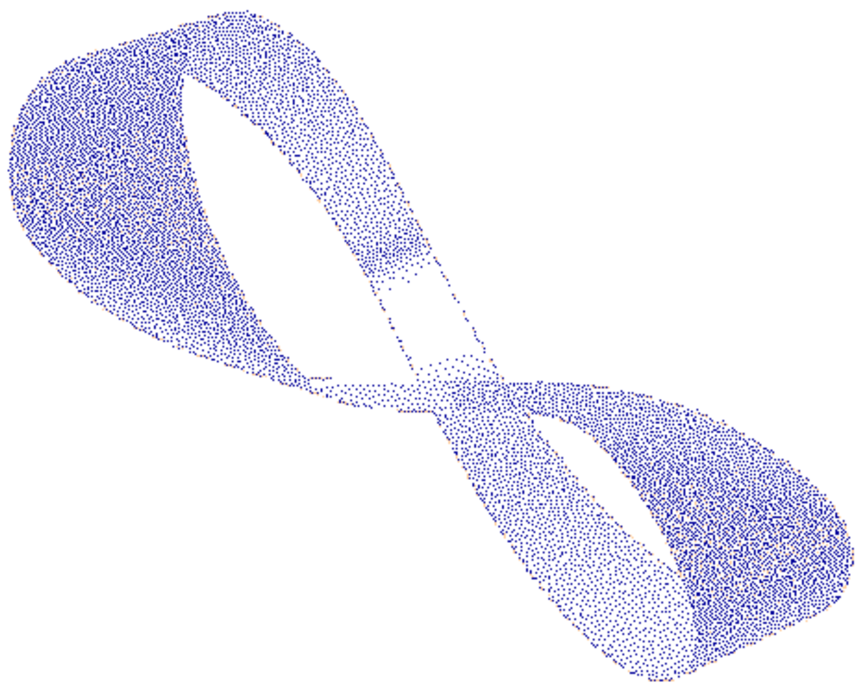
Department of Mathematics

Cornell University

Annual Report

1996–97



Year in Review: Mathematics Instruction and Research

Dedication

Wolfgang H. J. Fuchs

This annual report is dedicated to the memory of Wolfgang H. J. Fuchs, professor emeritus of mathematics at Cornell University, who died February 24, 1997, at his home.

Born on May 19, 1915, in Munich, Germany, Wolfgang moved to England in 1933 and enrolled at Cambridge University, where he received his B.A. in 1936 and his Ph.D. in 1941. He held various teaching positions in Great Britain between 1938 and 1950.

During the 1948–49 academic year, he held a visiting position in the Mathematics Department at Cornell University. He returned to the Ithaca community in 1950 as a permanent member of the department, where he continued to work vigorously even after his official retirement in 1985. He was chairman of the Mathematics Department from 1969 to 1973. His academic honors include a Guggenheim Fellowship, a Fulbright-Hays Research Fellowship, and a Humboldt Senior Scientist award.

Wolfgang was a renowned mathematician who specialized in the classical theory of functions of one complex variable, especially Nevanlinna theory and approximation theory. His fundamental discoveries in Nevanlinna theory, many of them the product of an extended collaboration with Albert Edrei, reshaped the theory and have profoundly influenced two generations of mathematicians. His colleagues will remember him both for his mathematical achievements and for his remarkable good humor and generosity of spirit.

He is survived by his wife, Dorothee Fuchs, his children — Annie (Harley) Campbell, John Fuchs and Claudia (Lewis McClellen) Fuchs — and by his grandchildren: Storn and Cody Cook, and Lorenzo and Natalia Fuchs McClellen.

Department of Mathematics

Annual Report 1996–97

Year in Review:

Mathematics Instruction
and Research

Cornell University

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

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

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

Robert Connelly, chair
Department of Mathematics
Cornell University
124 White Hall
Ithaca, NY 14853-7901

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

Table of Contents

The Year in Review 1996–97

This was an historic year for the Mathematics Department. We had an unusually high number of vacant faculty lines to fill, presenting a special opportunity for the department. We will be making decisions that will effect us for a long time. We initiated five tenure-track searches, and filled three faculty positions.

Persi Diaconis, a member of the National Academy of Sciences, has accepted the offer of the David Duncan Chair, previously held by Carl Sagan. He will hold half-time appointments in the Mathematics Department and the School of Operations Research and Industrial Engineering in the Engineering College. As a visitor during the 1996–97 academic year, Persi gave a course on Markov chains to a packed house in the fall and a course on the theory of finite groups in the spring. Persi seemed to be everywhere this year, giving seminars all over campus. We look forward to his return as a permanent member of our faculty; his presence will greatly benefit the department.

Yulij Ilyashenko from Moscow has accepted our offer of a five-year half-time appointment. He will join John Guckenheimer, John Hubbard and John Smillie to form one of the strongest groups in dynamical systems in the country. Yulij is presently a vice-president of the Moscow Mathematical Society, full professor at Moscow University, a leading researcher half-time at the Steklov Institute in Moscow, and dean of the Superior Mathematics College of the Independent University in Moscow. We look forward to a great deal of mutually beneficial interaction between the Moscow school of mathematics and Cornell.

Laurent Saloff-Coste also accepted a position on our faculty as a full professor, although he will be on leave during the 1997–98 academic year. Laurent comes to us from the Université Paul Sabatier in Toulouse, France, where he is director of research. He is an analyst, who has done statistics with Persi, probability theory, geometric group theory, Sobolev inequalities and analysis on Lie groups. He seems to have something in common with almost every member of our faculty! We are delighted to have him join our department.

Searches continue for the two remaining budget lines. One is a senior-level faculty position. At the present time we have a strong preference for a top ranked statistician. The second position will probably be at the assistant professor level in the area of algebra, analysis or applied mathematics. We continue in our endeavor to hire people capable of doing an excellent job of both teaching and research.

On another front, a cooperative effort with the College of Engineering has resulted in a significant restructuring of one of our freshman engineering calculus courses. Plans have been approved for the fall semester teaching of Math 192 — the second course in engineering calculus — to be converted from the existing large lecture system to smaller classes of about 25 students. Thanks to the generosity and cooperation of President Rawlings, Provost Randel, Dean Lewis and Dean Hopcroft, engineering freshmen will benefit from the advantages of smaller class sizes starting in the 1997–98 academic year. (For more information, see page 7.) As part of this plan, we were given permission to hire an additional H. C. Wang assistant professor to help offset the resultant need for additional instructors. We are pleased that this position will be filled by Xavier Buff from the Université de Paris-Sud. His area of expertise is in dynamical systems.

Chairman Connelly was assisted in these and various other endeavors by Stephen Chase as associate chairman, Richard Durrett as director of graduate studies, Tom Rishel as director of undergraduate teaching, and Lars Wahlbin as director of math majors. Mark Gross directed the department computer facilities, while Allen Back directed the instructional computer lab. John Smillie continues to oversee preparations for the department's upcoming move to Malott Hall.

In order to provide more immediate relief from the crowded conditions in White Hall, the College of Arts and Sciences has generously provided us with a suite of offices on the second floor of Lincoln Hall. In January, we moved 18 graduate students into this new office space, which became available after the Arts and Sciences Dean's Office relocated to Goldwin Smith Hall over the holiday break. We are pleased with the quality of the new space and delighted to be able to provide a better environment for some of our students. Many thanks to Jane Pedersen and Henry Crans for their help and cooperation in the relocation effort.

Faculty and graduate students continued to heighten our profile this year through special awards and honors (see page 5). Professor Reyer Sjamaar was awarded with a Sloan Research Fellowship, which is a very prestigious award. Several graduate students received awards this year: Alexander Teplyaev received a Sloan Doctoral Dissertation Fellowship; Sudeb Mitra and Nikhil Shah received Hutchinson Fellowships; Jeff Mitchell received the York Award for mathematics; and Hal Schenck received a Clark Teaching Award.

Once again, several Cornell undergraduates competed in the annual William Lowell Putnam Mathematics Competition. Over 2,400 students competed this year from 294 institutions across the United States and Canada. The Putnam exam is extremely difficult; most students receive only one or two points out of a possible 120. Professor John Hubbard coached the Cornell team, consisting of Jeremy Bem, Raju Chelluri and Robert Kleinberg; their score ranked thirteenth this year.

Our three team members were among ten Cornell students who competed. Two of these competitors, Jeremy Bem and Robert Kleinberg, were named Putnam Fellows for scoring among the top six of over 2,400 individual competitors. The individual scores of the Putnam Fellows are not announced; their scores fell between 76 and 98. This is truly an admirable achievement (see page 6). The department extends its congratulations to Bem and Kleinberg for distinguishing themselves and Cornell.

The department experienced several changes among its faculty and instructors this year. Reyer Sjamaar was appointed for another three-year term as assistant professor. Mark Gross was approved for promotion to associate professor with tenure. Russ Lloyd, who teaches supplemental mathematics courses for the Learning Skills Center, was also promoted: to the rank of senior lecturer. Jianguo Cao resigned to accept a position at Notre Dame. Roger Livesay retired and will be granted emeritus status. Professor Emeritus Wolfgang Fuchs passed away this year. (See *Faculty Changes*, page 4.)

This year's Visiting Faculty Program participants were: Professor Stephen Hilbert, Ithaca College in Ithaca, New York; Professor Kazem Mahdavi, SUNY at Potsdam in Postdam, New York; Professor John Meier, Lafayette College in Easton, Pennsylvania; Professor Thomas Stiadle, Ph.D. Cornell University, May 1996; Professor Michael White, Jefferson Community College in Watertown, New York. (For information about their experiences at Cornell, see page 65.) Recruitment efforts have produced five participants for the 1997–98 academic year.

Graduate student recruitment yielded eight new graduate students plus one transfer student for the 1997–98 academic year, reducing the program from 61 to 57 students. Applications numbered 190 while inquiries totaled nearly 2,000.

Support Staff

Unexpectedly at the beginning of the academic year, Diane Downing, who was the department's business manager for eight years, decided to leave us and launch herself into a new career as the Project 2000 Human Resource/Payroll Liaison. Diane will be working on the implementation of Project 2000 at Cornell as a liaison between Cornell and PeopleSoft. Diane put character and zip into our department. She is responsible for promoting a *technology friendly* organizational culture for the support staff, for which we are sincerely grateful. Although we were heartbroken to see her leave, she was determined, so we wished her well and set about searching for someone to replace her.

Fortunately, we were very lucky. We hired Colette Walls, who was the business manager at CISER (The Cornell Institute for Social and Economic Research), as well as business manager in the Classics Department before that. She took to the job with great skill and good judgment. The department is on course and doing extremely well, thanks to Colette.

Our accounts coordinator, Terri Denman, served as an *alpha tester* for the university's new electronic time collection module, COLTS (Cornell On-Line Time System). Mathematics administrative staff and student employees will give up their manual time cards and begin using this electronic time collection system in August.

Rachel Engler has joined the staff to provide full-time computer support for the department. One of the benefits of having an on-site computer specialist is illustrated by our expanded and updated website, which Rachel has developed and maintained for the past year and a half. Please refer to http://math.cornell.edu/ for additional information about mathematics at Cornell.

Graduate Program

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

Our incoming class consists of nine students. The current graduate students were very actively involved in the recruitment process and helped make it a success. The entering class is smaller than usual to offset the larger number of acceptances last year. As a result, the total number of graduate students will be 57, down from 61 in the 1996–97 academic year. We expect to return to the usual 12 to 13 new students for the incoming class in 1998–99.

We experienced several changes in the graduate program this year. Professor Dan Barbasch replaced Professor Richard Durrett as our director of graduate studies. Another change was the move of 18 of our current graduate students into office space in 201 Lincoln Hall. This arrangement seems to be working out very well. The move itself created more computer facilities for the graduate students. We also added three colleagues to the graduate field of mathematics: Professors Timothy Healey and Richard Rand from Theoretical and Applied Mechanics, and Professor Glen Swindle from Operations Research and Industrial Engineering.

The graduate students play an essential role in all aspects and functions of the department; they teach, conduct research, mentor undergraduates and participate in community outreach programs.

The research conducted by our graduate students is of the highest caliber. Frequently our advanced students are invited to give talks at national and international conferences. In 1996–97, the following students gave talks: M. Aguiar at the AMS meeting in Lawrenceville, NJ; D. Solomon and D. Hirschfeldt at the ASL meeting in Boston; A. Teplyaev, M. Gordina, N. Shah and E. Bueler at the AMS meeting in San Diego; K. Nyman, N. Shah and E. Belbase at MAA meetings; H. Schenk at meetings in the Netherlands, San Diego, Berkeley and Germany; S.-Y. Pan at the AMS summer research conference in Seattle; and J. Davoren at a conference in Yaroslavl, Russia.

The Olivetti Club is devoted to expository talks on current research areas and is run entirely by graduate students. The representatives and organizers were S. Ganguli and R. Budney in the fall semester, and J. Miller in the spring semester. In addition, many of the talks in the Analysis, Lie Groups, Dynamical Systems and Topology seminars were given by graduate students.

Graduate student teaching assistants are one of our most valuable teaching resources, and they often get recognition at the university level for their excellence. Over the years, several students have played a crucial role in the introduction and maintenance of the innovative project-oriented sections in one of our core calculus courses. The graduate students discuss their teaching experiences in the Occasional Seminar and sometimes lecture at meetings elsewhere. This year, M. Fung and L. Gold spoke at a conference on teaching at Minnowbrook.

Class representatives were: David Revelle, Vince Frisina, Walker White, Nikhil Shah, Eknath Belbase and Lisa Orlandi. The Graduate and Professional Student Representative was Eknath Belbase.

Research and Professional Activities

Department research expenditures totaled $1.3 million for the 1996–97 fiscal year. This included 38 grants and contracts from federal, state and private agencies awarded to 26 faculty. Faculty submitted 21 new grant proposals, nine of which have been funded to date, and requested the continuation of 29 awards. For information regarding specific faculty activities, see *Faculty Profiles*, pages 35–64.

Our research program struggles to adapt to recent changes, such as reduced tuition and increased benefit rates on summer faculty salaries. In some cases, these changes have created financial hardships for the research projects.

Editorships include: Louis Billera as associate editor of the *Journal of Algebraic Combinatorics*; James Bramble as editor of *Mathematics of Computation, Math. Model. Num. Anal.* and *Numerical Functional Analysis and Optimization*; Robert Connelly as editor of *Betreige für Algebra und Geometrie*; Keith Dennis as editor of *Mathematical Reviews*; Richard Durrett as editor of *Annals of Applied Probability*; Clifford Earle as managing editor of *Proceedings of the AMS*; José Escobar as international editor of *Innovación y Ciencia*; John Guckenheimer as editor of the *Journal of Experimental Mathematics*; Gene Hwang as associate editor of *Annals of Statistics*; Harry Kesten as associate editor of the *Indiana University Mathematics Journal* and the *New York Journal of Mathematics*; James Renegar as associate editor of the *SIAM Journal on Optimization* and the *Journal of Complexity*; Richard Shore as managing editor of *Bulletin of Symbolic Logic*; Birgit Speh as editor of the *New York Journal of Mathematics* and the *Journal of Representation Theory*; Robert Strichartz as managing editor of the *Journal of Fourier Analysis and Applications*; and Lars Wahlbin as managing editor of *Mathematics of Computation*.

Faculty Changes

Reyer Sjamaar was appointed for another three-year term as assistant professor. Jianguo Cao resigned to accept a position at Notre Dame.

The tenured faculty enthusiastically recommended that Mark Gross be promoted to associate professor with tenure, effective in fall 1997. Mark has been a very important part of our department, and we look forward to having him as a permanent member of our faculty.

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

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

Richard Liu, who had just ended his term as assistant professor, hoped to start a new job at the University of Nebraska starting in the 1996–1997 academic year. Unfortunately, while Richard was visiting Nebraska, he experienced a very serious health crisis and was placed on permanent disability.

On leave for 1995–96:
R. Keith Dennis, administrative leave, academic year
Clifford Earle, sabbatical leave, academic year
Roger Farrell, sabbatical leave, spring 1996
Leonard Gross, sabbatical leave, spring 1996
John Guckenheimer, sabbatical leave, academic year
Sa'ar Hersonsky, leave, spring 1996
John Hubbard, leave, academic year
G. Roger Livesay, sabbatical leave, spring 1996
Anil Nerode, sabbatical leave, spring 1996
Alfred Schatz, sabbatical leave, fall 1995
Shankar Sen, sabbatical leave, spring 1996
Birgit Speh, sabbatical leave, spring 1996
Michael Stillman, sabbatical leave, spring 1996
Robert Strichartz, sabbatical leave, spring 1996
Bernd Sturmfels, leave, academic year

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

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

Other department personnel changes are noted in the *Faculty and Staff Directory*, page 12.

New Faculty for 1997–98

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

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

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

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

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

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

Gifts

Alumni and friends were very generous this year in their gifts to the various endowments (page 22). Contributions were received in response to the department newsletter, *Math Matters*, which is distributed each semester in an attempt to keep our 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, Hal Schenck 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. This year's Eleanor Norton York Awards went to Jeffrey Mitchell in the Mathematics Department and was given jointly to Katherine Jore and Tyler Nordgren in the Astronomy Department.

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 Sudeb Mitra and Nikhil Shah.

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. As it was very difficult this year to select just one person, we awarded two prizes: one to Benjamin Pollock and one to Rajni Raman. Both of these young and able students received several different awards, not just for pure academics. They each had different strengths that appealed to us: Rajni has a lively, broad view of mathematics and its applications as a whole; and Ben has a nimble and lively mind, having the ability to see unusual ways of viewing a problem. We are actually quite excited because both Ben and Rajni have decided to come to Cornell for their undergraduate study.

Kieval Prize: The Kieval Prize was established in 1934 by Harry S. Kieval '36, a long-time benefactor of the Mathematics Department. Dr. Kieval left an endowment, upon his death in 1994, to continue the Kieval Prize, as well as an honorarium for visiting lecturers and an additional endowment to provide financial aid for undergraduate scholarships in mathematics. The Kieval Prize provides an annual award to an outstanding graduating senior mathematics major. The recipient of this award is selected by the Mathematics Department's Honors Committee on the basis of academic performance, the quality and variety of mathematics courses taken and faculty recommendations. The co-winners of the 1996–97 prize were Jeremy Bem and Robert Kleinberg.

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

Putnam Fellows: Graduating seniors Jeremy Bem and Robert Kleinberg were named Putnam Fellows this year, after finishing among the top six individual competitors at the 57th annual William Lowell Putnam Mathematics Competition. Both scored between 76 and 98, the highest range of scores this year. Putnam organizers do not announce individual scores for the six Putnam Fellows. The Putnam competition, considered the Olympics of college math, is so difficult that more than half of this year's 2,407 competitors scored five or fewer points of a possible 120, and a third scored zero.

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

Sloan Research Fellowship: The Sloan Research Fellowship was established in 1955 by the Sloan Foundation to provide support and recognition to young scientists, often in their first appointments to university faculties. Selection procedures are designed to identify those who show the most outstanding promise of making fundamental contributions to new knowledge. Reyer Sjamaar, an assistant professor who joined the department in 1994, was awarded the 1996 Sloan Research Fellowship for his work in the field of symplectic geometry. This area is at the crossroads between classical mechanics, differential geometry, complex analysis, topology, algebraic geometry and representation theory. Sjamaar's research reflects unusual talent and maturity in bringing all these fields to bear on the problems on which he works; the tools he has developed will allow mathematicians to deal with problems that were previously inaccessible.

