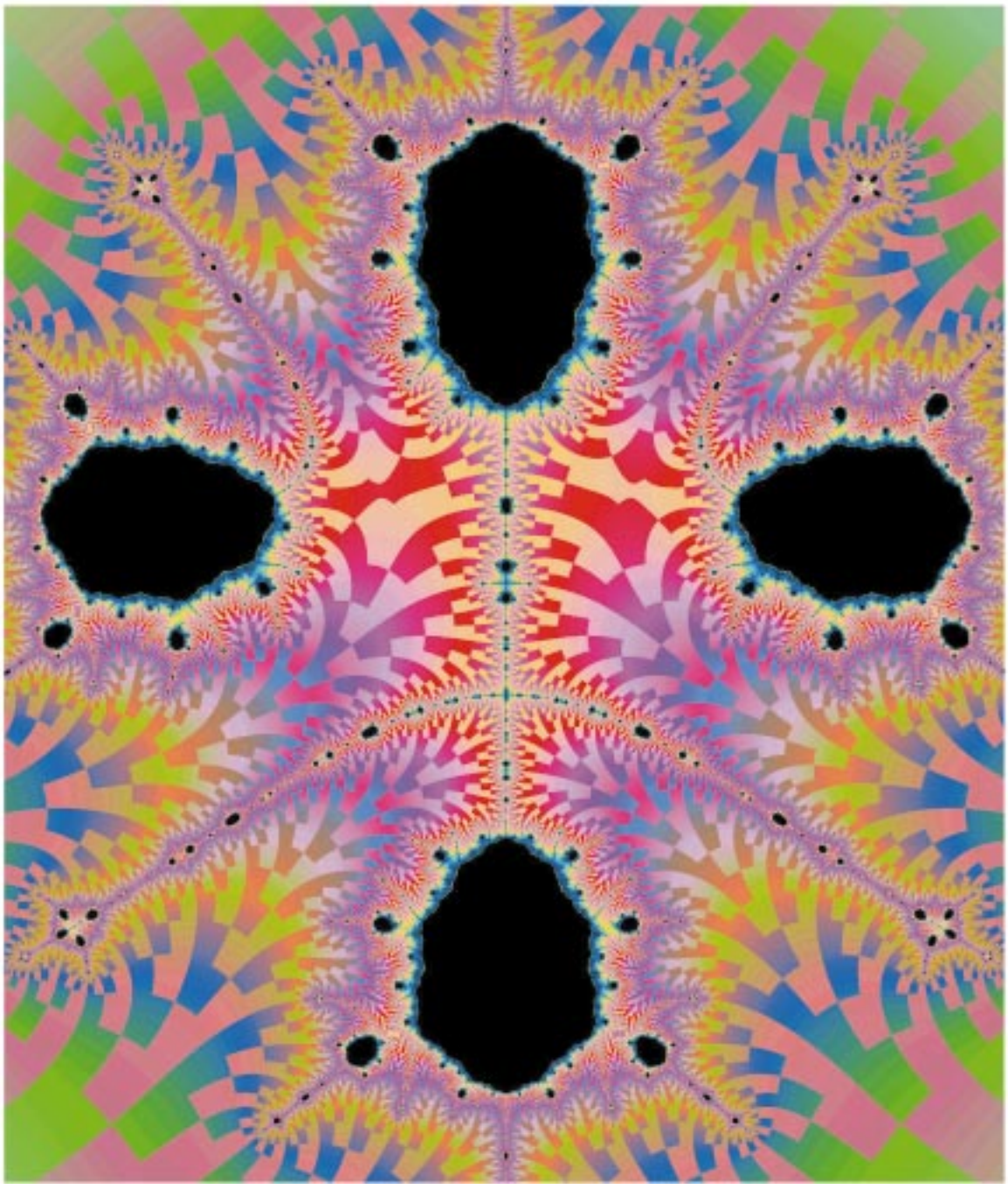
Department of Mathematics

Cornell University

Annual Report 1999-2000



Cover Art: The seemingly Rorschach image on the cover was created by a program written by Cornell undergraduate Karl Papadantonakis, under the direction of Professor John Hubbard. This and other programs and information are available at http://www.math.cornell.edu/~dynamics.

One of the earliest and most famous functions studied in dynamical systems is the complex quadratic $f_c\colon z \to z^2 + c$, where c is a complex parameter. Professor Hubbard significantly contributed to the understanding of f_c in the 1980s. His intuition was aided by helpful computer-generated images, like the Mandelbrot set. It has been a long time goal of his to create similar pictures for the more complicated Henon map, $H_{a,c}\colon (x, y) \to (x^2 + c - ay, x)$, a diffeomorphism of $\mathbb{C}^2$ with two complex parameters a, c. This goal is just being realized through several new programs by Mr. Papadantonakis.

The cover image is associated with a Henon map with $a = .2001416015625, c = -1.44404296875$. Since H is a map of $\mathbb{C}^2$, the picture shows only a slice of $\mathbb{C}^2$, but one which is dynamically significant. Pixels, x_0, are colored black if their orbits $\{x_0, H(x_0), H(H(x_0), \dots\}$ remain bounded, and colored according to rate of escape if they diverge to infinity. It is the goal of Professor Hubbard, and others at Cornell, to use these new programs to further their understanding of the Henon map.

Department of Mathematics

Annual Report 1999–2000

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 1999–2000

This was my first year as chair. I am happy to report that the department seems to have survived. The department also benefited from the efforts of Professor Stephen Chase as director of undergraduate studies, Professor Dan Barbasch as director of graduate studies and Senior Lecturer Thomas Rishel as teaching assistant coordinator. In addition, Professor Louis Billera served as chair of the computer committee, Professor Robert Strichartz as chair of the mathematics major committee, Professor Birgit Speh as chair of the faculty search committee and Professor John Guckenheimer as chair of the curriculum committee. Professors Cohen and Morley headed up the undergraduate advising committee (with the help of Steve Chase), and Assistant Professor Ravi Ramakrishna devoted considerable time and energy to the undergraduate Math Club committee. In addition, Assistant Professor Reyer Sjamaar did a great job of coordinating the Oliver Club for the 1999–2000 academic year. Professor Richard Durrett agreed to fill the newly created positon of VIGRE director. (See VIGRE, p. 2.)

We conducted a number of faculty searches during the 1999–2000 academic year. I am happy to report that we were quite successful in filling our vacant H. C. Wang Assistant Professor positions, as well as the first VIGRE Assistant Professor positions. Effective July 1, 2000, we welcome three new H. C. Wang Assistant Professors: José Ramirez (Courant Institute of Mathematical Sciences, NYU); Harrison Tsai (University of California at Berkeley); and Warwick Tucker (Instituto de Matemática Pura e Aplicada, Rio de Janeiro, Brazil). We also look forward to having the first four VIGRE Assistant Professors: James Conant (University of California at San Diego); Russell Miller (University of Chicago); Edward Swartz (University of Maryland at College Park); and Lawren Smithline (University of California at Berkeley). Irena Mitrea (University of Minnesota) also accepted an H. C. Wang position, but she will defer for one year.

The visiting faculty program participants for 1999–2000 were: William Dunbar, academic year (Simon's Rock College of Bard, Great Barrington, MA); Maria Fung, academic year (Cornell University); John Rosenthal, fall 1999 (Ithaca College); Stephen Wirkus, spring 2000 (Cornell University); and Xueqi Zeng, academic year (Condordia College, Moorhead, MN).

This was the third year of the originally planned three-year experiment in the restructuring of our teaching of engineering calculus. We were assisted in teaching Math 191, Math 193 and Math 192 during the fall 1999 semester by faculty from throughout the campus, additional instructional teaching assistants and an additional H. C. Wang Assistant Professor. The engineering restructuring effort will continue in its present form for at least two more years: the fall of 2000 and the fall of 2001.

Our graduate student community was active and productive this year, resulting in a variety of honors and awards. Leah Gold gave a lecture at the Special Session in Syzygies conference at the AMS meeting in Lowell, April 2000. Matthew Horak and Leah Gold received Hutchinson Fellowships for spring 2000. Lek-Heng Lim was awarded a Clare Hall Fellowship for 2000–01. Antal Jarai received the Battig Prize in fall 1999. Stephen Bullock received the Eleanor Norton York award in fall 1999. David Brown was awarded the Clark Teaching Award in spring 2000.

Each year we award the Kieval prize to an outstanding undergraduate senior. This year it was given to Karl Papadantonakis, who graduated summa cum laude in May 2000. Karl was a double major in the College Scholar Program and the Department of Mathematics. The College Scholar Program allows students with a well-defined program to design their own major. Admission to this program is quite competitive; typically only 10% of students are admitted. Karl concentrated on computer science, philosophy and music, and completed a very full degree program in mathematics. He also conducted research under a number of faculty in various departments but had singular success in his work with Professor John Hubbard.

Congratulations to Reyer Sjamaar, who was granted tenure and promoted to the rank of associate professor effective July 1, 2000.

Professor Moss Sweedler retired this year and was voted emeritus status. Moss continues to do mathematics research, but now for the Mathematics Research Office of the National Security Agency. Roger Farrell retired at the end of June 1999. On September 25, 1999, the departments of Mathematics and Statistical Sciences held a one-day conference honoring Roger's lifelong involvement in mathematics.

Tom Rishel left Cornell at the end of the 1999–2000 academic year to take the associate directorship of the

Mathematical Association of America in Washington, D.C. Tom will be in charge of programs and services at the MAA. He has enjoyed his stay in Ithaca and hopes to see everyone soon, either here or in D.C. Tom has been coordinating our teaching assistant program for many years and has been with the department continuously since 1974. He will be missed, not only by the graduate student community, but also by staff and faculty.

Professor John Hubbard was named by one of the university's undergraduate Merrill Presidential Scholars as the "faculty member who had the most positive influence" on his education at Cornell. This is the second year that John has been recognized in this way. Professor Yulij Ilyashenko was elected as President of the Independent University of Moscow in February 2000.

Peter Kahn spent the summer and fall of 1999 serving as an associate dean in the College of Arts and Sciences. This was the second time Peter was asked to serve as associate dean, and on this occasion he was asked to help fill in for the dean, who was on sabbatical.

Lou Billera, Peter Kahn and John Smillie attended a chair's conference at Indiana University, Bloomington, Indiana, held from August 6–8, 1999. The conference enabled mathematics chairs from around the country to discuss trends, problems and approaches for mathematics departments in the coming decade.

Once again, graduate student recruitment was both active and productive. We received 829 application inquiries and 182 completed applications during fall 1999. Ten graduate students will finish their programs of study by the end of summer 2000, and we will welcome 15 new graduate students in fall 2000. Our total graduate student population as we enter the 2000–01 academic year will be 67.

VIGRE

The NSF has come up with a new method for funding mathematics departments, which goes by the acronym VIGRE for Vertical Integration of Research and Education in the Mathematical Sciences. The overall objective of these grants is to increase the production of American mathematicians and prepare them for a variety of roles in society. These grants are for a period of five years and typically for about $2.5 million, which goes primarily to support graduate students and postdocs. The NSF is projecting that VIGRE grants will be a continuing component of mathematics funding. The department began work on its proposal last April with a series of focus groups. The process of preparing the application was genuinely a group effort of faculty and staff. Eighteen of our 41 faculty were involved on some level with preparing this proposal submission.

The VIGRE grant solicitation lists some specific goals but does not specify a plan for carrying these out. The means of achieving these goals is left up to the department to formulate. Thus, in order to apply for this grant the department is forced to think about departmental goals, strengths and weaknesses, and formulate a plan that takes these into account. We are asked to explore how our various activities, undergraduate education, graduate education, research and outreach, can and should interact. We are asked to make connections with "client" departments. In the process of applying for the grant, the department was also asked to collect data that shows to what extent it is meeting its goals. We are asked to review our curriculum to determine whether it is effective. In other words, in order to apply for the grant we are asked to undertake a valuable self-assessment.

Part of the review process was a site visit. This visit constituted a small-scale review of our ability to train graduate students and our success at training recent graduates to be mathematicians through our H. C. Wang Assistant Professor program. The panel also considered our success in interesting undergraduates in mathematics. I am happy to report that the review was very positive. The panel wanted to know about departmental commitment to the VIGRE initiatives. They were very impressed when told the number of our faculty who had been involved in various aspects of putting together the proposal. They were impressed with Robert Strichartz's involvement with undergraduates in his research, in particular with the fact that the undergraduates made substantial contributions to real mathematics problems and that they were joint authors on the resulting papers. They were impressed with the possibilities for cross-departmental research and collaboration that are possible for graduate students. As one example of such a research project Chip Aquadro (Molecular Biology and Genetics) talked about joint work with Rick Durrett in which they constructed probabilistic models of the distribution of gene sequences. They liked the idea that graduate students might be contributing to work that could be very useful in the pharmaceutical industry. The panel was also impressed with our proposed links with the Summer Math Program for minority students at Humacao in Puerto Rico.

We were awarded the grant, which begins with the 2000–01 academic year. We have used it to hire four postdocs

who will begin July 1, 2000. In addition, we are using this grant to provide support for four graduate students, including one alumnus of the Humacao program. We are also providing support for several graduate students to do special projects related to teaching and research next year. We are already using the grant to help support our Research Experiences for Undergraduates program this summer, and the department will be starting a Math Explorers Club for area high school students next year.

Graduate Program

The Cornell Mathematics Department is rated among the top in the country by the American Mathematical Society, typically somewhere between ninth and fifteenth in various "by reputation" surveys. The US News and World Report placed Cornell ninth in the nation in its 1999 national ranking of graduate mathematics programs.

The graduate program included 62 graduate students during the 1999–2000 academic year. Ph.D.s were awarded to eight students, while six earned master's degrees. The total number of students in the academic year 2000–01 will be 67.

The entering class will be formed of fifteen new Ph.D. students. Todd Kemp, Evgueni Klebanov and Antonio Montalban have received two-year fellowships. Franco Saliola and Everilis Santana-Vega received one-year fellowships from the Graduate School; these fellowships will cover full tuition and stipend. David Benbennick, Jeffrey Mermin and Kristin Camenga received VIGRE fellowships. This NSF grant will support students for four semesters during their first three years of graduate study. Roland Roeder has been awarded a fellowship from the Department of Defense, and Fernando Marques has received a full fellowship from the National Research Council of Brazil.

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. Two exciting programs that our graduate students participated in were the Expanding Your Horizons program, organized by university students for local schoolgirls, highlighting science and mathematics. Maria Sloughter and Melanie Pivarski put together several math games for the girls who participated in this year's program. David Brown and Kathryn Nyman worked with the Cornell Public Service Center preparing six-session mini-courses in mathematics. David's was on fractals and Kathryn's on graph theory. The courses were taught at the Candor Elementary and Middle School.

Some students are taking leadership roles in extracurricular activities. Suzanne Lynch is serving on the advisory board for *MAA Math Horizons Magazine*. Kathryn Nyman is director of the Professors for the Future program, effectively organizing graduate students to give talks at several universities and colleges associated with the Professors for the Future program. This program offers graduate students the opportunity to hone their lecturing skills.

The Ph.D. students continue to actively seek forums in which to present their research. David Brown delivered talks at Ithaca College and the MAA Seaway Section meetings at SUNY Oswego and Adirondack Community College. Stephen Bullock spoke at the University of Notre Dame's geometry seminar. Chris Hruska gave lectures at the International Conference on Geometric and Combinatorial Methods in Group Theory and Semigroup Theory at the University of Nebraska. Antal Jarai spoke at a conference organized by the Paul Erdös Summer Research Center of Mathematics in Budapest, Hungary. Suzanne Lynch spoke at the Wells College science colloquium and at the MAA Seaway Section meeting at SUNY Oswego. W. Gordon Ritter gave a lecture at the MAA Seaway Section meeting at Adirondack Community College. Sarah Spence gave a lecture at Hobart College. Finally, Kathryn Nyman gave talks at the MAA Seaway Section meetings at Ithaca College and Hobart College.

Two students, Henrique Araujo and Nelia Charalambous, participated in the MSRI summer graduate program held at Berkeley in the summer of 1999. Suzanne Lynch worked with the Research Experiences for Undergraduates program held during the summer of 1999 at Cornell University.

The following awards were given to students for outstanding academic achievement: the Hutchinson fellowship was awarded to Matthew Horak and Leah Gold; the Battig Award was given to Antal Jarai; and the York Award was presented to Stephen Bullock.

David Brown won the John M. and Emily B. Clark Distinguished Teaching Award for being an "extraordinarily successful teacher of calculus." He was also recognized for his many years of involvement with the Cornell Public Service Center.

W. Gordon Ritter is one of 40 students chosen worldwide to participate in the Clay Mathematics Institute summer school held in Boston. Lek-Heng Lim was awarded the Clare Hall Fellowship for 2000–01. He will spend the year at Cambridge University.

The Olivetti Club is devoted to expository talks on current research areas and is organized entirely by graduate students. This year the organizers were Sam Hsiao and Nelia Charalambous in the fall and Gordon Ritter and Ferenc Gerlits in the spring.

Class representatives were: Walker White (sixth year), Joe Miller (fifth year), David Revelle (fourth year), Wei Ouyang (third year), Noam Greenberg (second year) and Shawn Walker (first year). The Graduate and Professional Student Representative was Suman Ganguli.

Undergraduate Program

The undergraduate program in mathematics included 103 majors this year, and Bachelor's degrees were awarded to 34 students. One student graduated summa cum laude and three graduated cum laude. Eight of our graduates received distinction in all subjects.

The Math Club met weekly throughout the year on Wednesday afternoons. President Daniel Ramras was instrumental in organizing campus visits by distinguished scholars Joan Birman (Columbia University) in the fall and Peter Sarnak (Princeton University) in the spring. (See Department Colloquia, p. 34, for a list of talks.) Graeme Bailey and Ravi Ramakrishna provided expert assistance and guidance as the Math Club's advisors.

The Math Table continues to meet Friday evenings in Risley Dining Hall, where a table is reserved for interested undergraduate students to meet and share a meal with graduate students and faculty. The focus of Math Table is to reach out to the undergraduate community and increase awareness of mathematics and the math major. Both Birman and Sarnak participated in the Math Table dinners following their talks.

Research and Professional Activities

Department-sponsored research expenditures for the 1999–2000 fiscal year totaled $1,407,198. This included 38 grants and contracts from federal, state and private agencies awarded to 30 faculty. Faculty submitted 24 new grant proposals, 12 of which have been funded to date, and requested the continuation of 21 awards. (See also *Faculty Profiles*, pp. 39–73.)

Editorships include: Yuri Berest as a member of the editorial board of the *Journal of Nonlinear Mathematical Physics*; Louis Billera as associate editor of the *Journal of Algebraic Combinatorics* and *Discrete and Computational Geometry*; James Bramble as associate editor of *Mathematics of Computation*; Robert Connelly as editor of *Beiträge für Algebra und Geometrie*; R. Keith Dennis as consulting editor for 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*, *Potential Analysis* and the *Soochow Journal of Mathematics*; John Guckenheimer as editor of the *Journal of Experimental Mathematics*; Timothy Healey as a member of the editorial board of *Journal of Elasticity*; Harry Kesten as associate editor of the *Indiana University Mathematics Journal* and the *New York Journal of Mathematics*; Anil Nerode as editor of *Constraints*, *Annals of Mathematics and Artificial Intelligence*, *Mathematics and Computer Modelling*, and the *Journal of Pure and Applied Algebra*; Michael Nussbaum as a member of the editorial boards of *Annals of Statistics*, *Annales de l'Institut Henri Poincaré*, *Probabilités et Statistiques* and *ESAIM, Probability and Statistics*; Lawrence Payne as a member of the editorial boards of *Mathematical Methods in the Applied Sciences*, the *Glasgow Mathematical Journal*; Richard Rand on editorial board of *Journal of Vibration and Control*; James Renegar as associate editor of the *SIAM Journal on Optimization*; Laurent Saloff-Coste as associate editor of *Annals of Probability*, *Annales de la Faculté des Sciences de Toulouse* and *Stochastic Processes and their Applications*; Richard Shore as editor of *Studies in Logic and the Foundations of Mathematics* and managing editor of *Bulletin of Symbolic Logic*; Birgit Speh as editor of the *New York Journal of Mathematics* and the *Journal of Representation Theory*; Robert Strichartz as executive editor of the *Journal of Fourier Analysis and Applications*; Karen Vogtmann as associate editor of the *Bulletin of the American Mathematical Society*; Lars Wahlbin as managing editor of *Mathematics of Computation*; and James West as editor of *Fundamenta Mathematicae*.

Support Staff

This was a year of transition and adjustment for the Mathematics Department support staff. The move to more spacious quarters in Malott Hall presented many organizational and cultural changes, some of which were actually anticipated and planned for. Part of the new dynamic resulted from the carefully planned workplace

design in Malott. For the first time, support staff work together in one contiguous office suite. The main office area is designed specifically for reception, and the department is now able to immediately convey a welcoming presence to visitors, faculty and students. This new arrangement presents challenges as well as benefits. Over the past year departmental administration developed strategies to begin meeting those challenges in hopes of enhancing the obvious benefits that come with working in close proximity to one other.

To address issues of cross-training, the departmental administration decided to begin working to develop a "Task Manual." The objective is to work with individual staff members to write up task sheets outlining the key job tasks for each position. The end result will be a task manual listing the purpose and procedures for completing the key tasks needed to ensure the smooth running of the business operations for the department. Our hopes are to better design job tasks, to increase understanding of what employees duties are for both management and the employee, and to provide cross-training among support staff positions.

SCREMS Grant

The department submitted an NSF proposal in January 1999 under the program solicitation titled Grants for Scientific Computing Research Environments for the Mathematical Sciences (SCREMS). We were awarded the grant and received the funds in September 1999. The SCREMS program requires the university to match funds equally. The matching funds were provided by the College of Arts and Sciences and the Department of Mathematics.

During the past academic year, this grant has been used to purchase a powerful computer server, storage, backup, workstations with shared facilities, and color print services, which will be dedicated to the support of research in the mathematical sciences. The equipment will be used for several research projects, including the study of various aspects of dynamical systems, computational symbolic algorithms in algebraic geometry and commutative algebra, stochastic spatial models in probability, problems of enumeration in polyhedral combinatorics and hyperplane arrangements, and problems concerning the stability of configurations of points in space under natural distance constraints.

Research within the department tends to be conducted in clusters of faculty with overlapping shared interests. We have been in the forefront of research on the development of software for symbolic algebraic computations (Macaulay 2 by Professor Mike Stillman), the application of probability to real world problems (with Professor Rick Durrett), for example. The wide range and many directions of research have had a very healthy, stimulating effect on all the researchers in our department, which we would very much like to continue. With up-to-date equipment available to our research groups, we hope to continue in that excellent tradition.

One group that has benefited enormously from the SCREMS grant is the dynamical systems group which has been taking advantage of some fast new computers and the excellent color laser printer along with some interesting new algorithms produced by John Hubbard and Karl Papadantonakis to explore some new realms in complex dynamics.

Faculty Changes

The faculty unanimously and enthusiastically voted to promote Reyer Sjamaar to associate professor with tenure effective July 1, 2000.

Persi Diaconis formally resigned from his position as the David Duncan Professor of Physical Sciences this past year. He left in July 1998 to take a position at Stanford.

Moss Sweedler decided to retire effective June 30, 2000. He was voted emeritus professor status. Moss now conducts mathematics research for the Mathematics Research Office of the National Security Agency.

Senior Lecturer Thomas Rishel left Cornell at the end of May 2000 after many years of service to the department. He is now the associate director of the Mathematical Association of America in Washington, D.C. Tom has taught in the department since 1974 and has been coordinating our teaching assistant program since 1981.

Maria Terrell accepted the position of senior lecturer and teaching assistant coordinator formerly held by Tom Rishel. Maria comes to us from the College of Arts and Sciences where, in addition to her appointment as an adjunct associate professor in the Mathematics Department, she has spent the past decade as assistant dean for admissions and advising. We are very fortunate to have someone with Maria's extensive experience in this key position, and we look forward to working with her.

On leave for 1999–2000:
Robert Connelly, sabbatical leave, fall 1999
Robert Connelly, administrative leave, spring 2000

Persi Diaconis, leave, academic year
Alfred Schatz, sabbatical leave, spring 2000
Moss Sweedler, leave, academic year
Karen Vogtmann, sabbatical leave, academic year
Lars Wahlbin, sabbatical leave, spring 2000

On leave for 2000–01:
Dan Barbasch, sabbatical leave, spring 2001
R. Keith Dennis, sabbatical leave, fall 2000
David Henderson, sabbatical leave, fall 2000
John Hubbard, leave, academic year
Richard Platek, sabbatical leave, fall 2000
Oscar Rothaus, sabbatical leave, fall 2000
Avery Solomon, leave, academic year
Birgit Speh, sabbatical leave, spring 2001
Michael Stillman, sabbatical leave, spring 2001

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

Gifts

We continue to appreciate the kindness and generosity of alumni and other friends of mathematics. During the 1999–2000 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

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 Brown was presented with the Clark Award at a College of Arts and Sciences convocation honoring distinguished faculty and students.

Eleanor Norton York Award: The Eleanor Norton York Award was established by friends of Eleanor York, who died of cancer in 1993. Each year one student in the Mathematics Department and one student in the Astronomy Department, in which Eleanor was employed, are selected to receive this award. The recipients are chosen from those in the middle of their graduate education on the basis of their achievements to date and to encourage them to have even more success in the future. The Eleanor York Award for 1999–2000 was awarded to David Konreich in the Astronomy Department and will be presented to a Mathematics Department graduate student at the Fall Reception in August 2000. The previous winner in Mathematics was Stephen Bullock.

Freshman Math Prize: The department sponsored its second annual Freshman Math Prize Exam this year. The exam is reminiscent of the Hoover Prize exam, which the department used to administer about 15 years ago. Prizes for the new exam were funded by the winnings of the department's Putnam team. (The William Lowell Putnam Mathematics competition is an extremely difficult exam given nationally every December.) In the mid-1990s Cornell teams placed second twice and in the top ten twice, competing against over 250 teams. The annual Freshman Math Prize Exam is now funded in perpetuity. The winners this year were Prabhdeep Singh for first prize; and Michael Breining, Jason Gertz, Jonathan Helm and Daniel Sullivan tied for second prize.

Goldman Excellence in Teaching Award: Graeme Bailey was selected this year to receive the Kenneth A. Goldman Excellence in Teaching Award, which is the highest award for teaching in the College of Engineering. He was nominated by colleagues in Computer Science and selected by a committee comprised of former teaching prize winners and colleagues from other colleges at Cornell. Graeme will be recognized at the College of Engineering's Fall Faculty Convocation and Reception, where he will be presented with the prize that goes with the award.

Goldwater Scholarship: Daniel Ramras, a mathematics major and sophomore in the College of Arts and Sciences, was one of four Cornell recipients of a Goldwater Scholarship. With over 500 institutions nominating students, Cornell was one of only nine to have all of its nominees receive the award. The Goldwater Scholarship, honoring Senator Barry M. Goldwater, was designed to encourage outstanding students to pursue careers in the fields of mathematics, the natural sciences and engineering. It is a premier undergraduate award of its type in these fields. The one- and two- year scholarships cover college expenses up to $7,500 per year.

Hutchinson Fellowship: The Hutchinson Fellowship is awarded to mathematics graduate students who have been outstanding in their work as teaching assistants or as students in the graduate program. The award provides one semester of relief from teaching to allow the students to work on their thesis problems. Accordingly,

it is given to students who have completed three years of study and are not in their final year. This year's recipients were Leah Gold and Matthew Horak.

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 Judith Hubbard and Alexey Spiridinov. Judith will attend Caltech after a year in France, and Alexey will attend Princeton in the fall.

Kieval Prize: The Harry L. Kieval Prize in Mathematics, established in 1934 by Harry S. Keival '36, provides an annual award to an outstanding graduating senior mathematics major. The student is selected by the Mathematics Department's honors committee on the basis of academic performance, the quality and variety of math courses taken, and faculty recommendations. The 1999–2000 Kieval Prize was awarded to Karl Papadantonakis.

Karl Papadantonakis is graduating Summa Cum Laude. Based on his work with his math major advisor, John Hubbard, Karl produced images of Henon mappings that appeared on the cover of a 1998 math textbook. Karl also applied his math skills to the computing and engineering fields, helping to design a scalable multiplier computer chip that when fully developed could have significant implications for boosting computer speed. He is also an accomplished pianist and composer with an affinity for jazz. Several of his compositions are available on his web page at www.people.cornell.edu/pages/kp30/.

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

Instructional Activities

The faculty taught 119 courses in 208 lectures and 171 sections during the 1999–2000 academic year, generating 23,024 credit hours. They taught 5,898 students aided by 91 teaching assistants and associates. The enrollment figures are reflected on pp. 10–11. The Dept. of Theoretical and Applied Mechanics shares the teaching of engineering calculus and is accredited with 50% of the credit hours for Math 191 and 193 in the fall and Math 293 and 294 in the fall and spring; the remaining 18,766 credit hours are accredited to Mathematics.

