for my own use and as an instructional tool. All my class outlines and homework were distributed via a course webpage. The course "czar" was David Henderson, who assigned projects and gave some innovative entrée's to topics which will be of future value to me. My students were a mix of roughly two parts "life sciences" and one part miscellaneous; overall I found them inquisitive, hard-working and a delight to teach.

My spring teaching assignment was two sections of Math 112. All my class outlines and homework were again distributed via a course webpage. While I was surprised that the use of graphing calculators was not continued on exams, overall this instruction was as pleasant as any I've known.

Over spring break I took a couple of days to learn how to write and process 'forms' on webpages. This tool was used for my Occasional Seminar talk and is one I hope to employ for interaction with students in the future.

On the non-professional side, my family has enjoyed the year. Our adventures have included exploring "gorge-ous Ithaca," canoeing, extensive walking, campus lectures (e.g. Sir John Polkinghorne's), and several concerts. I made it a point to be sure that my pleasure reading included some of local significance, e.g. on Ithaca's history, biographies of Ezra Cornell and Andrew White, a history of Mormonism's birth, and a travelogue of canoeing the entire Hudson River.

I thank the entire department for its hospitality this year. My special thanks go to Cathy, Arletta, Joy, Michelle, et. al., for helping to make the year's logistics pleasant and painless. Thanks are also due Eastern Nazarene College for the sabbatical year investment in me. Finally, my heartfelt thanks go to my wife Laura and children David and Catherine for their willingness to transplant for a year.

Karl David

Wells College

This was my second go-round in the Visiting Program. Having "been there, done that" during my first sabbatical (1990–91), I knew what to expect, but personal circumstances were quite different this time. In 1995, my wife received her Ph.D. in molecular biology from Cornell and, after a two-year post-doctoral position here, she began a tenure-track position at Carthage College in Kenosha, Wisconsin at the same time I came here. Thus, we joined the ranks of academic couples who have experienced the "two-body problem." Happily, we survived the separation in good shape, and I will be taking a leave of absence from Wells College and joining her in

the Midwest in September, after teaching Math 111 in the summer school session here (which I also did as an appendix to my first visit).

The year was thus one of uncertainty and some anxiety, as I tried (without success so far) to find a suitable position in the Chicago/Milwaukee area. Nonetheless, the experience was definitely an enriching, refreshing and pleasurable one. I very much enjoyed teaching students of Cornell's caliber in Math 111 and Math 112. In addition, the altered circumstances — different text, different material (in part), use of calculator technology, and the interaction with other instructors (which doesn't happen in my home institution) — added considerable zest to my teaching... or so I hope!

For my professional advancement, I attended the lectures in the year-long combinatorics sequence, Math 441-442, taught by Persi Diaconis in the fall and Lou Billera in the spring. I also attended a fair number of Olivetti and Oliver Club seminars and participated regularly in the Occasional Seminar devoted to teaching issues, even inviting myself to lead the discussion one week (thank you, Tom Rishel!). The "free time" (i.e. that not spent in committees) allowed me to indulge my penchant for working on Math Monthly problems... although either they're getting harder or I'm getting less clever as I advance in years!

Outside the department, I also took advantage of Cornell's incomparably rich resources. I felt privileged to be able to hear Hans Bethe lecture about his life in physics, for example, or to hear Malcolm Bilson inaugurate a new fortepiano. The most moving experience was to hear Karel Husa's "Music for Prague 1968" in an inspired performance by the University Wind Ensemble in the presence of the composer. Not everything was passive enjoyment though: I sang in the Brahms German Requiem with the Ithaca Community Chorus (the Music Department's Judith Kellock giving us an enjoyable and useful workshop while in rehearsal), and I played some of my own piano compositions at the Mathematics Department's wonderful annual event, the Spring Concert.

And finally... years from now, I can tell people that I was right there, on the scene, during Cornell's "Year of the Pumpkin"!

Kenneth Ross

University of Oregon

Mathematics. At the Atlanta meeting in August 1996 I happened to have a conversation with Francis Su, a recent Ph.D. of Persi Diaconis. He has studied random walks on spheres. I suggested that it might be helpful if these were viewed as random walks on certain hypergroups. We've corresponded since. I've read several of his papers and made some observations and suggestions.

The correspondence with Su led me to return to a nagging problem left open in a 1973 paper I wrote with R. E. Edwards. This concerned the exact value of Helgason's constant. I had an idea based on a lemma that fell through on closer computer examination (by my Oregon colleague, Dick Koch, and another friend).

Fall term I attended a few analysis and probability seminars. I received and read notes from a graduate class on "random walks on infinite (discrete) groups," by Kenneth Brown. I also thoroughly enjoyed a talk on "The Statistics Police and the Bible Code" given by Persi Diaconis on November 19.