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

Instructional Activities

The department instructional programs included 102 undergraduate mathematics majors. Among these students were 45 double majors, one triple major and one dual degree major in programs with sister departments: Anthropology, Biological Sciences, Chemistry, Computer Science, Economics, German Studies, Government, Physics, Psychology and Romance Studies. Bachelor degrees were awarded to 33 students (page 25).

The graduate program included 61 graduate students. We received six outside fellowships in the 1996–97 academic year and were awarded 11 (one partial and 10 full) summer 1996 fellowships from Cornell's graduate school. Ph.D.s were awarded to five students, while two earned master of science special degrees. (See the degree lists on pages 23–25.)

The faculty taught 119 courses in 193 lectures, generating nearly 22,000 credit hours during the 1996–97 academic year. They taught 5,611 students aided by 83 teaching assistants and associates. The enrollment figures are reflected in the table on pages 10–11. In addition, approximately 278 students took 16 courses in the 1996 summer school, amounting to 986 credit hours.

Curriculum Changes

We added several new courses to the curriculum this year and have plans to add a few more next year. The gradual incorporation of graphing calculators in the teaching of Math 111 was completed, while project-based sections of Math 111 were offered for the first time. Innovations of similar or greater importance were introduced into the engineering calculus sequences. In preparation for the 1997–98 academic year, the syllabi of Math 111 and Math 112 have been revised and a new textbook chosen. Five courses were added to the curriculum in the 1996–97 academic year.

Math 181, *Elementary Logic and Formal Proof*, is designed for liberal arts students, including those who may be *math averse*. Rather than provide a systematic treatment of formal logic, it attempts to instill an appreciation for mathematics and its uses, as well as some understanding of the process by which intuitive notions are developed into precise mathematical statements. Each offering of the course consists of several topics, selected by the instructor, related to mathematical logic.

Math 474, *Basic Stochastic Processes*, is the Mathematics Department's first course in that topic at the undergraduate level. Professor Zhen-Qing Chen designed Math 474 as a second course in probability.

Math 500, *College Teaching*, is a six-week, one-credit, fall semester graduate course on the practical aspects of teaching at the college level. Topics covered include the preparation of syllabi, lesson plans, recitations and examinations. Further topics relevant to a career in academia are also discussed, such as the structure of colleges and universities, tenure, and professionalism. Math 500 was designed by Senior Lecturer Thomas Rishel.

Math 622, *Topics in Complex Analysis*, is a graduate course that covers advanced topics, such as Riemann surfaces and complex dynamics, selected by the instructor.

Math 686, *Proof Theory*, is an advanced graduate course which treats the basic ideas and methods of that area of mathematical logic, as well as major recent developments motivated by computer science and knowledge presentation theory.

Math 111–112, the department's main freshman calculus sequence for non-engineers, has undergone some major changes recently, and further developments are planned for the future. The incorporation of graphing calculators into the curriculum of Math 111 was completed this year. The process started in spring 1996 with three experimental sections and reached its completion in spring 1997, when the entire course, consisting of eight small lectures, used the TI-83 graphing calculator both in lecture and on homeworks. Professor David Henderson, who acted as czar (overseer) of Math 111 this spring and will again in fall 1997, is responsible for much of the work and planning involved in this endeavor. We are indebted to him for his crucial and continuing efforts.

The department continued the program, begun several years ago, of offering several project-oriented sections of Math 112, and for the first time extended this program to Math 111. In these special sections, individual homework assignments are in large part replaced by small group projects.

Finally, the syllabi of Math 111–112 were revised and a new text chosen for the sequence, following the recommendations of a special committee appointed by the department's Curriculum Committee and chaired by Professor Marshall Cohen. The most profound changes in these syllabi will affect Math 112, in which the unit on vectors will be dropped and a greater emphasis on differential equations supplied. These changes will be implemented in the 1997–98 academic year.

Syllabus changes in Math 293–294 that were recommended by the Mathematics/Engineering Liaison Committee in the 1995–96 academic year were phased in this year. The old syllabi of the two courses were essentially interchanged. Math 293 now covers differential equations and vector calculus, whereas Math 294 is primarily a course in linear algebra. (For further innovations in engineering calculus, see *Interdisciplinary Instructional Activity* below.)

The following new courses and sequences are planned for introduction in the 1997–98 academic year: Math 223–224, an integrated honors sequence in multivariable calculus and linear algebra; Math 441–442, an upper-level undergraduate sequence in combinatorics; and Math 785, an advanced graduate topics course in automata theory.

A curriculum change of an administrative nature was also adopted: We revised the numbering of our graduate level courses in order to bring the department's numbering system into conformity with the official Cornell system. This change will take effect in the 1997–98 academic year; its primary result is that the numbering of most graduate courses will be increased by 100.

Interdisciplinary Instructional Activity

Mathematics/Engineering Liaison: One of the last freshman mathematics courses to remain under the large lecture system is Math 192 — the second course in engineering calculus. Thanks to generous help from President Rawlings' fund for teaching initiatives, the College of Arts and Sciences, and the College of Engineering, we now have the resources to change this. Beginning in the 1997–98 academic year, the fall-semester teaching of Math 192 will take place in small classes of about 25 students. This course structure has been used for the first course in the engineering calculus sequence — Math 191 and Math 193 — for several years.

By teaching engineering calculus in smaller groups, we hope to provide freshmen with the opportunity to master and appreciate the material, while also promoting an instructional environment that will bring students and faculty closer together. Instructors who have been selected to teach this course show great promise for, or have established, an excellence in calculus instruction. We anticipate that the students will not only succeed in understanding the material but will also appreciate the significance and relevance of what they have learned.

Instructional support for the additional classes created through this endeavor will come roughly in equal numbers from three sources: mathematics faculty, graduate student instructors and faculty from other departments in both the Engineering and Arts colleges. In order to support the increased teaching load in Mathematics, we were granted an additional H. C. Wang assistant professorship, which will be filled by Xavier Buff. The graduate student instructors will be experienced teaching assistants. We hope that they will benefit greatly from this opportunity to gain more experience in teaching and student advising. The final source will consist of faculty with a strong background in mathematics, who may not otherwise have the opportunity to teach freshman calculus. In fall 1997 four such faculty members will participate: Professor Peter Stein from Physics, who is also dean of faculty; Professor Christine Shoemaker from Civil and Environmental Engineering; and professors Paul McIsaac and Charles Seyler from Electrical Engineering. We are very pleased that these excellent teachers have volunteered to be a part of our adventure.

Teaching Exchange: David Gries from Computer Science taught Math 181, *Elementary Logic and Formal Proof*, while John Guckenheimer taught a computer science course. Persi Diaconis, who would have taught one course in Mathematics and one course in Operations Research & Industrial Engineering, taught two courses in Mathematics, while Richard Durrett taught a course in OR&IE.

Relocation Preparations

In April the University hired the Ithaca architectural firm of Downing and Barradas to prepare preliminary plans for our anticipated move to Malott Hall, scheduled for the summer of 1999. These plans are being used by Jane Pedersen of the Arts College to estimate the costs of the project and do not necessarily represent what will be built. At the same time the existence of plans makes the project seem a little more real.

The biggest change for the department will be a much larger space for the library. Our current library space in White Hall is much too small for our collection. Moving to Malott will give us more shelf space and more study area as well as ensuring that we won't have to store part of our vital collection of books at a remote location. Other benefits include more space for our graduate students and the Mathematics Support Center.

We expect to have a more efficient layout for our administrative staff. One consequence of this is that we will be able to present a less confusing and more welcoming face to students and others who have business with the department. We expect to have a large departmental lounge, which will provide a pleasant space for faculty, graduate students and math majors to congregate, as well as providing a location for departmental receptions.

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

Department Needs

Professional and Support Staff: A reengineering attempt was made in the summer of 1996 enabling us to fill a vacant staff line, created by the departure of Karen Finch, with a full-time computer support person, thus reducing the number of administrative support staff from eight to seven. This attempt, although conducted with sincere effort, hasn't worked out. As indicated in the 1995–96 Annual Report (page 7), the department was already understaffed going into the 1996–97 academic year. The loss of one administrative support person was significant and had a serious impact on the level of support available to students and faculty in the department. This support issue is especially crucial for the areas of faculty recruiting and the undergraduate program. However, the computer support position was necessary, and we can no longer even imagine doing without this position. A request has been made to the college for permission to hire a secretary for the undergraduate program who will also function as department receptionist. We are hopeful that this request will be approved and we will be fully staffed in the fall of 1997.

Operating Budget: For many years the Department of Mathematics has operated quite dramatically *in the red* due to the lack of realistic allocations combined with the increasing technological and teaching complexity of the mathematics community. Negotiations between the department and the college administration have been underway during the 1996–97 academic year to develop an operating budget more in line with the history of spending in the department. A good faith effort has been made, and we enter the coming fiscal year with new general expense and teaching assistant budgets which begin to recognize our large and unique teaching effort and reflect our actual needs. We will monitor these budgets and review the expenditures at the end of the 1997–98 fiscal year to determine if they are adequate. New sources still need to be found that will cover travel expenses for faculty, funds for colloquium speakers, updated equipment for the White Hall computing facility, and increased acquisition funds for the mathematics library.

Equipment: Effective July 1, 1997, the College will begin a program to provide funds for the purchase of new computers every four years for each regular faculty and staff member. Now we need to focus our creative energies on identifying sources of funding to replace and update the equipment in the White Hall computer room. The current mix of computers in the fourth floor facility is extremely outdated, and the server has limited space capabilities. Rachel Engler has spent the past year trying to make room on the department server, by deleting obsolete accounts and software, in hopes of allowing us to limp along a bit longer. We will have to find the means to buy new equipment for our move to Malott in summer 1999.

Mathematics Course Enrollment Statistics

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
103	Mathematical Explorations	Lecture	Bailey	54	162	Fall 1996
103	Mathematical Explorations	Lecture	Morley, Taimina	61	183	Spring 1997
105	Finite Mathematics for Biologists	Lec/Sec	M. Terrell	252	756	Fall 1996
106	Calculus for Biologists	Lec/Sec	R. Terrell	138	414	Spring 1997
111	Calculus	Lecture	Berenstein, Brady, Lakic, Mahdavi, Meier, Stiadle, Strichartz, Veselov, White	447	1,788	Fall 1996
111	Calculus	Lecture	Henderson	153	612	Spring 1997
112	Calculus	Lecture	Bezdek, Rothaus	197	788	Fall 1996
112	Calculus	Lecture	Earle, Hilbert, Mahdavi, Stiadle, White	223	892	Spring 1997
121	Modern Calculus	Lecture	Ehrenborg	20	80	Fall 1996
122	Calculus	Lec/Sec	Erdélyi-Szabó, Sen	39	156	Fall 1996
122	Calculus	Lec/Sec	Brady	22	88	Spring 1997
150	From Space to Geometry	Lecture	Rishel	22	66	Fall 1996
171	Statistical Theory and Applications	Lec/Sec	Hwang	38	152	Fall 1996
171	Statistical Theory and Applications	Lec/Sec	Hwang, Lloyd	66	264	Spring 1997
181	Elementary Logic & Formal Proof	Lecture	Gries (Comp. Sci.)	26	78	Fall 1996
191	Calculus for Engineers	Lec/Sec	K. Brown	78	312	Fall 1996
192	Calculus for Engineers	Lec/Sec	M. Gross, Stillman	358	1,432	Fall 1996
192	Calculus for Engineers	Lec/Sec	Schatz	319	1,276	Spring 1997
193	Calculus for Engineers	Lec/Sec	Artemov, Readdy, Vogtmann, Wahlbin	243	972	Fall 1996
193	Calculus for Engineers	Lec/Sec	Ehrenborg	21	84	Spring 1997
213	Calculus	Lec/Sec	Back	31	124	Fall 1996
213	Calculus	Lec/Sec	Barbasch	36	144	Spring 1997
221	Linear Algebra & Calculus	Lec/Sec	Alperin, Barbasch, Diller, Hatcher	119	476	Fall 1996
221	Linear Algebra & Calculus	Lec/Sec	Berenstein, Chase, Hog-Angeloni	55	220	Spring 1997
222	Calculus	Lec/Sec	Hubbard, Speh	25	100	Fall 1996
222	Calculus	Lec/Sec	Back, Bailey, Diller, Veselov	73	292	Spring 1997
231	Linear Algebra	Lecture	Readdy	16	48	Spring 1997
281	Formal Logic	Lecture	Szabo (Phil.)	0	0	Spring 1997
293	Engineering Mathematics	Lec/Sec	R. Terrell	450	1,800	Fall 1996
293	Engineering Mathematics	Lec/Sec	R. Terrell	380	1,520	Spring 1997
294	Engineering Mathematics	Lec/Sec	Faculty	352	1,408	Fall 1996
294	Engineering Mathematics	Lec/Sec	Pilgrim	378	1,512	Spring 1997
321	Applicable Analysis	Lec/Sec	Bailey	20	80	Spring 1997
332	Algebra and Number Theory	Lecture	Chase	21	84	Fall 1996
336	Applicable Algebra	Lecture	Ehrenborg	24	96	Spring 1997
356	Groups and Geometry	Lecture	Pilgrim	15	60	Spring 1997
401	Honors Seminar: Topics in Modern Math.	Lecture	Strichartz	5	20	Spring 1997
403	History of Mathematics	Lecture	Taimina	15	60	Spring 1997
408	Mathematics in Perspective	Lecture	Solomon	9	36	Spring 1997
411	Introduction to Analysis	Lecture	Smillie	17	68	Fall 1996
413	Introduction to Analysis	Lecture	Rothaus, Sjamaar	35	140	Fall 1996
414	Introduction to Analysis	Lecture	Lindsay	24	96	Spring 1997
418	Intro. Theory Functions of One Complex Var.	Lecture	Smillie	8	32	Spring 1997
420	Applicable Analysis	Lec/Sec	J. West	18	72	Fall 1996
420	Applicable Analysis	Lec/Sec	Hubbard	27	108	Spring 1997
422	Applicable Analysis	Lec/Sec	Kuznetsov	18	72	Fall 1996
422	Applicable Analysis	Lec/Sec	Kuznetsov	16	64	Spring 1997
423	Applicable Analysis	Lecture	Lakic	4	16	Spring 1997
425	Numerical Solutions of Differential Equations	Lecture	Wahlbin	11	44	Spring 1997
427	Introduction to Ordinary Differential Equations	Lecture	Kesten	14	56	Fall 1996
428	Introduction to Partial Differential Equations	Lecture	Wahlbin	18	72	Spring 1997
431	Introduction to Algebra	Lecture	Speh	9	36	Fall 1996
431	Introduction to Algebra	Lecture	Readdy	10	40	Spring 1997
432	Introduction to Algebra	Lecture	M. Gross	4	16	Spring 1997
433	Introduction to Algebra	Lecture	Vogtmann	20	80	Fall 1996
434	Introduction to Algebra	Lecture	Sen	20	80	Spring 1997
436	Applications of Abstract Algebra	Lecture	Sweedler	11	44	Spring 1997
451	Euclidean and Spherical Geometry	Lecture	Solomon	24	96	Fall 1996
452	Classical Geometries	Lecture	Rishel	9	36	Spring 1997
453	Introduction to Topology	Lecture	K. Brown	8	32	Fall 1996
454	Introduction to Differential Geometry	Lecture	Henderson	10	40	Spring 1997
471	Basic Probability	Lecture	Kuznetsov	29	116	Fall 1996
472	Statistics	Lecture	Kuznetsov	11	44	Spring 1997

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
474	Basic Stochastic Processes	Lecture	Chen	4	16	Spring 1997
481	Mathematical Logic	Lecture	Artemov	10	40	Spring 1997
486	Applied Logic	Lecture	Constable (Comp. Sci.)	5	20	Spring 1997
490	Supervised Reading and Research	Ind Stud	Faculty	4	16	Fall 1996
490	Supervised Reading and Research	Ind Stud	Faculty	4	14	Spring 1997
500	College Teaching	Lecture	Rishel	13	13	Fall 1996
508	Mathematics for Secondary School Teachers	Lecture	Solomon	9	17	Spring 1997
511	Real and Complex Analysis	Lecture	Kesten	16	64	Fall 1996
512	Real and Complex Analysis	Lecture	Rothaus	10	40	Spring 1997
513	Topics in Analysis	Lecture	Pilgrim	3	12	Fall 1996
515	Mathematical Methods in Physics	Lecture	L. Gross	9	36	Fall 1996
516	Mathematical Methods of Physics	Lecture	L. Gross	2	8	Spring 1997
519	Partial Differential Equations	Lecture	Veselov	10	40	Fall 1996
520	Partial Differential Equations	Lecture	Veselov	7	28	Spring 1997
521	Measure Theory and Lebesgue Integration	Lecture	L. Gross	10	40	Fall 1996
522	Applied Functional Analysis	Lecture	Barbasch	6	24	Spring 1997
531	Algebra	Lecture	Barbasch	8	32	Fall 1996
532	Algebra	Lecture	Berenstein	2	8	Spring 1997
537	Analytic Number Theory	Lecture	Sen	3	12	Fall 1996
549	Lie Algebras	Lecture	Berenstein	3	12	Fall 1996
551	Introductory Algebraic Topology	Lecture	Livesay	9	36	Spring 1997
552	Differentiable Manifolds	Lecture	Cohen	6	24	Fall 1996
553	Differentiable Manifolds	Lecture	Cohen	7	28	Spring 1997
571	Probability Theory	Lecture	Chen	18	72	Fall 1996
572	Probability Theory	Lecture	Chen	12	48	Spring 1997
574	Introduction to Mathematical Statistics	Lecture	Farrell	14	56	Spring 1997
581	Logic	Lecture	Erdélyi-Szabó	3	12	Spring 1997
611	Seminar in Analysis	Seminar	Lakic	3	12	Fall 1996
612	Seminar in Analysis	Seminar	Wang	7	28	Spring 1997
613	Functional Analysis	Lecture	Lindsay	5	20	Fall 1996
617	Applied Dynamical Systems	Lecture	Guckenheimer	16	64	Fall 1996
622	Topics in Complex Analysis	Lecture	Lakic	5	20	Spring 1997
631	Seminar in Algebra	Seminar	Ehrenborg	6	24	Fall 1996
632	Seminar in Algebra	Seminar	Speh	3	12	Spring 1997
635	Topics in Algebra	Lecture	Diaconis	10	40	Spring 1997
639	Topics in Algebra II	Lecture	M. Gross	7	28	Spring 1997
640	Homological Algebra	Lecture	Stillman	4	16	Spring 1997
651	Seminar in Topology	Seminar	Cohen	3	12	Fall 1996
652	Seminar in Topology	Seminar	Vogtmann	2	8	Spring 1997
653	Algebraic Topology	Lecture	Hatcher	9	36	Fall 1996
654	Algebraic Topology	Lecture	Hatcher	4	16	Spring 1997
658	Topics in Topology	Lecture	Meier	7	28	Spring 1997
661	Seminar in Geometry	Seminar	Sjamaar	3	12	Fall 1996
662	Seminar in Geometry	Seminar	Hubbard	7	28	Spring 1997
667	Algebraic Geometry	Lecture	Stillman	16	64	Fall 1996
671	Seminar in Probability and Statistics	Seminar	Seminar	1	4	Fall 1996
672	Seminar in Probability and Statistics	Seminar	Seminar	0	0	Spring 1997
677	Stochastic Processes	Lecture	Diaconis	21	84	Fall 1996
678	Stochastic Processes	Lecture	Dynkin	7	28	Spring 1997
681	Seminar in Logic	Seminar	Shore	9	36	Fall 1996
682	Seminar in Logic	Seminar	Artemov	7	28	Spring 1997
683	Model Theory	Lecture	Erdélyi-Szabó	2	8	Spring 1997
686	Proof Theory	Lecture	Artemov	8	32	Fall 1996
688	Topics in Applied Logic	Lecture	Platek	2	8	Fall 1996
690	Supervised Reading and Research	Ind Stud	Faculty	21	150	Fall 1996
690	Supervised Reading and Research	Ind Stud	Faculty	33	151	Spring 1997