Curriculum Changes

One of the mandates of the department's new five-year NSF VIGRE grant is a thorough review of the entire mathematics curriculum. Proposed initiatives for the undergraduate curriculum, developed during several preliminary meetings of the department's VIGRE committee early in the fall, were presented to the faculty in November 1999. The vigorous discussion at that faculty meeting resulted in a rather long list of options for revision and development of our undergraduate mathematics courses. The department's curriculum committee, chaired by Professor John Guckenheimer, then went to work, focusing its attention primarily but not exclusively on the undergraduate program in analysis.

The curriculum committee's efforts resulted, first, in changes in the titles and catalog descriptions of a number of undergraduate courses so that they would interest a larger circle of students and more accurately reflect the contents of the courses. The courses affected, with their new titles, are: Math 105 (Finite Mathematics for the Life and Social Sciences), Math 106 (Calculus for the Life and Social Sciences), Math 420 (Differential Equations and Dynamical Systems) and Math 422 (Applied Complex Analysis). In addition, the curriculum committee designed and presented to the department a comprehensive plan for a serious revision of the undergraduate offerings in analysis. This plan will be further developed and implemented during the next academic year; it is expected that it will lead to the introduction of at least one 300-level analysis course in 2001–02, as well as substantial changes in several existing courses.

In a related VIGRE-inspired initiative, Professor Robert Strichartz designed two new undergraduate courses that will be offered next year: Math 402 (Smorgasbord Seminar) and Math 424 (Wavelets and Fourier Series). Math 424 will be taught by Professor Strichartz in spring 2001. Math 402, to be offered in fall 2000 and supervised by Professor Strichartz, is actually a lecture series by members of the Mathematics Department about current research topics in mathematics and is intended to provide advanced undergraduates with a taste of many different areas of the subject. A third new offering, the advanced

graduate course Math 774 (Asymptotic Statistics), will be given in spring 2001; it was designed and will be taught by Professor Michael Nussbaum.

Two new professional-level courses in mathematics education were introduced into the Mathematics Department's curriculum during the 1999–2000 academic year.

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

Math 507, *Teaching Secondary Mathematics: Theory and Practices*, provides direct experience of new approaches, curricula and standards in mathematics education by means of videotapes of classroom teaching, in-class exploration of mathematics problems, examination of software environments and their uses in the secondary school classroom, and other activities. The course was taught in spring 2000 by Senior Lecturer Avery Solomon.

Finally, in spring 2000 the department adopted a concentration in mathematical physics within the mathematics major; this new concentration complements the existing concentrations in computer science, economics and operations research.

Interdisciplinary Instructional Activity

Mathematics/Engineering Liaison: This year we finished revamping the syllabi for the first two years of the engineering mathematics courses, Math 191/3, Math 192, Math 293 and Math 294. The changes were adopted with overwhelming support. The new syllabi should seem more logical to the students and also allow Math 293 and Math 294 to be taken in either order. This last feature was requested by the Computer Science Department. The new syllabi were used in spring 2000 in Math 191 and Math 293. In the fall, the new syllabi for Math 192 and Math 294 will be used. The major changes in the syllabi include: (1) The second course, Math 192, starts with sequences and series, and methods of integration have been moved into Math 191. Some multivariable calculus is covered in the new Math 192. (2) Math 293 includes Green's theorem, differential equations and an introduction to partial differential equations, but no matrices or systems of differential equations. (3) Math 294 is almost completely linear algebra, with some applications to systems of differential equations. We should be able to cover some useful and interesting applied topics, such as computer graphics, in more depth than was possible with the previous syllabus.

There are many other small changes, ones that we think will make the material flow more logically and smoothly than the previous syllabi.

Engineering Restructuring: The Department of Mathematics, in collaboration with the Department of Theoretical and Applied Mechanics in the College of Engineering, has now completed the third year of an experimental program for the restructuring of the teaching of engineering calculus. The object of this program is the delivery of instruction in small classes for the second-semester engineering calculus course, Math 192, during the fall semesters. The program thus continues a process, begun in the early 1990s, of replacing large lectures by small classes in the first-year engineering calculus courses Math 191, 193 and 192. Thirty classes in these three courses were offered in fall 1999, with an average class size of 22 students.

According to the agreement setting forth the conditions for the restructuring plan, part of the instructional resources needed to staff the small classes is to be supplied by faculty recruited from scientific departments throughout the university. These faculty, some of whom are outstanding teachers, complement faculty and instructional TAs provided by the two core departments, Mathematics and T&AM. In fall 1999, we were pleased and fortunate to have T. Michael Duncan (Chemical Engineering), Chung-Yuen Hui (Theoretical and Applied Mechanics), Richard Rand (Theoretical and Applied Mechanics), James Shealy (Electrical Engineering), Christine Shoemaker (Civil and Environmental Engineering), Jane Wang (Theoretical and Applied Mechanics) and David Zax (Chemistry) serve as these additional recruited faculty. That semester was Prof. Duncan's second in the program and Prof. Shoemaker's third; both will continue with the program in fall 2000.

The restructuring experiment was originally planned for a duration of three years. However, in the spring of 1999, with the encouragement and support of Dean Phil Lewis of the College of Arts and Sciences and Dean John Hopcroft of the College of Engineering, the decision was made to continue the program in its current form through the fall semester of 2001. During the academic year 2001–02, the fifth year of the restructuring program, the experiment will be carefully evaluated and a decision made regarding its future.

New Faculty Members

James R. Conant

VIGRE Assistant Professor

James Conant received his Ph.D. from the University of California at San Diego in May 2000. His research interests include finite type knot invariants, as well as their generalization and application to other categories, such as groups and higher dimensional knots. His current interests include connecting the deep four-dimensional work of Mike Freedman with his own work. His thesis advisor at UCSD was Peter Teichner, and his thesis topic was finite type Vassiliev invariants.

Russell Geddes Miller

VIGRE Assistant Professor

Russell Miller received his Ph.D. in June 2000 from the University of Chicago. His thesis advisor was Robert Soare. Russell works in mathematical logic, in the area of computability theory (recursion theory). This area of logic explores the possibility of employing finite algorithms to determine the answers to mathematical questions and to define mathematical objects. His dissertation covers computable model theory, the study of the algorithmic complexity of mathematical objects, and automorphisms of the computably enumerable sets under inclusion.

José Ramirez

H. C. Wang Assistant Professor

José Ramirez received a Ph.D. from New York University in May 2000, where he was a graduate student at the Courant Institute of Mathematical Sciences. His work at NYU was mainly in probability and its connections to PDEs, under the supervision of his advisor, S. R. S. Varadhan. His current research interests relate large deviations and short time asymptotics of the semigroup in Dirichlet spaces. He is also beginning to explore applications to infinite dimensional spaces, like path spaces over manifolds.

Lawren Smithline

VIGRE Assistant Professor

Lawren Smithline received his Ph.D. in May 2000 from the University of California at Berkeley. His advisor was Robert Coleman, and his thesis was entitled *A new quadratic bound on congruences in the Gouvêa-Mazur conjectures on the p-adic modular forms*. Lawren's research work is in algebraic number theory. Over the next few years he plans to study the Gouvêa-Mazur conjectures and deeper relations among families of modular forms, Galois representations, and the eigencurve.

Edward Swartz

VIGRE Assistant Professor

Edward Swartz received his Ph.D. from the University of Maryland at College Park in 1999. His advisor was Karsten Grove, and his thesis title was *Matroids and quotients of spheres*. His research interests include Riemannian geometry, combinatorics, logic and topology. His current research involves connections between quotients of spheres by elementary abelian p-groups and matroids. Ed has spent the past academic year as a visiting assistant professor at Cornell University.

Harrison Tsai

H. C. Wang Assistant Professor

Harrison Tsai received his Ph.D. in June 2000 from the University of California at Berkeley, where his Ph.D. advisor was Bernd Sturmfels. Harrison's research is concerned with algorithms for D-modules. He is also interested in their application to algebraic geometry and algebraic analysis and in their implementation in computer algebra systems (in particular, Stillman's Macaulay 2). Harrison is a recent recipient of an NSF Postdoctoral Fellowship.

Warwick B. Tucker

H. C. Wang Assistant Professor

Warwick Tucker received a Ph.D. from Uppsala University, Sweden, in 1998 under the supervision of Prof. L. Carleson. His research interests focus on self-validating numerical algorithms for solving ordinary differential equations (ODEs), which is a generalization of the techniques used in his thesis, *The Lorenz attractor exists*, where he proved the existence of a strange attractor for the Lorenz equations. Tucker has spent the past two years doing postdoctoral studies in mathematics at the Instituto de Matemática Pura e Aplicada, Rio de Janeiro, Brazil.

Mathematics Course Enrollment Statistics

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
103	Mathematical Explorations	Lecture	Morley, Taimina	53	159	Fall 1999
103	Mathematical Explorations	Lecture	Morley, B. West	60	180	Spring 2000
105	Finite Mathematics for Biologists	Lec/Sec	M. Terrell	190	570	Fall 1999
106	Calculus for Biologists	Lec/Sec	Durrett	163	489	Spring 2000
111	Calculus	Lecture	Cohen, Dunbar, Rosenthal, Tisch, J. West, X. Zeng	342	1,368	Fall 1999
111	Calculus	Lecture	Petersen, Strichartz, Wirkus	150	600	Spring 2000
112	Calculus	Lecture	Barbasch	208	832	Fall 1999
112	Calculus	Lecture	Dunbar, Fung, Sen, X. Zeng	224	896	Spring 2000
121	Honors Calculus	Lecture	Rothaus, Solomon	23	92	Fall 1999
122	Honors Calculus	Lec/Sec	Epstein, Sjamaar	62	248	Fall 1999
122	Honors Calculus	Lec/Sec	Epstein, Henderson	24	96	Spring 2000
171	Statistical Theory and Applications	Lec/Sec	Bendikov, Hwang	73	292	Fall 1999
171	Statistical Theory and Applications	Lec/Sec	Bendikov, Hwang	85	340	Spring 2000
189	FWS: Reasoning about Reasoning	Lecture	N. Miller	17	51	Fall 1999
189	FWS: Reasoning about Reasoning	Lecture	N. Miller	16	48	Spring 2000
191	Calculus for Engineers	Lec/Sec	Healey (T&AM)*, Wahlbin	70	280	Fall 1999
192	Calculus for Engineers	Lec/Sec	Berest, Duncan (Chem. Eng.), Guckenheimer, Rand (T&AM)*, Topping, Wise, Zax (Chemistry), T. Zhang	332	1,328	Fall 1999
192	Calculus for Engineers	Lec/Sec	Ramakrishna	295	1,180	Spring 2000
193	Calculus for Engineers	Lec/Sec	Cady (T&AM)*, Hui (T&AM)*, Kable, Schatz, Shealy (EE), Shoemaker (C&EE), Z. Wang (T&AM)*	230	920	Fall 1999
193	Calculus for Engineers	Lec/Sec	Kable	13	52	Spring 2000
213	Calculus	Lec/Sec	B. West	25	100	Fall 1999
213	Calculus	Lec/Sec	Back	24	96	Spring 2000
221	Linear Algebra and Calculus	Lec/Sec	Buzzard, Gasharov, Limic, Swartz	117	468	Fall 1999
221	Linear Algebra and Calculus	Lec/Sec	Gasharov, Nerode, Swartz	82	328	Spring 2000
222	Calculus	Lec/Sec	Saloff-Coste, Strichartz	51	204	Fall 1999
222	Calculus	Lec/Sec	Brown, Shilnikov, Yamada	97	388	Spring 2000
223	Honors Linear Algebra and Calculus	Lec/Sec	Hubbard	32	128	Fall 1999
224	Honors Linear Algebra and Calculus	Lec/Sec	Hubbard	28	112	Spring 2000
231	Linear Algebra	Lecture	Buzzard	14	42	Spring 2000
293	Engineering Mathematics	Lec/Sec	Jenkins (T&AM)*, R. Terrell	594	2,376	Fall 1999
293	Engineering Mathematics	Lec/Sec	Hatcher	357	1,428	Spring 2000
294	Engineering Mathematics	Lec/Sec	Artemov, Rosakis (T&AM)*	350	1,400	Fall 1999
294	Engineering Mathematics	Lec/Sec	Phoenix (T&AM)*, Rosakis (T&AM)*	528	2,112	Spring 2000
321	Applicable Analysis	Lec/Sec	Bailey	22	88	Fall 1999
332	Algebra and Number Theory	Lecture	Speh	27	108	Fall 1999
336	Applicable Algebra	Lecture	Billera, Stillman	74	296	Spring 2000
356	Groups and Geometry	Lecture	Speh	18	72	Spring 2000
401	Honors Seminar: Topics in Modern Math.	Lecture	Bailey	16	64	Spring 2000
403	History of Mathematics	Lecture	Taimina	15	60	Spring 2000
411	Introduction to Analysis	Lecture	Kesten	14	56	Fall 1999
413	Honors Introduction to Analysis	Lecture	Escobar, Ramakrishna	50	200	Fall 1999
414	Honors Introduction to Analysis	Lecture	Kesten	27	108	Spring 2000
418	Function Theory of One Complex Var.	Lecture	Escobar	18	72	Spring 2000
420	Applicable Analysis	Lecture	Back	10	40	Fall 1999
420	Applicable Analysis	Lecture	Shilnikov	18	72	Spring 2000
422	Applicable Analysis II	Lecture	Yamada	7	28	Fall 1999
422	Applicable Analysis II	Lecture	Yamada	11	44	Spring 2000
423	Applicable Analysis III	Lecture	Bendikov	4	16	Spring 2000
427	Intro. to Ordinary Differential Equations	Lecture	Rothaus	8	32	Fall 1999
428	Intro. to Partial Differential Equations	Lecture	Topping	15	60	Spring 2000
431	Introduction to Algebra	Lecture	Chase	24	96	Fall 1999
432	Introduction to Algebra	Lecture	Berest	10	40	Spring 2000
433	Honors Introduction to Algebra	Lecture	Kable	29	116	Fall 1999
434	Honors Introduction to Algebra	Lecture	Dennis	19	76	Spring 2000
441	Introduction to Combinatorics	Lecture	Gasharov	19	76	Spring 2000
451	Euclidean and Spherical Geometry	Lecture	Henderson	16	64	Fall 1999
452	Classical Geometries	Lecture	Rybnikov	4	16	Spring 2000
453	Introduction to Topology	Lecture	Rishel	11	44	Fall 1999
454	Introduction to Differential Geometry	Lecture	J. West	6	24	Spring 2000
455	Applicable Geometry	Lecture	Billera	9	36	Fall 1999
471	Basic Probability	Lecture	Nussbaum	22	88	Fall 1999
472	Statistics	Lecture	Nussbaum	11	44	Spring 2000

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
486	Applied Logic	Lecture	Artemov	18	72	Spring 2000
490	Supervised Reading and Research	Ind Stud	Faculty	5	20	Fall 1999
490	Supervised Reading and Research	Ind Stud	Faculty	10	43	Spring 2000
500	College Teaching	Lecture	Rishel	4	4	Fall 1999
505	Educ. Issues in Undergraduate Math.	Lecture	Henderson	3	12	Fall 1999
507	Teaching Secondary Mathematics	Lecture	Solomon	7	28	Spring 2000
508	Math. for Secondary School Teachers	Lecture	Solomon	0	0	Fall 1999
508	Math. for Secondary School Teachers	Lecture	Solomon	20	20	Spring 2000
611	Real and Complex Analysis	Lecture	L. Gross	21	84	Fall 1999
612	Real and Complex Analysis	Lecture	Earle	17	68	Spring 2000
613	Topics in Analysis	Lecture	Hubbard	4	16	Fall 1999
615	Mathematical Methods in Physics	Lecture	L. Gross	2	8	Fall 1999
617	Dynamical Systems	Lecture	Ilyashenko	8	32	Fall 1999
619	Partial Differential Equations	Lecture	Ilyashenko	5	20	Fall 1999
620	Partial Differential Equations	Lecture	Topping	3	12	Spring 2000
621	Measure Theory & Lebesgue Integration	Lecture	Dynkin	10	40	Fall 1999
622	Applied Functional Analysis	Lecture	Rothaus	2	8	Spring 2000
631	Algebra	Lecture	Dennis	17	68	Fall 1999
634	Algebra	Lecture	Stillman	11	44	Spring 2000
650	Lie Groups	Lecture	Speh	5	20	Spring 2000
651	Introductory Algebraic Topology	Lecture	Sjamaar	16	64	Spring 2000
652	Differentiable Manifolds	Lecture	Yamada	7	28	Fall 1999
661	Geometric Topology	Lecture	J. West	8	32	Fall 1999
662	Riemannian Geometry	Lecture	Escobar	4	16	Spring 2000
671	Probability Theory	Lecture	Dynkin	12	48	Fall 1999
672	Probability Theory	Lecture	Saloff-Coste	7	28	Spring 2000
674	Introduction to Mathematical Statistics	Lecture	Nussbaum	2	8	Spring 2000
681	Logic	Lecture	Nerode	14	56	Spring 2000
713	Functional Analysis	Lecture	L. Gross	14	56	Spring 2000
715	Fourier Analysis	Lecture	Saloff-Coste	6	24	Fall 1999
717	Applied Dynamical Systems	Lecture	Guckenheimer	13	52	Spring 2000
722	Topics in Complex Analysis	Lecture	Epstein	1	4	Spring 2000
728	Seminar in Partial Differential Equations	Seminar	Schatz	4	16	Fall 1999
731	Seminar in Algebra	Seminar	Dennis	4	16	Fall 1999
732	Seminar in Algebra	Seminar	Peeva	4	16	Spring 2000
735	Topics in Algebra	Lecture	Kable	10	40	Spring 2000
737	Algebraic Number Theory	Lecture	Sen	7	28	Fall 1999
739	Topics in Algebra	Lecture	Gasharov	5	20	Fall 1999
751	Seminar in Topology	Seminar	Hatcher	4	16	Fall 1999
752	Seminar in Topology	Seminar	Cohen	6	24	Spring 2000
753	Algebraic Topology	Lecture	Hatcher	9	36	Fall 1999
757	Topics in Topology	Lecture	Brown	8	32	Fall 1999
758	Topics in Topology	Lecture	Kahn	4	16	Spring 2000
762	Seminar in Geometry	Seminar	Zuk	4	16	Fall 1999
767	Algebraic Geometry	Lecture	Stillman	14	56	Fall 1999
767	Algebraic Geometry	Lecture	Abramenko	3	12	Spring 2000
771	Seminar in Probability and Statistics	Seminar	Seminar	0	0	Fall 1999
772	Seminar in Probability and Statistics	Seminar	Seminar	0	0	Spring 2000
777	Stochastic Processes	Lecture	Kesten	5	20	Fall 1999
778	Stochastic Processes	Lecture	Dynkin	4	16	Spring 2000
781	Seminar in Logic	Seminar	Nerode	9	36	Fall 1999
782	Seminar in Logic	Seminar	Shore	8	32	Spring 2000
783	Model Theory	Lecture	Shore	7	28	Spring 2000
784	Recursion Theory	Lecture	Shore	8	32	Fall 1999
788	Topics in Applied Logic	Lecture	Platek	5	20	Fall 1999
790	Supervised Reading and Research	Ind Stud	Faculty	11	52	Fall 1999
790	Supervised Reading and Research	Ind Stud	Faculty	16	70	Spring 2000

TOTALS	Courses	Lectures	Enroll	Dept* Cr Hrs	Total Cr Hrs
Academic Year	119	208	5,898	18,766	23,024
Fall Semester	60	120	3,227	10,156	12,644
Spring Semester	59	88	2,671	8,610	10,380

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

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

Mathematics Department Directory 1999–2000

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

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

Associate Professor:
Richard Platek

Assistant Professors:
Yuri Berest
Irena Peeva
Ravi Ramakrishna
Reyer Sjamaar

Acting Professor:
Allen Back

Adjunct Professor:
Graeme Bailey

Adjunct Associate Professors:
Maria Terrell
Robert Terrell

H.C. Wang Assistant Professors:
Gregery Buzzard
Adam Epstein
Vesselin Gasharov
Anthony Kable
Vlada Limic
Konstantin Rybnikov
Peter Topping
Daniel Wise

Senior Lecturers:
Thomas Rishel
Avery Solomon
Beverly West

Field Members from Other Departments:
Timothy Healey (T&AM)
Dexter Kozen (Computer Science)
Richard Rand (T&AM)
James Renegar (OR&IE)

Visiting Faculty:
Sergei Artemov
Alexander Bendikov
Carsten Petersen
Andrey Shilnikov
Edward Swartz
Daina Taimina
Nancy Tisch
Sumio Yamada
Tusheng Zhang
Andrzej Zuk

Visiting Program Participants:
William Dunbar
Maria Fung
John Rosenthal
Stephen Wirkus
Xueqi Zeng

Visiting Scholars:
Peter Abramenko
Bruce Driver
Robert Fisher
Eduardo Garcia
Yuji Hamana
Yutaka Ishii
Peter Papadopol
Vladimir Veselov
Thomas Zaslavsky

Teaching Associates:
Richard Furnas
Shannon Kelly
Stephen Wirkus

Graduate Students:
Henrique Araujo
James Belk
Cynthia Bowers
David Brown
Ryan Budney
Stephen Bullock
Andrei H. Caldararu
Nelia Charalambous
Dan Ciubotaru
Jean Cortissoz
Alan Robert Demlow
Christopher Francisco
Yuval Gabay
Suman Ganguli
Ferenc Gerlits
Ilya German
Lee Gibson
Leah Gold
Noam Greenberg
Radu Haiduc
Spencer Hamblen
Christopher Hardin
Patrick Higgins
Matthew Horak
Geoffrey Christopher Hruska

Samuel Hsiao
Antal Jarai
Shannon Kelly
Sebastian Krief (nondegree)
JaEun Ku
Dmitriy Leykekhman
Hway Kiong Lim
Lek-Heng Lim
Yi Lin
Jennifer Suzanne Lynch
Swapneel Mahajan
Brian A. Meloon
Florian Milanovici
Joseph Stephen Miller
Nathaniel G. Miller
Steven Morris
Kathryn Louise Nyman
Wei Ouyang
Melanie Pivarski
Ofer Porat
Rajmohan Rajagopalan
David Robert Revelle
William Ritter
Hasanjan Sayit (nondegree)
Rebecca Schuller
Fernando Schwartz
Steven Sinnott
Maria Sloughter
Aaron Solo
Sarah Spence
Catherine Anne Stenson
Roman Tymkiv
Shawn Walker
Anke B. Walz
Walker McMillan White
Russell Woodroofe
Yan Zeng
Yan Zhang
Wenhuan Zhao
Huibin Zhou

Visiting Graduate Student:
Matthias Beck

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

Computer Consultants:
Douglas Alfors
Robert Terrell

Instructional Computer Lab:
Allen Back, director

Mathematics Support Center:
Douglas Alfors, director
Richard Furnas

Mathematics Library Staff:
Lee Ringland
Steven Rockey, librarian

Changes for 2000–01

Promotion:
Reyer Sjamaar, associate professor

New Professor Emeritus:
Moss Sweedler

New H.C. Wang Asst. Professors:
José Ramirez
Harrison Tsai
Warwick Tucker

VIGRE Asst. Professors:
James Conant
Russell Miller
Lawren Smithline
Edward Swartz

New Graduate Students:
David Benbennick
Janet Best
Kristin Camenga
Todd Kemp
Evgueni Klebanov
Fernando Marques
Jeffrey Mermin
Antonio Montalban
Roland Roeder
Gil Rosenberg
Franco Saliola
Everilis Santana-Vega
Hasanjan Sayit
Serguei Slavnov
Brigitta Vermesi

Faculty Departures:
Persi Diaconis
Adam Epstein

Thomas Rishel
Peter Topping
Daniel Wise

Faculty Leaves:
Dan Barbasch, spring 2001
R. Keith Dennis, fall 2000
David Henderson, fall 2000
John Hubbard, academic year
Richard Platek, fall 2000
Oscar Rothaus, fall 2000
Avery Solomon, academic year
Birgit Speh, spring 2001
Michael Stillman, spring 2001

Special Programs and Activities

Roger Farrell's Retirement

On September 25, 1999, the departments of Mathematics and Statistical Science held a one-day conference in honor of Roger Farrell's lifelong involvement in mathematics. The conference featured five very interesting academic talks delivered by distinguished speakers, including Jim Berger (Duke University), Don Burkholder (University of Illinois), Larry Brown (University of Pennsylvania), Iain Johnstone (Stanford University) and Jim Hobert (University of Florida). The majority of the speakers began by commenting on the impact Roger Farrell has had on them both personally and professionally.

The evening celebration featured Roger Farrell's life outside academia. The festivities began with a parade led by a Scottish bagpiper and a troupe of English and Scottish dancers, with Roger dressed in full Scottish regalia, including a kilt and sporran. Roger is an avid dancer, and all those attending were treated to several demonstrations of Scottish and English dances, with both Roger and his wife LeMoyne participating.

After a buffet dinner, the entertainment resumed with dance demonstrations by several local dance groups. The swing dancers were the hit of the evening. The national award-winning Lindy Hop dancers, made up of a group of Ithaca high school students, also gave an outstanding demonstration. Many of our usually shy mathematicians were inspired enough to join in the jitterbugging.

Those who were unfamiliar with Roger's impressive dancing were astounded. The reputation Roger acquired during his 40 years of service at Cornell as a shy mathematician has been broadened by this event.

The conference and the evening's entertainment were made successful and thoroughly enjoyable by the devoted efforts of Donna Smith and LeMoyne Farrell.

Finite Element Circus

On October 1–2, 1999, the Finite Element Circus met at Cornell to discuss the latest developments in numerical approximation of partial differential equations, such as those occurring in engineering practice for which the Finite Element Method is the industry standard.

The Finite Element Circus is a semi-annual event that originated in 1970. It travels from town to town, hence its name. It is a very informal gathering of researchers indeed, as no advance notice is required to attend. At the beginning of the Circus, those present who wish to talk raise their hand. The allotted time is then divided by the number of speakers, and the order of the speakers is determined by a lottery (formerly by drawing from a hat, now by computer).

Informal as the Circus may be, it has one interesting rule: you come to listen as well as to talk. Hence, you are not allowed to talk unless you stay for the whole conference. Yes, the rule is enforced!

Of course, to anyone who has been a student at Cornell it will seem very appropriate that the Circus met here. After all, the "esteemed institution on the hill" very much resembles a three-ring circus, bells, chimes and all. While the Circus has visited Cornell many times, this was the first time it was held in the department's new quarters. The organizers proudly showed off Malott Hall to their colleagues from far and near. Many envious comments were overheard, in particular about our library.

About forty people attended the Circus at Cornell, and sixteen people spoke. These days, travelling to a two-day conference far away is a bit of an expensive hassle and hence the Circus has spawned an offspring, the Texas Finite Element Rodeo. Occasionally they meet, in spite of distance; the spring 2000 meeting was a joint Circus-Rodeo down in Austin. For more about the Circus—its history, its poems and, oh yes, the speakers—see www.math.psu.edu/dna/fecircus.

A Midlife Crisis Funded by the NIH

For most of this decade, the focus of Richard Durrett's research has been on the application of stochastic spatial models to problems that arise from problems in ecology. Much of this work has been done with Simon Levin, who left Cornell for Princeton in 1992, and with Rick Harrison who is head of what is now called the Department of Ecology and Evolutionary Biology.

About three years ago, during the supervision of a Ph.D. thesis written by Semyon Kruglyak, Durrett met Chip Aquadro and became interested in his work on "microsatellites." These DNA repeat sequences (for example, CA repeated 7 or more times) have higher mutation rates than the rest of our DNA and are thus useful as genetic markers. Examples that have been in the headlines

are "Thomas Jefferson Fathered Slave's Last Child," and the verification that the sheep named Dolly was indeed a clone. Less famous, but perhaps more important, are their use as markers for locating genes and for dating events associated with the movement of humans out of Africa and subsequent colonization of Europe and the Americas.

For the purposes just mentioned, one needs a model of how DNA repeat sequences evolve in time. In 1998 Kruglyak, Durrett, Aquadro and Malcolm Schug (then a postdoc in the Aquadro lab) introduced a new model that avoided some of the problems with the then standard "stepwise mutation model." It provided a good fit to data from genetic databases on the abundance of microsatellites and to experimental work on their mutation rates. The mathematics involved in the model is very simple. In principle, an undergraduate with knowledge of stochastic processes could have developed it. However, the model is useful because it provides more accurate predictions of properties of microsatellites.

To follow up on this work, Durrett and Aquadro submitted a proposal for a supplement to Aquadro's NIH grant under a program to foster the development of cross-disciplinary collaborations for the "study of complex biological systems." The grant was funded in the spring of 1999 and will provide teaching relief for Durrett during the next three years so that he can develop the background necessary to do research in this area.