Around February 1, I visited Ohio University. The first part of the visit was to see two mathematicians, Archil Gulisashvili and Mrs. Ajit Iqbal Singh who was visiting from Delhi, India. Archil shared some of his recent work with me. Mrs. Singh and I thought about several items and I was later able to make a small contribution to one question concerning invariant means on hypergroups.

I gave several talks. On September 29 I spoke in the Analysis Seminar on some recent joint work with George Willis. On April 3, I gave the same talk at the University of Maryland. I gave a talk for undergraduates at Colgate University in April. In June I spoke at a meeting in New Hampshire of the Northeastern Section of the MAA.

Books. Charles Wright, at Oregon, and I are working on the Fourth Edition of our book on *Discrete Mathematics*. I also have a book contract with Springer to write a companion to my *Elementary Analysis* book aimed at prospective pre-college teachers. I keep an eye out for ideas, but I reserve my book-writing energies this year for discrete mathematics.

Teaching. In the fall term I faithfully attended a graduate statistics course in the Biometrics Unit, taught by Rick Cleary. This was very helpful, because I've taught business statistics over the years but I've never taken a class in statistics and listened to another teacher. This will greatly help me do a better job of teaching Math 243 when I return to Oregon. I attended some statistics seminars including one by the venerable Lehmann and an inspiring one by George Casella. Casella loaned me a very nice book on *Statistical Inference*, which he co-authored with Roger Berger. Also, I visited Cindy Van Es, who is a lecturer in Agricultural, Resource and Managerial Economics. She gave me some tips on how to manage large lecture courses

in statistics and provided me with some useful model handouts.

In the spring term, I continued to attend some of the statistics seminars in biometry, both the regular one and one run by graduate students. On February 19, I gave a talk about random walks on the integers to the graduate student seminar.

In the spring term, I taught two sections of calculus at Cornell. This has been a useful learning experience, the first time I've taught such a course using a graphing calculator and using a book that is alleged to be reform (the new Stewart).

Education. I continue to be heavily involved with the MAA, especially as chair of the MAA President's Task Force on the NCTM Standards. In addition to a heavy email correspondence involving our charge of responding to NCTM, I was involved with organizing panel discussions at the January AMS-MAA meeting in Baltimore and at the April NCTM meeting in Washington, D.C.

When I was MAA President (1995–96) I created a Task Force on Graduate Students. Tom Rishel served on this task force and has recently become chair of the task force. Tom and I have met weekly to discuss issues involving graduate students, especially the appropriate preparation for graduate students in this era. I have attended several seminars in the Mathematics Department at Cornell that are devoted to educational issues.

Also, I have had some productive conversations and meetings with people at Ithaca College, namely Eric and Margaret Robinson and John Maceli.

Miscellany. For the past year and a half, I have been an advisor to a big high school mathematics text project, Core-Plus Mathematics Project. I read and criticize the text, and I am pretty critical. They claim I am very helpful, though I don't know how much of my work affects the final product. In connection with this project, I was supposed to visit the headquarters at Western Michigan University in May, but a nasty case of shingles put an end to that idea.

I have served on two external review commmittees for departments of mathematics. These were Ohio University in Athens, Ohio, and at Southeast Missouri State University in Cape Girardeau, home of Rush Limbaugh. This is very hard work. It requires being a good listener and a fast learner, being tactful and working with a lot of new people. Writing the report is also hard work and requires great care and tact and the ability to make the right assumptions when confronted with conflicting information.

Henry K. Schenck

Cornell University

My research interests are in the areas of commutative algebra, algebraic and discrete geometry, and combinatorics; especially those problems which can be studied from a computational standpoint. I have studied splines (piecewise polynomial functions on a triangulated region of n space), following the algebraic approach introduced by Billera. This problem turns out to have an interesting connection to the study of ideals of "fat points" (sets of points (with multiplicities) in projective space). I am currently working on a problem involving hyperplane arrangements, and on a toric version of Green's conjecture.

Awards and Honors: National Science Foundation postdoctoral research fellowship, 1998. Clark distinguished teaching award, Cornell University, 1997. Mathematical Sciences Institute graduate fellowship, 1995.

Professional Activities: Member of the AMS and SIAM. Organizer, 1997 Route 81 Conference on Commutative Algebra and Algebraic Geometry.

Selected Publications:

Subalgebras of the Stanley-Reisner Ring, Discrete and Computational Geometry, to appear.

Fat Points, Inverse Systems, and Piecewise Polynomial Functions (with A. Geramita), J. of Alg., to appear.

A Spectral Sequence for Splines, Advances in Applied Mathematics **19** (1997), 183–199.

Local Cohomology of Bivariate Splines (with M. Stillman), J. Pure & Appl. Alg. **117-118** (1997), 535–548.

A Family of Ideals of Minimal Regularity and the Hilbert Series of $C^r(\hat{\Delta})$ (with M. Stillman), Advances in Applied Mathematics **19** (1997), 169–182.

Staff Profiles

Administration

Gayle Davis, Accounts Coordinator (1998): Gayle provides administrative, financial and personnel support for the Mathematics 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 non-academic appointments, maintains non-academic 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.