TOTALS	Courses	Lectures	Enroll	Cr Hrs
Academic Year	119	193	5,611	21,900
Fall Semester	54	101	3,190	12,433
Spring Semester	65	92	2,421	9,467

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

Faculty and Staff Directory

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

Associate Professors:
Richard Platek
Michael Stillman

Assistant Professors:
Jianguo Cao
Zhen-Qing Chen
Mark Gross
Reyer Sjamaar

Professors Emeritus:
James Bramble
Wolfgang Fuchs
Paul Olum
Lawrence Payne
Alex Rosenberg

Adjunct Professors:
Graeme Bailey

Adjunct Associate Professors:
Maria Terrell
Robert Terrell

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

Senior Lecturers:
Thomas Rishel
Avery Solomon
Beverly West

Teaching Associates:
Richard Furnas
Lidong Kong
John Mumma
Stephen Wills

Visiting Faculty:
Roger Alperin
Sergei Artemov
Károly Bezdek
Persi Diaconis
Cynthia Hog-Angeloni
Sergei Kuznetsov
J. Martin Lindsay
Margaret Readdy
Daina Taimina
Vladimir Veselov
Yang Wang

Visiting Program Participants:
Stephen Hilbert
Kazem Mahdavi
John Meier
Thomas Stiadle
Michael White

Visiting Scholars:
Jane-Jane Lo
Fabio Machado

Administrative Support Staff:
Colette Walls, manager
Shirley Allen
Terri Denman
Rachel Engler
Arletta Havlik
Joy Jones
Michelle Klinger
Catherine Stevens

Library Staff:
Steven Rockey, librarian
Michelle Paolillo
Raj Smith

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

Mathematics Support Center:
Douglas Alfors, director
Richard Furnas

Computer Facilities:
Rachel Engler
Richard Jaenson

Changes for 1997–98

Deaths:
Wolfgang Fuchs

Departures:
Jianguo Cao

New Professors:
Persi Diaconis
Yulij Ilyashenko
Laurent Saloff-Coste

New Professor Emeritus:
G. Roger Livesay

New H.C. Wang Asst. Professors:
Xavier Buff
Jiaping Wang
Daniel Wise

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

Graduate Student Directory

The graduate students in the Mathematics Department play a very important part in the smooth running of the department. Without the constant help of the current graduate students, the recruitment and admissions process for new graduate students would not be successful. This year has been a year of change. First of all, our director of graduate studies for several years, Prof. Richard Durrett, turned over his gavel to Prof. Dan Barbasch. Another change that took place was the move of 18 of our current graduate students into office space in 201 Lincoln Hall, while the remaining graduate students stayed in graduate offices here in White Hall. This arrangement seems to be working out very well. The move itself created more computer facilities for the graduate students.

The class representatives for 1996–97 were Lisa Orlandi (6th year), Eknath Belbase (5th year), Nikhil Shah (4th year), Walker White (3rd year), Vincent Frisina (2nd year) and David Revelle (1st year). The Graduate and Professional Student Representative was Eknath Belbase. The Olivetti Club organizers were Ryan Budney and Suman Ganguli in the fall and Joseph Miller in the spring.

Marcelo Aguiar
Henrique M. Araujo
Jeffrey Scott Baggett
Harel Barzilai
Robert John Battig
Eknath Belbase
Debra Lynn Boutin
David A. Brown
Ryan D. Budney
Edward Lee Bueler
Stephen Spratlin Bullock
Tianwen Cai
Andrei H. Caldararu
Sean Michael Crowe
Jennifer Mary Davoren
Alan Robert Demlow
Richard Dwayne Dunlap
Vincent Thomas Frisina
Maria G. Fung
Suman Ganguli
Gonzalo Garcia
Ferenc Gerlits
Ilya German
Leah H. Gold
Maria M. Gordina
Martin William Hill
Denis Roman Hirschfeldt
Geoffrey C. Hruska
Antal Jarai
Craig A. Jensen
Min Jeong Kang
David Ray Kennerud
Wicharn Lewkeeratiyutkul
Swapneel Mahajan
Brian A. Meloon
Joseph Stephen Miller
Nathaniel G. Miller
Robert Saxon Milnikel
Jeffrey Mitchell
Sudeb Mitra
Kathryn Louise Nyman
Luis O'Shea
Ricardo Antonio Oliva
Lisa A. Orlandi
Shu-Yen Pan
Ofer Porat
David Robert Revelle
Henry Koewing Schenck
Shayan Sen
Nikhil Shah
David Reed Solomon
Catherine Anne Stenson
David Stephenson
David Tang
Alexander Teplyaev
Juan Carlos Uribe
Anke B. Walz
Walker McMillan White
Bernd Wuebben
Yongjian Xiang
Andrei Zherebtsov

Special Programs and Activities

Faculty Publications

Louis Billera and C. Greene, R. Simon and R. Stanley, eds., *Formal Power Series and Algebraic Combinatorics, 1994: Proceedings*, DIMACS Series in Discrete Mathematics & Theoretical Computer Science, vol. 24, American Mathematical Society, 1996.

This book is devoted to the lectures presented at the Sixth International Conference on Formal Power Series and Algebraic Combinatorics held at DIMACS in May 1994. The conference attracted approximately 180 graduate students and junior and senior researchers from all over the world.

Generally speaking, algebraic combinatorics involves the use of techniques from algebra, algebraic topology, and algebraic geometry in solving combinatorial problems; or it involves using combinatorial methods to attack problems in these areas. Combinatorial problems amenable to algebraic methods can arise in these or other areas of mathematics, or in areas such as computer science, operations research, physics, chemistry, and, more recently, biology.

Because of this interplay among many fields of mathematics and science, algebraic combinatorics is an area in which a wide variety of ideas and methods come together. The papers in this volume reflect the interesting aspects of this rich interaction.

Richard Durrett, *Stochastic Calculus: A Practical Introduction*, CRC Press, 1996.

Stochastic Calculus is a graduate text which offers a user-friendly introduction to Brownian motion, stochastic integration, stochastic differential equations, diffusion processes, and related partial differential equations. These topics have applications ranging from pricing options on Wall Street to studying harmonic functions in domains in Euclidean space and on manifolds.

José F. Escobar and Jaime Lesmes, eds., *Proceedings of III Summer School in Differential Geometry, Partial Differential Equations and Numerical Analysis*, Colombian Academy of Sciences, Bogota, Colombia, 1996.

The text contains papers presented at the summer school by the main speakers of the conference, which was held at the Universidad de los Andes in Bogotá, Colombia in the summer of 1995. The authors of the articles are: J. Cao, J. F. Escobar, A. Freire and B. Solomon in differential Geometry; A. Castro, J. Cossio, R. J. Iorio, F. Linares and M. Scialmon in partial differential equations; and P. Joly, O. Perot, A. Schatz and S. Tabak in numerical analysis.

Dexter Kozen, *Automata and Computability*, Springer-Verlag, New York, 1997.

This undergraduate textbook, designed as a well-placed first course in the theory of computation, introduces students to the basic models of computation and shows how to develop their rich and varied structure. *Automata and Computability* leads students all the way from the basic results and methods of the classical theory of automata and formal languages through several supplementary chapters covering more advanced concepts.

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

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

Anil Nerode and Richard Shore, *Logic for Applications*, Second Edition, Springer-Verlag, 1997.

This textbook provides a first introduction to mathematical logic which is closely attuned to the applications of logic in computer science. In it the authors emphasize the notion that deduction is a form of computation. While all the traditional subjects of logic are covered thoroughly—syntax, semantics, completeness and compactness—much of the book deals with less traditional topics such as resolution theorem proving, logic programming, and non-classical logics—modal and intuitionistic—which are becoming increasingly important in computer science. The book also provides a systematic treatment of the elements of set theory, a historical overview of its subjects, and an extensive annotated bibliography.

No previous exposure to logic is assumed, so this will be suitable for upper level undergraduate or beginning graduate students in computer science or mathematics.

Lloyd N. Trefethen and David Bau, III, *Numerical Linear Algebra*, SIAM, 1997.

This is a concise, insightful, and elegant introduction to the field of numerical linear algebra. Designed for use as a stand-alone textbook in a one-semester, graduate-level course in the topic, it has already been class-tested by MIT and Cornell graduate students from all fields of mathematics, engineering, and the physical sciences. The authors' clear, inviting style and evident love of the field, along with their eloquent presentation of the most fundamental ideas in numerical linear algebra, have made it popular with teachers and students alike.

Numerical Linear Algebra aims to expand the reader's view of the field and to present the core, standard material in a novel way. This makes it a perfect companion volume to the encyclopedic treatment of the topic that already exists in Golub and Van Loan's now-classic *Matrix Computations*. All of the most important topics in the field, including iterative methods for the systems of equations and eigenvalue problems and the underlying principles of conditioning and stability, are covered. Trefethen and Bau offer a fresh perspective on these and other topics, such as an emphasis on connections with polynomial approximation in the complex plane.

Numerical Linear Algebra is presented in the form of 40 lectures, each of which focuses on one or two central ideas. Throughout, the authors emphasize the unity between topics, never allowing the reader to get lost in the details and technicalities. The book breaks with tradition by beginning not with Gaussian elimination, but with the QR factorization—a more important and fresher idea for the students, and the thread that connects most of the algorithms of numerical linear algebra, inlcuding methods for least squares, eigenvalue, and singular value problems, as well as iterative methods for all of these and for systems of equations.

Spring Concert Series

On the evening of Tuesday, May 6, 1997, approximately one-hundred people gathered at the Andrew D. White House for the Mathematics Department's seventh annual Spring Concert. During the following two hours, they were treated to a variety of compositions performed by a very talented group of performers drawn from the faculty, staff, graduate students, undergraduate students and departmental visitors. Works by Chopin, Mozart, Nixon, Correlli, Lassus, Bourne, Lizst, Verdi, Popper, Weeks & Smith and Lehrer were performed. Local composers Robert Strichartz and Denis Hirschfeldt were also featured. A diversity of instruments included voice, piano, clarinet, flute, alto flute, violin, cello and electric guitar. A short skit provided further entertainment. Refreshments were served during intermission.

The performers included Graeme Bailey, Jeremy Bem, Robert Connelly, Cliff Earle, Richard Ehrenborg, Denis Hirschfeldt, Chris Hruska, Vicki Howle, Eleanor Hubbard, Brian Hwang, Bobby Kleinberg, Nadia Liu, Nat Miller, Bob Milnikel, Kathryn Nyman, Margaret Readdy, Jon Rosenberger, Janna Solomon, Arsenia Soto, Cathy Stenson, Bob Strichartz and Moss Sweedler.

Topology Festival

The topology/geometry group of the Mathematics Department hosted the thirty-fifth annual Topology Festival on May 2–4 this year. Now an internationally known tradition, the festival was founded in part by Paul Olum in 1963 as a small regional conference that celebrated the return of spring and reviewed the outstanding results in topology during the preceding year.

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

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

Lisa Carbone, Columbia University: *Non-uniform Lattices on Uniform Trees*

William Dwyer, Notre Dame University: *Homology Decompositions for Classifying Spaces*

Michael Hopkins, MIT: *Topological Modular Forms*

Bruce Kleiner, University of Pennsylvania: *The Large-Scale Geometry of Spaces with Nonpositive Curvature*

Michah Sageev, University of Southhampton: *JSJ-Splittings for Finitely Presented Groups*

Zlil Sela, Columbia University: *Low Dimensional Topology, Algebraic Geometry Over Groups, and the Elementary Theory of Free Groups*

Zoltan Szabo, Princeton University: *Disproving the Minimal Conjecture*

The 36th Cornell Topology Festival will be held during the first week of May 1998.

Joint Meetings of the AMS and MAA

Cornell University was well-represented at the 1997 Joint Mathematics Meetings, held in San Diego in January. Numerous department faculty members, visiting faculty and graduate students attended, along with several former visitors and recent Ph.D.s. Special session talks were given by Prof. Robert Strichartz (with Jade Vinson) and graduate students Edward Bueler, Maria Gordina, Henry Schenck and Alexander Teplyaev. The department sponsored the attendance of two Cornell undergraduates: Jeremy Bem, a sophomore, and Robert Kleinberg, a senior.

Bem and Kleinberg spoke at the AMS Special Session on Research in Mathematics by Undergraduates, co-organized by department visitor John Meier of Lafayette College, who received his Ph.D. from Cornell in 1992. They gave the talk *Is Thompson's group F amenable?* jointly, and Kleinberg gave an additional talk entitled *Train tracks and zipping sequences for pseudo-Anosov braids*. Among the other participants in this special session were Jade Vinson and Shelly Harvey, who participated in the department's Research Experiences for Undergraduates program last summer.

Thomas Rishel, director of undergraduate teaching, moderated an MAA Panel Discussion, *Teaching at a College or University—Advice about Preparing for and Securing such Positions*, sponsored by the MAA Task Force on Graduate Students. Panelists—Richard Cleary, a former visiting program participant, John Meier, Teresa Moore of Ithaca College and graduate student Nikhil Shah—discussed the job interview process from the institution's perspective, what teaching at such institutions actually entails, the ingredients of a good vita and cover letter and programs on teaching designed for graduate students and how they affect the job search process. Rishel talked about preparing CVs and cover letters. He and Shah then spoke on the special programs for graduate students to interact with students and faculty at traditionally four-year colleges. Cleary and his current chair, Zsuzsanna Kadas, "interviewed" John Meier, asking the kinds of questions that job applicants would see in an employment register interview. Finally, Meier and Moore discussed the pleasures and pitfalls of being a young faculty member.

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 sponsored this year by the Fund for the Improvement of Postsecondary Education (FIPSE), an arm of the National Science Foundation, under the direction of Prof. Thomas Rishel.

Eleven Cornell graduate students gave ten talks on such topics as *Origami and mathematics* and *The history of the number pi* to a mixed audience of faculty and graduate students at Hobart and William Smith, Wells and Ithaca Colleges. This experience afforded participants the opportunity to talk about their work in ways that anticipate both professional meetings and job searches. Graduate students Eknath Belbase, Kathyrn Nyman and Nikhil Shah had the opportunity to give more advanced talks on thesis-related topics when they spoke at the MAA regional meeting in Fredonia, New York in November of 1996.

During the 1997 joint meetings of the MAA and AMS, Tom Rishel moderated an MAA Panel Discussion about university teaching. Richard Cleary of St. Michael's College, John Meier of Lafayette College (currently visiting Cornell), Teresa Moore of Ithaca College and Cornell graduate student Nikhil Shah formed the panel, which discussed the job interview process, teaching, the ingredients of a good vita and cover letter and programs on teaching designed for graduate students. Rishel talked about preparing CVs and cover letters and spoke with Shah on the special programs for graduate students to interact with students and faculty at traditionally four-year colleges. Cleary and his current chair, Zsuzsanna Kadas conducted a mock interview, using questions that can be expected in an employment register interview. Cleary, Meier, Moore and Rishel gave similar job market seminars at SUNY at Binghamton, Syracuse University and Cornell University. They will also conduct the Panel Discussion at the 1998 joint meetings to be held in Baltimore.

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

The National Research Council has asked Prof. Rishel to present a panel at a meeting of Mathematics Department chairs in November in Washington, DC, in hopes that more graduate departments will consider giving their students the opportunity to learn more about the professorate in the hands-on way Cornell has developed. Next year the program will continue with funding through the Dean of the Arts and Sciences College.

Expanding Your Horizons

Expanding Your Horizons is an annual day of hands-on workshops in mathematics and science for 6th, 7th, and 8th grade girls. The program is organized and run by women in mathematics and science, with the intention of generating interest in these subjects and of motivating the girls to continue taking mathematics and science courses throughout high school. On November 16, 1996, the graduate women of the Mathematics Department once again contributed to the success of the day by offering their popular "donut" workshop.

In this workshop, *Knots, Donuts, Surfaces and Teacups—an Exploration*, Debra Boutin, Jennifer Davoren and Lisa Orlandi introduced the girls to some of the basic ideas in topology. The girls formed teacups out of clay donuts to examine their topological "sameness," explored the "one sidedness" properties of the Möbius band, and examined the topological difference between a ball and a donut using some knot theory. The girls even got to eat a donut (a real one) along the way. With the help of Cheryl Barbasch, Holly Boutin, Margaret Readdy and Anke Walz, three groups of up to 15 girls each were able to participate. For the second year in a row, the girls from Lansing Residential Center were welcome participants at this workshop. Their enthusiasm is always a joy to behold!

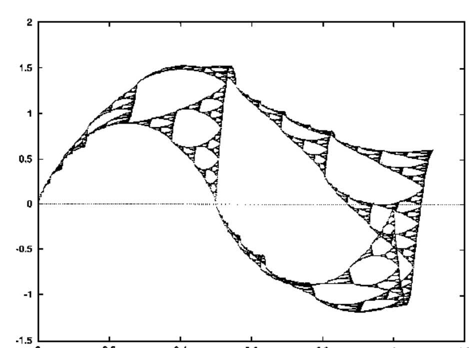
Mathematics Awareness Week

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

Research Experiences for Undergraduates Program

During the summer of 1996, the Cornell Mathematics Department held its third Research Experiences for Undergraduates (REU) program. Ten undergraduate students from colleges across the country participated in this research program, which is sponsored by the National Science Foundation. Three faculty members—Robert Strichartz, Kevin Pilgrim and Karoly Bezdek—directed the research projects. In addition to the research work, the students attended a Smorgasbord Seminar, in which members of the department gave lectures about their research specialties—a little taste of a lot of mathematics—and the students gave public lectures at the Undergraduate Research Forum. Quite a few of the students also went to the Seattle Mathfest to talk about their work at the summer MAA meeting. Several papers reporting on the research work have already been submitted for publication, and more are in the process of being prepared.

Students working with Prof. Strichartz studied analysis of fractals. One area of research concerned the analog of differential equations, to be named Fractal



Differential Equations (FDE) on the Sierpinski Gasket (SG). For the first time, computer generated images of solutions to FDEs were produced. The figure shows the graph of an eigenfunction of the Laplacian—the fractal analog of the sine function. Other images, including a "movie" of the fundamental solution of the wave equation on SG, are available (http://www.tc.cornell.edu/Edu/SPUR/SPUR96/Kyal/cover.html).

Students of Prof. Pilgrim worked on the dynamics of rational mappings of the complex plane. They constructed a catalog of examples of mappings with a finite postcritical set. These examples will be useful for gaining insight and formulating conjectures. Already they have led to a counterexample to a "theorem" that had been believed to be true.