Math Club Guest Lectures

Parametrizing Knots

Professor Joan Birman of Columbia University gave a Math Club guest lecture on November 19, 1999. The talk was entitled *Parametrizing Knots.*

Professor Birman is the recipient of a Guggenheim Fellowship as well as the Chauvenet Prize given by the Mathematical Association of America. She proved to be an animated and amusing lecturer, filling her hour-long talk with concrete results from her research and challenging open questions at the end. Birman's talk was the most popular guest lecture sponsored by the Math Club to date, drawing a large audience that included faculty members, graduate students and undergraduates from various majors. The success of the lecture was no accident. Professor Graeme Bailey, a long-time friend of Birman's, suggested the Math Club invite her to Cornell. Math Club president Daniel Ramras and Math Club faculty advisor Professor Ravi Ramakrishna then put in a lot of effort arranging for and organizing Professor Birman's visit and talk.

After the lecture, seventy-two students and faculty joined professors Birman and Bailey at the weekly Math Table for dinner in Risley Dining Hall. The department is most grateful for this weekly gathering, sponsored by the Faculty Fellow Program of Campus Life at Cornell.

Hilbert's Eleventh Problem

On April 28, 2000, Professor Peter Sarnak of Princeton University gave an invited talk to the Math Club, sponsored by Cornell's Student Activities Finance Committee. Approximately 100 people attended his talk, titled *Hilbert's Eleventh Problem: Representing Integers by Quadratic Forms*. About a hundred years ago the famous mathematician David Hilbert posed several problems for the next century at the International Congress of Mathematicians. Professor Sarnak reported on his recent work on the eleventh of these problems.

Professor Sarnak has won numerous awards, including a Sloan Fellowship and the Polya Prize. He was also the recipient of a Presidential Young Investigator award.

Summer Program

We offered twelve courses in the three-week, eight-week and six-week sessions in the summer of 1999. These courses covered subjects such as finite mathematics for biologists, linear algebra and calculus, and statistics. By offering a variety of summer courses, students are able to take classes to fulfill their graduation requirements or just to get ahead. Among our offerings is Mathematical Explorations (Math 103), which can cover a variety of different topics depending on the instructor, often providing an entertaining and appealing introduction to the breadth of application of mathematics in the modern world. Even for traditional calculus courses, the special characteristics of summer study allow a much greater interaction between students and faculty, which makes for a more exciting educational experience for both. There were a total of 265 students enrolled in our courses, which include students from Cornell, other colleges and high schools. One of the major attractions for high school students to come to Cornell is the opportunity to experience the vitality of mathematical life here, so much so that many of these students apply for undergraduate study at Cornell the following year. In addition to our own department faculty members, faculty visiting from colleges and universities in Pennsylvania, Oklahoma, Maryland and as far away as Italy and Hungary, join us in the summers to teach our courses. Mathematics graduate students appointed as teaching assistants provided support to all of our instructors last summer.

Spring Concert Series

On the evening of Monday, May 7, 2000, a group of talented faculty, visitors, graduate students, undergraduates and friends of the Mathematics Department performed before an appreciative audience in the department's tenth 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, including an original composition.

Prelude to Suite No. 4, Johann Sebastian Bach: Nathaniel Miller — cello.

Trio from Una Cosa Rara, Martin y Soler: Kathryn Nyman — soprano; Trinny Gaulke — soprano; Lee Gibson — tenor; David Kempe — piano.

Sonata No. 2 for violin and piano, Charles Ives: I. Autumn; II. In the Barn; III. Revival; Wendy de Heer — violin; Robert Strichartz — piano.

MatheMadrigals (selections), Robert Strichartz: 3. Solution of the cubic (Tartaglia); 4. Fermat's Last Theorem (Fermat); 5. Continuity and Limits (Newton/Cauchy/Newton); Tamara Dietrich-Muller — soprano; Kathryn Nyman — alto; Douglas Alfors — tenor; Clifford Earle — bass.

Guilty Looks Enter Tree Bears (a dramatization), H. L. Chance: Douglas Alfors, Kathryn Nyman, Donna Smith, Nora Balfour, Walker White, Colette Walls, Richard Furnas.

La Campanella, Franz Liszt: Amy Yang — piano.

Serenade, Franz Schubert: Frances Ng — violin; Graeme Bailey — piano.

Sonata No. 1 in B, W. A. Mozart: Weining Qiu — piano; Yourha Kang — flute.

Piano Sonata in A Minor, K.310, 3rd Movement, W. A. Mozart: Noam Greenberg — piano.

Sonata for Violin and Piano, 2nd movement, Cesar Franck: Gregery Buzzard — violin; Graeme Bailey — piano.

How Could I Ever Know? (from the Secret Garden), Lucy Simon, lyrics by Marsha Norman: Carolyn Sealfon — voice; Graeme Bailey — piano.

Untitled original dance, choreographed by Myriam Qureshi, music by Phil Collins: Myriam Qureshi, Jessica Lam — dancers.

A Mathematician's Progress (parody), music by Gilbert & Sullivan, lyrics by W. A. Hurwitz: John Hubbard — soloist; Clifford Earle — piano; David Brown, Christopher Hruska, Yutaka Ishii, Sebastian Krief, Karl Papadantonakis — chorus.

Topology Festival

The topology/geometry group of the Mathematics Department hosted the thirty-eighth annual Topology Festival on May 5–7 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. We were pleased to be able to hold this year's festival in our new home, Malott Hall.

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:

Chris Connell, University of Illinois at Chicago: *Volume Growth Rigidity*

John Roe, Pennsylvania State University: *Amenability and Assembly Maps*

Kevin Whyte, University of Utah: *Large Scale Geometry of Graphs of Groups*

Mark Sapir, Vanderbilt University: *Some Applications of Higman Embeddings*

Martin Bridson, Oxford University: *Subgroups of Semihyperbolic Groups*

Ross Geoghegan, Binghamton University: $SL(2)$ *Actions on the Hyperbolic Plane*

Stephen Bigelow, University of California at Berkeley: *Braid Groups are Linear*

Thomas Mark, Michigan State University: *Curve-Counting and Seiberg-Witten Invariants of Three-Manifolds*

The 39th Cornell Topology Festival will be held May 4–6, 2001.

Preparing Future Professors

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

Cornell graduate students gave ten talks on such topics as *Projective geometry and art* and *Codes and codebreaking* to a mixed audience of faculty and students at Hobart and William Smith, Wells and Ithaca Colleges. This experience afforded participants the opportunity to talk about their work in ways that anticipate both professional meetings and job searches. Graduate students Sarah Spence, Kathyrn Nyman, David Brown and Leah Gold coordinated these talks. Some of the student speakers were David Brown, Maria Fung, Suman Ganguli, Lee Gibson, Suzanne Lynch and Kathryn Nyman. In April, some of the above speakers were invited through the program to speak at the MAA sectional meeting in Syracuse, New York.

The National Science Foundation has funded a national Professors for the Future program administered through the AMS and MAA. Tom Rishel has been chairing the committee to choose the participating schools. In October he spoke on *Preserving PFF Once the Parade Passes* at a national coordinating event for the program.

Expanding Your Horizons

Expanding Your Horizons is an annual day of hands-on workshops in mathematics and science for seventh and eighth grade girls. The program is organized and run by women in mathematics and science, with the intention of generating interest in these subjects and of motivating the girls to continue taking mathematics and science courses throughout high school. On April 8, 2000, the graduate women of the Mathematics Department once again contributed to the success of the day by offering a sticky and fun workshop on donuts and topology.

In this workshop, *Knots, Donuts, Surfaces and Teacups*, James Belk, Cynthia Bowers, Kathryn Nyman, Melanie Pivarski and Maria Sloughter worked with the girls using paper, playdough and donuts to study properties of surfaces. The girls created mobius strips and experimented by guessing how many twists and pieces would appear after cutting them. Some of the girls tried different methods of cutting and inadvertently started with extra twists which yielded results that were surprising to girls and graduate students alike. We then made hexaflexagons before deforming playdough teacups into donuts. Afterwards, they took real donuts, wrapped string around them and ate them, forming torus knots. They learned that even mathematicians can utilize experimentation, and it can be both fun and tasty!

Mathematics Awareness Month

April is Mathematics Awareness Month, and this year the department organized several activities as our contribution to this national event. A number of faculty visited several local schools to give presentations to students, and the general public was invited to come to Malott Hall to hear the first in what will be an annual series of lectures aimed to present interesting new developments in mathematics to a wider audience. This year's lecture was *Chaos, Complication and Control* given by John Hubbard. Beginning with the example of the novice skier, who achieves stability by planting the skis wide but then discovers she has no control, and leading through more elaborate mathematical systems described by differential equations, Professor Hubbard showed how control is attainable only by sacrificing stability and skirting the edges of chaos. The talk was filled with amusing metaphors (such as the three philanthropists who compete to bring coffee, tea and wine to the doorstep of all the inhabitants of an unfortunate island) and beautifully illustrated by the output of computer simulations.

Mathematics Awareness Week at Area Schools

The American Mathematical Society encourages universities to support the idea of a mathematics awareness week in April at area schools. We have 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 chose their favorites among the designs submitted by students, and the Cornell Department of Mathematics chose a winner: Lila Fontes. The Departments of Mathematics at Cornell University and Ithaca High School kindly underwrote the cost of producing the T-shirts that were used as prizes, given to staff at Cornell and Ithaca High School and other area high schools, and sold at cost.

During the week, a problem of the day was announced over the loudspeaker each morning at Ithaca High School

and other area schools. 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 addition, at the request of local teachers, several faculty members from the department gave guest talks to math classes in area high schools. Topics included statistics, fractals and geometry. In all, the week increased awareness of mathematics as an ongoing experience and produced many smiling faces.

Research Experiences for Undergraduates Program

The summer of 1999 marked the sixth year of the Mathematics Department's Research Experiences for Undergraduates Program. REU is an intensive eight-week program in which ten of the brightest undergraduate mathematics majors from around the country come to Cornell to work on research projects under the direction of Cornell faculty and visitors. The program is funded by the National Science Foundation, and the current grant continues through 2001. Three high school teachers also participated in the 1999 program.

This was the first year that the program was held in Malott Hall, and the students were enthusiastic about our new headquarters. Instead of complaints about the lack of air conditioning (as in White Hall), we were treated to complaints about *too much* air conditioning — you can't win them all!

The areas of research for 1999 were: (1) Analysis on Fractals, directed by Robert Strichartz with the assistance of Alexander Teplyaev, a recent Cornell Ph.D.; (2) Complex Dynamics, directed by Adam Epstein and John Hubbard with the assistance of graduate student Suzanne Lynch; and (3) Discrete Geometry, directed by Karoly Bezdek, a visitor from Eötvös University in Budapest.

Analysis on Fractals

The students working on analysis on fractals were continuing work that has engaged many REU students since 1996. The goal is to create a kind of calculus for functions whose domain is a fractal rather than a smooth space, to create a framework in which important scientific problems may be addressed. To begin the process we have been concentrating on certain very symmetric examples, such as the Sierpinski gasket. Two complementary goals are to extend our understanding as deeply as possible for these special examples and to broaden the class of fractals as much as possible. Both goals were advanced during the summer's work. A notable achievement was the completion of a working finite element method to approximate solutions of fractal differential equations on the Sierpinski gasket, which may be found on the web at mathlab.cit.cornell.edu/~gibbons/. An article describing the whole field was published in the November 1999 issue of *Notices of the AMS*.

Complex Dynamics

The students working on complex dynamics met together for the first few weeks to familiarize and offer a general understanding of the subject to the participants. Having established a foundation upon which to start their research, the participants broke off into groups to explore different problems. Scott Wilson made an extensive investigation of the family M3, where one critical point is periodic of period 3. Ben Wittner and Mary Rees have studied this family, but much of the structure is still mysterious. Scott located, in particular, a whole new family of "exotic hyperbolic components." Vicki Kowalski and Scott Corry started writing a program called *Medusa*, which computes parameter values for a class of rational functions called *captures*. This should become a major exploration tool for the entire field. Alex Raichev investigated "long ray connections." The question of whether there are arbitrary long ray connections has implications for the limiting behavior of matings, and locating such things is a delicate problem in combinatorics. Melkana Brakalova and Keith Hilles-Pilant investigated the family M4. This is largely unexplored territory, and even the algebraic problems are interesting. They discovered many new phenomena, including an unexpected approximate periodicity. Since all of the projects were related, participants working on different problems often helped one another out. This created a collaborative atmosphere that played a large part in the results of each participant.

Discrete Geometry

The students working on discrete geometry were able to solve several problems involving bodies of constant width and sphere packings. For example, did you know that every convex body of constant width in 3-space may be illuminated by six directional sources? (Hint: Illumination means that the light ray must hit the surface and enter the body, not just glance a corner point.) Do you know what the minimum diameter is for a convex polytope in d-space with vertices with edge lengths of at least one? No one knows exactly, but it is now known to be at most 3, provided $n \geq d + 4$. While such results are easy to state, they required considerable ingenuity to discover! One of the students also discovered an error in a

much quoted paper of Bieberbach. It seems that Bieberbach merely stated that a proof he had given in the case of plane geometry also works in spherical geometry. Not so, it turns out, but Greg Blekherman of NYU came up with a correct proof. Two of the students in this group have been invited to a conference in Budapest to discuss their work.

Summer 2000 Program

The summer 2000 REU program will involve fifteen students (support for extra students comes from several sources, including the VIGRE grant), including seven from Cornell. The areas of research will be: (1) Analysis on Fractals, directed by Robert Strichartz with the assistance of Alexander Teplyaev; (2) Mathematical Problems from Biology, directed by Richard Durrett in coopertation with biogists Chip Aquadro, Rasmus Nielsen and Todd Vision; and (3) Algebraic Combinatorics, directed by Richard Ehrenborg and Margaret Readdy (former assistant professors at Cornell who will be joining the Mathematics Department at the University of Kentucky this fall) assisted by graduate student Leah Gold.

The Smorgasbord Seminar will continue into the fall semester as a one credit course.

Centers for Mathematics Research at Cornell

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. Terrence L. Fine was appointed director of CAM effective July 1, 1999.

The environment for applied mathematics at Cornell today is rich and varied. Viewed nationally, Cornell is a major center of activity in applied mathematics and scientific computations, and its students are among the best at Cornell. The 80 center faculty are drawn from the Department of Mathematics and 14 other departments in engineering and the sciences.

The following Mathematics Department faculty are members of CAM: L. Billera, R. Connelly, P. Diaconis, R. Durrett, E. B. Dynkin, J. F. Escobar, R. H. Farrell, L. Gross, J. Guckenheimer, J. H. Hubbard, H. Kesten, A. Nerode, A. H. Schatz, J. Smillie, M. Stillman, M. Sweedler and L. B. Wahlbin.

Center for the Foundations of Intelligent Systems

The Center for the Foundations of Intelligent Systems, directed by Anil Nerode, is part of a consortium of Berkeley, Stanford and Cornell devoted to all aspects of intelligent systems, 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.

Mathematics Library

The Mathematics Library has completed its first year of operation in Malott Hall. The new facility has changed the use of the library, and we have seen a fairly dramatic increase in the number of patrons. Even with a vast increase in the number of mathematics journals becoming available online our circulation has increased. However, traditionally the vast majority of our circulation is books instead of journals. This year all the books and journals related to mathematics education, which were housed in Mann Library, were transferred to the Mathematics Library to consolidate the collection.

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

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

The library staff consists of Steven Rockey, the director of the library, Lee Ringland, access services supervisor, and approximately a dozen part-time undergraduate student employees. The veteran professional staff and the competent student employees are always ready

to serve the public, and they welcome feedback. A primary goal is to make the library experience for the staff and patrons interesting, productive and enriching in a small and personal environment.

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

Digital Books

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

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

Project Euclid

Cornell University Library is the recipient of a $750,000 grant from the Andrew W. Mellon Foundation for a three-year project to create an online repository for mathematics and statistics publications. Titled "Project Euclid," its primary mission is to support the transition of independent mathematics and statistics journals to the online environment.

Independent journals have long been very important as an affordable means of disseminating high-quality research in theoretical and applied mathematics and statistics. The majority of these journals, however, have faced economic tensions and technical hurdles in making the transition to a web-based publication. Project Euclid will help publishers of independent mathematics journals by creating an infrastructure that will empower them to publish on the web, create economies of scale and increase their visibility by a combined online presence.

In Project Euclid, Cornell University Library (CUL) is collaborating with Duke University Press to set up an online repository — a virtual "one-stop" web site where researchers and scholars will be able to access dozens of important titles in mathematics and statistics. The Euclid site represents a new model of scholarly communication, as it will support the entire span of scholarly publishing from preprints to the distribution of published journals. Project Euclid will also provide journal editors with a unique set of web-based publishing tools that will enable them to streamline their editorial and peer review processes and publish in a more timely and cost-effective manner.

At Cornell, Project Euclid is managed by Zsuzsa Koltay, CUL's coordinator of electronic publishing. For more information about Project Euclid, visit euclid.library.cornell.edu/project/ or contact Zsuzsa Koltay at (607) 255-7964; e-mail zk10@cornell.edu.

Mirror Site for Zentralblatt für Mathematik

Cornell University Library has also set up a "mirror" web site to MATH, a major European resource, allowing the campus community and subscribers in the U.S. to more quickly access this online publication. A licensed database, MATH is the electronic version of Zentralblatt für Mathematik und ihre Grenzgebiete, the leading European indexing and reviewing service for the discipline. The mirror site can be found at euclid.library.cornell.edu.

Special Instructional Support

Computer Lab

Biggest users of the lab this year were elementary statistics (Math 171), mathematical explorations (Math 103), multivariable calculus and differential equations (Math 213), applicable analysis (Math 420), and the math teaching course, Math 507. Other classes making some use of the lab included the geometry courses Math 356, Math 452 and Math 454 as well as the probability course Math 471.

Last summer was a very active one for the Research Experiences for Undergraduates program in the lab. In part this was because of a very active dynamical systems group, the addition of a Research Experiences for Teachers component, as well as the analysis on fractals work which we have been supporting for a long time.

The lab took advantage of lower hardware upgrade prices to move five of its Macs to high speed G3 processors, as well as major enlargements of disk space on

most power macs. Our NT installation was improved to be oriented around an NT server setup, and our linux machines are now all running a Redhat 6.x with improved security services such as secure shell and tripwire. Changes in campuswide licensing options allow us now to deploy ten full copies of Matlab, in addition to the five copies of Mathematica in the lab as well as Maple on every machine.

The lab's machines for supporting classwide use continue to age, and in some cases fail. In some cases, our users are very interested in older software that runs best on older machines. And the lab has reasonably good resources for supporting smaller computing groups such as the REU students last summer. However, to run the latest software as well as being able to make better use of materials developed elsewhere, the lab should probably do a major upgrade of CPUs in the near future.

Mathematics Support Center

An academic support wing 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 eight 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.

In its new quarters in 256 Malott Hall, the MSC is located on a main thoroughfare through the building and is consequently much more accessible and visible to students than ever before. This may account for some of the additional traffic experienced this year (about a 15% increase). The increased space available to us in Malott Hall has greatly enhanced our service to students. We have several tutoring areas, which are sufficiently separated from one another, so that some privacy and noise issues are addressed, yet are not so widely separated that we lose contact with someone who is working on something. Our 'reception area' can accommodate students who are waiting for their turn at being tutored, and we have a couple of sites that work nicely for small groups. The small library of texts that we maintain can now be easily accessed by tutors and clients, and some mathematics computer programs provide some additional support when needed.

Management of the facility, strictly speaking, remains as before. We continue weekday hours of service (10:00 AM–5:00 PM), as well as Sunday afternoons (1:30–5:30 PM). During the past two summers we have made modest use (for the first time) of mathematics ideas in support of a limited portion of the mathematics curriculum (Mathematics 105). It is too early to have a clear indication of its value, but we hope to explore this more in the future, given the opportunity to purchase additional materials. We hope also to have a more visible web presence as time goes on and to replace some antiquated computer equipment.

The Mathematics Support Center has benefitted greatly from Emeritus Professor Roger Farrell's very kind and generous donation of tutoring time during the past year; he has been a popular tutor, and we are very grateful.

Learning Strategies Center

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

In the 1999–2000 academic year, the LSC provided academic support for Math 105, Math 106, Math 111, Math 112, Math 191 and Math 192. Support included respective supplemental courses Math 005, Math 006, Math 011, Math 012, Math 091 and Math 092. These courses consisted of a ninety-minute weekly lecture held on either Sunday, Monday or Wednesday evening, which reviewed material covered in the parent course, with an emphasis on problem solving and prelim preparation. In addition, extensive tutoring hours were provided by the supplemental course instructors and their assistants.

Support for Math 171, as well as other undergraduate statistics courses, was also provided by the LSC in the Academic Support Center for Undergraduate Statistics (ASCUS). The tutor-staffed lab was open Sunday–Thursday evenings, equipped with statistical software and respective problem sets for the courses supported.

During the 2000–01 academic year, support will continue to be provided as described above for Math 105, Math 106, Math 111, Math 112 and Math 171. Less formal academic support may also be provided for students in Math 190 (previously Math 191), during the first part of the fall semester.

NSF Undergraduate Faculty Enhancement Workshop

This workshop is funded by an Undergraduate Faculty Enhancement grant from the National Science Foundation. This was the sixth in a series of such 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. This year's workshop was two days in duration and was designed to provide opportunities for participants in previous workshops to share their expereinces with and their visions for the teaching of undergraduate geometry. The workshop was attended by fifteen mathematics faculty. The leaders of this year's workshop were: David Henderson, Kelly Gaddis (Lewis and Clark University), Jane-Jane Lo (Cornell University) and Daina Taimina (Cornell University and the University of Latvia).

Mathematics Education

Cornell/Schools Mathematics Resource Program

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

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

Activities of the CSMRP in 1999–2000 included: a series of Saturday workshops for teachers of middle and high school mathematics; courses for teachers in Ithaca, Broome county, Elmira and Windsor; work with teachers individually at DeWitt Middle School, Ithaca High School and Windsor Middle School; and summer workshops developing math lab activities for middle school and high school mathematics.

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

Once again, the department is thankful to alumni, friends and family who 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. Its 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. In June 1999, the library moved to a newly renovated facility in Malott Hall which tripled floor space and resulted in a 50% increase in shelving. There is now plenty of room for the library's 50,000 volumes and for a predicted 15 years of collection growth.

The 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 postdoctoral 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 1999–2000

Doctoral Degrees

August 1999

Maria G. Fung

Twisted Torsion on Compact Hyperbolic Spaces: A Representation-Theoretic Approach

MS Special, Cornell University, 1996
BS, Clark University, 1993
Committee: Speh, Barbasch, Earle, Henderson

Abstract: We consider a twisted version τ_θ of the Ray-Singer analytic torsion on compact locally symmetric spaces $X = K\backslash G/\Gamma$ (with G a noncompact connected semisimple Lie group, K its maximal compact subgroup, and Γ a discrete torsion-free cocompact subgroup), where θ is an automorphism of X with the property that $\theta^2 = 1$. We obtain a representation-theoretic interpretation of the twisted torsion. By considering $\theta =$ Cartan involution, we show that $|\tau_\theta| = 1$ for the compact locally symmetric spaces associated to the families of Lie groups locally isomorphic to $SO_0(2n+1, 1)$.

Denis Roman Hirschfeldt

Degree Spectra of Relations on Computable Structures

MS Special, Cornell University, 1998
BA, University of Pennsylvania, 1993
Committee: Shore, Kozen, Nerode

Abstract: The study of additional relations on computable structures began with the work of Ash and Nerode. The concept of degree spectra of relations was later introduced by Harizanov. In this dissertation, several new examples of possible degree spectra of relations on computable structures are given. In particular, it is shown that, for every c.e. degree $\mathbf{a}$, the set $\{\mathbf{0}, \mathbf{a}\}$ can be realized as the degree spectrum of an intrinsically c.e. relation on a structure of computable dimension two, thus answering a question of Goncharov and Khoussainov. Some extensions of this result are given, and the methods used in proving it are employed to construct a computably categorical structure whose expansion by a single constant has computable dimension ω. Degree spectra of relations on computable models of particular algebraic theories are also investigated. For example, it is shown that, for every $n > 0$, there is a computable integral domain with a subring whose degree spectrum consists of exactly n c.e. degrees, including $\mathbf{0}$. In contrast to this result, it is shown, for instance, that the degree spectrum of a computable relation on a computable linear ordering is either a singleton or infinite. In both cases, sufficient criteria for similar results to hold of a given class of structures are provided.

Sudeb Mitra

Teichmüller Theory and Holomorphic Motions

MS Special, Cornell University, 1996
BS, St. Xavier's College, Calcutta, 1985
Committee: Earle, Smillie, Strichartz

Abstract: The subject of holomorphic motions over the open unit disc shows some interesting connections between classical complex analysis and problems on moduli. It has also found many applications in complex dynamics. In this dissertation, we study holomorphic motions over more general parameter spaces. For a closed subset E of the Riemann sphere we study its Teichmüller space, which is shown to be a universal parameter space for holomorphic motions of that set over a simply connected complex Banach manifold. This universal property has several important consequences; one of them is a generalization of the "Harmonic λ-lemma." This is the best general theorem about extending holomorphic motions that is known at present. We also study some other applications.

Luis Miguel O'Shea

Abelian Sesquisymplectic Convexity for Orbifolds

MS, University College Dublin, 1993
BS, University College Dublin, 1992
Committee: Sjamaar, Barbasch, Hatcher

Abstract: We show how the quotient of the symplectic normal bundle to a suborbifold of a symplectic orbifold can be viewed as the symplectic normal bundle to the image of the suborbifold in the reduction of the symplectic orbifold. We use this to prove an orbifold sesquisymplectic version of the isotropic embedding theorem. We apply this to prove a symplectic slice theorem in the same setting and in turn use this to prove a convexity theorem in this setting. Finally we apply these results to toric orbifolds.

David Mark Stephenson

Asymptotic Density in an n-Threshold Randomly Coalescing and Annihilating Random Walk on the d-Dimensional Integer Lattice

MS Special, Cornell University, 1998
BS, Pennsylvania State University, 1992
Committee: Kesten, Tardos, Durrett

Abstract: We consider a system of particles, each of which performs a continuous time random walk on $\mathbb{Z}^d$. The particles interact only at times when a particle jumps to a site at which there are a least $n-1$ other particles present. If there are $i \geq n-1$ particles present, then the particle coalesces (is removed from the system) with probability c_i and annihilates (is removed along with another particle) with probability a_i. We call this process the n-threshold randomly coalescing and annihilating random walk. We show that, for $n \geq 3$, if both a_i and $a_i + c_i$ are increasing in i and if the dimension d is at least $2n+4$, then $P(t) := P\{\text{the origin is occupied at time } t\} \sim C(d,n)t^{-\frac{1}{n-1}}$, and $E(t) := E\{\text{number of particles at the origin at time } t\} \sim C(d,n)t^{-\frac{1}{n-1}}$.

The constants $C(d,n)$ are explicitly identified. The proof is an extension of a result obtained by H. Kesten and J. Van Den Berg for the 2-threshold coalescing random walk and is based on an approximation for $dE(t)/dt$.

May 2000

Stephen Spratlin Bullock

Warped Cohomology

MS Special, Cornell University, 2000
BS, University of Georgia, 1994
Committee: Speh, Barbasch, Escobar

Abstract: This work concerns the computation of various L_2 cohomology theories, where L_2 cohomology is an analogue of de Rham cohomology on complete Riemannian manifolds which demands the forms under consideration be square integrable. These computations take place on a class of manifolds defined herein, which generalize the arithmetic quotients of rank one symmetric spaces. In particular, they are all with the sole exception of the Euclidean line finite volume. Nevertheless, infinite dimensionality problems can still arise for this L_2 cohomology, so the square integrability condition is tightened or loosened by multiplying various exponential weighting functions into the Riemannian measure. This often produces finite dimensional weighted L_2 cohomology groups. Finally, the manifolds under study are sufficiently close to arithmetic quotients of rank one symmetric spaces that the cohomology of the links of the cusp points at infinity admits a weight space decomposition, allowing the definition of an analogue of the weighted cohomology of [GHM94] on them. This analogue, called warped cohomology, will in fact compute the weighted L_2 cohomologies defined above and is defined on many nonarithmetic spaces. Warped cohomology allows results on such spaces which are similar to the weighted L_2 construction of weighted cohomology (theorem A) derived on arithmetic quotients of symmetric spaces (of any rank) in [Nai99].

Andrei Horia Caldararu

Derived Categories of Twisted Sheaves on Calabi-Yau Manifolds

MS Special, Cornell University, 2000
BA, Hebrew University, 1993
Committee: M. Gross, Stillman, Earle, Kozen

Abstract: This dissertation is primarily concerned with the study of derived categories of twisted sheaves on Calabi-Yau manifolds. Twisted sheaves occur naturally in a variety of problems, but the most important situation where they are relevant is in the study of moduli problems of semistable sheaves on varieties. Although universal sheaves may not exist as such, in many cases one can construct them as twisted universal sheaves. In fact, the twisting is an intrinsic property of the moduli problem under consideration.