Cheri Farnsworth, Undergraduate Coordinator (1997): Cheri serves as the primary departmental receptionist, conducts the annual faculty recruitment effort, and provides administrative support for the undergraduate program, the administrative manager, and the summer Research Experiences for Undergraduates (REU) program. As undergraduate coordinator she is the primary resource person for the undergraduate majors program, which includes approximately 100 majors. She acts as liaison between faculty and their advisees, both majors and over 200 new students with undeclared majors. She hires, assigns, and supervises undergraduate graders and updates/disseminates information regarding the weekly seminar series. In the coming year, Cheri will also generate a web-based semiannual newsletter designed to help undergraduates with the pre-enrollment periods.

Arletta Havlik, Department Registrar (1968): 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): Joy is the building coordinator and copyroom specialist for the department. She coordinates the day-to-day service operations provided to faculty, visitors, staff and students. She orders supplies and performs records and facilities maintenance, information gathering and data input. Joy assists the accounts coordinator with department bookkeeping, purchasing and accounts payable, the chair's assistant with the academic appointment process, and foreign nationals with housing. She oversees the mailroom operations, maintains repair and renovation records, serves as department telephone coordinator and secures the building at night.

Michelle Klinger, Teaching Program Coordinator (1993): 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 each semester. Mikki oversees room assignments and changes, course file management, textbook ordering, and screens inquiries pertaining to courses offerings. She acts as back-up technical typist, processing original entry and editing of highly technical mathematical manuscripts. Mikki compiles information for and coordinates publication of the annual report, and is the editor of the departmental newsletter, *Math Matters*. She is also the back-up department receptionist and coordinates the annual capital equipment inventory.

Donna Smith, Graduate Field Coordinator (1997): Donna is responsible for the administration of the Mathematics Department graduate program beginning with the admissions process and continuing through graduation. She maintains matriculated student records, processes appointments and generally oversees the administrative functions of the graduate program, consisting of about 60 graduate students. In addition, she coordinates, schedules, plans and oversees all department social functions. Donna provides backup support to the Accounts Coordinator for the department's non-academic time collection and payroll effort and works with the administrative manager to monitor the annual teaching assistant budget.

Catherine Stevens, Assistant to the Chair (1969): 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/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): As business manager, Colette directs the financial, human resources, 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/university reports. Colette interviews, hires, assigns workloads and supervises the administrative support staff. She's also responsible for updating and maintaining the department's web based "Survival Manual" located at http://math.cornell.edu/~colette/Survival/survival.toc.html.

Computer Support

Douglas Alfors, Computer Consultant/Advisor (1998): As of May 21, 1998, 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. This is a half-time position. In addition, Doug serves as the director of the Mathematics Support Center.

Robert Terrell, Network Administrator (1997): As network administrator, Bob is responsible for the departmental computer servers including networking, backup, software and hardware installation, operations, and security. He maintains 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. This is a half-time position. Bob holds a second (academic) appointment as an adjunct professor.

Mathematics Support Center

Douglas Alfors, Director (1983): 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.), and oversees the use of the computers in the MSC. During 1997–98, he also assisted in the instruction of Math 105 (Finite Mathematics). This is a half-time position. In addition, Doug serves as a computer consultant/advisor for the department.

Richard Furnas, Teaching Associate (1981): 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. Often graduate students from other departments will benefit from his counsel on the use of a variety of mathematical techniques in their field of research. Dick also assists in the instruction each fall of Math 105 (Finite Mathematics) and each spring of Math 106 (Calculus for Biologists). This is a quarter-time position.

Mathematics Instructional Computer Lab

Douglas Alfors, Associate Director (1993): Through May 20, 1998, Doug worked with Director Allen Back in hosting lab visits from a variety of classes (particularly Math 111) and helping to plan and prepare computer instructional materials. This 25% FTE position became vacant when Doug accepted a department part-time computer consultant/advisor position referenced above.

Allen Back, Director (1993): 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 both 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, 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, Network Administrator (1995): Michelle is the library's network administrator and web master. She deals with problems related to the library management system.

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 collection. Drawing on his long experience he should be able to answer any reference question or help with any library related problem. Walk right in, send an e-mail or give him a call any time at work or at home.

Stace Sisco, Circulation Supervisor (1998): Stace currently oversees the operation of the Math Library's circulation and reserve services during daytime weekday hours. He is also responsible for the hiring, training, and supervision of student employees. Previously, Stace worked as a student supervisor at Cornell's Physical Sciences Library for two years while earning his B.A. in English, which he received in January.

Raj Smith, Evening Supervisor (1994): Raj is in charge of the library in the evening hours. He is the lead person on the library's Digital Books projects and is very involved in the library's computer services. Raj is also the chief organizer of the library's popular annual book sale. Raj's original connection to the library was back in his undergraduate days when he worked as a student assistant.