Students of Prof. Bezdek studied geometric problems involving lattices in Euclidean space and sphere packings. Among the new discoveries: 1) a lattice in d-dimensional space with exactly $2(2d-1)$ Voronoi vectors; 2) a lattice in 31-dimensional space generated by minimal vectors but with no minimal basis; and 3) a new upper bound for the number of touching pairs in a packing of unit spheres in d-dimensional space.

The department has received funding from the NSF to continue the program for the next five years. In addition, this summer (1997) we will have some Cornell funding to enhance the program through a Presidential discretionary grant. The faculty supervisors will be Robert Strichartz, Kevin Pilgrim and Richard Ehrenborg (combinatorics). Others who will be working on the projects are faculty visitors Christian Bluhm, Adam Epstein, Rick Kenyon, Margaret Readdy, Boris Rubin and Yang Wang and graduate student Alexander Teplyaev.

Centers and Institutes

Center for Applied Mathematics

Cornell's Center for Applied Mathematics 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. John Guckenheimer acted as director this year, and Tom Coleman of Computer Science will replace him as director next year. Despite a crisis in funding, the environment for applied mathematics at Cornell today is rich and varied. Viewed nationally, Cornell is a major center of activity in applied mathematics and scientific computations, and its students are among the best at Cornell. The 75 center faculty are drawn from the Department of Mathematics and thirteen other departments in engineering and the sciences.

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

Mathematical Science Institute

The Cornell University Mathematical Sciences Institute, funded primarily by the U. S. Army Research Office, provides a wide variety of support for research conducted by the faculty and students of the Mathematics Department. The support has taken the form of direct research support for faculty, postdoctoral associate appointments, graduate fellowships and graduate research assistantships, and support for all levels of scientific visitors and workshops. These have enhanced our program and contributed to our national visibility. Beyond the Mathematics Department, MSI has supported mathematical research projects in other departments across campus, including the Departments of Chemical Engineering, Civil Engineering, Computer Science, Electrical Engineering, Operations Research and Industrial Engineering, and Theoretical and Applied Mechanics.

L. Billera, J. Bramble, R. K. Dennis, R. Durrett, E. Dynkin, J. Guckenheimer, J. Hubbard, P. Kahn, H. Kesten, R. Liu, A. Nerode, A. Schatz, R. Shore, M. Stillman, B. Sturmfels, M. Sweedler, L. Wahlbin, and others have received administrative or research support from MSI over the years. Department members not receiving direct support from MSI have benefited from its presence through programs bringing in visitors who have participated in a wide range of department activities and who have undertaken joint research with department members. These visitors have substantially contributed to the scientific life of the department.

MSI will close on October 1, 1997. Some of its activities, the Multiple University center for Foundations of Intelligent systems (administered by Anil Nerode) and the NSA contracts (administered by Moss Sweedler), will continue in CAM.

Statistics Center

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

Mathematics Library

The Mathematics Library is Cornell's prestigious collection of source materials for mathematics research. Under the direction of Librarian Steven Rockey, the research collection consists of works in pure and applied mathematics, statistics, the history of mathematics, including biographies, and the collected works volumes of mathematicians. For undergraduates with an interest in mathematics, the library is a wonderful resource, which includes materials to support instructional and career needs as well as expository and recreational reading. The library has great historic depth and breadth, with materials from around the world in many languages.

The Mathematics Library encourages and welcomes all patrons in the Cornell community to use its resources. Reciprocal inter-library loan agreements with other institutions make Cornell's resources available throughout the world and open the world to Cornell researchers. Students' and researchers' 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 services such as professional reference services, online databases, digital books and journals and photocopying are available.

The Mathematics Library has a staff of three — Steve Rockey, Michelle Paolillo and Raj Smith — and approximately a dozen part-time undergraduate student employees. The veteran professional staff and the competent student employees are always ready to serve the public, and they welcome feedback. A primary goal of the library is to make the experience of the staff and patrons interesting, productive, and enriching in a small and personal environment.

The Mathematics Library has over 48,000 books and bound journal volumes, and an average of 1,500 new volumes are added each year. There are 540 current journal subscriptions. In addition, the library has a collection of video tapes, and a TV/VCR unit available in the library or for loan. Renovations again added a little more shelving space to the overcrowded stacks, which long ago reached their capacity. However, it is anticipated that space in the stacks will be exhausted before new facilities are available and the Mathematics Library will have to move a couple thousand low use volumes to the library annex in early 1998. The 1996–97 budget base for acquisitions is $182,500, not including income from endowments. The total endowment earning available for book purchases is now an additional $20,000.

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

Special Projects

Almost 600 out-of-print and out-of-copyright mathematics books have been scanned into a digital storage system and archival quality hard copy produced for each. These books are a significant fraction of all research level mathematics books from the late nineteenth and early twentieth century. The Mathematics Library is on the leading edge of digital imaging for preservation of brittle books. The bibliography of the books that have been scanned includes pricing and ordering information and is available via the Mathematics Library home page. It can also be reached directly at http://math.cornell.edu:/~library/reformat.html. To date we have sold several hundred books printed from the digital files to individuals and other libraries.

Special Instructional Support

Computer Lab

The lab had another active year. Biggest users included the whole range of sophomore-level courses, as well as differential equations and statistics courses, and undergraduates pursuing research. CD based mathematical instructional materials have begun to appear, including the beautiful *Interactive Differential Equations* collection authored in part by Beverly West and Steve Strogatz, both from Cornell. The adoption of graphing calculators in several of the calculus courses has significantly heightened the use of instructional computing technology within the department. There were major advances in linear algebra related course materials, as well as a significant upgrade of the lab's large Multivariable Calculus in the Lab collection. (An older web version is at http://mathlab.cit.cornell.edu/local_maple/mvc/lecguide.html.) The lab hosted geometry conferences and serves as a major site for teaching related courses. During the summer, the lab continues as the principal location for the majority of REU students to pursue their work. The lab has added its first Windows 95 and Linux machines, which should be especially valuable for future REU students.

Mathematics Support Center

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

Despite the obvious merits of its services, the Center continues to suffer from lack of sufficient space and dependence on antiquated equipment. An additional 150–200 square feet over the present 388 square feet is desperately needed over the next 2–3 years. As use of computers increases in the undergraduate mathematics curriculum, it is vital that antiquated computer equipment in the Center be updated with machines capable of running current mathematical software.

Learning Skills Center

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

In mathematics this year, the LSC provided academic support for Math 105, Math 106, Math 111, Math 112, Math 171, Math 191, Math 192 and Math 193. Support for all of these courses (except Math 171) included supplemental courses, tutoring and prelim review sessions. Supplemental or "00" courses meet on Sundays (in mathematics) to review the week's material from the *parent* course. LSC tutors were available during regularly scheduled hours, on a walk-in basis, free of charge, for all students in the course. Prelim review sessions were given 3–7 days in advance of prelims. Academic support in the form of tutoring was given to Math 171 students at the Academic Support Center for Undergraduate Statistics (ASCUS), where students in many introductory statistics classes campus-wide can come for tutoring and help on computer-based assignments.

Academic support for all of these courses will continue in this fashion during the 1997–98 academic year, with the exception that no support will be offered for Math 193. Math 191 and Math 193 are almost identical courses, with the exception that Math 193 students are required to have taken calculus in high school. These students were fairly proficient in calculus and their use of LSC support services was minimal. Therefore, resources available for use in this area will be focused into Math 191, where the demand for academic support services was intense.

NSF Undergraduate Faculty Enhancement Workshop

This workshop is intended for college and university faculty who teach (or soon will teach) an undergraduate geometry course, such as courses typically attended by future or in-service teachers. Twenty-eight college and university faculty attended the workshop held June 9–14, 1997, on Teaching Undergraduate Geometry.

In the mornings, participants experienced a learning and teaching environment, innovative both in terms of content and in terms of teaching methods. The content was the integration of geometries on plane, sphere and other surfaces — presented through problems which emphasize experiencing the meaning in the geometry. Student explorations, small group learning and writing assignments were explored. Parts of the student textbook on which the group focused can be viewed at the WWW site http://math.cornell.edu/~dwh.

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

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

Mathematics Education

Cornell/Schools Mathematics Resource Program

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

The CSMRP is aimed at improving the status of mathematics teaching and learning by providing in-service mathematics courses and workshops for teachers, researching and developing materials for use in the classroom which follow a broader approach to mathematics, and supporting and initiating cooperative efforts between Cornell University and local schools.

Among other initiatives, the CSMRP continues to assist Ithaca High School and other area schools in instituting "Math Labs" in their courses and is piloting a classroom intervention program in two middle schools.

Geometry Workshop for Mathematics Teachers

The Geometry Workshop introduces a hands-on approach to basic concepts in the high school curriculum, giving participants an opportunity to share new ideas. This year's workshop entitled *Exploring Geometry on Sphere, Plane and Screen* was held on June 26–30, 1997.

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

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

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

Teacher Education in Science and Mathematics

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 bachelor's 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.

Calculus Reform Resource Development

The recent systematic introduction of cooperative learning and project-based calculus reform into special sections of Math 112, and recently Math 111, are documented in a World Wide Web site, which features the history of the reform efforts, as well as a resource library for use by fellow reformers. This project was funded by a special mathematics education teaching assistantship in the fall, under which Harel Barzilai put Math 112 resources on the web and organized offline similar resources for Math 111.

The Web site now includes various instructional resources, including a full *HyperText Syllabus* where one can click on fliers for use in the course, cooperative learning in-class activities and longer-term projects, handouts for students, information for the instructor and more. Student handouts that are available include an explanation of the course structure, suggestions on working in groups, project guidlines and topic overviews like *If Only Every Function Were a Polynomial*.

We hope that, by sharing our resources online in an organized yet flexible format, our materials will be useful to both veteran users of projects and cooperative learning activities, and also to instructors — and institutions — who are interested in exploring, perhaps for the first time, these types of calculus reform. The URL is http://math.cornell.edu/ harelb/calc-reform.html

Mathematics Department Endowments

The department is thankful that alumni, friends and family continue to support the department endowments. 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 established much as the library endowment with major contributions coming from faculty who teach extra courses and donate their earnings to the fund.

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 Astronomy and Mathematics with an annual prize.

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.

The Israel Berstein Memorial Fund was established with a donation in his memory from his sister, Gita Fonarov. The memorial fund has as its central purpose: helping young mathematicians in the field of Topology. The fund is administered by a committee of close colleagues of Professor Berstein.

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.

Degrees Granted 1996–97

Doctoral Degrees

August 1996

Jeffrey Scott Baggett

Non-normal Dynamics and Hydrodynamic Stability

BS, University of Portland, 1990
MS Special, Cornell University, 1993
Committee: Trefethen, Guckenheimer, Wahlbin

Abstract: This thesis explores the interaction of non-normality and nonlinearity in continuous dynamical systems. A solution beginning near a linearly stable fixed point may grow large by a linear mechanism, if the linearization is non-normal, until it is swept away by nonlinearities resulting in a much smaller basin of attraction than could possibly be predicted by the spectrum of the linearization. Exactly this situation occurs in certain linearly stable shear flows, where the linearization about the laminar flow may be highly non-normal leading to the transient growth of certain small disturbances by factors which scale with the Reynolds number.

These issues are brought into focus in Chapter 1 through the study of a two-dimensional model system of ordinary differential equations proposed by Trefethen, et. al. [*Science*, **261**, 1993].

In Chapter 2, two theorems are proved which show that the basin of attraction of a stable fixed point, in systems of differential equations combining a non-normal linear term with quadratic nonlinearities, can decrease rapidly as the degree of non-normality is increased, often faster than inverse linearly.

Several different low-dimensional models of transition to turbulence are examined in Chapter 3. These models were proposed by more than a dozen authors for a wide variety of reasons, but they all incorporate non-normal linear terms and quadratic nonlinearities. Surprisingly, in most cases, the basin of attraction of the *laminar flow* shrinks much faster than the inverse Reynolds number.

Transition to turbulence from optimally growing linear disturbances, streamwise vortices, is investigated in plane Poiseuille and plane Couette flows in Chapter 4. An explanation is given for why smaller streamwise vortices can lead to turbulence in plane Poiseuille flow. In plane Poiseuille flow, the transient linear growth of streamwise streaks caused by non-normality leads directly to a secondary instability.

Certain unbounded operators are so non-normal that the evolution of infinitesimal perturbations to the fixed point is entirely unrelated to the spectrum, even as $t \to \infty$. Two examples of this phenomenon are presented in Chapter 5.

Tianwen Tony Cai

Nonparametric Function Estimation Via Wavelets

BS, Hangzhou University, 1986
MS, Shanghai University, 1989
MA, SUNY at Buffalo, 1992
Committee: L. Brown, Liu, Casella

Abstract: The nonparametric function estimation has very important applications in statistics as well as many other fields such as signal processing. The recent development of wavelet bases based on multiresolution analyses suggests new techniques for statistical estimation. In this dissertation, we consider two problems in nonparametric regression model: estimation of regression functions for unequispaced designs and estimation of derivative of regression functions.

For equispaced designs, the Donoho-Johnstone wavelet shrinkage procedures for estimating regression functions have been shown to be near optimal in theory and very useful in practice. But in many applications, the samples are unequispaced. We first show that direct application of the Donoho-Johnstone procedures to unequispaced samples are in many cases suboptimal. Then we propose a new adaptive wavelet shrinkage estimate for unequispaced designs. We show that the estimate is near-minimax in global estimation and attains exact adaptive minimax rate for pointwise estimation. The procedure is implemented in *SPlus*. Simulations are conducted and confirm the theoretical results.

We are intersted in one type of homogeneous linear inverse problems—estimating derivative of regression functions. By using wavelets as a tool and applying the so-called Wavelet-Vaguelette decomposition and Vaguelette-Wavelet decomposition, we construct two estimates of derivative of regression functions for equispaced samples. Both estimates are shown to be adaptive and near minimax in global estimation. They attain the exact adaptive minimax rate for estimation at a point.

The techniques developed in this dissertation can also be applied to other statistical problems such as nonparametric hypothesis testing which includes signal detection problem as a special case.

Richard Dwayne Dunlap

Superconvergence Points in Locally Uniform Finite Element Meshes for Second Order Two-Point Boundary Value Problems

BS, Georgia Institute of Technology, 1989
MS Special, Cornell University, 1992
Committee: Wahlbin, Guckenheimer, Trefethen

Abstract: A superconvergence *point* for a finite element approximation is a family of points $\xi(h)$ such that the pointwise error at the point has a higher degree of accuracy than the global error. Such points can be sought for either function values or derivatives; we shall restrict ourselves to function values and first derivatives. Recent results have shown that such points can be found at points where the mesh is locally symmetric (i.e. symmetric in a $Ch \ln 1/h$ neighborhood of the point); in particular, if the mesh is locally uniform, superconvergence points occur at the meshpoints and midpoints of intervals.

We find the location of all interior superconvergence points for function values and derivatives occurring in the finite element discretization of second order two point boundary value problems. We further note that a complete understanding of this problem leads to a knowledge of the location of superconvergence points in certain second order problems on multi-dimensional tensor product spaces and in the L_2 projection.

The problem can be reduced to one of finding the roots of even or odd polynomials on an interval satisfying certain orthogonality conditions and having certain roots at the endpoints. The resulting pattern of superconvergence points is found to have several remarkable features.

May 1997

Edward Lee Bueler

The Heat Kernel Weighted Hodge Laplacian on Noncompact Manifolds

BS, California State University at Chico, 1991
MS Special, Cornell University, 1994
Committee: L. Gross, Wahlbin, Barbasch
Abstract: Unavailable for publication.

Henry Koewing Schenck

Homological Methods in the Theory of Splines

BS, Carnegie-Mellon University, 1986
MS Special, Cornell University, 1995
Committee: Stillman, M. Gross, Sweedler, Billera

Abstract: This thesis is devoted to the study of splines, which are piecewise polynomial functions of a prescribed order of smoothness on a triangulated (or otherwise polyhedrally subdivided) region Δ of $\mathbf{R}^d$. The set of splines of degree at most k (i.e. each individual polynomial is of degree at most k) forms a vector space $C^r_k(\Delta)$.

It turns out that a good way to study $C^r_k(\Delta)$ is to embed Δ in $\mathbf{R}^{d+1}$, and form the cone $\hat{\Delta}$ of Δ with the origin. Then the set of splines (of all degrees) on $\hat{\Delta}$ is a graded module $C^r(\hat{\Delta})$ over the polynomial ring R in $d+1$ variables, and the dimension of $C^r_k(\Delta)$ is the dimension of $C^r(\hat{\Delta})$ in degree exactly k.

The thesis follows the work of Billera and Rose, who defined a chain complex such that $C^r_k(\Delta)$ appears as the top homology module, and approaches the problem from the viewpoint of homological algebra (but using a different chain complex $(\mathcal{R}/\mathcal{J})$).

First, we analyze the lower homology modules in the planar case, and prove that the module $C^r(\hat{\Delta})$ is free if and only if the module $H_1(\mathcal{R}/\mathcal{J})$ vanishes. We prove that this latter module has finite length, and is nonzero whenever Δ has positive genus. For a fixed configuration Δ, we prove a criterion which gives sufficient conditions for $C^r(\hat{\Delta})$ to be nonfree, i.e. for $H_1(\mathcal{R}/\mathcal{J})$ to be nonzero.

Next, we relate the *local geometry* of Δ (the arrangement of lines at each vertex) to ideals generated by powers of homogeneous linear forms in $\mathbf{R}[x, y]$, and completely describe the resolutions possible for such ideals. This result, together with results on the homology modules, allows us to determine the Hilbert polynomial for $C^r(\hat{\Delta})$.

In the final chapter, we consider the situation for an arbitrary d-dimensional simplicial complex Δ. Generalizing the planar results, we obtain bounds on the dimension of the homology modules $H_i(\mathcal{R}/\mathcal{J})$ for all $i < d$. Specializing to the case where Δ is a topological d-ball, we use a spectral sequence argument to relate the lower homology modules to $C^r(\hat{\Delta})$. For example, we prove that $C^r(\hat{\Delta})$ is free iff $H_i(\mathcal{R}/\mathcal{J})$ is zero for all $i < d$. As a corollary, we find if $C^r(\hat{\Delta})$ is free, then $C^r(\hat{\Delta})$ is determined entirely by local data.