A fundamental construction due to Mukai associates to a universal sheaf is a transform between the derived category of the original space and the derived category of the moduli space, which often turns out to be an equivalence. In the present work we study what happens when the universal sheaf is replaced by a twisted one. Under these circumstances we obtain a transform between the derived category of sheaves on the original space and the derived category of twisted sheaves on the moduli space.

The dissertation is divided into two parts. The first part presents the main technical tools: the Brauer group, twisted sheaves and their derived category, as well as a criterion for checking whether an integral transform is an equivalence (a so-called Fourier-Mukai transform). When this is the case we also obtain results regarding the cohomological transforms associated to the ones on the level of derived categories.

In the second part we apply the theoretical results of the first part to a large set of relevant examples. We study smooth elliptic fibrations and the relationship between the theory of twisted sheaves and Ogg-Shafarevich theory, K_3 surfaces, and elliptic Calabi-Yau threefolds. In particular, the study of elliptic Calabi-Yau threefolds leads us to an example which is likely to provide a counterexample to the generalization of the Torelli theorem from K_3 surfaces to threefolds. A similarity between the examples we study and certain examples considered by Vafa-Witten and Aspinwall-Morrison shows up, although we can only guess the relationship between these two situations at the moment.

Antal Jarai

Incipient Infinite Clusters in 2D Percolation

MS, Eötvös Loránd University, 1996
Committee: Kesten, Durrett, Saloff-Coste

Abstract: We study several kinds of large clusters in critical two-dimensional percolation, and show that the microscopic (lattice scale) view of these clusters when they are observed from the perspective of one of their sites is described by Kesten's incipient infinite cluster (IIC), as it was conjectured in [Ai97]. This way we relate the IIC to other objects in critical percolation that have been proposed as alternatives [ChChDu, ChCh, Ai97].

The mentioned relationship is established for spanning clusters, large clusters in a finite box, the inhomogeneous model of J. Chayes, L. Chayes and R. Durrett, and the invaded region in invasion percolation without trapping.

Other related theorems are proved. It is shown that for any k greater than or equal to 1 the difference in size between the kth and $(k+1)$st largest critical clusters in a finite box goes to infinity in probability as the size of the box goes to infinity. The distribution of the Chayes-Chayes-Durrett cluster is shown to be singular with respect to the IIC. A new upper bound for the growth rate of the invasion percolation cluster, matching the lower bound up to a constant factor, is obtained.

Master of Science

August 1999
Chow Ying Lee
Thesis: Matroids and Random Walks
AB, Cornell University, 1998

Master of Science Special

(No Thesis Required)

August 1999

Qi Lu, Mathematics
BS, Beijing University, 1997
Committee: Hwang, Wahlbin, J. West

January 2000

Jennifer Suzanne Lynch, Mathematics
BS, University of Missouri at Rolla, 1997
Committee: Hubbard, Earle, Smillie

Wei Ouyang, Mathematics
BA, Jamestown College, 1997
Committee: Strichartz, Saloff-Coste, Kozen

May 2000

Suman Ganguli, Mathematics
BS, University of Chicago, 1995
Committee: Nerode, Shore, Kozen

Wenhuan Zhao, Mathematics
BA, Bennington College, 1997
Committee: Sweedler, Dynkin, Henderson

Bachelor of Arts

January 2000

Sean William Copeland
James Michael Egelhof
Michael B. Priscott †

May 2000

Jamie Lynn Bessich †
Ilan Birnbaum
William Robert Brickles
Christopher Buscemi
Yonghee Jenny Chang
Christine Eun Choo
Katherine Ann Copic
Jeffrey Damien Deluca
Dion Kane Harmon
Cum Laude in Mathematics
Sung-Shin Hong
Alexander Isaac Hubbard
Cum Laude in Mathematics
Cum Laude in Physics
Misha Kapushesky
Magna Cum Laude in Comparative Literature
Linda Lau †
Wayne William Lee
Ruidong Li †
Yufeng D. Li
Aaron Jacob Lowenkron
Meredith Anne Mann
Andrew John McCabe
Fung Ng
Karl Spyros Papadantonakis †
Summa Cum Laude in Mathematics
Brian Lee Pfaff
Anthony Victor Pulido
Alexander Raichev †
Cum Laude in Mathematics
Gopal R. Rajegowda
Daria L. Sharman
David I. Siegel †
Cum Laude in Philosophy
Katherine Munroe Swift
Lauren M. Thal †
Nina Nialani Tillman
Philip Pei-Tze Yuen

† **Distinction in all subjects**

Department Colloquia

Analysis Seminar

August 1999

Adrian Constantin, University of Zurich (Switzerland): *Some aspects of a shallow water equation*

September 1999

Sumio Yamada, Cornell University: *On rank of harmonic mappings*

Peter Topping, Cornell University: *Repulsion and quantization in almost-harmonic maps*

Sandra Pott, University of Edinburgh (UK): *Matrix A_2 weights, matrix BMO and the Hilbert transform*

October 1999

Robert Strichartz, Cornell University: *Mock Fourier series*

Yulij Ilyashenko, Cornell University and Moscow State University (Russia): *Growth and zeroes of holomorphic functions and Hilbert type numbers for Abel equations*

Alexander Bendikov, Cornell University: *Ultraconstructivity of Markov semigroups*

November 1999

Laurent Saloff-Coste, Cornell University: *When does elliptic Harnack imply parabolic Harnack?*

Eduardo Garcia, Universidad Santiago de Compostela (Spain) and Cornell University: *Osserman manifolds in semi-Riemannian geometry*

Mathew Gursky, Indiana University: *Fully nonlinear equations in conformal geometry and 4-manifolds of positive Ricci curvature*

Robert Fisher, Idaho State University and Cornell University: *Generalized immersions and the rank of the second fundamental form*

Lars Wahlbin, Cornell University: *A negative result on positive approximation*

December 1999

Noel Lohoue, University of Paris at Orsay (France): *Topics in harmonic analysis on Riemannian manifolds*

January 2000

Camil Muscalu, Brown University: *Multilinear singular integrals*

Irina Mitrea, University of Minnesota: *Spectral properties of elliptic layer potentials on curvilinear polygons*

February 2000

Eduardo Gatto, DePaul University: *Fractional calculus on non-coordinate spaces*

Cliff Earle, Cornell University: *Conformal mapping to variable domains*

March 2000

Yuri Berest, Cornell University: *Analysis of linear differential operators on some singular algebraic varieties*

Sumio Yamada, Cornell University: *Weil-Petersson geometry of Teichmüller spaces and mapping class group actions*

Thierry Coulhon, Université de Cergy-Pontoise (France): *Manifolds and graphs with slow heat kernel decay*

Robert Strichartz, Cornell University: *The shape of the error: a new paradigm in approximation theory*

April 2000

Laurent Saloff-Coste, Cornell University: *Elliptic Harnack inequality in space-time space*

Gilad Lerman, Yale University: *Geometric transcriptions of sets and their application to data analysis*

Combinatorial and Algebraic Geometry Seminar

August 1999

Marcelo Aguiar, Université de Montréal (Canada): *Infinitesimal Hopf algebras and the* **cd***-index of polytopes*

September 1999

Yuri Berest, Cornell University: *Noncommutative projective geometry and ideal classes of the Weyl algebra*

Matthias Beck, Temple University and Cornell University: *The number of lattice points in rational polytopes*

Veit Elser, Cornell University: *Crystallography and Riemann surfaces*

October 1999

Takayuki Hibi, Osaka University (Japan): *Upper bounds for the graded Betti numbers of simplicial complexes with a given f-vector*

Edward Swartz, Cornell University: *Matroids and quotients of spheres*

Edward Swartz, Cornell University: *Finite linear quotients of spheres*

Diane Maclagan, University of California at Berkeley: *Combinatorics of the toric Hilbert scheme*

November 1999

Vesselin Gasharov, Cornell University: *Hilbert functions*

Matthias Beck, Temple University and Cornell University: *Polytopes, lattice points and photography*

Michael Stillman, Cornell University: *The toric Hilbert scheme*

Irena Peeva, Cornell University: *Koszul algebras*

March 2000

Alexandre Tchernev, State University of New York at Albany: *Homological properties of polynomial functors*

Leah Gold, Cornell University: *A bound on the multiplicity for codimension 2 lattice ideals*

April 2000

Stephanie van Willigenburg, York University: *Pieri operators on posets*

Marc Chardin, Université Pierre et Marie Curie (France): *The canonical module and computational algebraic geometry*

Curtis Greene, Haverford College: *Posets, S_n characters, rational function identities and lattice point enumeration*

Konstantin Rybnikov, Cornell University: *Lattice vectors and lattice polytopes*

May 2000

Francis Edward Su, Harvey Mudd College and Cornell University: *Three proofs of a polytopal generalization of Sperner's Lemma*

Dynamics and Geometry Seminar

September 1999

Yulij Ilyashenko, Cornell University and Moscow State University (Russia): *Minimal attractors*

John Hubbard, Cornell University: *How to prove KAM in the simplest case* (in two parts)

October 1999

Mike Shub, IBM: *Stable ergodicity*

Kaushal Verma, Syracuse University: *Hyperbolic automorphisms and holomorphic motions in two complex variables*

Tadashi Tokieda, University of Illinois at Urbana-Champaign and the Université du Quebec à Montréal (Canada): *Perturbation theory for symmetric hamiltonian systems*

Anton Borisiuk, Moscow State University (Russia): *Global bifurcations on the Klein bottle*

Svetlana Katok, Penn State University: *Rigidity of measurable structure for algebraic actions of higher-rank abelian groups*

November 1999

Rob Benedetto, University of Rochester: *Dynamics of p-adic rational functions*

John Guckenheimer, Cornell University: *Canards in a model of reciprocal inhibition*

Yutaka Ishii, Cornell University: *A two-dimensional kneading theory for Lozi maps and their entropy formulae*

January 2000

John Hubbard, Cornell University: *Newton's method in two complex variables* (in two parts)

February 2000

Carsten Petersen, Cornell University: *On critical holomorphic quasi circle maps* (in two parts)

Adam Epstein, Cornell University: *(Limits of) quadratic rational maps with a (degenerate) parabolic fixed point*

March 2000

Saeed Zakeri, University of Pennsylvania: *Dynamics of cubic Siegel polynomials*

Andrey Shilnikov, Cornell University: *Blue-sky catastrophe bifurcation*

April 2000

Dierk Schleicher, SUNY at Stony Brook: *The dynamics of exponential maps and the dimension paradox*

Lie Groups Seminar

September 1999

Ravi Ramakrishna, Cornell University: *Deforming Galois representations and Serre's conjecture*

Reyer Sjamaar, Cornell University: *Symplectic implosion*

Anthony Kable, Cornell Univ.: *Exceptional representations of GL(n) and their tensor products* (in two parts)

October 1999

Rebecca Goldin, University of Maryland: *The cohomology ring of weight varieties*

Kari Vilonen, Brandeis University: *Representation theory of algebraic groups and the affine Grassmannian*

November 1999

Yuri Berest, Cornell University: *Calogero-Moser particles and infinite-dimensional algebraic groups*

Stephen Bullock, Cornell University: *The Nomizu/vanEst theorem*

Andrzej Zuk, Cornell University: *On groups generated by finite automata*

February 2000

Peter Abramenko, University of Bielefeld (Germany) and Cornell University: *On the homological finiteness properties of S-arithmetic groups*

Werner Mueller, Universitaet Bonn (Germany) and Institute for Advanced Study: *On the spectrum of the Laplacian on locally symmetric spaces of finite volume*

Roger Howe, Yale University: *Infinitesimal structure of principal series — further examples*

March 2000

Andrei Zelevinsky, Northeastern University: *Double Bruhat cells in semisimple Lie groups*

Simon Gindikin, Rutgers University: *Complex geometry and representations of real semisimple Lie groups*

April 2000

Dan Barbasch, Cornell University: *Spherical unitary dual for split classical groups*

Eckhard Meinrenken, University of Toronto (Canada): *Verlinde's formulas as fixed point formulas*

Pavel Winternitz, Université de Montréal (Canada): *Lie symmetries of difference equations*

Logic Seminar

August 1999

Walker White, Cornell University: *Algorithmic complexity of some model theoretic properties* (in two parts)

September 1999

Roman Tymkiv, Cornell University: *Intuitionistic arithmetic*

Joseph Miller, Cornell University: *Realizability and recursive mathematics* (in five parts)

Richard Shore, Cornell University: *Defining the Turing jump I*

Sergei Artemov, Cornell University: *Proof realizability*

Harold Hodes, Cornell University: *Generalizing natural deduction (at least slightly)*

October 1999

Alexandre Evfimievski, Cornell University: *A probabilistic algorithm for updating files over a communication link*

Philip Scowcroft, Wesleyan University: *Intuitionistic analysis* (in two parts)

Alexei Kopylov, Cornell University: *Linear logic* (in two parts)

Walker White, Cornell University: *Realizability and recursive mathematics* (in two parts)

November 1999

Suman Ganguli, Cornell University: *Realizability and recursive set theory* (in three parts)

Harvey Friedman, Ohio State University: *Approximate fixed points, disjoint covers and optimized posets*

Steve Zdancewic, Cornell University: *Computational interpretation of classical proofs*

January 2000

Vitezslav Svejdar, Karlovy University (Czech Republic): *PSPACE-completeness in some non-classical logics*

February 2000

Richard Shore, Cornell University: *Defining the Turing jump* (in two parts)

Roman Tymkiv, Cornell University: *Constructive ordinals and Pi-1-1 sets* (in two parts)

Joseph Miller, Cornell University: *Variations on timed automata*

Yuval Gabay, Cornell University: *The hyperarithmetic hierarchy* (in three parts)

Suman Ganguli, Cornell University: *Decidable Kripke models for modal logic* (in three parts)

March 2000

Noam Greenberg, Cornell University: *Sigma-1-1 predicates of reals* (in four parts)

Richard Shore, Cornell University: *Another splitting theorem*

April 2000

Roman Tymkiv, Cornell University: *Finite computable dimension does not relativize*

Gerald Sacks, Harvard University and MIT: *E-recursion* (in two parts)

Walker White, Cornell University: *Metarecursion: enumerability* (in two parts)

May 2000

Walker White, Cornell University: *Metarecursion: priority arguments* (in two parts)

Occasional Seminar

September 1999

Carla Martin, Thomas Rishel and Walker White, Cornell University: *The job market*

October 1999

Kathryn Nyman and others, Cornell University: *The NSF fellowship process for graduate students and younger faculty*

November 1999

Thomas Rishel, Cornell University: *Finding voice amid the rigor of mathematics*

April 2000

Maria Fung and Walker White, Cornell University: *Advice from new graduates*

Oliver Club

August 1999

Steve Gelbart, Weizmann Institute (Israel): *An introduction to Langlands' program*

September 1999

Robin Forman, Rice University: *Discrete Morse theory*

Bruce Driver, University of California at San Diego and Cornell University: *Path integrals on manifolds*

Persi Diaconis, Cornell University and Stanford University: *Probability and Hecke algebras*

Mike Shub, IBM: *Are chaotic dynamical systems usually statistically robust?*

October 1999

Andrzej Zuk, Ecole Normale Superieure de Lyon (France) and Cornell University: *On groups with Kazhdan's property (T)*

Igor Pak, Yale University: *Probability and computing on groups*

Kari Vilonen, Brandeis University: *Geometric Langlands conjecture*

Anatole Katok, Pennsylvania State University: *Exotic dynamics in the smooth and the real-analytic category*

November 1999

Eriko Hironaka, Florida State University and Harvard University: *The geometry of Salem numbers*

Harvey Friedman, Ohio State University: *Enormous integers in real life*

John Shareshian, University of Miami: *Monotone graph properties*

December 1999

Yulij Ilyashenko, Cornell University and Moscow State University (Russia): *Hilbert's sixteenth problem (second part) near its centenary*

January 2000

Richard Schwartz, University of Maryland: *Dynamical versions of Household theorems in projective geometry*

February 2000

Alexander Bendikov, Cornell University: *Brownian motion on compact groups*

Werner Mueller, Universitaet Bonn (Germany) and Institute for Advanced Study: *Extremal Kaehler metrics and Ray-Singer analytic torsion*

Bernd Sturmfels, University of California at Berkeley: *Rational hypergeometric functions*

Itay Neeman, Harvard University: *Unraveling analytic sets*

March 2000

Lisa Traynor, Bryn Mawr College: *Legendrian rational tangles*

Carsten Petersen, Roskilde University (Denmark) and Cornell University: *Topology and geometry of quadratic Siegel Julia sets*

Andrei Zelevinsky, Northeastern University: *Generalized Littlewood-Richardson coefficients, canonical bases and total positivity*

Kumar Murty, University of Toronto (Canada): *The fundamental group of a locally symmetric variety*

April 2000

Sergei Artemov, Moscow State University (Russia) and Cornell University: *Reflections on proof theory*

Martin Golubitsky, University of Houston and Boston University: *Visual hallucinations and pattern formation in the primary visual cortex*

Eckhard Meinrenken, University of Toronto (Canada): *Noncommutative equivariant de Rham theory*

Peter Abramenko, University of Bielefeld (Germany) and Cornell University: *On (twin) buildings and (Kac-Moody) groups*

May 2000

Ross Geoghegan, Binghamton University: *SL(2) actions on the hyperbolic plane*

Olivetti Club

September 1999

John Hubbard, Cornell University: *Kolmogorov's theorem on conservation of invariant tori*

Walker White, Cornell University: *The importance of computable structures*

Suzanne Lynch, Cornell University: *The baby uniformization theorem: complex analysis at its best*

October 1999

David Brown, Cornell University: *Moebius transformations, univalent maps and the mysterious Schwarzian derivative*

William Gordon Ritter, Cornell University: *Symplectic manifolds, topology and modern physics*

David Revelle, Cornell University: *Random walks on groups: the abridged version*

November 1999

Antal Jarai, Cornell University: *Invasion percolation*

Jean Cortissoz, Cornell University: *On the Skorokhod almost sure representation theorem*

José Escobar, Cornell University: *The geometry of the first Steklov eigenvalue*

Christopher Hruska, Cornell University: *Group actions on trees*

February 2000

Roman Tymkiv, Cornell University: *The concept of dimension in topology*

Alan Demlow, Cornell University: *Maximum norm estimates for the finite element method*

Ryan Budney, Cornell University: *A relationship; the implicit function theorem, cobordism of manifolds and stable homotopy theory*

Noam Greenberg, Cornell University: *Forcing: or, how I learned to stop worrying and love relative consistency results*

William Gordon Ritter, Cornell University: *Beautiful applications of category theory in many different branches of mathematics*

March 2000

Swapneel Mahajan, Cornell University: *The Hanna Neumann conjecture*

Matthew Horak, Cornell University: *Automatic groups*

Christopher Francisco, Cornell University: *An introduction to Gröbner bases and their applications*

April 2000

Joseph Miller, Cornell University: *Decidable theories and automata*

Leah Gold, Cornell University: *Bringing syzygies down to earth*

Lee Gibson, Cornell University: *Sylvester's problem: proofs and exploration*

Kathryn Nyman, Cornell University: *From walking fruit flies to scheduling final exams; applications and characterizations of interval graphs*

May 2000

Yuri Berest, Cornell University: *Geometry without points*

Probability Seminar

September 1999

Vlada Limic, Cornell University: *LIFO queue in heavy traffic, branching and measure-valued processes*

Bruce Driver, University of California at San Diego and Cornell University: *Quasi-invariance of heat kernel measure on loop groups*

Claudia Neuhauser, University of Minnesota: *Diversity, stability and coexistence in competitive multispecies models*

Radu Zaharopol, Binghamton University: *What is the support that an attractive probability (measure) gets?*

October 1999

Maury Bramson, University of Minnesota: *Application of fluid models to recurrence and central limits for queueing networks*

Antal Jarai, Cornell University: *The invasion percolation cluster*

November 1999

Richard Durrett, Cornell University: *Chutes and ladders in Markov chains*

Michael Nussbaum, Cornell University: *Asymptotic equivalence of statistical experiments*

Yasunari Fukai, Kyushu University (Japan): *Potential kernel and hitting distribution of two-dimensional random walk*

Sidney Resnick, Cornell University: *The infinite source Poisson model for data communications*

Percy Deift, New York University: *Asymptotics for random permutations*

January 2000

Kenneth Brown, Cornell University: *The Moran model (work of Aldous)*

February 2000

Bruce Driver, University of California at San Diego and Cornell University: *Comparing heat kernel and pinned Wiener measure on loop groups*

José Ramirez, New York University: *Short time asymptotics in Dirichlet spaces*

Yuri Kondratiev, Bonn University (Germany): *Stochastic analysis on configuration spaces*

Sebastien Blachere, University of Toulouse (France): *Internal diffusion limited aggregation on hypercubic lattices*

March 2000

Yuji Hamana, Kyushu University (Japan) and Cornell University: *Some asymptotics of the range of random walks*

Alexander Bendikov, Cornell University: *Elliptic diffusions on infinite products*

Francis Su, Harvey Mudd College and Cornell University: *The discrepancy metric and random walks by irrational rotation*

April 2000

Radu Zaharopol, Binghamton University: *What does the support tell us about the uniqueness of the invariant probability measure?*

Konstantin Rybnikov, Cornell University: *Tension percolation*

Mike Cranston, University of Rochester: *Dispersion for stochastic flows*

Konstantin Rybnikov, Cornell University: *Bootstrap percolation of iterated convex hulls*

May 2000

Vladas Sidoravicius, IMPA Brasil: *Glauber dynamics at zero temperature*

Topology and Geometric Group Theory Seminar

September 1999

Dani Wise, Cornell University: *Eventually injective endomorphisms*

Christopher Hruska, Cornell University: *Ladders, towers and the B. B. Newman spelling theorem*

Andrzej Zuk, Cornell University: *On an isoperimetric inequality for infinite finitely generated groups*

John Meier, Cornell University: *Tame combings and variations on Cannon's almost convexity*

October 1999

William Dunbar, Simon's Rock College and Cornell University: *Orbit spaces of crystallographic groups*

Edward Swartz, Cornell University: *Finite linear quotients of spheres* (in two parts)

Martin Bridson, Oxford University (UK): *The grammatical complexity of groups and manifolds*

Allen Hatcher, Cornell University: *3-manifolds as tinkertoys*

November 1999

Marshall Cohen, Cornell Univ.: *Klyachko's theorem: car crashes and equations over groups* (in two parts)

Thomas Stiadle, Wells College: *Generalized Waldhausen K-theory and homology with stratified coefficients*

Dani Wise, Cornell University: *Negative curvature and residual finiteness*

Boris Goldfarb, State University of New York at Albany: *Rigidity and the large scale*

January 2000

Richard Schwartz, University of Maryland: *Circle quotients and string art*

February 2000

Marshall Cohen, Cornell University: *Long-standing questions on Whitehead torsion*

Marshall Cohen, Cornell University: *Group extensions and unsolved problems in Whitehead torsion*

Peter Abramenko, University of Bielefeld (Germany) and Cornell University: *On opposition in spherical buildings*

March 2000

John Hubbard, Cornell University: *On the topology and homology of Farey blowups* (in two parts)

Dan Farley, SUNY at Binghamton: *Finiteness and CAT(0) properties of diagram groups*

Edward Swartz, Cornell University: *Logic meets Riemannian geometry*

April 2000

Ferenc Gerlits, Cornell University: *Kontsevich's graph homology*

Peter Kahn, Cornell University: *When is a symplectic circle action Hamiltonian?*

Michael Shapiro, Cornell University: *Dehn's algorithm revisited*

Christopher Hruska, Cornell University: *Small cancellation groups are automatic*

Robert Fisher, Idaho State University and Cornell University: *An alternative view of connections in Riemannian geometry*

May 2000

Ryan Budney, Cornell University: *Mapping class groups of spherical 3-manifolds*

Undergraduate Mathematics Club

Fall 1999

John Hubbard, Cornell University: *Dynamics of the forced pendulum*

Daniel Ramras, Cornell University: *Matchings in graphs*

Ravi Ramakrishna, Cornell University: *The distribution of the primes*

Mason Porter, Cornell University: *The history of dynamical systems*

Jon Kleinberg, Cornell University: *An application of linear algebra to the internet*

Robert Strichartz and Nina Tillman, Cornell University: *Generalizations of the Shannon sampling theorem*

Anthony Pulido, Cornell University: *The classification of the finite simple groups*

John Rosenthal, Ithaca College and Cornell University: *Hamming finger games*

Ravi Ramakrishna, Cornell University: *Cutting up polyhedra*

Joan Birman, Columbia University: *Special guest lecture on knot theory*

Spring 2000

Robert Strichartz and Richard Durrett, Cornell University: *The Cornell REU program*

Suzanne Lynch, Cornell University: *Crazy curves*

Sergei Artemov, Moscow State University (Russia) and Cornell University: *The Godel provability calculus*

Daniel Ramras, Cornell University: *Unique perfect matchings*

Anselm Levskaya, Cornell University: *Inverting the Hilbert matrix*

Gregory Padowski, Cornell University: *An ancient algorithm*

Francis Edward Su, Cornell University: *The Banach-Tarski paradox*

Mason Porter, Cornell University: *Quantum chaos*

William Dunbar, Simon's Rock College and Cornell University: *Spiral staircases in the 3-sphere*

Jordan Barry, Cornell University: *Mathematical mystery meat*

Peter Sarnak, Princeton Unversity: *Special guest lecture on Hilbert's eleventh problem*

1999–2000 Faculty Publications

Yuri Berest and G. Wilson, *Classification of Rings of Differential Operators on Affine Curves*, International Math. Research Notices **2** (1999), 105–109.

Yuri Berest and P. Winternitz, *Huygens' Principle and Separation of Variables*, Reviews in Mathematical Physics **12** (2) (2000), 159–180.

Louis J. Billera and Amy Meyers, *Shellability of Interval Orders*, Order **15** (1999), 113–117.

Louis J. Billera, Kenneth Brown and **Persi Diaconis**, *Random Walks and Plane Arrangements in Three Dimensions*, Amer. Math. Monthly **106** (1999), 502–524.

Louis J. Billera and Gábor Hetyei, *Linear Inequalities for Flags in Graded Partially Ordered Sets*, J. Comb. Theory, Series A **89** (2000), 77–104.

Louis J. Billera and Richard Ehrenborg, *Monotonicity of the* **cd***-Index for Polytopes*, Math. Z. **233** (2000), 421–441.

Kenneth Brown, *The Coset Poset and Probabilistic Zeta Function of a Finite Group*, J. Algebra **225** (2000), 989–1012.

Gregery Buzzard, *Nondensity of Stability for Polynomial Automorphisms of* $\mathbb{C}^2$, Indiana U. Math. J. **48** no. 3 (1999), 857–866.

Gregery Buzzard, *Algebraic Surfaces Holomorphically Dominable by* $\mathbb{C}^2$, Invent. Math. **139** no. 3 (2000), 617–659.

Marshall Cohen and Martin Lustig, *The Conjugacy Problem for Dehn Twist Automorphisms of Free Groups*, Commentarii Mathematici Helvetici **74** (1999), 179–200.

Clifford Earle, F. P. Gardiner and N. Lakic, *Isomorphisms Between Generalized Teichmüller Spaces*, Complex Geometry of Groups, Contemp. Math. **240** (1999), 97–110.

Clifford Earle and Zhong Li, *Isometrically Embedded Polydisks in Infinite Dimensional Teichmüller Spaces*, J. Geom. Anal. **9** (1999), 51–71.

Clifford Earle, *The Ahlfors Mollifiers*, Contemp. Math. **256** (2000), 11–16.

Clifford Earle, F. P. Gardiner and N. Lakic, *Asymptotic Teichmüller Space, Part One: The Complex Structure*, Contemp. Math. **256** (2000), 17–38.

Clifford Earle and S. Mitra, *Variation of Moduli Under Holomorphic Motions*, Contemp. Math. **256** (2000), 39–67.

José F. Escobar, *An Isoperimetric Inequality and the First Steklov Eigenvalue*, J. Func. Anal. **165** (1999), 101–116.

Vesselin Gasharov, Irena Peeva and V. Welker, *The lcm-Lattice in Monomial Resolutions*, Math. Res. Lett. **6** (1999), 521–532.

Vesselin Gasharov, *On Stanley's Chromatic Symmetric Function and Clawfree Graphs*, Discrete Math. **205** (1999).

Vesselin Gasharov and **Irena Peeva**, *Binomial Free Resolutions for Normal Toric Surfaces*, PAMS **127** (1999), 1583–1588.

Vesselin Gasharov, Irena Peeva and Volkmar Welker, *Rationality for Generic Toric Rings*, Math. Z. **233** (2000).

W. G. Choe and **John Guckenheimer**, *Computing Periodic Orbits with High Accuracy*, Comp. Meth. Appl. Mech. Engr. **170** (1999), 331–341.

John Guckenheimer, *SIAM Past President's Address*, SIAM News (Oct. 1999).