Master of Science Special

(No Thesis Required)

January 1997
David Reed Solomon, Computer Science
BS, University of Notre Dame, 1992
Committee: Shore, Nerode, Kozen

May 1997
Ajay Ramaswamy Subramanian, Mathematics
MA, SUNY at Stony Brook, 1994
Committee: Jarrow, Durrett, Resnick, Swindle

Bachelor of Arts

August 1996
John Lloyd Mumma III
Cum Laude in Mathematics

January 1997
Robert James DeBellis
William Philip Szostak †

May 1997
Henry Hamilton Andrews
Jeremy Lipsitz Bem †
Summa Cum Laude in Mathematics
Randie Lou Britt
Sarah Elizabeth Burnett †
Hay-Jin Byun
Anna Temple Cabral
Emma Elizabeth Cale
Kristina Suzanne Doman
Mya Fonarov †
David Alan Glickenstein †
Cum Laude in Mathematics
Ellen Dawn Goodman †
Ravi Chandra Goud
James Edward Hamblin †
Cum Laude in Mathematics
Robert David Kleinberg †
Summa Cum Laude in Mathematics
Wing Piu Lee
Frederick Charles Mahakian
Jesse Robert Matheson
Daniel Aaron Murray †
Cum Laude in Mathematics
Hoai Andrew Nguyen
Zulfikar Amin Ramzan †
Cum Laude in Computer Science
Stephen Peter Rusek †
Aba R. Schubert †
Maxim Y. Shpak †
Summa Cum Laude in Theoretical Evolutionary Biology
Timothy L. Swec
Songwee Melvyn Teo †
Cum Laude in Mathematics
Lilyan Volbidakht
John Daniel Walther
Michel Jen-Hsuan Weng
Monica F. Yichoy
Eugene Seunghern Yoo

† **Distinction in all subjects**

Department Colloquia

Analysis Seminar

February 97

Yang Wang, Georgia Institute of Technology and Cornell University: *Self-affine tilings*

Fedor Nazarov, Michigan State University: *Trigonometric series*

Alexander Teplyaev, Cornell University: *Laplacian on infinite fractals*

Clifford Earle, Cornell University: *Dependence of conformal invariants on parameters*

March 97

Nikola Lakic, Cornell University: *Unique extremality and Strebel points in the Teichmüller space*

J. Milne Anderson, London Univ. (England): *Quasiconformal self-mappings with smooth boundary values*

Robert Strichartz, Cornell University: *Introduction to fractal differential equations*

J. Martin Lindsay, Nottingham University (England) and Cornell University: *Time-reversal for noncommutative dynamical systems*

Anders Öberg, Uppsala University (Sweden): *Invariant measures for random iterations*

April 97

Sudeb Mitra, Cornell University: *Teichmüller theory and holomorphic motions*

Sergei Kuznetsov, Cornell University: *On removable lateral singularities for nonlinear parabolic PDEs*

Dierk Schleicher, University of Munich (Germany) and SUNY at Stony Brook: *Newton's method in complex dynamics*

Maria Gordina, Cornell University: *Holomorphic functions on infinite dimensional groups*

May 97

Christian Bluhm, Cornell University: *Salem sets*

José Escobar, Cornell University: *Geometry of the first Stekloff eigenvalue*

Combinatorial and Algebraic Geometry Seminar

September 96

Mark Gross, Cornell University: *Mirror symmetry explained?* (in two parts)

John Hubbard, Cornell University: *Blow-ups of complex divisors viewed as real subvarieties and applications to dynamics*

October 96

John Hubbard, Cornell University: *Henon mappings, compact analytic surfaces and a strange surgery*

Irena Peeva, Massachusetts Institute of Technology: *Noncommutative Gröbner basis*

Vesselin Gasharov, University of Michigan: *Green and Gotzmann theorems for polynomial rings with restricted powers of the variables*

November 96

Arjeh M. Cohen, Eindhoven University of Technology (Netherlands): *Some indications that the exceptional groups form a series*

David Eisenbud, Brandeis University: *Gale transform and free resolutions*

January 97

Tony Pantev, Massachusetts Institute of Technology: *Geometric factorization of linear fundamental groups*

March 97

Allan Adler, Bowling Green, KY: *On* $v^2w + w^2x + x^2y + y^2z + z^2v = 0$ *and related topics*

Wolfram Decker, University of Saarbrucken (Germany): *Generating invariants of finite groups—algorithms and implementations*

April 97

David Mond, University of Warwick (England): *Computing the homology of the image of a finite mapping*

Robert Friedman, Columbia University: *Vector bundles and F-theory*

Dynamics and Geometry Seminar

September 96

John Hubbard, Cornell University: *Adam Epstein's proof of the bound on the number of non-repelling cycles of a rational map*

Hartje Kriete, Georg-August University (Germany): *Local connectivity of Fatou component boundaries for parahyperbolic maps*

John Smillie, Cornell University: *Expanding maps* (in two parts)

Jeffrey Diller, Cornell University: *Green's functions, electric networks and the geometry of Riemann surfaces* (in two parts)

October 96

John Hubbard, Cornell University: *Henon mappings, compact analytic surfaces and a strange surgery*

John Hubbard, Cornell University: *The classification of parabolic points* (in three parts)

Vladimir Veselov, Cornell University: *Compactifications of Fatou mappings as dynamical systems* (in two parts)

Adam Epstein, SUNY at Stony Brook: *Algebraic dynamics: contradiction, finiteness, and transversality principles*

December 96

Jeffrey Diller, Cornell University: *Pluripotential theory and complex dynamics in several variables*

January 97

Jeffrey Diller, Cornell University: *Pluripotential theory and dynamics of rational maps of* P^2 (in two parts)

February 97

Xavier Buff, University of Paris-Sud (France): *Julia sets, measure and renormalization*

John Hubbard, Cornell University: *Thurston's characterization of rational maps: Dierk Schleicher's extension to postcritically infinite case*

March 97

Guiai Peng, City University of New York: *On the dynamics of nondegenerate polynomial endomorphisms of* C^2

Ricardo Oliva, Cornell University: *Combinatorics of complex Henon mappings*

Duncan Sands, SUNY at Stony Brook: *Complex bounds*

April 97

Jeffrey Diller, Cornell University: *Hyperbolic endomorphisms of* P^2*—a paper Fornaess and Sibony* (in three parts)

Geometry Seminar

September 96

Ludwig Danzer, University of Dortmund (Germany): *The SCDs, space-fillers with rather surprising properties*

Ludwig Danzer, University of Dortmund (Germany): *Some problems and a few theorems about discrete, aperiodic, but strictly ordered structures*

Lie Group Seminar

September 96

Arkady Berenstein, Cornell University: *Group-like elements in quantum groups and the Feigin's conjecture* (in three parts)

November 96

Leonard Gross, Cornell University: *A local Peter-Weyl theorem* (in two parts)

Lisa C. Jeffrey, McGill University (Canada) and Institute of Advanced Study: *Vanishing theorems in the cohomology of moduli spaces of holomorphic bundles on a Riemann surface*

December 96

Anatol Kirillov, University of Montreal (Canada): *Macdonald polynomials and affine Hecke algebras*

January 97

Alfredo Brega, University of Cordoba (Argentina): *On the centralizer of* K *in the universal enveloping algebra*

February 97

Persi Diaconis, Harvard University and Cornell University: *What are Euler angles?*

Diko Mihov, Massachusetts Institute of Technology: *Dixmier algebras and quantization of nilpotent orbits*

Eric Sommers, Massachusetts Institute of Technology: *A family of affine Weyl group representatives*

March 97

Susan Tolman, Princeton University: *The cohomology ring of symplectic manifolds and reduced spaces*

Shu-Yen Pan, Cornell University: *Local theta correspondence and minimal* K*-types* (in two parts)

April 97

Jason Fulman, Harvard University and Cornell University: *Cycle indices for the finite classical groups*

Logic Seminar

August 96

Robert Milnikel, Cornell University: *Finite automata and finite model theory* (in two parts)

September 96

Max Kanovich, Russian Humanities State University (Russia) and University of Pennsylvania: *Resource automata* (in two parts)

Miklós Erdélyi-Szabó, Cornell University: *Decidability in the intuitionisitic/constructive theory of the real lines* (in two parts)

Reed Solomon, Cornell University: *The finite model property*

Vivian Morley, Cornell University: *Inductive definitions* (in three parts)

Denis Hirschfeldt, Cornell University: *The density of branching degrees* (in two parts)

October 96

Reed Solomon, Cornell University: *The reverse mathematics of ordered groups*

Manuel Lerman, University of Connecticut: *Embedding ranked partial lattices in the computability enumerable degrees*

Joseph Miller, Cornell University: *Inductive definability*

Nathaniel Miller, Cornell University: *The role of diagrams in proofs* (in two parts)

Joseph Miller, Cornell University: *Inductive definability: partial fixed points*

November 96

Robert Milnikel, Cornell University: *Complexity classes: a quick review*

Walker White, Cornell University: *The decision problem for two variable first order logic*

Suman Ganguli, Cornell University: *First order reductions*

Dexter Kozen, Cornell University: *Kleene algebra with tests and commutativity conditions*

Reed Solomon, Cornell University: *Complexity of least fixed point logic*

Denis Hirschfeldt, Cornell University: *Second order logic and Fagin's theorem for NP*

Reed Solomon, Cornell University: *Complexity of partial fixed point logic*

December 96

Joseph Miller, Cornell University: *Transitive closure operators*

January 97

Sergei Artemov, Cornell University: *On modal counterparts of intuitionistic logic*

Suman Ganguli, Cornell University: *Introduction to basic proof theory*

February 97

Nathaniel Miller, Cornell University: *Natural deduction versus Hilbert style systems*

Jennifer Davoren, Cornell University: *On topological semantics of intuitionistic logic*

Jason Hickey, Cornell University: *Nuprl: a system for formal mathematics* (in two parts)

Reed Solomon, Cornell University: *Cut elimination with applications* (in two parts)

Harold Hodes, Cornell University: *An abstract view of constructive rules for a sentential connective: inversion and complementation*

March 97

Walker White, Cornell University: *Interpolation theorem in first order logic*

Reed Solomon, Cornell University: *Reverse mathematics and ordered groups*

Denis Hirschfeldt, Cornell University: *Undecidability and 1-types in any interval of the computably enumerable degrees*

April 97

Todd Wilson, Cornell University: *Normalization for natural deduction* (in two parts)

Miklós Erdélyi-Szabó, Cornell University: *Topological completeness of the first order intuitionistic logic*

Victor Marek, University of Kentucky: *Logic programming with costs*

Robert Milnikel, Cornell University: *Linear logic* (in two parts)

Sergei Artemov, Cornell University: *Proof realizations of intuitionistic logic*

Denis Hirschfeldt, Cornell University: *Proof theory of arithmetic* (in two parts)

May 97

Andre Scedrov, University of Pennsylvania: *Proof games, optimization and complexity*

Occasional Seminar on Undergraduate Education

September 96

Thomas Rishel, Cornell University: *What should we tell students; and what should we expect them to know?*

Rachel Hastings, Kathryn Nyman, Nikhil Shah and Catherine Stenson, Cornell University: *The professors for the future program*

Maria Fung and Catherine Stenson, Cornell University: *Calculators in calculus*

October 96

Stephen Hilbert, Ithaca College; Kazem Mahdavi, SUNY at Potsdam; John Meier, Lafayette College; all at Cornell University: *The job market: the view from small colleges*

Harel Barzilai, Cornell University: *Calculus reform: from Math 112 to Math 111 to the world (wide web)*

November 96

David Henderson, Cornell University: *Choosing a Math 111-112 text*

John Meier, Lafayette College and Cornell University, and Teresa Moore, Ithaca College: *What they didn't tell me about teaching until I got to a small college*

February 97

Richard Furnas, Cornell University: *Opportunities for teaching meaningful mathematics in a finite mathematics course*

April 97

Thomas Rishel, Cornell University, and Mary Ann Rishel, Ithaca College: *Writing, cognition and math*

Daina Taimina, University of Riga (Latvia) and Cornell University: *Teaching mathematics in Latvia and at Cornell*

May 97

Harel Barzilai, Cornell University: *Graduate student initiated calculus reform*

Oliver Club

September 96

John Hubbard, Cornell University: *Compactifications of rational maps: a solution of a conjecture of Milnor*

Laurent Saloff-Coste, Université Paul Sabatier (France): *Random walks and geometry of finitely generated groups*

October 96

Jeffrey Diller, Cornell University: *Complex analysis via hyperbolic geometry*

John Meier, Lafayette College and Cornell University: *Groups and their graphs; subgroups and their subgraphs*

Richard Rand, Cornell University: *The mathematics of pumping a swing*

Persi Diaconis, Harvard University and Cornell University: *A generalization of 1+1=2*

November 96

Martin Bridson, Oxford University (England) and Princeton University: *Isoperimetric inequalities for finitely presented groups*

Mark Gross, Cornell University: *Mirror symmetry and special Lagrangian submanifolds*

J. Martin Lindsay, Nottingham University (England) and Cornell University: *The quantization of stochastic analysis*

December 96

John Morgan, Columbia University: *Seiberg-Witten invariants for four-dimensional manifolds*

Anatol Kirillov, University of Montreal (Canada): *Schubert polynomials for classical groups*

January 97

Robert Connelly, Cornell University: *The bellows conjecture*

February 97

Fred Diamond, Massachusetts Institute of Technology: *Modular forms and Fermat's last theorem*

Clifford Earle, Cornell University: *The Teichmüller space of a closed set in the plane*

Allen Moy, University of Michigan: *Some geometric techniques in representation theory*

Michael Stillman, Cornell University: *Computer algebra using Macaulay II*

March 97

Susan Tolman, Princeton University: *Equivariant symplectic topology and picturology*

Nick Trefethen, Cornell University: *Random triangular matrices and random Fibonacci sequences*

April 97

John Smillie, Cornell University: *Billiards on polygonal tables*

Cynthia Hog-Angeloni, University of Frankfurt (Germany) and Cornell University: *Detecting 3-manifold presentations*

Siye Wu, Institute for Advanced Study: *Equivariant holomorphic Morse theory*

Robert Friedman, Columbia University: *Vector bundles and F theory*

May 97

Bruce Kleiner, University of Pennsylvania: *The large-scale geometry of spaces with non-positive curvature*

Olivetti Club

September 96

Richard Ehrenborg, Cornell University: *Two theorems and a lemma: one in combinatorics, one in topology and one in linear algebra*

Ofer Porat, Cornell University: *Secret sharing schemes*

October 96

Hal Schenck, Cornell University: *Algebra, geometry and combinatorics*

Ryan Budney, Cornell University: *Cobordism and homology*

Francis Fung, Princeton University: *An introduction to Polya-Redfield enumeration*

November 96

Ferenc Gerlits, Cornell University: *The Banach-Tarski paradox*

Kelly Wieand, Harvard University and Cornell University: *Random walks and electric networks*

Antal Jarai, Cornell University: *On singular braids*

Stephen Wills, Cornell University: *A beginner's guide to quantum probability*

December 96

Maria Fung, Cornell University: *A peek into the theory of classical modular forms*

February 97

Moss Sweedler, Cornell University: *Conjugacy, orbits and fixed points: how and why*

Joseph Miller, Cornell University: *Integration in finite terms*

Andrei Caldararu, Cornell University: *What is the genus of an algebraic curve, and what is it good for?*

March 97

John Hubbard, Cornell University: *Why you can't solve $x' = x^2 - t$ using elementary functions, or indefinite integrals of those, etc.*

Jason Fulman, Harvard University and Cornell University: *An introduction to Hall polynomials*

John Rosenthal, Ithaca College: *Card shuffling and the Riemann hypothesis*

April 97

Hal Schenck, Cornell University: *Toric varieties*

Reed Solomon, Cornell University: *Hilbert's program and Gödel's incompleteness theorem*

Denis Hirschfeldt, Cornell University: *The computably enumerable degrees and the priority method*

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

Jeffrey Mitchell, Cornell University: *The heat equation on compact Lie groups*

Probability Seminar

September 96

Yosi Rinott, University of California at San Diego: *A CLT for dependent summands and applications to the anti-voter model and other models*

Sivaguru Sritharan, University of Colorado and U.S. Navy: *The martingale problems of turbulence, its prediction and optimal control*

Laurent Saloff-Coste, Université Paul Sabatier (France): *Diffusions on infinite products*

October 96

Zhen-Qing Chen, Cornell University: *Green's function estimates for alpha-stable processes in bounded domains*

Harry Kesten, Cornell University: *Reimer's inequality for disjoint occurence of events*

Igor Pak, Harvard University: *Random walks on groups: strong stationary time approach*

November 96

C. R. Hwang, Academia Sinica (Taiwan): *Convergence rates for some Monte Carlo Markov chains*

Ted Cox, Syracuse University: *A spatial model for the abundance of species*

Ren-min Song, University of Michigan: *Intrinsic ultracontractivity and conditional gauge for symmetric stable process*

Nikhil Shah, Cornell University: *Predator mediated coexistence*

December 96

Richard Durrett, Cornell University: *Probability problems arising from the study of DNA sequences*

January 97

Alexander Yushkevich, University of North Carolina at Charlotte: *Blackwell optimality in Markov decision processes*

February 97

Zhen-Qing Chen, Cornell University: *Estimates on distance between two diffusion kernels*

Alexander Teplyaev, Cornell University: *Eigenfunctions on Sierpinski lattices*

Persi Diaconis, Harvard University and Cornell University: *Measures for measures*

Jason Fulman, Harvard University and Cornell University: *Probability in classical groups over finite fields*

March 97

Donald Turcotte, Cornell University: *Self-organized criticality and the statistics of natural hazards*

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

Sergei Kuznetsov, Cornell University: *Polar boundary sets for superdiffusions and removable lateral singularities for nonlinear parabolic PDE's*

Susan Holmes, Cornell University: *Charles Stein's method for birth and death chains*

April 97

Jeff Steif, Chalmers University: *Dynamical percolation*

David Heath, Cornell University: *Risk measures for use in regulating financial institutions*

Glen Swindle, Cornell University: *Some nonlinear PDEs arising from finance*

Martin Hildebrand, SUNY at Albany: *A directed version of the Metropolis algorithm*

Robert Battig, Cornell University: *Completeness of securities market models: an operator point of view*

May 97

Maria Gordina, Cornell University: *Diffusions and holomorphic functions on infinite dimensional groups*

Topology and Geometric Group Theory Seminar

September 96

Wolfgang Metzler, University of Frankfurt (Germany): *On the homotopy theory and the simple-homotopy theory of 2-complexes*

Kazem Mahdavi, SUNY at Potsdam: *Automatic groups and relatively free groups* (in two parts)

Peter Kahn, Cornell University: *Seiberg-Witten theory: an overview*

Allen Hatcher, Cornell University: *The Jaco-Shalen Johannson splitting of 3-manifolds*

Roger Livesay, Cornell University: *Matveev's proof of the Rubenstein-Thompson algorithm for recognizing S^3*

Roger Alperin, San Jose State University and Cornell University: *Remarks on triangles of groups*

October 96

Karen Vogtmann, Cornell University: *The JSJ splitting for finitely presented groups, I*

Laurent Saloff-Coste, Université Paul Sabatier (France): *Isoperimetry on groups*

Marshall Cohen, Cornell University: *The JSJ splitting for finitely presented groups, II and III*

November 96

Noel Brady, Cornell University: *The geometry of certain kernel subgroups of right-angled Artin groups* (in two parts)

Harel Barzilai, Cornell University: *Patched handlebodies and homological finiteness of mapping class groups*

Mark Feighn, Rutgers University at Newark: *The solvable subgroups of $Out(F_N)$*

Susan Hermiller, New Mexico State University: *Isoperimetric functions and solvable groups*

Mark Brittenham, Vassar College: *Essential laminations are everywhere*

December 96

Noel Brady, Cornell University: *The JSJ splitting for finitely presented groups, IV, V and VI*

Noel Brady, Cornell University: *Some finiteness properties of kernels of right-angled Artin groups*

Takashi Tokieda, McGill University (Canada): *Wiggling of curves and null sets of symplectic capacity*

January 97

Noel Brady, Cornell University: *Morse theory and finiteness properties of groups*

February 97

Marshall Cohen, Cornell University: *The simplicial complex of graphs of groups* (in two parts)

Karen Vogtmann, Cornell University: *Whitehead's algorithm for surface automorphisms*

Cynthia Hog-Angeloni, University of Frankfurt (Germany) and Cornell University: *Non-efficient groups and homotopy equivalent 2-complexes*

Harel Barzilai, Cornell University: *Contractible disk complexes for finiteness properties of mapping class groups*

Robert Kleinberg, Cornell University: *Train tracks and zipping sequences for pseudo-Anosov braids* (in two parts)

March 97

Ryan Budney, Cornell University: *Unoriented cobordism theory*

Cynthia Hog-Angeloni, Univ. of Frankfurt (Germany) and Cornell University: *Comparison of 2-complexes and the generalized Andrews-Curtis conjecture*

April 97

Allen Hatcher, Cornell University: *Introduction to the topology of hyperplane arrangements* (in two parts)

Ross Geoghegan, SUNY at Binghamton: *Actions of discrete groups on non-positively curved spaces*

Persi Diaconis, Harvard University and Cornell University: *Random walk and hyperplane arrangements*

May 97

Arkady Berenstein, Cornell University: *Combinatorics of hyperplane arrangements*

Working Seminar in Algebraic Combinatorics

September 96

Persi Diaconis, Harvard University and Cornell University: *From Spitzer's lemma to Baxter algebras* (in two parts)

November 96

Roger Farrell, Cornell University: *Some generalizations of Spitzer's identity* (in two parts)

Roger Farrell, Cornell University: *Spitzer's identity, examples*

February 97

Richard Ehrenborg, Cornell University: *Exponential generating functions and the theory of species*

Richard Ehrenborg, Cornell University: *Composition of generating functions*

Richard Ehrenborg, Cornell University: *A bijective proof of the Lagrange inversion formula*

Richard Ehrenborg, Cornell University: *Lagrange inversion and the cycle indicator series*

March 97

Richard Ehrenborg, Cornell University: *Cycle indicator series and plethysm*

Marcelo Aguiar, Cornell University: *Braids and q-binomials*

Marcelo Aguiar, Cornell University: *Braids and quantum groups*

Margaret Readdy, Cornell University: *Binomial posets*

April 97

Margaret Readdy, Cornell University: *Sheffer posets and rank selections*

Roger Farrell, Cornell University: *The Paley construction of Hadamard matrices* (in two parts)

Jason Fulman, Harvard University and Cornell University: *The combinatorics of q-Bell numbers*

Research Grant Activity

Funded and Continuing Grants

Source	Amount	Starts	Ends	Title
AMS	$427,725	1/01/95	12/31/97	Editor—*Mathematical Reviews*
NSF	$225,000	6/01/93	11/30/96	A Software System for Algebraic Geometry Research
NSF	$135,956	8/15/96	7/31/99	A Software System for Algebraic Geometry Research
NSF	$315,000	6/01/94	5/31/97	Algorithms and Numerical Analysis for Partial Differential and Integral Equations
NSF	$60,000	6/01/94	11/30/97	Algorithms and Numerical Analysis for Partial Differential Equations
NSF	$90,000	6/01/95	5/31/98	Analysis Over Loop Spaces
NSF	$204,086	6/01/96	5/31/99	Branching Measure-Valued Processes and Related Nonlinear Partial Differential Equations
NSF	$89,300	6/01/97	6/01/00	Calabi-Yau Threefolds and Birational Geometry
NSF	$27,630	4/01/97	4/01/00	Computability, Logic and Complexity
NSF	$120,000	3/01/94	2/28/97	Cornell's REU Summer Institute in Mathematics
NSF	$248,788	3/15/97	3/01/02	Cornell's Summer REU Program in Mathematics
NSF	$90,064	6/01/94	5/31/97	Dynamics of Polynomial Diffeomorphisms
NSF	$82,338	6/01/97	6/01/00	Dynamics of Polynomial Diffeomorphisms
NSF	$67,350	6/01/94	5/31/97	Elliptic Threefolds and Calabi-Yau Threefolds
NSF	$64,055	7/01/93	6/30/97	Geodesics and Minimal Surfaces in Manifolds with Non-Positive Curvature
NSF	$219,800	7/01/96	6/30/99	Geometric and Algebraic Topology
NSF	$82,710	4/01/96	3/31/99	Harmonic Analysis and Self-Similarity
NSF	$203,000	7/01/93	12/31/96	Interacting Particle Systems
NSF	$122,190	7/01/95	6/30/98	Logic and Computability
NSF	$216,000	7/01/96	6/30/99	Particle Systems: Theory for Applications to Biology
NSF	$113,000	6/01/95	5/31/98	Polytopes, Subdivisions and Piecewise Polynomial Functions
NSF	$363,000	9/01/94	2/28/97	Presidential Faculty Fellow: Linear and Nonlinear Analysis in Geometry
NSF	$180,684	6/01/94	11/30/97	Representation Theory and Automorphic Forms
NSF	$225,000	6/01/97	6/01/00	Representation Theory and Automorphic Forms
NSF	$144,382	6/01/94	5/31/97	Software for Simulating Stochastic Spatial Models
NSF	$157,244	7/01/96	6/30/99	Some Problems in Probability Theory
NSF	$150,000	6/15/97	6/01/00	Some Variational Problems in Differential Geometry
NSF	$60,000	8/01/93	7/31/97	Statistical Intervals
NSF	$243,836	4/15/95	3/31/98	Stochastic Spatial Models
NSF	$27,814	5/15/95	7/31/96	Summer School in Differential Geometry, Partial Differential Equations and Numerical Analysis: Bogota, Columbia, June 1995
NSF	$97,707	6/01/97	6/01/00	Symplectic Geometry and Stratified Spaces
NSF	$51,770	6/01/97	5/31/99	Teichmüller Theory and Quadratic Differentials
NSF	$73,357	6/01/97	6/01/00	The Structure of Expanding Rational Maps as Holomorphic Dynamical Systems
NSF	$310,500	7/15/93	6/30/97	Topology
NSF	$80,000	1/01/96	12/31/97	Undergraduate Faculty Enhancement in Mathematics
NYS	$25,000	7/01/96	6/30/97	CSMRP/Ithaca Schools Project
RPI	$5,000	7/01/96	6/30/97	Supplemental Subcontract for NYS CSMRP/Ithaca Schools Project
Sloan	$35,000	9/16/96	9/15/98	Alfred P. Sloan Research Fellowship for Dr. Reyer Sjamaar in Mathematics

Total Expenditures for the 1996–97 Fiscal Year=$1,300,000

Submitted Grants

Source	Amount	Starts	Ends	Title
NSA	$9,310	6/28/98	7/01/98	A Conference in Probability at Cornell—In Honor of Harry Kesten
NSA	$36,853	6/01/97	5/31/99	Markov Processes, Stochastic Analysis and Related Problems
NSF	$9,310	1/01/98	12/31/98	A Conference in Probability at Cornell—In Honor of Harry Kesten
NSF	$221,722	7/01/97	7/01/00	Algorithms and Numerical Analysis for Partial Differential and Integral Equations
NSF	$233,527	7/01/97	7/01/00	Algorithms and Numerical Analysis for Partial Differential Equations
NSF	$76,943	7/01/97	7/01/00	Complexity in the Constructive and Intuitionistic Theory of Reals
NSF	$27,661	7/01/97	6/30/98	Computational and Theoretical Aspects of the **cd**-Index
NSF	$224,061	6/01/97	6/01/00	High-Dimensional Empirical Linear Prediction
NSF	$94,733	6/01/97	6/01/00	Markov Processes, Stochastic Analysis and Related Problems
NSF	$20,949	7/01/97	6/30/98	On Determining New Eulerian Posets and Their **cd**-Indexes
NSF	$120,722	7/01/97	10/01/00	Software for Simulating Stochastic Spatial Models
NSF	$70,796	8/01/97	8/01/00	The Geometry of Kernel Subgroups of Nonpositively Curved Cube Complex Groups

The Faculty and their Research

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

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

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

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

•**Jianguo Cao**, Assistant Professor; Ph.D. (1989) University of Pennsylvania; Differential geometry, partial differential equations.

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

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

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

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

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

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

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

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

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

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

Wolfgang Fuchs, Professor Emeritus; Ph.D. (1941) Cambridge University; Theory of meromorphic functions.

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

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

John Guckenheimer, Professor and Director of CAM; Ph.D. (1970) Univ. of California at Berkeley; Dynamical systems.

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

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

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.

Peter J. Kahn, Professor; Ph.D. (1964) Princeton University; Algebraic topology, differential topology, and real algebraic geometry and their applications.

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

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

G. Roger Livesay, Professor; 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 MSI; Ph.D. (1956) University of Chicago; Mathematical logic, recursive functions, computer science, mathematics of AI environmental engineering.

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

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

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.

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

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

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

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

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

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

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

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

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

Lloyd N. Trefethen, Professor of Comp. Sci.; Ph.D. (1982) Stanford University; Scientific computing, numerical and complex analysis, differential equations and linear algebra.

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 1996–97 academic year.*

Faculty Profiles

Dan Barbasch

Professor of Mathematics

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 American Mathematical Society, 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.

The Dual Reductive Pairs Correspondence for Odd Orthogonal Groups (with J. Adams), to appear.

Classification of 1-K Type Representations (with A. Moy), preprint.

Unitary Spherical Spectrum for Split Classical p-adic Groups, Acta Applicandae Mathematicae.

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), preprint.

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

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.

Professional Activities: Research professor at the Mathematical Sciences Research Institute, Berkeley (1996–97). Member of the AMS, MAA, and SIAM. Reviewer for the NSF and the Binational Science Foundation. Referee for European Journal of Combinatorics, Discrete and Computational Geometry and Journal of Algebraic Combinatorics. Member of the program committee for Special Year in Combinatorics at MSRI (1996–97). Chair of the organizing committee for MSRI workshop on Geometric Combinatorics (1997).

Invited Lectures:

Flag enumeration in zonotopes and arrangements, Conference on Discrete and Computational Geometry, Mt. Holyoke College (1996).

Enumeration of faces in convex polytopes, spheres and hyperplane arrangements, invited hour address, Reg. AMS Mtg., Lawrenceville, NJ (1996); MSRI-Evans Lecture Series, Univ. California at Berkeley (1997); Univ. Kansas (1997); Claremont Grad. School (1997).

The geometry of products of minors, University of California at Berkeley (1996).

Noncommutative enumeration in ranked posets, University of California at San Diego (1997).

Selected Publications:

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

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

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

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

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

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

Noel Brady

H. C. Wang Assistant Professor of Mathematics

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

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

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

Professional Activities: Referee for a few journals.

Invited Lectures:

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

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

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

On the geometry of kernels of right-angled Artin groups, SUNYA Topology and Group Theory Conf. (1996).

Combing kernels of certain right-angled Artin groups, Université de Montreal (1996).

Morse theory and finiteness properties of groups, SUNY at Binghamton (1997).

On the geometry of kernels of right-angled Artin groups, SUNY at Binghamton (1997).

Selected Publications:

Asynchronous Automatic Structures on Closed Hyperbolic Surface Groups; in Geometric Group Theory, Vol. 3 (R. Charney, M. Davis, M. Shapiro, eds.), OSU Math. Research Institute Publ., de Gruyter, 1995.

Morse Theory and Finiteness Properties of Groups (with M. Bestvina), Invent. Math. (1997), to appear.

Filling Invariants at Infinity for Manifolds of Nonpositive Curvature (with B. Farb), Trans. Amer. Math. Soc., to appear.

Branched Coverings of Cubical Complexes and Subgroups of Hyperbolic Groups, Jour. London Math. Soc., submitted.

Combing Kernels of Certain Right Angled Artin Groups (with M. Bestvina), in preparation.

Higher Connectivity at Infinity for Right Angled Artin Groups (with J. Meier), in preparation.

James H. Bramble

Professor Emeritus of Mathematics

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

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

Selected Publications:

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

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

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

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

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

Kenneth Brown

Professor of Mathematics

Until recently my main interests have been algebra and topology. I have especially enjoyed using topological methods to study infinite discrete groups. In some of my early work, for instance, I studied Euler characteristics of groups. I obtained formulas relating the Euler characteristic (a topological concept) to purely algebraic properties of groups. When applied in special cases, these formulas unexpectedly led to new results in algebraic number theory. More recently, I have 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 am currently trying to incorporate methods of analysis and probability into my work on discrete groups.

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

Selected Publications:

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

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

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

Buildings, Springer-Verlag, New York, 1989.

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

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

Jianguo Cao

Assistant Professor of Mathematics

Over the years my research has covered a wide range of areas in differential geometry, such as: geometry of geodesics, equivariant Ricci curvature equation, isoperimetric inequalities, minimal harmonic functions and Martin boundary, to name the most prominent ones.

Since 1988 I have been interested in the geometric and topological structure of certain manifolds with bounded curvature, by using methods related to geodesics and partial differential equations.

In some of my early work, I studied simple closed geodesics on convex surfaces jointly with Professor E. Calabi. This joint project led to some new results in the geometry of spheres with variable curvature. For instance, we have found that on any smooth convex surface the shortest closed geodesic does not have any self-intersection points.

My research on the curvature problem involves some a-priori estimates for equivariant Ricci curvature equations. The joint work with D. DeTurck establishes a systematic way to solve the Ricci curvature equation with symmetry. Much of my research on curvature is also related to the topological structure of 4-dimensional manifolds with positive isotropic curvature. My work in this direction led to a very simple but elegant proof of a theorem of Richard Hamilton on the classification of simply-connected 4-manifolds with non-negative curvature operators. Hamilton's original argument used very deep analysis.

For the past five years, my principal research efforts have been devoted to studying manifolds with non-positive curvature. Prof. Clifford Earle first got me interested in a problem which concerns the Bers-Nielsen kernel on non-compact surfaces with negative curvature. I was able to derive a new result in this direction, by showing that the infinite Nielsen kernel is actually very "small." Since then I have become progressively more interested in geometric analysis on manifolds of non-positive curvature. My recent result on the marked length spectrum concerns the rigidity problem of closed geodesics. It asserts that the geometry of negatively curved surfaces of finite area can be uniquely characterized by the marked length spectrum. This result supersedes some of the early work of Guillemin-Kazhdan, Sarnak, Otal, Muller and others in this direction.

My research interests in the spectrum of Laplacian and minimal harmonic functions have also been influenced by Professor E. Dynkin. In his internationally renowned book "Markov Processes" published in 1965, Professor Dynkin proposed to study the set of all normalized minimal harmonic functions on certain non-compact manifolds, which nowadays is called the Martin-boundary problem. One of my research results shows that the Martin boundary of any simply-connected uniform visibility manifold can be identified with the sphere at infinity. This result provides a new partial answer to the long standing problem suggested by Professor Dynkin nearly thirty years ago. This result on the Martin boundary is the best result in this area.

In the recent cooperation with Professor José Escobar, I was interested in isoperimetric inequalities on manifolds of non-positive curvature. We were able to show that the optimal Euclidean isoperimetric inequality holds for compact domains in PL-manifolds with non-positive curvature. This latest result provides a PL-version of a solution to a conjecture of Gromov.

Awards and Honors: Member of the Institute for Advanced Study (1989–90). NSF Grant awards since 1989.

Professional Activities: Member of the AMS. Referee for the NSF and journals of the AMS.

Invited Lectures:

Combinatorial and Riemannian isoperimetric inequalities on non-compact spaces, Chinese University of Hong Kong (1995).

Quasi-isometries and rigidity of non-compact surfaces with non-compact surfaces, CUNY (1995).

Spectral rigidity of non-compact surfaces of non-positive curvature, Chinese University of Hong Kong (1995).

Isoperimetric inequalities and harmonic functions on non-compact manifolds, Mathematisches Forschungsinstitut Oberwolfach, Germany (1995).

Ergodicity and rigidity of geodesic flow on non-compact surfaces, University of Warwick, England (1995).

Minimal volume and finiteness theorems for manifolds with Gromov's hyperbolicity, AMS 910th meeting, New York City (1996).

Selected Publications:

The Ricci Curvature Equation with Rotational Symmetry (with D. DeTurck), Amer. J. Math. **116** (1994), 224–250.

The Bers-Nielsen Kernels and Souls of Open Surfaces with Negative Curvature, Michigan J. Math. **41** (1994) 13–30.

Rigidity for Non-compact Surfaces of Finite Area and Certain Kahler Manifolds, Journal of Dynamic System and Ergodic Theory **15** (1995), 475–516.

A New Isoperimetric Comparison Theorem for Surfaces of Variable Curvature (with I. Benjamini), Duke Math. J. **85** (1996), 359–396.

Examples of Simply-Connected Liouville Manifolds with Positive Spectrum (with I. Benjamini), J. Diff. Geom. App. **6** (1996), 31–50.

An Isoperimetric Comparison Theorem for PL-manifolds of Non-positive Curvature (with José Escobar), revised version, May 1996.

Minimal Volume and Finiteness Theorem of Certain Non-positively Curved Manifolds, submitted.

A New Isoperimetric Estimate and its Applications to the Martin Boundary, JAMS, 46 pages submitted.

Stephen U. Chase

Associate Chair and Professor of Mathematics
Director of Undergraduate Studies

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

Selected Publications:

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

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

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

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

Zhen-Qing Chen

Assistant Professor of Mathematics

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

Professional Activities: Member of the AMS and IMS. Reviewer for Mathematical Reviews. Referee for Annals of Probability, Journal of Functional Analysis, Journal of Mathematical Physics, Probability Theory and Related Fields, Stochastics and Stochastics Reports, Stochastic Processes and their Applications, Studia Mathematica, and Applied Mathematics and Optimization.

Selected Publications:

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

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

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

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

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

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

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

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

Harnack Principle for Elliptic Systems (with Z. Zhao), J. Diff. Equation, to appear.

Holomorphic diffusions and boundary behavior of harmonic Functions (with R. Durrett and G. Ma), Ann. Probab., to appear.

Intrinsic Ultracontractivity and Conditional Gauge for Symmetric Stable Processes (with R. Song), J. Func. Anal., to appear.

Marshall M. Cohen

Professor of Mathematics

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

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

Professional Activities: Member of the AMS and MAA.

Selected Publications:

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

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

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

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

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

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

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

Robert Connelly

Chair and Professor of Mathematics

Discrete geometry is my main area of interest. My central focus is through the geometry of rigid structures. This is applied to problems of packings and coverings of spheres for example. A basic problem is the following: Given a finite configuration of points in Euclidean space and equality and inequality constraints on some of the pairs of distances, when is there another non-congruent configuration that satisfies the given constraints? When is there a *flex* of this configuration, a continuous motion, that satisfies the constraints? This is related to stable *tensegrity* structures made of strings that hold a collection of sticks suspended rigidly in space. Indeed it is possible to *classify* certain types of symmetric tensegrity structures by this theory.

Awards and Honors: Display of computer generated pictures of stable tensegrity structures at the Cathedral of St. John, the Divine, New York, NY, sponsored by the Pratt Institute (Nov. 1995–Jan. 1996). Sobczyk Lecture at Clemson University (1995). Asteroid Connelly 4816, named in honor of Robert Connelly.

Professional Activities: Member of the AMS and MAA. Reviewer for Mathematical Reviews. Referee for the Journal of Discrete and Computational Geometry, American Mathematical Monthly, Mathematics Magazine, Journal of Differential Geometry, International Journal of Solids and Structures, and Betreige für Algebra und Geometrie. Editor for Betreige für Algebra und Geometrie. Co-organized (with K. Bezdek, A. Bezdek and K. Böröczky) Geometry Festival III, a satellite conference of the European Congress of Mathematicians, Budapest, Hungary. Organized the subconference on Rigid and Flexible Objects: Symmetry, Washington, D.C.