W. G. Choe and **John Guckenheimer**, *Using Dynamical Systems Tools in Matlab*; in Numerical Methods for Bifurcation Problems in Large-Scale Dynamical Systems, IMA119, 2000, pp. 85–114.

Timothy Healey, *Bifurcation and Metastability in a New One-Dimensional Model for Martensitic Phase Transitions*, Comp. Meth. Appl. Mech. Engr. **170** (1999), 407–421.

David Henderson, *Square Roots in the Sulba Sutra*; in Geometry at Work (Catherine Gorini, ed.), MAA Math Notes 53, Washington, DC, MAA, 2000.

David Henderson, *Experiencing Geometry in Euclidean, Spherical and Hyperbolic Spaces*, Prentice Hall, 2000.

Gorodetski and **Yulij Ilyashenko**, *Some New Robust Properties of Invariant Sets and Attractors of Dynamical Systems*, Funct. Anal. Appl. **33** no. 2 (1999).

Yulij Ilyashenko and Li Weigu, *Nonlocal Bifurcations*, a monograph, Russian translation, edited, MCCME, Che-Ro, 1999.

Harry Kesten and Z-G Su, *Asymptotic Behavior of the Critical Probability for Rho-Percolation in High Dimensions*, Probab. Theory Rel. Fields (2000).

Harry Kesten and Z-G Su, *Some Remarks on AB-Percolation in High Dimensions*, J. Math. Phys. **41** (2000), 1298–1320.

D. Aldous and **Vlada Limic**, *The Entrance Boundary of the Multiplicative Coalescent*, EJP **3** (1998).

Vlada Limic, *On the Behavior of LIFO Preemptive Resume Queues in Heavy Traffic*, ECP **5** (2000).

Lawrence Payne and B. Straughan, *Convergence for the Equations for a Maxwell Fluid*, Studies in Appl. Math. **103** (1999), 267–278.

Lawrence Payne, J. C. Song and B. Straughan, *Continuous Dependence and Convergence Results for Brinkman and Forchheimer Models with Variable Viscosity*, Proc. Roy. Soc. London A **455** (1999), 2173–2190.

Lawrence Payne and B. Straughan, *Effect of Errors in the Spatial Geometry for Temperature Dependent Stokes Flows*, J. Math. Pure Appl. **78** (1999), 609–632.

K. A. Ames and **Lawrence Payne**, *Continuous Dependence on Modeling for Some Well Posed Perturbations of the Backward Heat Equation*, J. Ineq. Appl. **3** (1999), 51–64.

A. P. Korostelev and **Michael Nussbaum**, *The Asymptotic Minimax Constant for Sup-Norm Loss in Nonparametric Density Estimation*, Bernouilli **5** (6) (1999), 1099–1118.

Michael Nussbaum, *Minimax Risk: Pinsker Bound*; in Encyclopedia of Statistical Sciences, update volume 3 (S. Kotz, ed.), John Wiley (1999), 451–460.

R. Haberman and **Richard Rand**, *Sequences of Orbits and the Boundaries of the Basin of Attraction for Two Double Heteroclinic Orbits*, International J. Nonlinear Mechanics **34** (1999), 1047–1059.

J. R. Cooke, **Richard Rand** and E. T. Wirkus, *Nonlinear Dynamics of the Bombardier Beetle*, Proc. 1999 ASME Design Engineering Technical Conferences, paper no. DETC99/VIB-8011 (CD-ROM).

D. V. Ramani and **Richard Rand**, *Nonlinear Normal Modes in a System with Nonholonomic Constraints*, Proc. 1999 ASME Design Engineering Technical Conferences, paper no. DETC99/VIB-8052 (CD-ROM).

S. Mason and **Richard Rand**, *On the Torus Flow* $Y' = A+B\cos Y+C\cos X$ *and its Relation to the Quasiperiodic Mathieu Equation*, paper presented at the 1999 ASME Design Engineering Technical Conferences, paper no. DETC99/VIB-8174.

Richard Rand and S. Wirkus, *Dynamics of Two Coupled van der Pol Oscillators with Delay Coupling*, Proc. 1999 ASME Design Engineering Technical Conferences, paper no. DETC99/VIB-8318 (CD-ROM).

James Renegar, *A Mathematical View of Interior-Point Methods in Convex Optimization*, SIAM, 2000.

Thomas Rishel, *Handbook for Mathematics Teaching Assistants*, Preliminary Ed., MAA Math Notes, 1999.

A. Bendikov and **Laurent Saloff-Coste**, *Potential Theory on Infinite Products and Locally Compact Groups*, Potential Analysis **11** (1999), 325–358.

A. Grigorýan and **Laurent Saloff-Coste**, *Heat Kernel on Connected Sums of Riemannian Manifolds*, Math. Research Letters **6** (1999), 307–321.

Richard Shore, *The Recursively Enumerable Degrees*; in Handbook of Computability Theory (E. R. Griffor, ed.), North-Holland, Amsterdam, 1999, 169–197.

P. Cholak, S. Goncharov, B. Khoussainov and **Richard Shore**, *Computably Categorical Structures and Extension by Constants*, J. Symb. Logic **64** (1999), 13–37.

Richard Shore and A. Sorbi, *Jumps of* Σ^0_2*-High e-Degrees and Properly* Σ^0_2 *e-Degrees*; in Recursion Theory and Complexity (M. Arslanov and S. Lempp, eds.), de Gruyter Series in Logic and its Applications **2**, de Gruyter, Berlin, 1999, 157–172.

B. Khoussainov and **Richard Shore**, *Effective Model Theory: the Number of Models and their Complexity*; in Models and Computability, Invited Papers from Logic Colloquium '97 (S. B. Cooper and J. K. Truss, eds.), LMSLNS **259**, Cambridge University Press, Cambridge, England, 1999, 193–240.

Richard Shore and T. Slaman, *Defining the Turing Jump*, Math. Research Letters **6** (1999), 711–722.

Rohlfs and **Birgit Speh**, *Pseudo Eisenstein Series and Cohomology of Arithmetic Groups I* (1999).

Robert Strichartz, *Analysis on Fractals*, Notices AMS **46** (1999), 1199–1208.

Robert Strichartz, *Evaluating Integrals Using Self-Similarity*, Amer. Math. Monthly **107** (2000), 316–326.

Elizabeth Ayer and **Robert Strichartz**, *Exact Hausdorff Measure and Intervals of Maximal Density for Cantor Sets*, Trans. AMS **351** (1999), 3725–3741.

Robert Strichartz and Yang Wang, *Geometry of Self-Affine Tiles I*, Indiana U. Math. J.l **48** (1999), 1–23.

Richard Kenyon, Jie Li, **Robert Strichartz** and Yang Wang, *Geometry of Self-Affine Tiles II*, Indiana U. Math. J. **48** (1999), 25–42.

Oren Ben-Basset, **Robert Strichartz** and Alexander Teplyaev, *What Is Not in the Domain of the Laplacian on Sierpinski Gasket Type Fractals*, J. Func. Anal. **166** (1999), 197–217.

Robert Strichartz, *Some Properties of Laplacians on Fractals*, J. Func. Anal. **164** (1999), 181–208.

Robert Strichartz, *Isoperimetric Estimates on Sierpinski Gasket Type Fractals*, Trans. AMS **351** (1999), 1705–1752.

Kyallee Dalrymple, **Robert Strichartz** and Jade Vinson, *Fractal Differential Equations on the Sierpinski Gasket*, J. Fourier Anal. Appl. **5** (1999), 203–285.

Peter Topping, *An Example of a Nontrivial Bubble Tree in the Harmonic Map Heat Flow*; in Harmonic Morphisms, Harmonic Maps and Related Topics (J. C. Wood et al, eds.), CRC Press, 1999.

Peter Topping, *The Isoperimetric Inequality on a Surface*, Manuscripta Math. **100** (1999), 23–33.

Peter Topping, *Pressure Estimates in Two Dimensional Incompressible Fluid Flow*, Physica D **137** (2000), 143–156.

The Faculty and their Research

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

Yuri Berest, Assistant Professor; Ph.D. (1997) Université de Montreal (Canada); Partial differential equations, mathematical physics, algebraic geometry.

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

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

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

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

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

•**Robert Connelly**, Professor; 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, group theory, mathematical bibliography.

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

Richard Durrett, Professor; Ph.D. (1976) Stanford University; Problems in probability theory that arise from ecology and genetics.

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 Emeritus; 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.

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

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

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

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

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

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

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

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

Harry Kesten, Goldwin Smith 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.

Michael Nussbaum, Professor; Ph.D. (1979) Academy of Sciences Berlin (Germany); Mathematical tatistics.

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

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

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

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

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 and Chair; Ph.D. (1977) University of Chicago; Dynamical systems.

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

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

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

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

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 1999–2000 academic year.*

Faculty Profiles

Graeme Bailey

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

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

Outside the primarily research front, this past year I've given a number of invited talks to student and alumni groups, was voted ACSU "Faculty of the Year," received the Kenneth A. Goldman Excellence in Teaching award, served on the Rhodes, Marshall, Churchill and Fulbright Fellowship committees for the nth year — again the university was successful in having several winners — was involved in continuing university discussions on developing more vital faculty/student interactions (serving on the University Program House Committee and the North Campus Committee), was the faculty advisor for the Judo Club, remained involved with Cornell EMS, enjoyed my eleventh year as a Faculty Fellow at Risley and gave the usual plethora of concerts.

Dan Barbasch

Professor of Mathematics
Director of Graduate Studies

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

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

Invited Lectures:

Unitary representations and endoscopy, AMS Regional Conference, Maryland.

Selected Publications:

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

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

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

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

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

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

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

The Associated Variety of Unipotent Representations, preprint.

Yuri Berest

Assistant Professor of Mathematics

Awards and Honors: CMS Doctoral Prize (1998). NSF Grant No. 0071792 (2000).

Professional Activities: Editor of the Journal of Nonlinear Mathematical Physics.

Administrative Activities: Member of the Graduate Admissions Committee.

Invited Lectures: Centre de Recherches Mathématiques Colloquium, Université de Montreal, Canada (Apr. 2000). British Mathematics Colloquium, Leeds, UK (Apr. 2000). Northeastern University Seminar (Nov. 1999).

Selected Publications:

Huygens' Principle and Coxeter Groups (with A. Veselov), Russian Math. Surveys **48** (2) (1993), 183–184.

Hadamard's Problem and Coxeter Groups: New Examples of Huygens' Equations (with A. Veselov), Func. Anal. Appl. **28** (1) (1994), 3–12.

Huygens' Principle and Integrability (with A. Veselov), Russian Math. Surveys **49** (6) (1994), 7–77.

Lacunae of Hyperboic Riesz Kernels and Commutative Rings of Partial Differential Operators, Lett. Math. Pys. **41** (1997), 227–235.

Huygens' Principle in Minkowski Spaces and Soliton Solutions of the Korteweg-de vries Equation (with I. Loutsenko), Comm. Math. Phys. **190** (1) (1997), 113–132

Solution of a Restricted Hadamard Problem on Minkowski Spaces, Commun. Pure and Appl. Math. **50** (1997), 1019–1052.

Hierarchies of Huygens' Operators and Hadamard's Conjecture, Acta Appl. Math. **53** (1998), 125–185.

The Problem of Lacunas and Analysis on Root Systems, Trans. Amer. Math. Soc. (1999).

Classification of Rings of Differential Operators on Affine Curves (with G. Wilson), Internat. Math. Res. Notices **2** (1999), 105–109.

Automorphisms and Ideals of the Weyl Algebra (with G. Wilson), Math. Annalen (1999).

Louis J. Billera

Professor of Mathematics

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

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

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

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

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

Invited Lectures:

Enumeration of faces of polytopes: the current state of affairs, Conference on Discrete and Computational Geometry, Ascona, Switzerland (June 1999).

Enumerative invariants of convex polytopes, AMS Regional Meeting, Providence, RI (Oct. 1999).

Geometry of the space of phylogenetic trees, Mathematisches Forschungsinstitut Oberwolfach (May 2000).

Selected Publications:

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

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

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

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

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

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

James H. Bramble

Professor Emeritus of Mathematics

For the past 25 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: Distinguished Professor of Mathematics at Texas A & M University. Member of the AMS and SIAM. Associate Editor of Mathematics of Computation. Member of Editorial Boards of Numerical Functional Analysis and Optimization, Advances in Computational Mathematics, RAIRO, Panamerican Mathematics Journal and Communications in Applied Analysis. Member of Scientific Committee for the International Conferences on Domain Decomposition.

Invited Lectures:

Least-squares for second order elliptic problems, Conference honoring J. Tinsley Oden, Austin, TX (Jan. 1997).

H^s-stable finite element space decompositions, IMACS Conference, Jackson Hole, WY (1997); Workshop in Austria (Oct. 1997).

Least-squares negative norm finite element approximations for div-curl systems, SIAM Annual Meeting, Toronto, Canada (July 1998).

Computational scales of Sobolev norms with application to preconditioning, Conference on Computational Methods, Sophia, Bulgaria (Aug. 1998).

On some recent results on "shift" theorems for elliptic boundary value problems, Special Session of the AMS, Austin, TX (Oct. 1999).

Selected Publications:

A Least-Squares Approach Based on a Discrete Minus One Inner Product for First Order Systems (with R. Lazarov and J. Pasciak), Math. Comp. **66** (1997), 935–955.

Iterative Techniques for Time Dependent Stokes Problems (with J. Pasciak), Inter. Jour. Computers and Math. with Appl. **33** (1997), 13–30.

Analysis of the Inexact Uzawa Algorithm for Saddle Point Problems (with J. Pasciak and A. Vassilev), SIAM J. Numer. Anal. **34** (1997), 1072–1092.

Least-Squares for Second Order Elliptic Problems (with R. Lazarov and J. Pasciak), Comp. Meth. Appl. Eng. **152** (1998), 195–210.

Non-overlapping Domain Decomposition Algorithms with Inexact Solves (with J. Pasciak and A. Vassilev), Math. Comp. **67** (1998), 1-20.

A Negative-norm Least Squares Method for Reissner-Mindlin Plates (with T. Sun), Math. Comp. **67** (1998), 901-916.

A Locking-Free Finite Element Method for Naghdi Shells (with T. Sun), J. Comp. and Applied Math. **89** (1997), 119–133.

Inexact Uzawa Algorithms for Nonsymmetric Saddle Point Problems (with J. Pasciak and A. Vassilev), SIAM J. Num. Anal., to appear.

A Multigrid Theory for an Anisotroic Problem (with X. Zhang), Math. Comp., to appear.

Computational Scales of Sobolev Norms with Application to Reconditioning (with J. Pasciak and P. Vassilevski), Math. Comp., to appear.

Multigrid Methods; in Handbook for Numerical Analysis (with X. Zhang), P. Ciarlet and J. Lions, eds., North Holland, 250 pages.

Kenneth Brown

Professor of Mathematics

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

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

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

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

Invited Lectures:

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

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

Selected Publications:

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

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

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

Buildings, Springer-Verlag, New York, 1989.

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

Random Walks and Plane Arrangements in Three Dimensions (with L. Billera and P. Diaconis), Amer. Math. Monthly **106** (1999), 502–

Semigroups, Rings and Markov Chains, J. Theoretical Probability (2000), to appear.

The Coset Poset and Probabilistic Zeta Function of a Finite Group, J. Algebra **225** (2000), 989–1012.

Improper Actions and Higher Connectivity at Infinity (with J. Meier), Comment. Math. Helv. (2000), to appear.

Gregery Buzzard

H. C. Wang Assistant Professor of Mathematics

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

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

Awards and Honors: NSF Postdoctoral Fellowship (1998). Invited guest of Institut des Hautes Études Scientifiques (summer 1999).

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

Invited Lectures:

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

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

Selected Publications:

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

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

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

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

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

Nondensity of Stability for Polynomial Automorphisms of $\mathbb{C}^2$, Indiana U. Math. J. **48** no. 3 (1999), 857-866.

Algebraic Surfaces Holomorphically Dominable by $\mathbb{C}^2$, Invent. Math **139**, no. 3 (2000), 617–659.

An Interpolation Theorem for Holomorphic Automorphisms of $\mathbb{C}^n$ (with F. Forstneric), J. Geom. Anal., 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. Algebra **91** (1984), 207–257.

Marshall M. Cohen

Professor of Mathematics

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

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

In addition to research and teaching, I deeply value and enjoy my role as a faculty advisor to undergraduates.

Awards and Honors: Winner of the Dean's Award for Advising in 1992, the first year in whichthis award was given. (It is now called the Robert A. and Donna B. Paul Award for Excellence in Advising.)

Professional Activities: Member of the AMS and the 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 **74** (1999), 179–200.

Robert Connelly

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 as well as applications to robotics, protein folding, motion planning and percolation problems in physics and probability.

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.

Professional Activities: Member of the AMS and the MAA. Reviewer for the Mathematical Reviews. Referee for various journals. Editor for Beiträge für Algebra und Geometrie. Organized the Fourth Geometry Festival (with K. Bezdek, A. Bezdek and K. Boroczky), Budapest, Hungary (1999). Organized a workshop on discrete geometry (with B. Erdahl, W. Whiteley and M. Senechal) at the AMS Conference in Lowell, MA (Apr. 2000).

Invited Lectures:

The bellows conjecture, Conference on Discrete and Computational Geometry, Ascona, Switzerland (June 1999); Case Western, Ohio (Aug. 1999); University of Illinois at Urbana-Champaign (Aug. 1999).

Symmetric tensegrities, ICAAM Conference at Edinburgh, Scotland (July 1999), University of Laramie (Aug. 1999).

Two-distance functions, Budapest, Hungary (July 1999).

Two-distance preserving functions, University of Illinois at Urbana-Champaign (Aug. 1999); Western Washington University (Nov. 1999); Technical University of Vienna, Austria (Dec. 1999).

Tension percolation Geometry Festival at Budapest, Hungary (Nov. 1999); ETH Zurich, Switzerland (Dec. 1999).

Several talks on *Rigidity* and *the carpenter's rule problem*, Workshop on Discrete and Computational Geometry (associated with McGill Univ., Canada) at Barbados (Jan.–Feb. 2000).

The carpenter's rule problem, Reed College (2000).

Selected Publications:

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

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

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

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

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

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

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

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

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

Tension Percolation (with K. Rybnikov and S. Volkov), submitted.

Straightening Polygonal Arcs and Convexifying Polygonal Cycles (with E. Demaine and G. Rote), in preparation

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

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.

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

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

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

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

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

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

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

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

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

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

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

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

Richard Durrett

Professor of Mathematics

My research concerns problems in probability theory that arise from ecology and genetics. Most of my efforts in the first direction have been joint work with Simon Levin in Ecology and Evolutionary Biology at Princeton. At the borderline between genetics and ecology is the study of hybrid zones. I have studied this topic with Rick Harrison in Ecology and Evolutionary Biology at Cornell, using stochastic spatial models to model systems he has studied exerimentally. For the last three years I have been working closely with Chip Aquadro in Molecular Biology and Genetics at Cornell. Most of our joint work has focused on modelling the evolution of DNA repeat sequences, genetic markers that are useful in locating genes or in studying population structure on the time scale of hundreds or thousands of generations.

During the 1999–2000 academic year, I enjoyed a two course teaching reduction thanks to a supplement to Chip Aquadro's NIH grant, funded by an initiative to get mathematicians and computer scientists working with biologists on the complex problems that arise in the study of molecular evolution. This support will continue at the level of one course per year in the next two years. In the fall of 2000, I will teach a graduate seminar on this topic to tell others about what I learned on my time off.

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). Coxeter Lectures, Fields Institute, Toronto, Canada (1999).

Administrative Activities: VIGRE Coordinator.

Professional Activities: Editor for Annals of Applied Probability (1997–1999).

Books:

Lecture Notes on Particle Systems and Percolation, Wadsworth Pub. Co., Belmont, CA (1988).

Probabiity: Theory and Examles, Wadsworth Pub. Co., Pacific Grove, CA (1991); Second Edition, Duxbury Press (1995).

The Essentials of Probability, Duxbury Press (1993).

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

Essentials of Stochastic Processes, Springer-Verlag (1998).

Selected Recent Papers:

Coexistence Results for Some Competition Models (with C. Neuhauser), Ann. Appl. Probab. **7** (1997), 10–45.

Spatial Aspects of Interspecific Competition (with S. Levin), Theoret. Pop. Biol. **53** (1998), 30–43.

Equilibrium Distributions of Microsatellite Repeat Length Resulting From a Balance Between Slippage Events and Point Mutations (with S. Kruglyak, M. Schug and C. Aquadro), Proc. Nat. Acad. Sci. **95** (1998), 10774–10778.

Rescaled Contact Processes Converge to Super-Brownian Motion in Two or More Dimensions (with E. Perkins), Prob. Theor. Rel. Fields **114** (1999), 309–399.

Stochastic Spatial Models, SIAM Review **41** (1999), 677–718.

Spatial Models for Hybrid Zone Evolution (with L. Buttel and R. Harrison), Heredity **84** (2000), 9–19.

Selective Mapping: A Strategy for Optimizing the Construction of High-Density Linkage Maps (with T. Vision, D. Brown, D. Shmoys and S. Tanksley), Genetics **155** (2000), 407–420.

Eugene B. Dynkin

Professor of Mathematics

A. R. Bullis Chair

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

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

Awards and Honors: Member of the National Academy of Sciences, USA. Prize of Moscow Mathematical Society. Fellow of The American Academy of Arts and Sciences. Fellow of the IMS. Leroy P. Steele Prize for cumulative influence of the total mathematical work. Honorary member of the Moscow Mathematical Society. Doctor Honoris Causa of Université 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: International Congresses of Mathematicians: Plenary One-Hour Address, Stockholm (1962); Nice (1970); Vancouver (1974). The Hardy Lecturer (1979). The Wald Lecturer (1991). The A. Aisenstadt Lecturer (1992–93). The Barrett Lecturer (1993). The Ordway Lecturer (1995). International Conference on Infinite-Dimensional (Stochastic) Analysis and Quantum Physics, Leipzig (1999). Workshop on Interactive Measure-Valued Processes, The Fields Institute, Toronto, Canada (Mar. 1999). Workshop on Markov Processes, Changsha (1999). Workshop on Partial Differential Equations, The Mittag-Leffler Institute (2000).

Selected Publications:

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

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

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

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

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

Extinction of Superdiffusions and Semilinear PDEs (with S. Kuznetsov), J. Func. Anal. **162** (1999), 346–378.

Selected Papers of E. B. Dynkin with Commentary, Amer. Math. Soc. and International Press, 2000.

Clifford Earle

Professor of Mathematics

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

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

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

Invited Lectures:

Quasiconformal variation of slit domains, University College, London (Oct. 1999).

Variation of moduli under holomorphic motions, Mt. Baldy Conference on Analysis, Harvey Mudd College (Nov. 1999).

Using quasiconformal maps to study conformal invariants, Mathematics Colloquium, University of Warwick (June 2000).

Selected Publications:

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

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

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

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

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

Adam Epstein

H. C. Wang Assistant Professor of Mathematics

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

Invited Lectures: Midwest Dynamical Systems Conference (Oct. 1999). AMS Special Session on Holomorphic Dynamics and Related Topics (Jan. 2000).

Selected Publications:

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

Quasiconformal Variation of Slit Domains (with C. Earle) Proc. Amer. Math. Soc., to appear.

Bounded Hyperbolic Components of Quadratic Rational Maps, Erg. Thy. and Dyn. Sys., to appear.

Infinitesimal Thurston Rigidity and the Fatou-Shishikura Inequality, Annals of Mathematics, submitted.

José F. Escobar

Professor of Mathematics

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

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

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

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

of the AMS, Communications in Analysis and Geometry, among others, and the NSF.

Invited Lectures:

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

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

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

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

Selected Publications:

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

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

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

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

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

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

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

An Isoperimetric Inequality and the First Steklov Eigenvalue, J. Func. Anal. **165** (1999), 101–116.

Roger Farrell

Professor Emeritus of Mathematics

Retired as of July 1, 1999, I am still semi-active in the department and try to come in most days to audit classes and work some in the Math Support Center. I am not active in research.

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

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

Selected Publications:

Multivariate Calculation, Springer-Verlag, 1985.

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

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

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

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

Spitzer and Bohnenblust, Revisited (1997), preprint.

Vesselin Gasharov

H. C. Wang Assistant Professor of Mathematics

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

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

Selected Publications:

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

Complete Intersection Dimension (with L. Avramov and I. Peeva), Publ. Math. IHES **86** (1997).
On the Neggers-Stanley Conjecture and the Eulerian Polynomials, J. Combin. Theory (A) **82** (1998).
Factoring the Poincaré Polynomials for the Bruhat Order on S_n, J. Combin. Theory (A) **83** (1998).
Hilbert Functions and Homogeneous Generic Forms II, Compositio Mathematica **116** (1999).
The lcm-lattice in Monomial Resolutions (with I. Peeva and V. Welker), Math. Res. Lett. **6** (1999).
Rationality for Generic Toric Rings (with I. Peeva and V. Welker), Mathematische Zeitschrift **233** (2000).
Sufficiency of Lakshmibai-Sandhya Singularity Conditions for Schubert Varieties, Compositio Mathematica, to appear.

Leonard Gross

Professor of Mathematics

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

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

Professional Activities: Editorial boards of the Journal of Functional Analysis, Reviews in Mathematical Physics, Soochow Journal of Mathematics, Revista Colombiana de Matemématicas and Electronic Research Announcements of the American Mathematical Society. Board of Governors of the Institute of Mathematics and Its Applications, Minnesota (1989–91). Co-organizer of special session at American Mathematical Society meeting (Apr. 1998). Co-organizer of satellite of IMP, Warwick, UK (July 2000).

Invited Lectures:
Quantization on compact Lie groups and the universal enveloping algebra, Von Neumann Symp., MIT (1994).
Hilbert spaces of holomorphic functions on complex Lie groups, Taniguchi Symp., Warwick, England (1994).
The mathematical ramifications of Wiener's program in statistical physics, Wiener Centenary Symposium, Lansing, MI (1994).
Hall's transform via the Segal-Bargmann Map, London Mathematical Society (1995).
Hall's transform and quantum mechanics, Probability Towards 2000, Columbia University (1995).
Hilbert spaces of holomorphic functions on complex Lie groups, Paris, France (1996); Bochum, Germany (1996); Mannheim, Germany (1996).
Hypercontractivity over complex manifolds, Paris (1998); London (1998).
Analysis on loop groups, Kusadaci, Turkey (1998).

Selected Publications:
Abstract Wiener Spaces, Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability, Vol 2, pt. 1 (1965), 31–41.
The Cauchy Problem for the Coupled Maxwell and Dirac Equations, Comm. Pure App. Math. **19** (1966), 1–15.
Existence and Uniqueness of Physical Ground States, J. Func. Anal. **10** (1972), 52–109.
Logarithmic Sobolev Inequalities, Amer. J. Math. **97** (1975), 1061–83.
Convergence of $U(1)_3$ Lattice Gauge Theory to its Continuum Limit, Comm. Math. Phys. **92** (1983), 137–162.
A Poincaré Lemma for Connection Forms, J. Func. Anal. **63** (1985), 1–46.
Logarithmic Sobolev Inequalities on Loop Groups, J. Func. Anal. **102** (1991), 268–313.
Uniqueness of Ground States for Schrödinger Operators Over Loop Groups, J. Func. Anal. **112** (1993), 373–441.
A Local Peter-Weyl Theorem, Trans. AMS **352** (1999), 413–427.
Hypercontractivity Over Complex Manifolds, Acta Math. **182** (1999), 159–206.

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: 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. Founding Chair, SIAM Activity Group on Life Sciences. Theoretical Division Review Committee, Los Alamos National Lab (2000–)

Administrative Activities: Member of the FABIT committee, Arts College Committee on Curriculum and served on panel of Appeals Committee (fall 1999).

Invited Lectures: Charles Amick Lecturer, University of Chicago (June 1999); Keynote lecture, Equadiff Symposium, Berlin (Aug. 1999); Frontiers Lecturer, Texas A&M University (Mar. 2000); Erskine Professor, Canterbury University, New Zealand (May–June 2000); New Zealand Society of Math. Lecturer (May–June 2000).

Selected Publications:

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

SIAM Past President's Adress, SIAM News (Oct. 1999).

Using Dynamical Systems Tools in Matlab (with W. G. Choe); in Numerical Methods for Bifurcation Problems and Large-Scale Dynamical Systems, IMA119 (2000), 85-114.

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

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

Torus Maps From Weak Coupling of Strong Resonances (with A. Khibnik), Contemp. Math., Am. Math. Soc., in press.

Analysis of a Subcritical Hopf-Homoclinic Bifurcation (with A. Willms), Physica D, in press.

Numerical Analysis of Dynamical Systems; in Handbook of Dynamical Systems, in press.

Computing Periodic Orbits and Their Bifurcations with Automatic Differentiation (with B. Meloon), SIAM J. Sci. Stat. Comp., in press.