Selected Publications:

On Generic Global Rigidity (B. Sturmfels and P. Gritzmann, eds.), Proc. DIMACS Workshop on Polyhedral Combinatorics, in honor of V. Klee **4** (1991), 147–155.

The Stability of Tensegrity Frameworks (with W. Whiteley), International Journal of Space Structures **7** no. 2 (1992), 153–163.

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 Vol. of Discrete and Comput. Geom., 313–319.

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

Globally Rigid Symmetric Tensegrities (with M. Terrell), Structural Topology (1995).

Finite and Uniform Stability of Sphere Packings (with A. Bezdek and K. Bezdek), to appear.

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). 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).

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.

Jeffrey Diller

H. C. Wang Assistant Professor of Mathematics

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

While a visitor at Indiana University, I grew acquainted with the new and rapidly emerging field of multi-variable complex dynamics. Pluripotential theory has emerged as a standout tool in this field which at present, when compared with its one variable cousin, has relatively few useful techniques at its disposal. My concern thus far has been to apply pluripotential theory to study dynamics of birational maps of the complex projective plane.

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

Selected Publications:

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

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

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

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

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

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

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

Richard Durrett

Professor of Mathematics

Director of Graduate Studies

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

Recently I have become interested in probability problems arising from genetics. Some of that work is being done in collaboration with Rich Harrison in Ecology & Systematics and with Chip Aquadro in Population Genetics.

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

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

Selected Publications:

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

The Essentials of Probability, Duxbury Press, 1993.

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

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

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

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

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

Eugene B. Dynkin

Professor of Mathematics
A. R. Bullis Chair

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

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

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

Professional Activities: Member of the AMS and the Bernoulli Society. Advisory boards of Probability Theory and Its App. and Math. in Operations Research. Scientific advisor of the International Center for Mathematical Sciences, Edinburgh, Great Britain.

Invited Lectures:

Superdiffusions and nonlinear PDE’s, Workshop “Some problems of stochastic analysis”, East Lansing (1996).

Probability and PDE’s, series of three lectures, Distinguished Visitor, University of California at San Diego (1997).

Toward the description of all positive solutions of the equation $Lu = u^a$, Paris VI (1997).

Selected Publications:

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

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

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

Linear Additive Functionals of Superdiffusions and Related Nonlinear P. D. E. (with S. E. Kuznetsov), Trans. Amer. Math. Soc. **348** (1996), 1959–1987.

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

Clifford Earle

Professor of Mathematics

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

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

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

Selected Publications:

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

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

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

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

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

Richard Ehrenborg

H. C. Wang Assistant Professor of Mathematics

My main area of interest is algebraic combinatorics. Much of my latest work has dealt with understanding the **cd**-index, which is a compact way to encode the flag f-vector of a convex polytope, and more generally, of an Eulerian poset. Together with Margaret Readdy, I introduced coalgebra techniques to the theory of polytopes. This has enabled me to solve a number of open questions concerning polytopes and zonotopes.

For instance, together with Louis Billera and Margaret Readdy, I settled the question that the linear span of flag f-vectors of zonotopes span the same space as convex polytopes, that is, the space given by the generalized Dehn-Sommerville equations. Using coalgebra techniques, we found an explicit formula for the **cd**-index of the lattice of regions of an oriented matroid given the flag f-vector of its lattice of flats. This is the first explicit method to compute the **cd**-index for a large class of Eulerian posets. As one of the applications of our result, we proved a zonotopal analogue of a difficult conjecture of Stanley (MIT): among all n-dimensional zonotopes, the n-dimensional cube has the smallest **cd**-index coefficientwise. Margaret Readdy and I have also studied the braid arrangements A_n and B_n in this context.

Some of my current projects include: with Margaret Bayer (University of Kansas), to understand the toric f-vector of an Eulerian poset using coalgebra techniques; with Einar Steingrímsson (Chalmers, Sweden), to study the excedance set statistics of permutations; with Margaret Readdy, to study complex hyperplane arrangements and supersolvability; with Louis Billera, to use commutative algebra to prove the nonnegativity of the sparse flag k-vector.

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

Professional Activities: Member of the AMS, AWM, MAA and Svenska Matematikersamfundet. General member of the Mathematical Sciences Research Institute, Special Year in Combinatorics (1996–1997). Coorganizer and faculty supervisor for Cornell's Research Experiences for Undergraduates Program in Mathematics (summer 1997).

Invited Lectures:

The **cd***-index and zonotopes*, AMS sectional meeting, Wayne State University (1997).

The **c**-*2***d***-index of oriented matroids and hyperplane arrangements*, Mathematical Sciences Research Institute (1996).

The **cd***-index, coproducts and zonotopes*, The Tutte Colloquium, University of Waterloo (1996).

Selected Publications:

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

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

Playing Nim on a Simplicial Complex (with E. Steíngrimsson), Electronic Jour. Comb. **3**, R9 (1996), 33pp.

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

The **cd***-Index of Zonotopes and Arrangements* (with L. Billera and M. Readdy), Rota Festschrift, to appear.

The **c***-2***d***-Index of Oriented Matroids* (with L. Billera and M. Readdy), Journal of Combinatorial Theory, Series A, to appear.

A Recursive Formula for the **cd***-Index of Braid Arrangements* (with M. Readdy), Discrete and Computational Geometry, submitted.

Miklós Erdélyi-Szabó

H. C. Wang Assistant Professor of Mathematics

My main area of interest is the study of classical models of second order intuitionistic arithmetic, especially their complexity in various languages and language fragments. The results obtained in this area give useful hints about what may be expected to be true constructively (in Bishop's sense) or in an intuitionistic theory of reals, but they are usually easier to get: the model's nice topological structure is a great help. A question which is of particular interest to me is this: are the fragments of the models which were shown to be decidable implied by constructively or intuitionistically plausible axioms for the reals? There is quite a gap between the results about the models and their constructive counterpart, a fact which should keep me busy as a gap-filler.

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

Selected Publications:

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

Decidability of Scott's Model as an Ordered **Q***-Vector Space*, Journal of Symbolic Logic, to appear.

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

Coding True Second Order Arithmetic into the Real-Algebraic Structure of Topological Models, in preparation.

José Escobar

Professor of Mathematics

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

Awards and Honors: Presidential Faculty Fellowship (1992–1997), created by President Bush to be given to 15 scientists in the nation each year. Colciencias Award, Category A (1996). Alejandro Angel Escobar Foundation: Mention of Excellence in Science (1995).

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

Editorial Board of the Electronic Journal of Differential Equations since 1993 and Revista Colombiana de Matemáticas since 1992. Int'l editor of Innovación y Ciencia since 1992. Referee for the Journal of the AMS, Journal of the Mathematical Society of Japan, Duke

Mathematical Journal, Communications in Partial Differential Equations, Indiana Mathematical Journal, Proceedings of the AMS, Communications in Analysis and Geometry and the NSF.

Invited Lectures:

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

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

My experiences in life and the mathematical sciences, Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) meeting, El Paso (1995).

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

Selected Publications:

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

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

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

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

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

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

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

An Isoperimetric Comparison Theorem for PL-manifolds of Non-positive Curvature (with Jianguo Cao), preprint.

Roger Farrell

Professor of Mathematics

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

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

Selected Publications:

Multivariate Calculation, Springer-Verlag, 1985.

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

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

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

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

Spitzer and Bohnenblust, Revisited (1997), preprint.

Wolfgang Fuchs

Professor Emeritus of Mathematics

My major area of research is Classical Theory of Functions of one complex variable, especially Nevanlinna Theory, Theory of Approximation, especially by polynomials and rational functions defined in subsets of C.

Professional Activities: Consultant for Prometheus, Inc. Referee for several journals. Reviewer for Mathematical Reviews and Zentralblatt. Collaborator with Dr. Walter Bergweiler on problems concerning the distribution of zeros of entire functions.

Leonard Gross

Professor of Mathematics

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

Awards and Honors: Guggenheim Fellow (1974–75). Humboldt Prize (1993).

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

Invited Lectures:

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

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

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

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

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

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

Selected Publications:

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

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

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

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

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

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

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

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

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

Mark Gross

Assistant Professor of Mathematics

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

Professional Activities: Reviewer for Math Reviews.

Selected Publications:

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

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

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

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

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

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

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

John Guckenheimer

Professor of Mathematics

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

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

Professional Activities: Chair of the organizing committee for the 1997–98 program at IMA, Minneapolis Geometry Center (NSF S&T Center), University of Minnesota. Advisory Board for The Geometry Center, University of Minnesota. President of SIAM. SIAM Board of Trustees. NSF Metacenter National Allocations Committee (supercomputer resources). Ex officio member of the Joint Policy Board on Mathematics and the Conference Board on Mathematical Sciences. Participant in a Board of Mathematical Sciences Retreat, *Actions for the Mathematical Sciences in a Changed Environment*. Consultant for United Technologies Research Center. Co-chair of the NSF panel on prediction (1996). Editor of the Journal of Experimental Mathematics. Editorial Board for SIAM Review, Aequationes Mathematicae and International Journal of Bifurcation and Chaos.

Administrative Activities: Director of the Center for Applied Mathematics. Director of research programs at the Theory Center. Principal investigator for the Theory Center's REU Program (SPUR). Member of the FABIT committee. Ad hoc member of the promotion committee in the College of Engineering.

Selected Publications:

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

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

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

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

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

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

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

Bifurcation, Bursting and Spike Frequency Adaptation (with R. Harris-Warrick, J. Peck and A. Willms), Journal of Computational Neuroscience, in press.

Defining Functions for Multiple Hopf Bifurcations (with W. Govaerts and A. Khibnik), SIAM J. Num. Anal., 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 surfaces of a particular type in a three-dimensional manifold. More recently I have been writing a couple of graduate-level textbooks in topology, trying to lessen the large gap which has developed between the standard first-year courses and current research.

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

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

Selected Publications:

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

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

David W. Henderson

Professor of Mathematics

In my research activities I have been investigating the geometry and topology of triangulated spaces and spaces of isomorphic triangulations and embedding. I am also investigating the intuitionistic foundations of geometry. I am involved in Mathematics Education. I am interested in the meaning of mathematics and the meaningful learning of mathematics. Some of my work in this area has been in connection with two programs of which I have been instrumental in the motivation, development and teaching: Cornell/Schools Mathematics Resource Program and Teacher Education in Science and Mathematics Program. These programs are described elsewhere in this report.

In addition, I am currently involved in extensive curriculum innovation projects in undergraduate mathematics. My first book, published in August 1995, has been requested by faculty in 50 countries so far and is currently being translated into Portugese. My second book *Differential Geometry: A Geometric Introduction* will appear in July of 1997. I started a third book which will be a calculus supplement giving a geometric foundation of calculus.

Professional Activities: Referee for the NSF and various journals. Panel on Equity and Diversity of the Mathematical Sciences Education Board, National Academy of Sciences. Member of the AMS, MAA, National Council of Teachers of Mathematics and the ICME Study Group on the Teaching of Geometry for the twenty-first century.

Selected Publications:

The Space of Simplexwise Linear Homeomorphisms of a Convex Z-Disk, Topology **23** (1984).

Spaces of Geodesic Triangulations of the Sphere (with M. Awartani), Trans. Amer. Math. Soc. **303** (1987).

The Masquerade of Formal Mathematics, PDME, London (1990).

Proof as a Convincing Argument that Answers — Why?, ICME, Quebec City (1992).

Geometric Solutions to Quadratic and Cubic Equations, Pythagoros (1994).

Compactifications of the Ray with the Arc as Remainder Admit no n-mean, Proc. AMS (1995).

Experiencing Geometry on Plane and Sphere, Prentice-Hall, 1995.

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

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

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

Square Roots in the Sulba Sutra; in Topics in Applied Geometry, MAA, 1996.

John Hubbard

Professor of Mathematics

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

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

Most of my research over the last 5 years has been devoted to dynamics in several complex variables. I have co-authored three foundational papers in the field; a fourth, in press, establishes among other things some intriguing relations between iteration theory and complex analytic surfaces. I am also writing three books on a very advanced level, one giving a treatment of Teichmüller space and its applications in theorems of Bill Thurston, the second on dynamics of one complex variable, and the third on differential geometry.

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

J. T. Gene Hwang

Professor of Mathematics

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

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

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

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

Invited Lectures:

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

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

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

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

Selected Publications:

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

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

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

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

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

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

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

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

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

Maximum Likelihood Estimation Under Order Restricted Parameters by the Prior Feedback Method (with C. Robert), JASA, to appear.

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

Peter J. Kahn

Professor of Mathematics

I am a topologist and a geometer, focusing largely on the theory of smooth manifolds and real algebraic varieties. I have recently become interested in the Donaldson-Seiberg-Witten theory on low-dimensional manifolds. This provides a host of new analytic and algebraic tools that have led to the solution of a number of outstanding problems.

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).

Selected Publications:

Characteristic Numbers and Oriented Homotopy Type, Topology **3** (1965), 81–95.

Self-equivalences of (n–1)-connected 2n-manifolds, AMS Bull. **72** (1966), 562–566.

Chern Numbers and Oriented Homotopy Type, Topology **7** (1968), 69–93.

The Non-Finite Homotopy Type of Some Diffeomorphism Groups, (with P. Antonelli and D. Burghelea), Topology **11** (1972), 1–49.

The Concordance-Homotopy Groups of Geometric Automorphism Groups (with P. Antonelli and D. Burghelea), Springer Lecture Notes **215** (1972).

Mixing Homotopy Types of Manifolds, Topology **14** (1975), 203–216.

Homotopy-dimension and Simple Cohomological Dimension of Spaces (with K. Brown), Comment. Math. Helv. **52** (1977), 111–127.

Counting Types of Rigid Frameworks, Inventiones Math. **55** (1979), 297–308.

Steenrod's Problem and k-invariants of Certain Classifying Spaces, Springer Lecture Notes **967** (1982).

Equivariant Homology Decompositions, AMS Trans. **298** (1986), 245–271.

Rational Moore G-spaces, AMS Trans. **298** (1986), 273–287.

A Paradigm for Robust Geometric Algorithms (with J. Hopcroft), Algorithmica **7** (1992), 339–380.

A Continuity Property for Local Price Adjustment Mechanisms (with J. Herrmann), Journal of Mathematical Economics, to appear.

Harry Kesten

Professor of Mathematics

I am a probabilist. My main research interests are percolation theory and random walks, and in general I like to dabble in models inspired by Statistical Mechanics.

One model I have recently returned to is the first-passage percolation model. To each edge e of the integer lattice in d dimensions one assigns a passage time $X(e)$. These $X(e)$ are assumed independent, identically distributed and nonnegative. One is interested in the random set $B(t)$ of points which can be reached from the origin by time t. In particular how big are the fluctuations of the boundary of $B(t)$? This is a special example of the fluctuations of a random surface. In the case of $B(t)$ I proved the first upper bound for these fluctuations in terms of a power of t. These have now been improved by K. Alexander and lower bounds for the fluctuations have been given by C. Newman and M. Piza. The challenge now is to close the gap between these upper and lower bounds.

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

Professional Activities: Associate editor of the Indiana University Mathematics Journal and the New York Journal of Mathematics. Advisory board member of Electronic J. Probability. Honorary board member of J. d'Analyse Mathematique.

Selected Publications:

Products of Random Matrices (with H. Furstenberg), Ann. Math. Statist. **31** (1960), 457–469.

Hitting Probabilities of Single Points for Processes with Stationary Independent Increments, Memoir no. 93, Amer. Math. Soc. (1969).

Percolation Theory for Mathematicians, Birkhäuser, Boston, 1982.

Aspects of First-Passage Percolation; in Ecole d'été de Probabilités de Saint-Flour XIV, (P. L. Hennequin, ed.), Lecture Notes in Math **1180**, Springer-Verlag, 1986, pp. 125–264.

On the Speed of Convergence in First-Passage Percolation, Ann. Appl. Probab. **3** (1993), 296–338.

Dexter Kozen

Professor of Computer Science

Joseph Newton Pew, Jr., Professor in Engineering

My research interests include the theory of computational complexity, especially complexity of decision problems in logic and algebra, program logic and semantics, and computational algebra. Recent work includes: new polynomial-time algorithms for type inference in type systems with subtypes and recursive types; algorithms solving systems of set constraints as used in program analysis; a unification algorithm for set constraints and a new constraint logic programming language based on set constraints; development of the theory of rational spaces and their relationship to set constraints; an algorithm for decomposition of algebraic functions; a new polynomial-time algorithm for resolution of singularities of plane curves; efficient algorithms for optimal transmission of encoded video data; optimality results for digital interleavers; and complexity and completeness results for Kleene algebras with tests. Recently I have begun to investigate the application of Kleene algebra and the modal mu-calculus to problems in software security.

Professional Activities: Program committee of IEEE Symp. Foundations of Computer Science (FOCS, 1996). Supervisory board of the Centre for Basic Research in Computer Science (BRICS), Aarhus University. Organizing committee of IEEE Symp. Logic in Computer Science. Organizing committee of Dagstuhl Seminar on Tree Automata (Oct. 1997).

Administrative Activities: College of Engineering Undergraduate Admissions Committee. University Arbitration Panel.

Selected Publications:

A Complete Gentzen-Style Axiomatization for Set Constraints (with A. Cheng); in Proc. 23rd Int'l Colloq. Automata, Languages and Programming (F. M. auf der Heide and B. Monien, eds.), Lecture Notes in Computer Science 1099, Springer-Verlag, 1996, pp. 134–145.

The Complexity of Kleene Algebra with Tests (with E. Cohen and F. Smith), Technical Report TR96-1598, Cornell University (1996).

Tarskian Set Constraints (with R. Givan, D. McAllester and C. Witty); in Proc. IEEE 11th Symp. Logic in Computer Science, 1996, pp. 138–147.

Rational Spaces and Set Constraints, Theor. Comp. Sci. **167** (1996), 73–94.

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

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

On the Complexity of Reasoning in Kleene Algebra, Technical Report TR97-1624, Cornell University (1997); in Proc. IEEE 12th Symp. Logic in Comput. Sci., 1997, to appear

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

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

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

Nikola Lakic

H. C. Wang Assistant Professor of Mathematics

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

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

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

Invited Lectures:

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

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

Asymptotic Teichmüller spaces, MSRI (1996).

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

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

Selected Publications:

Infinitesimal Teichmüller Geometry, Complex Variables (1996).

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

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

G. Roger Livesay

Professor of Mathematics

My major area of research is in Topology, 3-dimensional manifolds with finite cyclic fundamental groups.

Michael Morley

Professor of Mathematics

Professor Morley's primary interest and contribution to the department lies in his devotion to the students. His skill, wisdom, commitment and sensitivity in advising is very well-known throughout the Arts College. Comments about Michael Morley speak to his devotion: "[Mike Morley] is exactly the sort of advisor that Cornell needs..."; "...has a creative and total commitment to taking care of students..."; "...has been available to everyone's advisees who wander in unhappy." These comments speak eloquently of Prof. Michael D. Morley.

Professor Morley's primary research interests lie in the areas of advanced mathematical logic and model theory.

Awards and Honors: Robert A. and Donna B. Paul Award for Excellence in Advising (1996).

Professional Activities: President of the Association for Symbolic Logic (1986–89).

Administrative Activities: Department advising committee (1995–). Associate Chair and Director of Undergraduate Studies (1984–95).