Numerical Computation of Canards (with K. Hoffman & W. Weckesser), Intl. J. Bifurcation & Chaos, in press.

Allen E. Hatcher

Professor of Mathematics

A common thread through much of my research is the idea of studying the space of all topological objects of a certain kind, for example, the space of all finite polyhedra, the space of all diffeomorphisms of a manifold, or the space of all knots. Recently I have also been writing a couple of graduate-level textbooks in topology, trying to lessen the large gap which has developed between the standard first-year courses and current research.

Awards and Honors: Sloan Fellow (1976–80). Invited address at 1978 Int'l Congress of Mathematicians.

Professional Activities: Referee for the NSF and various research journals.

Selected Publications:

Higher Simple Homotopy Theory, Annals of Math. **102** (1975), 101–137.

A Proof of the Smale Conjecture, Annals of Math. **117** (1983), 553–607.

Algebraic Topology I, an on-line textbook available at http://www.math.cornell.edu/~hatcher.

Timothy J. Healey

Professor of Theoretical and Applied Mechanics

I am interested in the rigorous analysis of nonlinear partial differential equations arising in continuum mechanics — in particular, nonlinear elasticity. Although the basic theory, being a branch of classical mechanics, is well understood, it produces formidable nonlinear problems the resolution of which is in many cases beyond the reach of present-day mathematics. In other words, there are many open problems. Currently we are developing and applying generalized degree-theoretic methods for global continuation and bifurcation problems, in many cases yielding the first existence theorems for "large" classical solutions in nonlinear elasticity. Finally, we mention that the theory has a wide range of engineering applications — from flexible structures and solids to shape-memory alloys — from aircraft to lingerie!

Professional Activities: Member of the Editorial Board of the *Journal of Elasticity*.

Administrative Activities: Member of the fields of mathematics and applied mathematics.

Invited Lectures:

New existence theorems in nonlinear elasticity, 2000 SIAM Annual Meeting, Puerto Rico.

Global symmetry of twisted elastic rings, Symmetry and Stability in Nonlinear Mechanics, Univ. Budapest (July 2000).

Selected Publications:

Preservation of Nodal Structure on Global Bifurcating Solution Branches of Elliptic Equations with Symmetry (with H. Kielhofer), J. Diff. Eq. **106** (1993), 665–684.

Global Branches of Positive Weak Solutions of Semilinear Elliptic Problems over Non-smooth Domains (with H. Kielhofer and C. Stuart), Roy. Soc. Edinburgh **124A** (1994), 371–388.

Unbounded Branches of Globally Injective Solutions in the Forced Displacement Problem of Nonlinear Elasticity (with P. Rosakis), J. Elasticity **49** (1997), 65–78.

Free Nonlinear Vibrations for a Class of Two-Dimensional Plate Equations: Standing and Rotating Waves (with H. Kielhöfer), Nonlinear Analysis TMA **29** (1997), 501-531.

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

The Role of the Spinodal Region in One-Dimensional Martensitic Phase Transitions (with A. Vainchtein, P. Rosakis and L. Truskinovsky), Physica D (1998), 29–48.

Bifurcation and Metastability in a New One-Dimensional Model for Martensitic Phase Transitions, Comp. Meth. Appl. Mech. Engr. **170** (1999), 407–421.

David W. Henderson

Professor of Mathematics

I would classify my work as pertaining to aspects of mathematics that impinge on the teaching and learning of mathematics — the emphasis is on the mathematics not on education. My main theme is that we should enliven our conception of what "proof" is and that proofs should be a central part of mathematics teaching at all levels, where my definition of "proof" is: A convincing communication that answers — Why?

In addition, I am currently involved in extensive curriculum innovation projects in undergraduate mathematics. My first book, *Experiencing Geometry on Plane and Sphere*, published in August 1995, has been requested by faculty in 50 countries so far and has been translated into Portugese. My second book *Differential Geometry: A Geometric Introduction* appeared in July of 1997. My third book, *Experiencing Geometry in Euclidean, Spherical and Hyerbolic Spaces*, appeared in summer 2000. It is an extensive revision and expansion of my first book. Other books are in process.

Professional Activities: Referee for the NSF and various journals. Panel on Equity and Diversity of the Mathematical Sciences Education Board, National Academy of Sciences. Member of the AMS, MAA, National Council of Teachers of Mathematics. Invited participant in the international ICMI Study Group on the Teaching of Geometry for the Twenty-First Century (Sicily) and the ICMI Study Group on the Teaching of Undergraduate Mathematics (Singapore).

Numerous workshops (at Cornell and other places in the USA and abroad) about geometry and teaching geometry for mathematics professors and high school teachers — in part supported by grants from NSF and Title IIA Federal grants.

Administrative Activities: Committe for Teacher Education in Agriculture, Mathematics and Science; Health Program Advisory Group; Undergraduate Admissions Committee.

Invited Lectures and Workshops:

Four one-day workshops for school teachers (with A. Solomon and D. Taimina), Cornell University (1999–2000 academic year).

Ask "why?", insist on seeing, experience deeply, learn from others, invited presentation to Third Annual Legacy of R. L. Moore Conference, Austin, TX (Apr. 2000).

Organized and led in week-long NSF Undergraduate Faculty Enhancement workshop, *Teaching Undergraduate Geometry*, Cornell University (June 2000).

Teachers as mathematicians — mathematicians as teachers, invited address in the Models for the Educaiton of Future School Teachers at summer 2000 Meeting of the Canadian Mathematical Society (June 2000).

Selected Publications:

Compactifications of the Ray with the Arc as Remainder Admit No n-Mean (with M. Awartani), PAMS (1995).

Experiencing Geometry on Plane and Sphere, Prentice-Hall, 1996.

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

Building Upon Student Experience in a College Geometry Course (with Lo and Gaddis), For the Learning of Mathematics **16**, 1 (1996), 34–40.

I Learn Mathematics From My Students—Multiculturalism in Action, For the Learning of Math. **16**, 2 (1996).

Square Roots in the Sulba Sutra; Chapter in Geometry at Work (C. Gorini, ed.), MAA Notes **53**, 2000.

Experiencing Geometry in Euclidean, Spherical and Hyperbolic Spaces, Prentice-Hall (2000).

John Hubbard

Professor of Mathematics

Differential equations are the main way in which mathematical models of real systems are constructed, and understanding their behavior is the main contribution a mathematician can make to applications. I am interested in understanding the behavior of differential equations and their close relatives: iterative systems. In particular, I try to see how such systems behave in the complex domain, largely because complex analysis brings new and powerful techniques to bear on the problems.

The availability of powerful computers and computer graphics has changed the way this sort of research is done. In the course of investigations of even such simple iterative systems as quadratic polynomials, amazing pictures show up, rather as artifacts to be investigated than as man-made objects. I anticipate that this sort of experimental mathematics will become a major trend.

Most of my research over the last five years has been devoted to dynamics in several complex variables. I have co-authored four foundational papers in the field. I am also writing three books on a very advanced level, one giving a treatment of Teichmüller space and its applications in theorems of Bill Thurston, the second on dynamics of one complex variable, and the third on differential geometry.

During the summer I also directed an NSF-funded REU program for four students (two from Harvard, one from Cornell, one from Iowa). The resulting presentation by one of these students at the MAA MathFest in Toronto was chosen as one of the outstanding talks at the MAA Student Paper Sessions. During the school year I continued to work with undergraduates on research projects. One of these students, a physics major, was selected as a Merrill Presidential Scholar, and named me as "the faculty member who has had the most positive influence on his education at Cornell."

Of the papers accepted for publication in the past year, two stand out. *A Compactification of Hénon Mappings in $\mathbb{C}^2$ as Dynamical Systems* (with P. Papadopol and V. Veselov), which will appear in Acta Mathematica, builds a bridge between dynamics and algebraic or analytic geometry. The paper uses blow-ups to show that there is a topology on $\mathbb{C}^2 \sqcup S^3$ homeomorphic to a 4-ball such that the Hénon mapping extends continuously. In doing so it proves a result suggested by Milnor, involving embeddings of solenoids in S^3 which are topologically different from those obtained from Hénon mappings. I am currently exploring the application of this method to other problems.

The Forced Damped Pendulum: Chaos, Complication and Control, which will appear in the American Mathematical Monthly, shows how a computer can yield amazing but rigorous results about differential equations using methods accessible to undergraduates. It explores the dynamics of the forced pendulum, as described by the differential equation $x'' + Fx' + \sin \omega x = A \cos t$, for the parameter values $F = 0.1$, $\omega = 1$ and $A = 1$. This pendulum has an attracting periodic oscillation of period 2π, but if you color the plane of initial conditions $x(0)$, $x'(0)$ according to how many times the pendulum goes over the top before settling down to this oscillation, the corresponding "basins of attraction" are extremely wild; in fact they form "lakes of Wada": every point in the boundary of one basin is in the boundary of all the infinitely many others.

I spent the spring semester on leave in Marseille, France, and took advantage of it to give a number of lectures in Paris and other French cities, and to give invited lectures at meetings in Pisa and Crete.

J. T. Gene Hwang

Professor of Mathematics

Recently, I started to focus mainly on the theory of statistical intervals. Statistical intervals, such as confidence intervals, prediction intervals and tolerance intervals are one of the major areas in statistics. By providing intervals, statisticians demonstrate the possible range of the interested parameters or future observations.

Much of my research is stimulated by scientific and engineering applications. Although my primary interest is in theory, the solutions often can be used directly in application. My recent joint work with the National Institute of Standards and Technology is one example.

Awards and Honors: I. W. Burr Award (1979). NSF grant awards since 1979. IMS Fellow (1988). Elected Member of Int'l Statistical Institute (1989). Senior Research Fellowship at NIST (Sept. 1–Nov. 30, 1993).

Professional Activities: Referee for JASA, Ann. Stat., J. Multivariate, Sankhya. Member of the ASA, IMS and ICSA.

Invited Lectures:

Individual bioequivalence, Bioequivalence conference, Dusseldorf, Germany (1995).

Measurement error models in predicting compressive strength of concrete, Central University and Taiwan University, Taiwan (1995).

Prediction and confidence intervals: why so different?, Central University (1995); Cambridge University, England (1995); and Purdue University (1996).

HELP in NIST, Applied Statistics conference, Baltimore ICSA (1996).

Selected Publications:

Construction of Improved Estimators in Multiparameter Estimation for Discrete Exponential Families (with Malay Ghosh and Kam-Wah Tsui), Ann. Stat. **11**, no. 2, (1983), 351–367. Discussions by James O. Berger, H. M. Hudson and Carl Morris. Reply with Ghosh and Tsui, 375–376.

The Nonexistence of $100\,(1-\alpha)\%$ *Confidence Sets of Finite Expected Diameter in Errors-in-Variables and Related Models* (with L. Gleser), Ann. Stat. **15** (1987), 1351–1362.

Estimation of Accuracy in Testing (with G. Casella, C. Robert, M. Wells and R. Farrell), Ann. Stat. **20**, (1992), 490–509.

Is Pitman Closeness a Reasonable Criterion? (with C. Robert and W. E. Strawderman), JASA **88** (1993), 57–63. Discussed by 8 statisticians. Reply, 74–76.

Confidence Interval Estimation Subject to Order Restrictions (with S. D. Peddada), Ann. Stat. **22** (1994), 67–93.

Confidence Intervals Associated with Tests for Bioequivalence (with J. Hsu, H. K. Liu and S. J. Ruberg), Biometrika **81** (1994), 103–114.

Fieller's Problems and Resampling Techniques, Statistica Sinica **5** (1995), 161–171.

Optimal Confidence Sets, Bioequivalence and the Limacon of Pascal (with L. D. Brown and G. Casella), JASA **90** (1995), 880–890.

Maximum Likelihood Estimation Under Order Restricted Parameters by the Prior Feedback Method (with C. Robert), JASA **91** (1996), 167–172.

An Unbiased Test for the Bioequivalence Problem (with L. D. Brown and Axel Munk), Ann. Stat. **25** (1997), 2345–2367.

Prediction Intervals in Artificial Neural Network (with A. Adam Ding), JASA **92** (1997), 748–757.

Prediction Intervals, Factor Analysis Models and High-Dimensional Empirical Linear Prediction (HELP) (with A. Adam Ding), JASA, to appear.

Yulij Ilyashenko

Professor of Mathematics

My research interests are several branches of dynamical systems both in real and complex domains. They include: limit cycles in real and complex planes; analytic differential equations, with relations to complex analysis and algebraic geometry; local and nonlocal bifurcations and so on. Some main objects to study are:

(1) Limit cycles of polynomial vector fields in the real plane. For instance, in [1] I proved that for a *fixed* polynomial vector field the number of limit cycles is finite.

(2) Geometric properties of foliations determined by analytic vector fields in the complex plane.

(3) Bifurcations of planar polycycles (separatrix polygons).

(4) New nonlocal bifurcations in higher-dimensional spaces, and many others.

Professional Activities: President of the Independent University of Moscow. Vice-President of the Moscow Mathematical Society. Member of the editorial boards

of the journals: Functional Analysis and its Applications (Nauka, Moscow); Dynamical and Control Systems (Plenum Press, New York and London); Ergodic Theory and Dynamical Systems (Cambridge University Press, UK); Proceedings of Moscow Mathematical Society (Moscow University Press, Moscow); and Mathematical Enlightenment, ser. 3 (Moscow Center of Continuous Mathematical Education, Moscow).

Invited Lectures:

Global and local aspects of the theory of complex differential equations, 45-minute invited talk, International Congress of Mathematicians, Helsinki, 1978.

Finiteness theorems for limit cycles, 45-minute invited talk, International Congress of Mathematicians, Kyoto, 1990.

Selected Publications:

1. *Finiteness Theorems for Limit Cycles*, Amer. Math. Soc., Transl. Vol. 94, 1991, 288 pp.
2. Editor of *Nonlinear Stokes Phenomena*, Advances in Soviet Mathematics, Vol. 14, Amer. Math. Soc., 1993.
3. Editor of *Concerning Hilbert's 16th problem* (with Yakovenko), Amer. Math. Soc., 1995, 219 pp.
4. Editor of *Differential Equations with Real and Complex Time*, a collection of papers, proceedings of the Steklov Institute, Vol. 213, 1996.
5. *Nonlocal Bifurcations* (with Li Weigu), Mathematical Surveys and Monographs Vol. 66, Amer. Math. Soc., 1998.

Anthony Kable

H. C. Wang Assistant Professor of Mathematics

My main research interests are in analytic number theory, more specifically the study of various zeta and L-functions in order to obtain number-theoretic information. The L-functions I study come from two sources, namely automorphic functions (or representations) and prehomogeneous vector spaces. The latter are particularly fascinating because, while they have deep arithmetic applications, they do not seem to fit directly into the standard framework for understanding arithmetically important L-functions.

Selected Publications:

Prehomogeneous Vector Spaces and Field Extensions II (with Akihiko Yukie), Inventiones Mathematicae **130** (1997), 315–344.

The Mean Value of the Product of Class Numbers of Paired Quadratic Fields I & II (with Akihiko Yukie), submitted.

The Tensor Square of an Exceptional Representation on the General Linear Group, submitted.

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, summer and fall 1999).

Selected Publications:

Characteristic Numbers and Oriented Homotopy Type, Topology **3** (1965), 81–95.

Self-Equivalences of $(n-1)$-connected $2n$-manifolds, AMS Bull. **72** (1966), 562–566.

Chern Numbers and Oriented Homotopy Type, Topology **7** (1968), 69–93.

The Non-finite Homotopy Type of Some Diffeomorphism Groups, (with P. Antonelli and D. Burghelea), Topology **11** (1972), 1–49.

The Concordance-Homotopy Groups of Geometric Automorphism Groups (with P. Antonelli and D. Burghelea), Springer Lecture Notes **215** (1972).

Mixing Homotopy Types of Manifolds, Topology **14** (1975), 203–216.

Homotopy-Dimension and Simple Cohomological Dimension of Spaces (with K. Brown), Comment. Math. Helv. **52** (1977), 111–127.

Counting Types of Rigid Frameworks, Inventiones Math. **55** (1979), 297–308.

Steenrod's Problem and k-invariants of Certain Classifying Spaces, Springer Lecture Notes **967** (1982).
Equivariant Homology Decompositions, AMS Trans. **298** (1986), 245–271.
Rational Moore G-spaces, AMS Trans. **298** (1986), 273–287.
A Paradigm for Robust Geometric Algorithms (with J. Hopcroft), Algorithmica **7** (1992), 339–380.
A Continuity Property for Local Price Adjustment Mechanisms (with J. Herrmann), Journal of Mathematical Economics, to appear.

Harry Kesten

Goldwin Smith Professor of Mathematics

I am a probabilist. My main research interests are percolation theory and random walks, and in general I like to dabble in models inspired by Statistical Mechanics.

One model I have recently returned to is the first-passage percolation model. To each edge e of the integer lattice in d dimensions one assigns a passage time $X(e)$. These $X(e)$ are assumed independent, identically distributed and nonnegative. One is interested in the random set $B(t)$ of points which can be reached from the origin by time t. In particular how big are the fluctuations of the boundary of $B(t)$? This is a special example of the fluctuations of a random surface. In the case of $B(t)$ I proved the first upper bound for these fluctuations in terms of a power of t. These have now been improved by K. Alexander and lower bounds for the fluctuations have been given by C. Newman and M. Piza. The challenge now is to close the gap between these upper and lower bounds.

Professional Activities: Associate editor of the Indiana University Mathematics Journal and the New York Journal of Mathematics. Advisory board member of Electronic J. Probability. Honorary board member of J. d'Analyse Mathematique.

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

Selected Publications:
Products of Random Matrices (with H. Furstenberg), Ann. Math. Statist. **31** (1960), 457–469.
Hitting Probabilities of Single Points for Processes with Stationary Independent Increments, Memoir no. 93, Amer. Math. Soc. (1969).
Percolation Theory for Mathematicians, Birkhäuser, Boston, 1982.
Aspects of First-Passage Percolation; in Ecole d'été de Probabilités de Saint-Flour XIV, (P. L. Hennequin, ed.), Lecture Notes in Math **1180**, Springer-Verlag, 1986, pp. 125–264.
On the Speed of Convergence in First-Passage Percolation, Ann. Appl. Probab. **3** (1993), 296–338.

Dexter Kozen

Professor of Computer Science
Joseph Newton Pew, Jr., Professor in Engineering
http://www.cs.cornell.edu/kozen/

My research interests include the theory of computational complexity, especially complexity of decision problems in logic and algebra, program logic and semantics, and computational algebra. Recent work includes: new polynomial-time algorithms for type inference in type systems with subtypes and recursive types; algorithms solving systems of set constraints as used in program analysis; a unification algorithm for set constraints and a new constraint logic programming language based on set constraints; development of the theory of rational spaces and their relationship to set constraints; an algorithm for decomposition of algebraic functions; a new polynomial-time algorithm for resolution of singularities of plane curves; efficient algorithms for optimal transmission of encoded video data; optimality results for digital interleavers; and complexity and completeness results for Kleene algebras with tests. Recently I have begun to investigate the application of Kleene algebra and the modal mu-calculus to problems in software security.

Professional Activities: Program committee of Foundations of Software Science and Computation Structure, Mathematical Foundations of Computer Science. Editorial Board of the Journal of Relational Methods in Computer Science, the Journal of Algorithms (special issue). Supervisory Board, Centre for Basic Research in Computer Science (BRICS), Aarhus University.

Awards and Honors: Class of 1960 Scholar, Williams College.

Administrative Activities: College of Engineering Undergraduate Admissions Committee. University Arbitration Panel. Faculty advisor for Cornell Men's Rugby,

Football Club and Johnson Graduate School of Management Rugby.

Invited Lectures:

Parikh's Theorem in commutative Kleene algebra, FLOC '99, Trento, Italy (July 1999).

On Hoare logic and Kleene algebra with tests, FLOC '99, Trento, Italy (July 1999).

On Hoare logic, Kleene algebra and types, International Congress for Logic, Methodology and Philosophy of Science, Kracow, Poland (Aug. 1999).

Language-based security, 24th Conference on Mathematical Foundations of Computer Science, Wroclaw, Poland (Sept. 1999); Dartmouth College (March 2000).

On the completeness of prepositional Hoare logic, RelMiCS 5 Conference, Quebec City, Canada (Jan. 2000).

Selected Publications:

Parikh's Theorem in Commutative Kleene Algebra (with M. Hopkins), Proc. Conference Logic in Computer Science (LICS '99), IEEE (1999), 394–401.

On Hoare Logic, Kleene Algebra and Types, Cornell University, Computer Science, TR99-1760 (1999); in Proc. Conference Logic in Computer Science (LICS '99), IEEE (1999), 167–172.

Language-Based Security; in Proc. Conference of Mathematical Foundations of Computer Science (MFCS '99), ed. M. Kutylowski, L. Pacholski, and T. Wierbicki, volume 1672 of Lecture Notes in Computer Science, Springer-Verlag (1999), 284–298.

On the Completeness of Propositional Hoare Logic (with J. Tiluryn), Cornell University, Computer Science, TR99-1766 (1999).

Certification of Compiler Optimizations Using Kleene Algebra with Tests (with M. Patron), Cornell University, Computer Science, TR99-1779 (1999).

On the Completeness of Prepositional Hoare Logic (with J. Tiluryn); in Proc. of the Fifth International Seminar Relational Methods in Computer Science (RelMiCS 2000), ed. J. Desharnais (2000), 195–202.

Dynamic Logic (with D. Harel and J. Tiluryn), MIT Press, Cambridge, MA, 2000, in press.

Vlada Limic

H. C. Wang Assistant Professor of Mathematics

I enjoy studying probabilistic models. My thesis was on characterization of certain coalescence processes, which are a model of infinitely many dust particles merging together over a long period of time and forming meteors, planets, etc. I am also interested in problems related to queues and queueing systems. Stochastic queueing systems are models of a factory production cycle, or a telephone exchange or the internet. These mathematical realizations are still quite complicated to analyze directly, so it is important to find useful approximations in order to answer questions about the qualitative behavior of the corresponding queueing system. During the past year, Rick Durrett got me interested in several problems motivated by genetics, and I also became interested in random walks with reinforcement, which are a model of thinking process and memory.

Awards and Honors: NSF Postdoctoral Fellowship (1998).

Professional Activities: Referee for several journals.

Selected Publications:

The Entrace Boundary of the Multiplicative Coalescent (with D. Aldous), EJP **3** (1998), paper 3.

On the Behavior of LIFO Preemptive Resume Queues in Heavy Traffic, ECP **5** (2000), paper 2.

A LIFO Queue in Heavy Traffic, Ann. Appl. Prob., to appear.

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

My principal research at present is in hybrid sstems. This is both the logic of hybrid systems (program specification and verification) and extracting digital control programs for hybrid systems. The former is developed in modal logics, the later using the relaxed calculus of variations on manifolds an the apparatus of connections as controls. I also continue work on model theory and recursive model theory of nonstandard logics, foundations of logic programming, and multiple agent hybrid systems. The latest round of publications are below, a full bibliograpy is on the website www.math.cornell.edu/~anil/. I continue as Director of the Center for Foundations of Intelligent Systems, within a Multiple University Research Initiative with Berkeley and Stanford.

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 Univ. Research Inst. (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:

Logic Programs, Well-Orderings and Forward Chaining (with V. Marek and J. Remmel), Festschrift on the Occasion of Rohit Parikh's 60th Birthday. Ann. Pure Appl. Logic **96** no. 1–3 (1999), 231–276.

Computability and Complexity in Analysis, including papers from the seminar held at Castle Dagstuhl, April 1997 (A. Nerode, K. -I. Ko and K. Weihrauch, eds.), Theoret. Comput. Sci. **219** no.1–2 (1999); Elsevier Science, B.V., Amsterdam, 1999, pp. ix–xii, 1–510.

Scalable Data and Sensor Fusion via Multiple Agent Hybrid Systems (with W. Kohn and J. Remmel); in Hybrid Systems V, 1999, pp. 122-141.

QoS Based Evaluation of the Berkeley Continuous Media Toolkit (with S. Parikh, S. Srivastava, S. Varadarajan and D. Wijesekera); in Multimedia Tools and Applications, 1999.

Experimental Evaluation of Loss Perception in Continuous Media (with M. Foresti, D. Wijesekera and S. Srivastava), ACM Multimedia Journal (1999).

A Mathematical Framework for Asynchronous, Distributed Decision-Making Systems with Semi-autonomous Entities: Algorithm Synthesis, Simulation and Evaluation (with X, Ge, S. Ghosh, T. Lee, J. Lu and W. Kohn), Proceedings of the Fourth International Symposium on Autonomous Decentralized Systems, ISADS99, Tokyo, Japan, 1999, pp. 206–212.

Hybrid systems V (P. Antsaklis, W. Kohn, S. Sastry, eds.), Lecture Notes in Computer Science bf 1567, Springer-Verlag, 1999.

Normal Forms for Functional Independencies (with D. Wijesekera, M. Ganesh and J. Srivastava), Theoretical Computer Acience (2000), to appear.

Performance Evaluation of Synchronization Losses in the Continuous Media Toolkit (with D. Wijesekera, J. Srivastava, S. Varadarajan and S. Parikh), IEEE Workshop in Quality of Service in Multimedia (2000), to appear.

Performance Evaluation of Media Losses in the Continuous Media Toolkit (with D. Wijesekera, J. Srivastava, S. Varadarajan and S. Parikh), ACM Workshop in Software Engineering issues in Multimedia, 2000.

Quantum Wave Processor (with W. Kohn), Technical Report CFIS 00-05 (2000).

Logics for Hybrid Systems (with J. Davoren), Technical Report CFIS 00–04 (2000).

Decidable Kripke Models for Modal Logics (with S. Ganguli), Technical Report CFIS 00–02 (2000).

Human Perception of Media and Synchronization Losses (with D. Wijesekera, J. Srivastava and M. Foresti), ACM Multimedia Systems (2000).

A Mathematical Framework for Asynchronous Distributed Decision–making Systems with Semi-autonomous Entities: Algorithm Synthesis, Simulation and Evaluation (with X. Ge, S. Ghosh, W. Kohn, T. Lee and J. Lu), IEICE Transactions on Fundamentals (2000).

Foreword to: *Principles of Modeling and Asynchronous Distributed Simulation of Complex Systems* by S. Ghosh, IEEE Press, 2000.

Constructive Logics and Lambda Calculi (with G. Odifreddi), 500 pp., book in preparation.

Automata Theory and Its Applications (with B. Khoussainov), Birkhauser, 2000, 480 pp., in press.

Agent Control, Enterprise Models and Supply Chain Systems (with W. Kohn), book in preparation.

Normal Forms and Syntactic Completeness Proofs for Functional Independencies (with M. Ganesh, J. Srivastava, D. Wijesekera), J. Theoretical Computer Science, to appear.

Michael Nussbaum

Professor of Mathematics

My research program focuses on developing a better theoretical understanding of the asymptotic theory of statistical experiments, in connection with statistical smoothing and curve estimation and nonparametric inference for stochastic processes. Current topics include Gaussian and Poisson approximation of nonparametric experiments in the Le Cam sense, constructive realization of equivalence, asymptotic risk bounds for density estimation and nonparametric regression, nonparametric models for point processes, diffusion processes and autoregression, functional limit theorems for empirical processes, statistical treatment of inverse and ill-posed problems.

Awards and Honors: Fellow of the Institute of Mathematical Statistics

Professional Activities: Member of Editorial Boards of Annals of Statistics, Annales de l'Institut Henri Poincré, Probabilités et Statistiques and of ESAIM, Probability and Statistics.

Invited Lectures:

Nonparametric function estimation, neural nets and risk asymptotics, summer course at Oberwolfach, Germany (DMV-seminar), jointly with A. Barron, Yale and Laszlo Gyorfi, Budapest (June 2000).

Selected Publications:

Asymptotic Equivalence of Density Estimation and Gaussian White Noise, Ann. Stat. **24** (1996), 2399–2430.

Asymptotic Equivalence for Nonparametric Generalized Linear Models (with I. Grama), Probability Theory and Related Fields **111** (1998), 167–214.

Diffusion Limits for Nonparametric Autoregression (with G. Milstein), Probability Theory and Related Fields **112** (1998), 167–214.

The Asymptotic Minimax Constant for Sup-Norm Loss in Nonparametric Density Estimation (with A. Korostelev), Bernoulli **5** (6) (1999), 1099–1118.

Minimax Risk: Pinsker Bound; in Encyclopedia of Statistical Sciences, Vol.3 (S.Kotz, ed.), John Wiley, New York (1999), 451–460.

Lawrence Payne

Professor Emeritus of Mathematics

My research interests lie in several areas of partial differential equations: Isoperimetric Inequalities, Ill-Posed and Non-Standard Problems, Growth Decay and/or Blowup of Solutions, and applications to various problems in Solid and Fluid Mechanics. My most recent interests have been in the study of Overdetermined Systems and Saint Venant type problems for nonlinear equations.

Awards and Honors: Steele Prize in mathematics (1972). Honorary D.Sc. from the National University of Ireland (1990). Honorary Fellow of the Royal Society of Edinburgh (1991). Citation of Merit, Iowa State University (1992).

Professional Activities: Editorial board member of Math. Methods in Appl. Sci. and Glasgow Mathematical Journal. Advisor for Pitman Monographs.

Selected Publications:

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

Convergence for the Equations for a Maxwell Fluid (with B. Straughan), Studies in Applied Math. **103** (1999), 267–278.

Continuous Dependence and Convergence Results for Brinkman and Forchheimer Models with Variable Viscosity (with J. Song and B. Straughan), Proc. Roy. Soc. London A **455** (1999), 2173-2190.

Effect of Errors in the Spatial Geometry for Temperature Dependent Stokes Flows (with B. Straughan), J. Math. Pure Appl. **8** (1999), 609–632.

Continuous Dependence on Modeling for Some Well Posed Perturbations of the Backward Heat Equation (with K. Ames), J. Ineq. Appl. **3** (1999), 51–64.

Irena Peeva

Assistant Professor of Mathematics

My work is in algebra. I am especially interested in problems which are at the interface between commutative algebra, algebraic geometry, combinatorics and noncommutative algebra.

Awards and Honors: Alfred P. Sloan Doctoral Dissertation Fellowship (1994–1995). Alfred P. Sloan Research Fellowship (1999–2001). C.L.E. Moore Instructorship at M.I.T. (1995-1998).

Professional Activities: (Co)organizer of the following conferences: Workshop on Regularity of Toric Varieties at the University of California at Berkeley (1996); The Sixth Route 81 Conference on Algebraic Geometry and Commutative Algebra at SUNY at Albany (1996); Special Session in Commutative Algebra at the AMS Meeting in Montreal (1997); Special Session in Commutative Algebra at the AMS Meeting in Chicago (1998). Special Session in Algebraic Geometry and Commutative Algebra at the Joint Mathematics Meetings in Washington, D.C. (2000).

Selected Publications:

Complete Intersection Dimension (with L. Avramov and V. Gasharov), Publications Mathématiques IHES **86** (1997).

Generic Lattice Ideals (with B. Sturmfels), JAMS **11** (1998), 363–373.

Rationality for Generic Toric Rings (with V. Gasharov and V. Welker), Mathematische Zeitschrift **233** (2000), 93–102.

Monomial Resolutions (with D. Bayer and B. Sturmfels), Mathematical Research Letters **5** (1998), 31–46.

Cohomology of Real Diagonal Subspace Arrangements Via Resolutions (with V. Reiner and V. Welker), Compositio Mathematica **117** (1999), 107–123.

How to Shell a Monoid (with V. Reiner and B. Sturmfels), Mathematische Annalen **310** (1998).

Syzygies of Codimension 2 Lattice Ideals (with B. Sturmfels), Mathematische Zeitschrift **229** (1998).

Deformations of Codimension 2 Toric Varieties (with V. Gasharov), Compositio Mathematica, to appear.

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.

Ravi Ramakrishna

Assistant Professor of Mathematics

My research is in Galois theory. This is the branch of mathematics concerned with symmetries of solutions of equations. There is an object that encodes all symmetries of solutions to all equations, the absolute Galois group of the rational numbers. I study this object and its relatins with number theory. The study of these symmetries has gained an increasingly important role in number theory in recent years. In particular, Galois theory played an important role in the solution of Fermat's Last Theorem.

Invited Lectures: Brandeis/Harvard/MIT/Northeastern colloquium (Sept. 1999). University of Maryland Colloquium (Nov. 1999), VT/Quebec Number Theory Seminar (Jan. 2000).

Selected Publications:

Lifting Galois Representations, Inventiones Mathematicae **138** (1999), 537–562.

Deforming an Even Representation II — Raising the Level, J. Number Theory **72** (1998), 92–109.

Deforming an Even Representation, Inventiones Mathematicae **132** (1998), 563–580.

Richard H. Rand

Professor of Theoretical and Applied Mechanics

Current research work involves the application of perturbation methods and computer algebra to problems in nonlinear dynamics. In particular, we are using the computer algebra system MACSYMA to perform the lengthy algebraic manipulations associated with a variety of approximate methods for treating systems of nonlinear differential equations, such as the method of normal forms and center manifolds, Lie transforms, and averaging.

We have applied this approach to such problems as the dynamics of resonant capture, coupled limit-cycle oscillators, the parametric stability of a rotating rigid body, parametric stiffness control of flexible structures, the behavior of van der Pol's equation at infinity, the determinancy of degenerate equilibria, the nonlinear stability of L_4 in the three-body problem, and Hilbert's 16th problem.

These mathematical studies have been applied to a number of biomathematical problems in collaborative work with biologists. These problems have included the fluid dynamics of green plants, the neurobiology of swimming in fish, the dynamics of retinal chemistry in the human eye, and the mechanics of the cornea.

Awards and Honors: Amer. Soc. Agricultural Eng. Best Paper Award (1982). Dean's Prize for Innovation in Undergraduate Teaching, Cornell University (1986). Dean's Prize for Excellence and Innovation in Teaching, Cornell University (1993). Dean's Prize for Excellence in Teaching, Cornell University (1995). Elected a Fellow of the American Society of Mechanical Engineers (1995).

Professional Activities: Member of the Society of Industrial and Applied Mathematics (SIAM). Editorial Board of the *Journal of Vibration and Control* (1995–).

Selected Publications:

Computer Algebra in Applied Mathematics: An Introduction to MACSYMA, Research Notes in Mathematics **94**, Pitman, Boston, 1984, 181 pp.

Perturbation Methods, Bifurcation Theory, and Computer Algebra (with D. Armbruster), Applied Mathematical Sciences **65**, Springer-Verlag, 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.

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.

Relaxation Oscillations in Tidally Evolving Satellites (with D. Quinn, B. Gladman and P. Nicholson), Celestial Mech. and Dyn. Astronomy **67** (1997), 111–130.

A Mathematical Model of a Placido Disk Keratometer and its Implications for Recovery of Corneal Topography (with R. A. Applegate and H. C. Howland), Optometry and Vision Science **74** (1997), 926–930.

Nonlinear Modal Analysis of a Cracked Beam (with M. Chati and S. Mukherjee), J. Sound and Vibration **207** (1997), 249–270.

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

Modeling the Pumping of a Swing (with S. Wirkus and A. Ruina), College Math. J. **29** (1998), 266–275.

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

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

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.

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.

A Mathematical View of Interior-Point Methods for Convex Optimization, SIAM (2000).

Thomas Rishel

Senior Lecturer of Mathematics

My research area is topology. I have written on generalizations of metric spaces and on conditions for topological spaces to preserve products.

As director of undergraduate teaching, I am interested in curriculum and course design. These interests led to the organization of the Occasional Seminar on Undergraduate Education, as well as the design of four new courses in teaching, algebra and geometry which make substantial use of writing assignments. I have given numerous talks and written some papers on these courses.

My other responsibilities include: supervising and training teaching assistants, scheduling, budgeting and evaluation. I perform a similar service for part-time and visiting faculty. These activities have led to my being on a number of national and regional committees on graduate education, teaching and employment.

Awards and Honors: Professors for the Future Award, Pew Foundation (1994–98). MAA Seaway Section Distinguished Teaching Award (1995). Clark Teaching Award, Cornell University (1981).

Professional Activities: Reviewer for Math Reviews. Referee for the Proceedings of the AMS and PRIMUS. Member of the AMS and MAA. Chair of the MAA Task Force on Graduate Study. FIPSE grant for Future Professors' Program (1995–). Chair of the AMS-MAA Committee on Employment. External evaluator, SUNY at Oswego (1998). Chair of the AMS-MAA Professors for the Future Committee (1998–2001).

Administrative Activities: Executive committee of ALCU (1993–). Curriculum Committee. Organizer of the Occasional Seminar on Undergraduate Education (1991–). Johnson Museum Committee on Education. Cornell Arts College Bylaws Committee, Academic Integrity Hearing Board.

Invited Lectures and Workshops:

A freshman-level geometry curriculum, UFE Workshop, Cornell University (May 1998).

Professors for the future programs in mathematics, NSF Graduate Initiatives Conference, Washington (June 1998).

Teaching initiatives for graduate students, Canadian Math Congress, Kingston, Ontario (Dec. 1998).

Writing in the teaching and learning of mathematics (6 hour minicourse), AMS-MAA Joint Meetings, San Antonio (Jan. 1999).

Using writing in teaching mathematics, MAA Oklahoma Section Meeting (Mar. 1999).

Advice from a teaching award winner, MAA Seaway Section Meeting (Apr. 1999).

Finding voice amid the rigor of mathematics, Fourth National Writing Across the Curriculum Conference, Cornell University (June 1999); Rochester March 2000).

Teaching workshop for graduate students and new faculty (4 hour workshop), MAA Mathfest, Providence (July 1999); Los Angeles (Aug. 2000).

Job Forum, AMS-MAA Joint Meeting, Washington, D.C. (Jan. 2000).

T.A. Trainers' Forum, AMS-MAA Joint Meeting, Washington, D.C. (Jan. 2000).

Consultant, Cain Writing Program, Rice University (Feb. 2000).

Selected Publications:

Products in Countably Compact and M-Spaces, Y. Kodama Festschrift (1991).

Geometry as Metaphor: Writing in the Math Classroom; in Teaching Critical Thinking (Clark and Biddle, eds.), Prentice-Hall, 1993, pp. 124–136.

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

Writing in the Teaching and Learning of Mathematics (with J. Meier), MAA Math Notes **48**, 1998.

The Academic Job Search in Mathematics, AMS Publications, 1998.

Handbook for Mathematics Teaching Assistants, Preliminary Edition, MAA Math Notes, 1999.

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 (1994–1999), Stochastic Processes and Their Applications (1999–) and for Annales de la Faculté des Sciences de Toulouse (1996–).

Invited Lectures:

Analysis on the infinite dimensional torus, Durham Research Symposium on Stochastic Analysis (1999).

Brownan motions on compact groups, Geometric Stochastic Analysis, Oberwolfach (2000).

Random walks on groups, 20 years after H. Kesten's thesis, Year 2000 Seminar on Stochastic Processes, Salt Lake City (2000).

Selected Publications:

A Note on Poincaré, Sobolev, and Harnack Inequalities, Duke J. Math. **65** IMRN 2 (1992), 27–38.

Analysis and Geometry on Groups (with T. Coulhon and N. Varopoulos), Cambridge Tracts in Mathematics 100, Cambridge University Press, 1993.

Comparison Techniques for Random Walk on Finite Groups (with P. Diaconis), Ann. Prob. **21** (1993), 2131–2156.

Elliptic Diffusions on Infinite Products (with A. Bendikov), J. Reine Angew. Math. **493** (1997), 171–220.

Lectures on Finite Markov Chains, Ecole d'été de probabilités de Saint Flour 1996, Lect. Notes Math. 1665, Springer, 1997, 301–413.

Walks on Generating Sets of Groups (with P. Diaconis), Invent. Math. **134** (1998), 251–299.

Potential Theory on Infinite Products and Locally Compact Groups (with A. Bendikov), Potential Analysis **11** (1999), 325–358.

Heat Kernel on Connected Sums of Riemannian Manifolds (with A. Grigoryan), Mathematical Research Letters **6** (1999), 307–321.

Alfred H. Schatz

Professor of Mathematics

My field of research is numerical analysis. I have been principally involved in the analysis and construction of finite element methods for the approximate solution of partial differential equations. In particular I have been investigating both the local behavior of such matters and another phenomena associated with them called superconvergence. Many physical problems have solutions that are smooth in some places and are nonsmooth (having singularities) in others. In the numerical solution of these problems, the singular part of the solution is not only difficult to approximate but often lowers the quality of (pollutes) the approximation even where the solution is nice. I have been involved in understanding this phenomena and finding a way to improve the approximations.

Another facet of the research is to find properties of the computed approximate solutions which, when taken into account, can be used to produce better approximations than one has before. These are so called superconvergent approximations and their importance resides in the fact that the original approximations are usually difficult to obtain but usually the new approximates may be orders of magnitude better and easily computed from them.

Selected Publications:

Superconvergence in Finite Element Methods & Meshes Which are Locally Symmetric with Respect to a Point (with I. Sloan and L. Wahlbin), SIAM Journal of Numerical Analysis, to appear.

Interior Maximum Norm Estimates for Ritz Galerkin Methods Part II (with L. Wahlbin), Mathematics of Computation, to appear.

Some New Error Estimates for Ritz Galerkin Methods with Minimal Regularity Assumptions (with J. Wang), Mathematics of Computation, submitted.

Shankar Sen

Professor of Mathematics

Most of my research concerns invariants associated with representations of Galois groups of p-adic fields and algebraic number fields. These invariants, though of an arithmetic nature, are related to classical invariants arising in complex algebraic geometry; their study should shed light on geometric aspects of equations over number fields or p-adic fields. Recently, I have studied families of Galois representations depending analytically on p-adic parameters, and how the invariants for such families change with the parameters. Techniques from p-adic analytic function theory and functional analysis have proved useful in this connection.

Invited Lectures: Nottingham conference on Number Theory (1996). Cambridge University, England (1996). Conference on Arithmetic, Algebra, Geometry; Braga, Portugal (1997). Durham conference on Group Theory and Number Theory (3 lectures, 1997).

Selected Publications:

Lie Algebras of Galois Groups Arising from Hodge-Tate Modules, Annals of Math. (1973).

On Explicit Reciprocity Laws, J. Reine Angew Math. (1980 & 1981).

Continuous Cohomology and p-adic Galois Representations, Inventiones Math. (1980).

Integral Representations Associated with p-adic Field Extensions, Inventiones Math. (1988).

The Analytic Variation of p-adic Hodge Structure, Annals of Math. (1988).

An Infinite-Dimensional Hodge-Tate Theory, Bulletin Math. Soc. France (1992).

Galois Cohomology and Galois Representations, Inventiones Math. (1993).

Richard A. Shore

Professor of Mathematics

My major research interests have centered around analyzing the structures of relative complexity of computation of functions on the natural numbers. The primary measure of such complexity is given by Turing reducibility: f is easier to compute than g, $f \leq_T g$, if there is a (Turing) machine which can compute f if it is given access to the values of g. I have also worked with various other interesting measures of such complexity that are defined by restricting the resources available primarily in terms of access to g. The general thrust of my work has been to show that these structures are as complicated as possible both algebraically and logically (in terms of the complexity of the decision problems for their theories). These results also allow one to differentiate among different notions of relative complexity in terms of the orderings they define. Another major theme in my work has been the relationship between these notions of computational complexity and ones based on the difficulty of defining functions in arithmetic. Restricting the computational resources more directly in terms of time or space leads out of recursion theory and into complexity theory. Relaxing the restrictions by allowing various infinitary procedures leads instead into generalized recursion theory or set theory. The methods developed in these investigations are also useful in determining the effective content of standard mathematical theorems (when can existence proofs be made effective) and the inherent difficulty of combinatorial theorems in proof theoretic terms. Recently, I have also been working on issues in effective model theory and algebra connected with the problem of how the computational properties of algebraic structures can vary with different (but always computable) presentations of the models.

Professional Activities: Member of the AMS, ASL, ACM and SIGACT. Referee and reviewer for the NSF, the Natural Sciences and Engineering Research Council of Canada, the US-Israeli Bi-National Science Foundation, the New Zealand Mathematical Society Research Awards and many journals.

Editor of the Journal of Symbolic Logic (1984–93). Nominating committee and publications committee of the Association of Symbolic Logic (1993–94). Managing editor for the Bull. Symbolic Logic (1993–). Council member of the Assn. Symbolic Logic (1984–). Editor of Studies in Logic and the Foundations of Mathematics, North-Holland (1996–).

Selected Publications:

α-Recursion Theory; in Handbook of Mathematical Logic (J. Barwise, ed.), North-Holland, 1977, pp. 653–680.

The Homogeneity Conjecture, Proceedings of the National Academy of Sciences **76** (1979), 4218–4219.

Definable Degrees and Automorphisms of $\mathcal{D}$ (with L. Harrington), Bull. Amer. Math. Soc. (NS) **4** (1981), 97–100.

The Degrees of Unsolvability: The Ordering of Functions by Relative Computability; in Proc. Inter. Congress of Mathematicians (Warsaw) (1983) PWN-Polish Scientific Publishers, Warsaw 1984, Vol. 1: 337–346.

The Structure of the Degrees of Unsolvability; in Recursion Theory (A. Nerode and R. A. Shore, eds.), Proceedings of The Symposia in Pure Mathematics **42**, AMS, Providence, R. I. (1985), 33–51.

Recursive Limits on the Hahn-Banach Theorem (with A. Nerode and G. Metakides), Contemporary Mathematics **39** (1985), 85–91.

On the Strength of König's Theorem for Infinite Bipartite Graphs (with R. Aharoni and M. Magidor), J. Comb. Theory (B) **54**, (1992), 257–290.

The p-T-degrees of the Recursive Sets: Lattice Embeddings, Extension of Embeddings and the Two Quantifier Theory (with T. Slaman), Theoretical Computer Science **92** (1992), 263–284.

Logic for Applications (with A. Nerode), Texts and Monographs in Computer Science, Springer-Verlag, New York, 1993; second edition, Graduate Texts in Computer Science, Springer-Verlag, New York, 1997.

Definability in the Recursively Enumerable Degrees (with A. Nies and T. Slaman), Bull. Symb. Logic **2** (1996), 392–404.

Effective Model Theory: The Number of Models and Their Complexity (with B. Khoussainov); in Models and Computability, Invited Papers from Logic Colloquium '97 (S. Cooper and J. Truss, eds.) LMSLNS **259**, Cambridge University Press, Cambridge, England, 1999, pp. 193–240.

Defining the Turing Jump (with T. Slaman), Math. Research Letters **6** (1999), 711–722.

Reyer Sjamaar

Assistant Professor of Mathematics

My research area is symplectic geometry. In most of my work I apply methods developed in singularity theory, invariant theory and representation theory to the study of Lie group actions on symplectic manifolds.

Awards and Honors: Sloan Fellow (1996).

Selected Publications:

Holomorphic Slices, Symplectic Reduction and Multiplicities of Representations, Ann. Math. (2) **141** (1995), 87–129.

Symplectic Reduction and Riemann-Roch Formulas for Multiplicities, Bull. Amer. Math. Soc. (new series) **33** (1996), 327–338.

Convexity Properties of the Moment Map Re-examined, Adv. Math. **138** (1998), 46–91.

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

Projections of Coadjoint Orbits, Moment Polytopes and the Hilbert-Mumford Criterion (with A. Berenstein), J. Amer. Math. Soc., 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, Comment. 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.

Polynomial Diffeomorphisms of $\mathbf{C}^2$ *VII: Hyperbolicity and External Rays* (with E. Bedford), Ann. Scient. Ec. Norm. Sup. **4** (32) (1999), 455–497.

Billiards on Rational-Angled Triangles (with R. Kenyon), Comment. Math. Helv. **75** (2000), 65–108.

The Dynamics of Billiard Flows in Rational Polygons; in Encyclopedia of Mathematical Sciences, vol. 100 (edited by Yu. Sinai), Springer-Verlag, 1999.

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 Agriculture, Mathematics and Science program in the Department of Education has involved me in supervising student teachers and coteaching the math/science methods course Educ 602.

In addition to these courses, I am the director of the Cornell/Schools Mathematics Resource Program (CSMRP). Through this program I organize and coteach 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 con-

cepts from a more mature standpoint, and also present interesting and relevant topics to get teachers interested in their own mathematical explorations, as well as presenting new curricula and introducing software environments as teaching tools. We now have a core group of about 25 teachers, and a larger group of about 50 others who are part of our e-mail list and occasionally attend.

Our week long summer institute for mathematics teachers, given for the past eleven years, has recently focused on teaching geometry, especially exploring geometry on spheres and other surfaces, and Geometer's Sketchpad software.

Our program in the classrooms focuses on a few exemplary teachers, supporting their efforts to develop modules and activities in the classroom, and share these with other teachers through visits, workshops, and actual classroom intervention. One of our middle school teachers taught a model two-week unit at two different middle schools while the 7th and 8th grade teachers watched, and then they taught the lessons to their other sections. Math lab activities and structure developed with high school teachers is being used in classrooms in several districts.

My current interests include developing exploratory units for high school mathematics, the use of Sketchpad as an environment for learning geometry, and integrating mathematics and philosophy in a humanist context. A long range plan is to produce materials for a manual for 6-12 mathematics teachers which would provide essential insights into selected topics, interrelations and meanings. This text would also serve pre-service teachers of mathematics, helping them to look back at their own pre-college experiences from a more mature standpoint. I am interested in studying the role of intuition in mathematical exploration, and in continuing to pursue the relation of philosophy and mathematics as a route to self-knowledge.

Grants: Twelve DDE Title IIA grants awarded by the New York State Department of Education to support in-service programs for teachers, 1986–present. Participant in UFE grant through NSF for enhancement of college teaching, with David Henderson, 1995–present.

Articles/Videos:

A manual of mathematics labs to accompany Course I mathematics (with Amy Davis of Moravia High School), self published.

Puppies Pen, a video of a pilot intervention program for Middle School Mathematics.

Levels of Knowledge submitted for publication in Parabola, 1997.

A Constructivist Dilema: an Episode from Middle School Mathematics.

Geometric Patterns in Nature, being prepared for publication.

Proportions and Levels of Meaning in Mathematics; in For the Learning of Mathematics, 1991.

What is a Line?; in For the Learning of Mathematics, 1991.

A Fractal Outline of a Fractal Course, AMTYS journal, 1989.

Birgit Speh

Professor of Mathematics

I am interested in representation theory of semisimple Lie groups as well as in arithmetic groups and analytic number theory. In the last few years most of my work concerned around the cohomology of arithmetic groups, in particular Lefschetz numbers of automorphisms of finite order and the application to problems in automorphic forms and number theory.

Awards and Honors: Humboldt Prize (1995). Sloan Fellowship (1983).

Professional Activities: Reviewer for the NSF. Editor of the New York Journal of Mathematics and the Journal of Representation Theory.

Selected Publications:

Unitary Representations of $GL(n, R)$ with Non-trivial (g, K)-Cohomology, Inv. Math. **71** (1983), 443–465.

A Cohomological Method for the Determination of Limit Multiplicities of Representations with Cohomology in the Cuspidal Spectrum (with J. Rohlfs), Duke Mathematical Journal **55** (1987), 199–211.

Representations with Cohomology in the Discrete Spectrum of Subgroups of $SO(n, 1)(Z)$ and Lefschetz Numbers (with J. Rohlfs), Annales Scientifiques d'Ecole Normale Sup. (1987), 89–136.

Automorphic Representations and Lefschetz Numbers (with J. Rohlfs), Annales Scientifiques d'Ecole Normale Sup. (1989).

Lefschetz Numbers and Twisted Stabilized Orbital Integrals (with J. Rohlfs), Math. Annalen **296** (1993).

Seiberg Witten Equations on Locally Symmetric Spaces, Proc. of Symposia in Pure Math. **68**.

Michael Stillman

Professor of Mathematics

My main areas of interest are computational algebra and algebraic geometry, commutative algebra, and algebraic geometry. My original interest in computational methods was their application to problems in algebraic geometry. Since then, my work has proceeded in several related directions. I have studied the complexity of the algorithms (mainly Gröbner bases). I have been developing algorithms for computing in commutative algebra and algebraic geometry. For example, I have developed algorithms for manipulating line bundles in algebraic geometry (with M. Brundu), computing Hilbert functions (with D. Bayer), and finding integral closures of polynomial rings.

My original interest in these methods was to actually use them in my research in algebraic geometry. D. Bayer (of Columbia) and I have designed and implemented a specialized computer algebra system, which we call "Macaulay", which includes many of these algorithms. Hundreds of researchers use this system. The latest version includes algorithms for a large number of useful operations in algebraic geometry (written with D. Eisenbud).

Selected Publications:

A Criterion for Detecting m-regularity (with D. Bayer), Invent. Math. **87** (1987), 1–11.

A Theorem on Refining Division Orders by the Reverse Lexicographic Order (with D. Bayer), Duke Math. J. **55** (1987), 321–328.

Determinantal Equations for Algebraic Curves of High Degree (with D. Eisenbud and J. Koh), Amer. J. Math. **110** (1988), 135–147.

On the Complexity of Computing Syzygies (with D. Bayer), J. Symbolic Comp. **6** (1988), 135–147.

Computing the Equations of a Variety (with M. Brundu), Trans. AMS (1991), to appear.

Some Matrices Related to Green's Conjecture (with D. Bayer), Sundance Conference Proceedings on Free Resolutions (1991), to appear.

Robert S. Strichartz

Professor of Mathematics

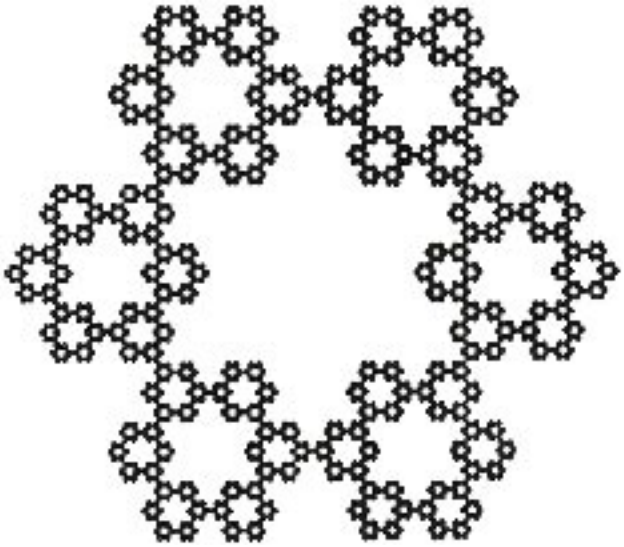
Mathematics is an adventure. As a research mathematician, I have wandered along many paths, always enjoying the discoveries that have come my way and never knowing exactly where I might be heading next. I have certainly not been following a geodesic! Perhaps its has been just a random walk. Yet sometimes I think there has been some purpose behind it, to bring me to the work I am doing today. So here is a synopsis of where I have been and what it might add up to.

In my thesis I studied Sobolev spaces, an important class of function spaces useful in the theory of partial differential equations, and gave an important characterization of Sobolev spaces with smoothness coefficient not equal to an integer. (*Multipliers on Fractional Sobolev Spaces*, J. of Math Mech. **16** (1967), 1031–1060)

In my early work I studied applications of harmonic analysis to wave equations (*Convolutions with Kernels Having Singularities on Spheres*, Trans. Amer. Math. Soc. **148** (1970), 461–478; *A Priori Estimates for the Wave Equation and Some Applications*, J. Func. Anal. **5** (1970) 218–235; and *Restrictions of Fourier Transforms to Quadratic Surfaces and Decay of Solutions of Wave Equations*, Duke Math J. **44** (1977), 705–714) and made contributions to the theory of pseudo-differential operators (*A Functional Calculus for Elliptic Pseudo-Differential Operators*, Amer. J. Math. **94** (1972), 711–722) and harmonic analysis on semi-simple symmetric spaces (*Harmonic Analysis on Hyperboloids*, J. Func. Anal. **12** (1973), 341–383).

Beginning in the 1980s, my work became more geometric. I applied harmonic analysis to integral geometry (L^P *Estimates for Radon Transforms on Euclidean and Non-Euclidean Spaces*, Duke Math J. **48** (1981), 699–727), in which the central problem is to reconstruct a function from its integrals over geometrically simple sets such as straight lines or planes. This is the mathematical theory that underlies the modern advances in X-ray diagnoses. I used Riemannian geometry as a kind of metaphoric prism to understand the significance and relationships among the basic concepts and constructions of harmonic analysis (*Analysis of the Laplacian on a Complete Riemannian Manifold*, J. Func. Anal. **52** (1983), 48–79, and *Harmonic Analysis a Spectral Theory of Laplacians*, J. Func. Anal. **87** (1989), 51–148). I also studied a generalization of Riemannian geometry which I am trying to call "Sub-Riemannian" (as opposed to the unwieldy name "Carnot-Caratheodory"). This geometry is related to sub-elliptic differential equations, and arises naturally in the theory of nilpotent Lie groups (*Sub-Riemannian Geometry*, J. Diff. Geom. **24** (1986), 221–263).

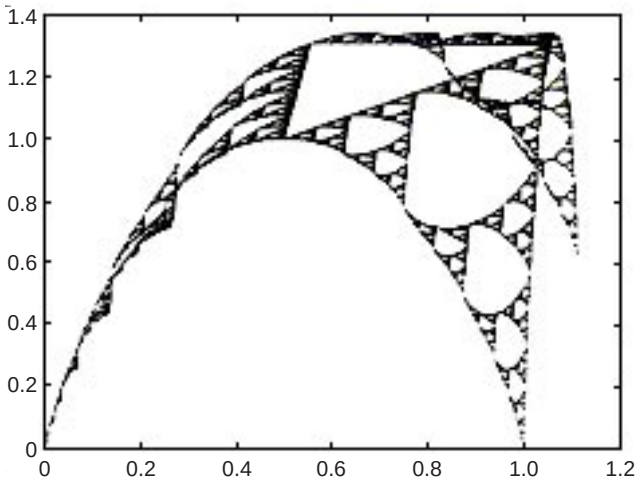
In the 1990s I began working on fractal geometry and the theory of wavelets. The underlying theme in both these areas is the idea of *self-similarity*, in which the whole is written as a sum of parts, each of which is similar to the whole. A simple example is an interval, which can be broken into two pieces, and each piece expands to recover the original interval. More interesting examples include the von Koch snowflake, the Sierpinski gasket, or the hexagasket, or "fractal Star of David," shown here.



I have developed the idea of a Fractal Plancherel Theorem, both in the general case (*Fourier Asymptotics of Fractal Measures*, J. Func. Anal. **89** (1990), 154–187) and for self-similar measures (*Self-Similar Measures and their Fourier Transforms I, II, III*, Indiana U. Math. J. **39** (1990), 797–817; **42** (1993), 367–411; Trans. Amer. Math. Soc. **336** (1993), 335–361), in which I showed how the fractal properties of a measure show up in the asymptotic behavior of its Fourier transform.

In connection with this work I have become involved with what might be called "experimental mathematics." The idea is to use computer experiments to explore mathematical problems, with the goal of 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 **351** (1999), 3725–3741; and *Nonlinear Self-Similar Measures and their Fourier Transforms* (with D. Glickenstein), Indiana U. Math. J. **45** (1996), 205–220.). See also the web sites http://mathlab.cit.cornell.edu/~gibbons and http://mathlab.cit.cornell.edu/~tillman.

For the past four years I have been working on analysis on fractals. The idea is to develop the analog of calculus for functions defined on fractals and to study the resulting fractal differential equations that might be used to model physical processes taking place in fractal objects. Through the work of Jun Kigami, it is possible to define the analog of a Laplacian on some fractals, including the hexagasket shown above, as a limit of difference quotients. This Laplacian has some strange properties, such as: 1) there exist localized eigenfunctions; 2) there exist harmonic functions locally constant, but not globally constant; 3) if the Laplacian of u is defined, then the Laplacian of u^2 is not defined (unless u is constant); 4) the associated wave equation does not have a finite propogation speed. I have been working on learning more about this Laplacian, and I have developed tools of numerical analysis to approximate solutions to various fractal differential equations. The graph of the ground state eigenfunction on the Sierpinski gasket is shown below.



Since the Laplacian is a second order differential operator, it seems natural to look for analogs of first order operators, such as the gradient. I have begun to study these, but the story turns out to be more complicated. I am also beginning to study questions that are suggested by ideas coming from partial differential equations, analysis on manifolds and harmonic analysis. An expository article, *Analysis on Fractals*, was published in Notices AMS **46** (1999), 1199–1208, explaining some of these ideas. I see this area as a rapidly developing field with many connections to other areas of mathematics, and I am pleased to be able to bring my own perspective, based on my past experience, to help its development. Perhaps this is my mathematical destiny. My experimental

research has been done in collaboration with undergraduate students, with the support of the REU (Research Experiences for Undergraduates) Program sponsored by the NSF. Starting in the summer of 1994, I have directed an REU site program at Cornell that involves 10 undergraduate students and 3 faculty members.

In addition to my research, I have maintained an interest in mathematical exposition. I received a Lester Ford Award from the Mathematical Association of America in 1983 for expository writing, and in 1982 I won the first prize in the French Museum Competition sponsored by the Mathematical Intelligencer. I have recently published two textbooks. *A Guide to Distribution Theory and Fourier Transforms*, CRC Press, 1993 and *The Way of Analysis*, Jones and Bartlett, 1995, based on course notes that have been used at Cornell for many years in Math 413, 414, 422 and 515.

Moss Sweedler

Professor of Mathematics

First I worked in the area of Hopf algebras and wrote *Hopf Algebras*, which came to be the standard reference book on the subject. H. Allen and I used Hopf algebras to prove a 25 year old conjecture of Jacobson. Over the ensuing years until about the mid eighties, I worked and published in the areas of commutative algebra and algebraic geometry, real-algebraic geometry, homological algebra, algebraic groups, purely inseparable field extensions and general positive characteristic phenomena, simple algebras and generalizations of the Brauer group, and differential algebra. Since the mid eighties I have primarily worked in the area of computer algebra, especially computational commutative algebra. This has produced both theoretical and applied results with applications beyond mathematics, such as to error control codes and resulted in my position as Director of the Army Center of Excellence for computer algebra.

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 Admissions and 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://www.math.cornell.edu/~bterrell

Bob Terrell enjoys teaching mathematics and has written software for teaching partial differential equations. He was once an engineer, and might be the only member of the department with patents on machinery.

Peter Topping

H. C. Wang Assistant Professor of Mathematics

My research is centered on the theory of nonlinear partial differential equations, with an emphasis on those arising in the calculus of variations. I am studying such equations arising in geometric analysis, applied analysis and differential geometry.

Particular areas of specialization currently include harmonic maps, curvature flows, isoperimetric inequalities, Willmore surfaces and geometric hydrodynamics.

Invited Lectures: Université Libre de Bruxelles, joint Warwick-Brussels Colloquium (July 1999). Conference on PDE, Oberwolfach, Germany (July 1999). Analysis Seminar, Universitaet Bonn, Germany (July 1999). Analysis Seminar, ETH Zurich, Switzerland (July 1999). Analysis Seminar, Cornell University (Sept. 1999). Geometric Analysis Seminar, Princeton (Apr. 2000). British Mathematical Colloquium, Leeds, UK (Apr. 2000). Geometry Seminar, Georgia Tech (May 2000). Barrett Lectures, University of Tennessee (May 2000). Nonlinear PDE Conference, Ascona, Switzerland (June 2000).

Selected Publications:

Rigidity in the Harmonic Map Heat Flow, J. Differential Geometry **45** (1997), 593–610.

The Optimal Constant in Wente's L^∞ Estimate, Comment. Math. Helvetici **72** (1997), 316–328.

Mean Curvature Flow and Geometric Inequalities, J. Reine Angew. Math. **503** (1998), 47–61.

The Isoperimetric Inequality on a Surface, Manuscripta Math. **100** (1999), 23–33.

Pressure Estimates in Two Dimensional Incompressible Fluid Flow, Physica D **137** (2000), 143–156.

Towards the Willmore Conjecture, Calc. Var. (2000), to appear.

Repulsion and Quantization in Almost-Harmonic Maps and Asymptotics of the Harmonic Map Flow (1999), preprint.

Karen Vogtmann

Professor of Mathematics

A fundamental technique for studying a group G is to view G as a group of automorphisms of geometric object C. Geometric and topological properties of C can then be used to study algebraic properties of G. Beautiful classical examples of this are the theory of arithmetic and S-arithmetic groups acting on homogeneous spaces and buildings, including work of Borel and Serre on cohomological properties of these classes of groups, and the theory of groups of surface homeomorphisms acting on the Teichmüller space of the surface. My main area of research interest is in developing geometric theories for other classes of groups. In particular, I have worked with orthogonal and symplectic groups, SL_2 of rings of imaginary quadratic integers, groups of automorphisms of free groups, and mapping class groups of surfaces.

Awards and Honors: NSF Visiting Professorships for Women, Cornell University (1984–85). Invited hour address, AMS Summer Meeting, Provo, Utah (1986). NSF Career Advancement Award, MSRI (1989). Research Professorship, MSRI (1995).

Professional Activities: Executive committee of the Council of the AMS. Referee for professional journals. Committee on Meetings and Conferences of the AMS. Associate Editor for Research-Expository articles, Bulletin of the AMS. Research board of the American Institute of Mathematics.

Selected Publications:

Spherical Posets and Homology Stability for $O_{n,n}$, Topology **20** (1981), 119–132.

Moduli of Graphs and Automorphisms of Free Groups (with M. Culler), Inventiones **84** (1986), 91–119.

Equivariant Outer Space and Automorphisms of Free-by-Finite Groups (with S. Krstic), Comment. Math. Helvetici **68** (1993) 216–262.

A Group-Theoretic Criterion for Property FA (with M. Culler), Proc. AMS **124** no. 3 (1996), 677–683.

Cerf Theory for Graphs (with A. Hatcher), Jour. London Math. Soc. **58** part 3 (1998), 633–655.

A Whitehead Algorithm for Surface Groups (with G. Levitt), Topology, to appear.

Lars B. Wahlbin

Professor of Mathematics

At present one can compute "solutions" to very tough nonlinear, singular problems on, say, a supercomputer. Most often, numerical analysis does not furnish theorems that cover a practical situation, but it provides insight into the behavior of the relevant numerical method on carefully chosen model problems with, at best, some of the most pertinent difficulties of the real problem present.

My work in numerical analysis is aimed at gaining a fundamental understanding of numerical methods. Such insight is also necessary for constructing better algorithms. My particular interest is in methods for partial differential equations, and lately I have been studying the precise and detailed behavior of the finite-element methods in a variety of problems; the most interesting ones contain singularities of various degrees of nastiness.

Professional Activities: Managing editor for Mathematics of Computation.

Selected Publications:

Local Behavior in Finite Element Methods; in Handbook of Numerical Analysis (P. G. Ciarlet and J. L. Lions, eds.), Vol.II (Part 1), North Holland (1991), 353–522.

Superconvergence in Galerkin Finite Element Methods, Springer Lecture Notes in Mathematics **1605**, Springer-Verlag New York, 1995.

Beverly H. West

Senior Lecturer of Mathematics

My chief interest is in mathematics teaching, using interactive computer graphics, particularly in differential equations, multivariable/vector calculus, and dynamical systems (both real and complex).

It has been a great pleasure this year to participate in Steve Strogatz' (Theoretical and Applied Mechanics) IGERT program to give interdisciplinary training to graduate students in nonlinear dynamics. My delight in applications and mathematical modeling was heightened by the learning of new results in diverse fields, from medicine and robotics to ecology and finance.

The greatest highlight of the year was traveling to Egypt as part of a Women in Science Delegation from the People-to-People Ambassador Program. It was a thrill to exchange expertise with American, Egyptian and Australian scientists in diverse fields — medicine and pharmacology, thermal engineering, mineralogy, water resources, geophysics, biology and chemistry.

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 Nov. 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).

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.

Invited Lectures:

MAA Short Course on Teaching Differential Equations (with Paul Blanchard et. al.; July 1999).

Successful take-home examinations: multivariable calculus and differential equations, International Conference on Technology in Collegiate Mathematics (ICTCM), San Francisco (Nov. 1999).

Real time dynamics: why it makes a difference (with J. McDill), International Conference on Technology in Mathematics Teaching (ICTMT), Plymouth, England (Aug. 1999) and MAA Winter Meetings (Jan. 2000); Women in Science Delegation to Egypt.

Selected Publications:

*Analyzer** (with D. Alfors), an exhaustive software package for studying functions of a single variable (1990 EDUCOM/NCRIPTAL Distinguished Mathematics Software Award), Addison Wesley, 1992.

MacMath (with J. Hubbard), 12 interactive graphics programs for the Macintosh, to accompany the Differential Equations texts, second edition, Springer-Verlag, 1994; new expanded version in progress.

A New Look at the Airy Equation with Fences and Funnels (with J. Hubbard, J. McDill and A. Noonburg), College Mathematics Journal (1994); Proceedings of the Organic Mathematics Project (1996); CECM at Simon Fraser University (1997).

Differential Equations: A Dynamical Systems Approach (with J. Hubbard), Springer-Verlag; Part I: One-Dimensional Equations, 1991, 1997; Part II: Higher-Dimensional Equations, 1995.

Interactive Differential Equations (with S. Strogatz, J. M. McDill, J. Cantwell and H. Hohn), a CD-ROM with laboratory workbook, Addison Wesley Interactive, 1996, 1.1 for Mac and 2.0 for Windows, 1997.

ODE Architect (with C•ODE•E, NSF Consortium for ODE Experiments), John Wiley and Sons, 1998. An interactive teaching, learning and research environment on CD Rom with Companion Book of 269 pages. This package won an Invision '98 award as one of "The 9 Best CD-Roms on the Planet" (against all sorts of nonmathematics competitors)!

Technology in Differential Equations Courses: My Experiences, Student Reactions, a chapter for an MAA volume on teaching differential equations "in the new millenium" (M. Kallaher, ed.).

Differential Equations and Linear Algebra (a combined text with J. Stanley Farlow, James E. Hall and Jean Marie McDill), Prentice Hall, 2000, 600 pages.

James West

Professor of Mathematics

My research has focused on the topology and symmetries of manifolds of finite and infinite dimensions, and on the related topics of polyhedra, absolute neighborhood retracts, function spaces and spaces of sets.

An example of the interplay between these theories is that manifolds modeled on the Hilbert cube appear naturally in several ways as limits of stabilization processes for finite-dimensional objects, and, unlike standard function space stabilization, retain more of their important properties, e.g., simple homotopy type. Study of the Hilbert cube manifolds has produced several of the initial breakthroughs in introducing control into the homeomorphism theory of finite-dimensional manifolds. This in turn, has been useful in analyzing the failure of the classical matrix algebra to describe equivariant homeomorphisms and homotopy types of manifolds with locally linearizable transformation groups, which in turn has led to new results on the topological classification of linear representations of finite groups. I have been involved in these studies.

Awards and Honors: Invited Address, AMS Summer School on Algebraic and Geometric Topology, Stanford (1976). Invited Address, Moscow Mathematical Society (1978). Invited Address, Inter. Congress of Mathematicians, Helsinki (1978). Karcher Lectures, University of Oklahoma at Norman (1979).

Professional Activities: Editorial board member of Fundamenta Mathematicae. Delegate with Women in Science Delegation to Egypt (Apr. 2000).

Invited Lectures:

Origins of infinite-dimensional topology in North America, history special session, AMS Regional Meeting, Austin (Oct. 1999).

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

William Dunbar

Simon's Rock College of Bard

I enjoyed my year as a visiting faculty member in the Mathematics Department at Cornell. Coming from six years teaching at a small college where the students are generally two years younger than the norm, having left high school to start college early, I often have had to persuade students that they are at a "real college." I hope to make good use of my experience teaching calculus (Math 111 and 112) to "real college students," in informal ways, when I return to Simon's Rock College. I had not worked under a czar for many years and was happy to find that the existence of e-mail greatly facilitated communication among the instructors as well as between the instructors and the czar. It was also a relief to have support in dealing with student requests for exceptions, given my lack of familiarity with the bureaucracy here and with customary practice. However, I admit that it was disconcerting to try to prepare my students for exams that someone else would be writing.

During the fall 1999 semester, I attended John Hubbard's course on Teichmüller theory and Mike Stillman's course on algebraic surfaces. They are both energetic and engaging lecturers, and in both cases I had the opportunity to gain a deeper understanding of an area of mathematics which I knew previously mostly from hearsay. Hubbard's course leaked into the spring as a weekly meeting in which a few of us worked at clarifying, with some success, murky proofs of a few fundamental theorems.

It was great to have such a broad range of talks available. I frequented the meetings of the Undergraduate Math Club and the Olivetti and Oliver Clubs, as well as the Topology and Geometric Group Theory Seminar, and occasionally visited others as well. The Math Club was kind enough to invite me to give a talk on an old obsession of mine, the field of planes which are orthogonal to a Hopf fibration of the three-sphere by circles. Computer graphics have made the details of this plane field much easier to visualize, and it serves to illustrate some basic concepts in differential geometry (Ehresmann connections, and hence Riemannian curvature — in this case, of the two-sphere).

Walking up to campus through Cascadilla Gorge or biking up University Avenue (weather permitting) was strenuous but exhilarating, and I'm happy to say that now, in the final days of my stay, I arrive a little less pooped than I was in the fall. I've also enjoyed visiting the many gardens and other landscaped areas around campus. I will return home with many fond memories of the people I've met and the places I've seen.

Maria Fung

Cornell University

I feel very fortunate to have been given the opportunity to spend an extra year at the Mathematics Department at Cornell University after I completed my Ph.D. in August of 1999. It was invaluable for me to stay in a familiar environment and seek advice from experienced colleagues while testing the waters of the job market. I feel very obliged to my advisor, Prof. Speh, for all her help with everything; also my gratitude goes out to Tom Rishel for his willingless to lend a hand at crucial times. Teaching Math 111 under the czarship of Marshall Cohen in the fall and Math 112 with Shankar Sen in the spring provided two very different and interesting experiences. The contrast in style and emphasis was remarkable! The opportunity to go to interesting talks in the Oliver and Lie group seminars is something I am going to miss at my new position at the University of Wisconsin Stout. Also, I would like to thank the Department for sponsoring my participation in the Seaway Section Project NExT. Ithaca and Cornell are going to be forever very special places for me, and I do look forward to chances to come back for a visit in the future!

John Rosenthal

Ithaca College

The 1999–2000 academic year was the second time I participated in the visiting faculty program. I greatly appreciate that it made it more feasible for me to take a year as opposed to one semester sabbatical leave. I also greatly appreciate that I only had to teach in the fall semester so that as the year progressed I had increased time for nonteaching activities.

I attended several courses during the year. In the fall I attended Keith Dennis's *Algebra* course and Richard Shore's *Recursion Theory* course. I have never seen anyone involve students in a lecture as well as Richard Shore. He does an inspiring job of soliciting suggestions from students and getting them to understand why one should expect to use certain techniques of proof. I am thinking about how I can get students to be such active thinkers in my upper level undergraduate courses. In the spring I attended Michael Stillman's *Commutative Algebra* course and Anthony Kable's *Analytic Number Theory* course. I have always found talks in analytic number theory hard to comprehend; in contrast, Kable's lectures were exceptionally clear. He also provided a fine sense of how more recent developments are related to the classical results he presented.

After attending Cliff Earle's *Complex Analysis* course in spring 1993, I decided to teach an undergraduate complex analysis course at Ithaca College. Although a lot of work to prepare, it was a lot of fun to teach. Having attended Anthony Kable's *Analytic Number Theory* course, I am thinking about how I might offer aspects of it as an undergraduate course or at least incorporate a proof of a weak form of the Prime Number Theorem into the complex analysis I will be teaching in spring 2001.

Calculus 111 at Cornell has a considerably greater theoretical emphasis than the "reform" calculus courses I have recently taught. Teaching such a course has made me think a lot about how theoretical material should be presented in calculus. Students tend to have an easier time understanding intuitive arguments rather than careful proofs. What I think one ought to do in freshman calculus is present intuitive arguments, explain the flaws in the arguments, and then for some results present careful proofs. When possible the careful proofs we present should show some connection with the intuitive arguments.

I was particularly impressed with the series of exercises that Marshall Cohen developed on why it is necessary for students to be cautious in the use of a graphing calculator. I expect to incorporate many of these ideas when I teach calculus at Ithaca College in the fall.

Rethinking the teaching of theoretical results in calculus also led me to rethink how I teach our undergraduate analysis course. Our students come out of a "reform" calculus course. When they take analysis, they ought to be given some sense of why the presentation needs to be so different from what they encountered in calculus and why so much preliminary work is needed before they get to the concepts of the derivative and the definite integral.

Increasingly at Ithaca College we try to give our students an undergraduate research experience. During the year I spent considerable time examining a number of "simple" problems in number theory that I believe our undergraduates with persistence, guidance, some inspiration, but not much background ought to be able to tackle. I look forward to challenging students with these problems.

My thanks for a great year and for help escaping my administrative duties on South Hill.

Stephen Wirkus

Cornell University

I consider myself very fortunate to have held teaching associate and visiting assistant professor postions in the Cornell University Mathematics Department during the 1999–2000 academic year. I had spent the previous five years in the Center for Applied Math as a graduate student and was already somewhat familiar with the department and definitely enjoyed the new location in Malott Hall.

Having only "TA'd" in the past, it was good experience for me to teach two sections of Math 112 in the fall and two sections of Math 111 in the spring. I spent much of the fall semester searching for job openings and the first part of the spring interviewing for jobs. As I was mainly looking at teaching schools, all of them loved the fact that I was actually getting teaching experience before coming to their school. And I don't feel like I'm jumping in over my head next year either! I accepted a job in the Department of Mathematics at California State Polytechnic University, Pomona (or Cal Poly for short) and will be putting much of my Calculus teaching experience to use next year.

I was also able to attend the MAA meeting in Oswego as a Seaway NExT fellow in April. That provided an excellent opportunity to meet other young faculty around

the area and exchange ideas about teaching. Outside of teaching and job searching, I did find some time to work on research. I presented a summary of my thesis as well as some new results at the first David Blackwell-Richard Tapia Distinguished Lecture Series in May. It was a good experience and a nice way to finish up the year.

I am very grateful to Tom Rishel for his help over the years in finding TA postions and to both Tom and Stephen Chase for the opportunity to spend the year teaching at Cornell. Thanks also to the staff for their help and always smiling faces. It was definitely a year well spent.

Xueqi Zeng

Concordia College

I feel very fortunate to have been offered a visiting position during the 1999–2000 academic year at the Department of Mathematics of Cornell University for my sabbatical leave.

I taught two sections of Math 111 in the fall and two sections of Math 112 in the spring. Working under the command of a czar reminded me of the old days as a graduate student. Most of the students in these courses are freshmen. I have seen many of them have a difficult time making the transition from high school to an Ivy League University. Teaching students at Cornell is challenging and teaching non-mathematics majors is even more challenging.

The Mathematics Dapartment offers a program rich in variety, which serves students with different academic interests and with different mathematical ability. My year at Cornell was enjoyable and fruitful, which will definetely benefit my home institution. My thanks to professors Morley, Hurbbard, Speh and Topping for letting me sit in on their classes. From these courses I have learned a great deal. My thanks to Professor Cohen for giving me a copy of his manuscripts, and Professor Taimina for sharing with me her years of experience of teaching the history of mathematics. In the coming fall I plan to integrate a chapter of differential equations in my second semester of calculus and redesign the senior special topics class to make it serve as a capstone course for the mathematics major. I will actively participate in the mathematics curriculum review, and it would be impossible without my experience at Cornell.

I have also had the good fortune to meet Doug Alfors; he and his wife are alumni of Concordia College.

Very special thanks go to Beverly West who makes the visitors feel at home. I am deeply grateful for all her help to me and my husband.

My thanks also to each of the support staff for helping to make my year successful.

Staff Profiles

Administration

Nora Balfour, Undergraduate Coordinator (1998): As undergraduate coordinator, Nora is the primary resource person for the undergraduate program, which includes approximately 80 majors. She acts as liaison between faculty and their advisees, both majors and over 200 students (mostly first or second year) with undeclared majors. She hires, assigns, oversees time collection and supervises undergraduate graders. Nora coordinates the application process for the summer Research Experiences for Undergraduates (REU) program and maintains various departmental web pages. She is also the departmental receptionist, conducts the annual faculty recruitment effort, provides administrative support both for the undergraduate program and the administrative manager and is the editor of the department newsletter, *Math Matters*.

Gayle Davis, Accounts Coordinator (1998): Gayle provides administrative, financial and personnel support for the department. In accordance with university and agency regulations, she develops research budgets and oversees proposal submissions to the Office of Sponsored Programs. She monitors account transactions, approves expenditures and maintains account information and records. She also processes nonacademic appointments, maintains nonacademic personnel records, oversees time collection, processes payroll vouchers and distributes paychecks. Gayle assists the administrative manager in the day-to-day operations of the department and serves as acting manager when the administrative manager is unavailable. She is the functional supervisor for the administrative staff.

Arletta Havlik, Department Registrar (1968): 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 copy room specialist for the department. She coordinates the day-to-day service operations provided to faculty, visitors, staff and students. She orders supplies, processes purchase orders and performs records and facilities maintenance, information gathering and data input. Joy assists the accounts coordinator with travel reimbursements, cash deposits, records management and accounts payable. She oversees the mailroom operations, maintains repair and renovation records and secures the building at night. Joy is the person to whom any building issues (e.g. repairs, heating and cooling) are reported. In additional, she coordinates the refreshments for the weekly seminar series.

Michelle Klinger, Teaching Program Coordinator (1993): Mikki provides administrative support for the mathematics teaching program, assisting the associate chair and the teaching assistant coordinator. She works directly with the teaching assistant coordinator to generate the department course schedules. Mikki oversees room assignments and changes, course file management and textbook ordering and screens inquiries pertaining to course offerings. She also acts as back-up technical typist. Mikki works with the administrative manager to compile information for and publish the annual report. She is the back-up department receptionist, coordinates the annual capital equipment inventory, publishes a weekly seminar bulletin and maintains/generates department database directories and related reports. Mikki updates and maintains many of our departmental web pages. She also issues keys and maintains the department's access device log for all keyholders.

Donna Smith, Graduate Field Coordinator (1997): Donna is responsible for the administration of the department's graduate program, beginning with the admissions process and continuing through graduation. She provides primary support to the director of graduate studies, maintains matriculated student records, processes appointments and generally oversees the administrative functions of the graduate program, consisting of about 63 graduate students. She works with the administrative manager and the teaching assistant coordinator to monitor the annual teaching assistant budget. In addition, she coordinates, schedules, plans and oversees all department social functions. Donna provides backup support to the accounts representative for the department's time collection and payroll effort and serves as the department's telephone coordinator.

Catherine Stevens, Assistant to the Chair (1969): Cathy provides executive, administrative and secretarial support to the chair and faculty of the Mathematics Department. Cathy maintains the chair's calendar, screens calls and schedules appointments. She assigns office space and works with the chair to compile teaching and committee assignments. Cathy coordinates faculty searches, processes academic personnel forms and maintains academic personnel files. She assists foreign nationals in obtaining proper visa status, arranges lectures and accommodations for prospective faculty and visitors and schedules benefits counseling for new academic employees. Cathy plays a key administrative role in overseeing the summer session course offerings, including budget development, teaching assistant assignments and grader support.

Colette Walls, Administrative Manager (1996): As business manager, Colette directs the financial, personnel, facilities, communications and funds procurement operations. Her responsibilities include planning, managing and evaluating the general administrative operations of the department. She assists the chair (and others) in administering selected academic activities including the course count, budget process, leave replacement funding and TA budget. She maintains, monitors and reconciles departmental appropriated, gift and endowment accounts and acts as liaison with central college and university offices. She oversees and participates in the publication of newsletters, the annual report and various external surveys and generates a variety of department, college and university reports. Colette interviews, hires, assigns workloads and supervises the administrative support staff. She is also responsible for updating and maintaining the department's web-based *Survival Manual for Faculty and Teaching Assistants*, which can be found at www.math.cornell.edu/~colette/Survival/ survival.toc.html.

Computer Support

Douglas Alfors, Computer Consultant and Advisor (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.

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 some of the departmental web pages, provides maintenance for the department computer systems—including UNIX, Sun, Macintosh and PC operating systems—and provides computer consulting, diagnostic and troubleshooting support for department members.

Mathematics Support Center

Douglas Alfors, Director (1983): Doug directs and coordinates MSC academic support for mathematics, principally for introductory courses. Such support includes the interviewing, hiring and supervision of student tutors; the day-to-day running of the MSC office; preparation and distribution of written support capsules; and planning and conducting various workshops on topics of common interest (e.g. graphing, infinite series, integration, etc.). He also oversees the use of the computers in the MSC.

Richard Furnas, Teaching Associate (1981): Richard has been a mainstay of the Mathematics Support Center since its inception in the early 1980s. He serves as a tutor, review session leader and general Macintosh guru. Graduate students from other departments often benefit from his counsel on the use of a variety of mathematical techniques in their field of research. Dick also assists in the instruction of Math 105 (*Finite Mathematics*) each fall and of Math 106 (*Calculus for Biologists*) each spring.

Mathematics Instructional Computer Lab

Allen Back, Director (1993): Allen is responsible for the primary computer instruction laboratory for the teaching of mathematics. The lab is a teaching arm of the Mathematics Department, and the director addresses pedagogic issues in appropriate instructional uses of computers, acting as a resource person in all related areas. He is responsible for the installation and upkeep of hardware and software, as well as addressing all personnel issues of the lab including selection, training and supervision. Allen also contributes to the development of sample materials, assignments, and help documentation and software of interest to faculty and staff. He gives demonstrations, helps with software use, serves as an advisor on technical issues and assists in relevant grant proposals.

Mathematics Library

Lee Ringland, Access Services Supervisor (1999): Lee oversees the operation of the Math Library's circulation and reserve services. She is also responsible for the hiring, training and supervision of student employees. Lee can help you with reference questions and is in charge of the library when Steve is not available.

Steven Rockey, Mathematics Librarian (1972): Steve is in charge of the library and makes all policy, management and budget decisions. He is the contact for questions about book, journal or other format purchases for the library. Drawing on many years of experience in the library, he can often find an answer or solution for most any question or problem. Walk right in, send an e-mail or give him a call any time at work or at home.