Anil Nerode

Goldwin Smith Professor of Mathematics

I have contributed to automata theory, recursive function theory, recursive algebra, complexity-theoretic algebra, and lately to the theory of concurrent programming, non-monotonic logics, implementing logics by linear programming, and hybrid systems in engineering and science. Hybrid Systems are networks of discrete and continuous devices and can be analyzed by a combination of logical and functional analytic methods. I and my co-worker W. Kohn have concentrated on algorithms for extracting digital control programs forcing continuous systems to satisfy their design requirements. I have been a principal speaker and organizer of many national and international conferences in these fields. I directed NSF grants for thirty years. I was Chair of the Mathematics Department at Cornell for five years. I am involved in an extensive university-industrial-military cooperation with ORA Corporation, Intermetrics Corporation and the US Army and ARPA-DSSA on hybrid systems. I do applied consulting work in many areas for the US Environmental Protection Agency (I was on their Science Board for years), the American Board of Family Practice, Intermetrics Corporation, ORA Corporation, etc.

Professional Activities: Vice President of the AMS. Member of the MAA, ACM and IEEE. Executive committee of the Center for Theory and Simulation. Director of the Mathematical Sciences Institute (an Army Center of Excellence) since 1987. Editorial boards of Annals of Pure and Applied Logic, Future Generation Computing, Annals of Mathematics and Artificial Intelligence, Logical Methods in Computer Science, Computer Modeling and Simulation, and Constraints.

Administrative Activities: Member of the graduate fields of Mathematics, Applied Math., Computer Science, Science and Tech. Studies, and Cognitive Studies.

Selected Publications:

Continualization: A Hybrid Systems Control Technique for Computing (with W. Kohn and J. B. Remmel), CESA (1996).

Multiple Agent Hybrid Control for Manufacturing Systems (with W. Kohn, J. B. Remmel and J. James), IFAC (1996).

Feedback Derivations: Near Optimal Controls for Hybrid Systems (with W. Kohn and J. B. Remmel), CESA (1996)

Hybrid Systems: Chattering approximations to relaxed controls (with X. Ge, W. Kohn and J. B. Remmel); in Hybrid Systems III (Alur, Henzinger, Sontag, eds.), LNCS 999, Springer-Verlag, 1996.

Hybrid Knowledge Bases (with J. J. Lu and V. S. Subraahmanian); in IEEE Trans. Knowledge and Data Engineering, 1996, pp. 773–785.

Complexity of Predicate Logic Abduction (with V. Marek and J. B. Remmel); in Proceedings of the Eleventh Annual IEEE Symposium on Logic in Computer Science (LICS '96), 1996.

Logic for Applications (with R. Shore), second edition, Springer-Verlag Computer Science Series, 1997.

Principle of Logic and Logic Programming, second edition (with G. Metakides), Elsevier Science Publ., 1997.

Distributed Hybrid Models for Traffic Control (with W. Kohn and J. B. Remmel); in Hybrid Systems IV, LNCS, Springer-Verlag, 1997.

Intuitionistic Logic and Hybrid Systems (with S. Artemov and J. Davoren); in Logical Foundations of Computer Science: 4th Int'l Symp., Proc., LNCS, Springer-Verlag, 1997.

Scalable Data and Sensor Fusion via Multiple Agent Hybrid Systems (with W. Kohn and J. B. Remmel), IEEE Trans., special issue on Hybrid Systems (1997), to appear.

Automata Theory and Computer Science (with B. Khoussainov), in preparation.

Constructive Logics and Lambda Calculi (with G. Odifreddi), in preparation.

Lawrence Payne

Professor Emeritus of Mathematics

My research interests lie in several areas of partial differential equations: Isoperimetric Inequalities, Ill-Posed and Non-Standard Problems, Growth Decay and/or Blowup of Solutions, and applications to various problems in Solid and Fluid Mechanics. My most recent interests have been in the study of Overdetermined Systems and Saint Venant type problems for nonlinear equations.

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

Invited Lectures:

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

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

Selected Publications:

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

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

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

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

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

Kevin Pilgrim

H. C. Wang Assistant Professor of Mathematics

I received my Ph.D. in May of 1994, from the University of California at Berkeley. The math department here graciously deferred my appointment for one year so that I could stay at the Mathematical Sciences Research Institute in Berkeley during the 1994–95 year.

Following in the footsteps of my mathematical "father" (Curt McMullen) and "grandfather" (Dennis Sullivan), my research focuses on developing the growing dictionary between the theories of iterated rational maps and Kleinian groups as conformal dynamical systems on the Riemann sphere. In the fall of 1996, I gave an introductory graduate-level course on this topic. Some relevant questions which are known in the setting of Kleinian groups include the following: How can one combine a rational map with another one, or decompose it into simpler pieces? Can one find a combinatorial object associated to a rational map which encodes dynamically interesting features? What are the topological and geometric properties possessed by the *fractal* Julia set of a rational map? Can one understand the space of all rational maps of a given degree? While much is known about these questions for polynomials, little is known in the more general setting of rational maps. The investigation of this area had been hampered by the lack of an adequate family of nice examples with which to generate conjectures and test hypotheses. In the summer of 1996, I supervised a Research Experience for Undergraduates in mathematics. Three undergraduates and I systematically developed a *catalog* of examples of nice rational maps and investigated their combinatorics. This involved using symbolic algebra packages to find solutions of systems of polynomial equations over the complex numbers, the results of which give parameters for rational maps, drawing pictures of the corresponding Julia sets, and then determining the combinatorics of the maps themselves.

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

Selected Publications:

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

Combining Rational Maps and Controlling Obstructions (with Tan Lei), Ergodic Theory and Dynamical Systems, to appear.

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

James Renegar

Professor of Operations Research and Industrial Engineering
Director of Graduate Studies

My research relates to the computational complexity of problems arising in numerical analysis and mathematical programming. I have been especially interested in linear programming, solution procedures for systems of polynomial equations, and decision methods for the first order theory of the reals. Recently, I have been attempting to tie the theory of linear programming more closely to functional analysis and numerical analysis. For example, I have introduced quantities akin to condition numbers into the analysis of contemporary linear programming algorithms (i.e., interior-point methods).

Professional Activities: Associate editor of the SIAM Journal on Optimization and the Journal of Complexity.

Selected Publications:

A Polynomial Time Algorithm, Based on Newton's Method for Linear Programming, Mathematical Programming **40** (1988), 59–93.

On the Computational Complexity and Geometry of the First-Order Theory of the Reals, Journal of Symbolic Computation **13** (1992), 255–352.

Linear Programming, Complexity Theory and Elementary Functional Analysis, Mathematical Programming **70** (1995), 279–351.

Thomas Rishel

Senior Lecturer of Mathematics

My research area is topology. I have written on generalizations of metric spaces and on conditions for topological spaces to preserve products.

As Director of Undergraduate Teaching, I am interested in curriculum and course design. These interests led to the organization of the Occasional Seminar on Undergraduate Education, as well as the design of four new courses in teaching, algebra and geometry which make substantial use of writing assignments. I have given numerous talks and written some papers on these courses.

My other responsibilities include: supervising and training teaching assistants, scheduling, budgeting and evaluation. I perform a similar service for part-time and visiting faculty. These activities have led to my being on a number of national and regional committees on graduate education, teaching and employment.

Awards and Honors: Professors for the Future Award, Pew Foundation (1994–97). NSF Grant: Geometry (1992–95). MAA Seaway Section Distinguished Teaching Award (1995). Clark Teaching Award, Cornell University (1981).

Professional Activities: Reviewer for Math Reviews. Referee for the Proceedings of the AMS and PRIMUS. Member of the AMS and MAA. Member of the MAA Task Force on Graduate Study. Organizer of the MER Forum meeting, Cornell University (Nov. 1995). Project director of Professors for the Future (1994–96). FIPSE grant for Future Professors' Program (1995–). Member of the AMS-MAA Committee on Employment.

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

Invited Lectures:

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

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

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

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

Embedding PFP in the disciplines, Phoenix (Apr. 1997).

Selected Publications:

Products in Countably Compact and M-Spaces, Y. Kodama Festschrift (1991).

Geometry as Metaphor: Writing in the Math Classroom; in Teaching Critical Thinking (Clark and Biddle, eds.), Prentice-Hall, 1993, pp. 124–136.

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

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

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

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

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

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

Adding the Math: Narrative and Cognitive Methods in Mathematics (with J. Meier), MAA Math Notes, to appear.

Oscar Rothaus

Professor of Mathematics

My principal mathematical interest in the last 10 years or so has been logarithmic Sobolev inequalities and Spectral Geometry. I was drawn to log-Sobolev inequalities because of their connection with ground state for Schrödinger and other operators.

During my most recent sabbatic in London, I worked with Professor E. B. Davies on the problem of estimating ground state for Bochner Laplacian on Euclidean vector bundles. We hoped to generalize to this setting the mechanism of Bochner-Lichnerowicz-Weitzenbock inequalities, and their use by Li and Yau particularly. To a degree we succeeded; our results are contained in two papers published recently in the Journal of Functional Analysis.

Most recently, I am returning to combinatorial problems in coding theory and to new questions in logarithmic Sobolev inequalities.

Professional Activities: Member of the Corporate Relations Committee and the Reprinted Books Committee of the AMS. Consultant for the Inst. Def. Analysis and the MITRE Corporation. Consultant to SAIC.

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.

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.

Selected Publications:

Lie Algebras of Galois Groups Arising from Hodge-Tate Modules, Annals of Math. (1973).

On Explicit Reciprocity Laws, J. Reine Angew Math. (1980 & 1981).

Continuous Cohomology and p-adic Galois Representations, Inventiones Math. (1980).

Integral Representations Associated with p-adic Field Extensions, Inventiones Math. (1988).

The Analytic Variation of p-adic Hodge Structure, Annals of Math. (1988).

An Infinite-dimensional Hodge-Tate Theory, Bulletin Math. Soc. France (1992).

Galois cohomology and Galois representations, Inventiones Math. (1993).

Richard A. Shore

Professor of Mathematics

My major research interests have centered around analyzing the structures of relative complexity of computation of functions on the natural numbers. The primary measure of such complexity is given by Turing reducibility: f is easier to compute than g, $f \leq_T g$, if there is a (Turing) machine which can compute f if it is given access to the values of g. I have also worked with various other interesting measures of such complexity that are defined by restricting the resources available primarily in terms of access to g. The general thrust of my work has been to show that these structures are as complicated as possible both algebraically and logically (in terms of the complexity of the decision problems for their theories). These results also allow one to differentiate among different notions of relative complexity in terms of the orderings they define. Another major theme in my work has been the relationship between these notions of computational complexity and ones based on the difficulty of defining functions in arithmetic. Restricting the computational resources more directly in terms of time or space leads out of recursion theory and into complexity theory. Relaxing the restrictions by allowing various infinitary procedures leads instead into generalized recursion theory or set theory. The methods developed in these investigations are also useful in determining the effective content of standard mathematical theorems (when can existence proofs be made effective) and the inherent difficulty of combinatorial theorems in proof theoretic terms.

Professional Activities: Member of the AMS, ASL, ACM and SIGACT. Referee and reviewer for the NSF, the Natural Sciences and Engineering Research Council of Canada, the US-Israeli Bi-National Science Foundation, the New Zealand Mathematical Society Research Awards and many journals.

Editor of the Journal of Symbolic Logic (1989–93). Nominating committee and publications committee of the Association of Symbolic Logic (1993–94). Managing editor for the Bull. Symbolic Logic (1993–). Council member of the Assn. Symbolic Logic (1984–). Editor of Studies in Logic and the Foundations of Mathematics, North-Holland (1996–).

Selected Publications:

α-Recursion Theory; in Handbook of Mathematical Logic (J. Barwise, ed.), North-Holland, 1977, pp. 653–680.

The Homogeneity Conjecture, Proceedings of the National Academy of Sciences **76** (1979), 4218–4219.

Definable Degrees and Automorphisms of $\mathcal{D}$ (with L. Harrington), Bull. Amer. Math. Soc. (NS) **4** (1981), 97–100.

The Degrees of Unsolvability: The Ordering of Functions by Relative Computability; in Proc. Inter. Congress of Mathematicians (Warsaw) (1983) PWN-Polish Scientific Publishers, Warsaw 1984, Vol. 1: 337–346.

The Structure of the Degrees of Unsolvability; in Recursion Theory (A. Nerode and R. A. Shore, eds.), Proceedings of The Symposia in Pure Mathematics **42**, AMS, Providence, R. I. (1985), 33–51.

Recursive Limits on the Hahn-Banach Theorem (with A. Nerode and G. Metakides), Contemporary Mathematics **39** (1985), 85–91.

On the Strength of König's Theorem for Infinite Bipartite Graphs (with R. Aharoni and M. Magidor), J. Comb. Theory (B) **54**, (1992), 257–290.

The p-T-degrees of the Recursive Sets: Lattice Embeddings, Extension of Embeddings and the Two Quantifier Theory (with T. Slaman), Theoretical Computer Science **92** (1992), 263–284.

Logic for Applications (with A. Nerode), Texts and Monographs in Computer Science, Springer-Verlag, New York, 1993; second edition, Graduate Texts in Computer Science, Springer-Verlag, New York, 1997.

Definability in the Recursively Enumerable Degrees (with A. Nies and T. Slaman), Bull. Symb. Logic **2** (1996), 392–404.

Computable Isomorphisms, Degree Spectra of Relations and Scott Families (with B. Khoussainov), Ann. Pure and Applied Logic, to appear.

Reyer Sjamaar

Assistant Professor of Mathematics

My research area is symplectic geometry. In most of my work I apply methods developed in singularity theory, invariant theory and representation theory to the study of Lie group actions on symplectic manifolds.

Awards and Honors: Sloan Fellow (1996).

Selected Publications:

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

Holomorphic Slices, Symplectic Reduction and Multiplicities of Representations, Ann. Math. (2) **141** (1995), 87–129.

Symplectic Reduction and Riemann-Roch Formulas for Multiplicities, Bull. Amer. Math. Soc. (new series) **33** (1996), 327–338.

Convexity Properties of the Moment Map Re-examined, Adv. Math., to appear.

John Smillie

Professor of Mathematics

My area of interest is dynamical systems. I have done work on polygonal billiards and dynamics of flows on Teichmüller space; analysis of algorithms; and diffeomorphisms of surfaces. I am currently working on complex dynamics in two dimensions.

Selected Publications:

Flat Manifolds with Non-zero Euler Characteristic, Comm. Math. Helv. **52** (1977), 453–455.

Periodic Points of Surface Homeomorphisms with Zero Entropy, Ergodic Theory and Dynamical Systems **3** (1983), 315–334.

Ergodicity of Billiard Flows and Quadratic Differentials (with S. Kerckhoff and H. Masur), Annals of Mathematics **124** (1986), 293–311.

The Euler Characteristic of the Group of Outer Automorphisms of a Free Group (with K. Vogtmann), Journal of Pure and Applied Algebra **44** (1987), 329–348.

Rayleigh Quotient Iteration for Non Symmetric Matrices (with S. Batterson), Mathematics of Computation **55** no. 191 (1990), 169–178.

Polynomial Diffeomorphisms of C^2: Currents, Equilibrium Measures and Hyperbolicity (with E. Bedford), Inventiones Math. **103** (1991), 69–99.

Avery Solomon

Senior Lecturer of Mathematics

My areas of interest are mathematics education, epistemology of education and the relation of geometry and arithmetic. Much of my work has been focused on getting teachers to share ideas and problems relating to their classroom teaching experience. The workshops I teach focus on having teachers use a variety of alternative approaches to mathematics, giving them experience presenting and exploring mathematical ideas in physical and inter-disciplinary contexts, and making use of computer environments as investigative tools. I have also been involved in several curriculum development projects as well: a collection of experiments for a high school mathematics lab, an undergraduate geometry course and a manual for high-school mathematics teachers.

Half of my position is in the Department of Education, where I supervise student teachers, co-teach courses for prospective teachers and am a part of the ongoing mathematics education research group. As part of my Department of Mathematics responsibilities, I teach graduate inservice courses for teachers of mathematics, both at Cornell and at sites within a 60 mile radius of Ithaca. In addition, I serve as a consultant for area school districts, work with people in neighboring colleges to develop outreach programs, supervise programs in public schools, and organize and teach Saturday and summer workshops for mathematics and science teachers.

Professional Activities: Member of the MAA and NCTM. Development and teaching of the Cornell Young Scholars program (1989–93). Taught in the NSF Summer Geometry Institute for High School Teachers, Mt. Holyoke College (1991). Directed a pilot Math Lab project at Ithaca High School (1992–). Director of the Cornell/Schools Mathematics Resource Program (CSMRP, 1989–). Advisor to the Ithaca City School District pilot elementary mathematics program (1984–94).

Invited Lectures:

The roots of calculus, The Future of Calculus conference, Ithaca College (1991).

Mandala symbolism in Plotinus and *Light metaphors in Neo-Platonism*, 9th Conference on Ethics, Aesthetics and Ontology, Columbia University (1992).

Philosophical implications of Plato's divided line, 11th Conference on Ethics, Aesthetics and Ontology, Cornell University (1994).

Workshop on mathematics labs in the classroom, annual meeting of AMTNYS (1994 and 1995).

Selected Publications:

A Fractal Outline of a Fractal Course, AMTNYS Journal (1989).

What is a Line?, For the Learning of Mathematics (1991).

Proportions and Levels of Meaning in Mathematics, For the Learning of Mathematics (1991).

Geometric Patterns in Nature, being prepared for publication.

Birgit Speh

Professor of Mathematics

I am interested in representation theory of semisimple Lie groups as well as in arithmetic groups and analytic number theory. In the last few years most of my work concerned around the cohomology of arithmetic groups, in particular Lefschetz numbers of automorphisms of finite order and the application to problems in automorphic forms and representation theory.

Awards and Honors: Humboldt Prize (1995).

Professional Activities: Reviewer for the NSF. Editor of the New York Journal of Mathematics and the Journal of Representation Theory.

Selected Publications:

Unitary Representations of $GL(n, R)$ with Non-trivial (g, K)-Cohomology, Inv. Math. **71** (1983), 443–465.

A Cohomological Method for the Determination of Limit Multiplicities of Representations with Cohomology in the Cuspidal Spectrum (with J. Rohlfs), Duke Mathematical Journal **55** (1987), 199–211.

Representations with Cohomology in the Discrete Spectrum of Subgroups of $SO(n,1)(Z)$ and Lefschetz Numbers (with J. Rohlfs), Annales Scientifiques d'Ecole Normale Sup. (1987), 89–136.

Automorphic Representations and Lefschetz Numbers (with J. Rohlfs), Annales Scientifiques d'Ecole Normale Sup. (1989).

Lefschetz numbers and twisted stabilized orbital integrals (with J. Rohlfs), Mathematische Annalen **296** (1993).

Michael Stillman

Associate Professor of Mathematics

My main areas of interest are computational algebra and algebraic geometry, commutative algebra, and algebraic geometry. My original interest in computational methods was their application to problems in algebraic geometry. Since then, my work has proceeded in several related directions. I have studied the complexity of the algorithms (mainly Gröbner bases). I have been developing algorithms for computing in commutative algebra and algebraic geometry. For example, I have developed algorithms for manipulating line bundles in algebraic geometry (with M. Brundu), computing Hilbert functions (with D. Bayer), and finding integral closures of polynomial rings.

My original interest in these methods was to actually use them in my research in algebraic geometry. D. Bayer (of Columbia) and I have designed and implemented a specialized computer algebra system, which we call "Macaulay", which includes many of these algorithms. Hundreds of researchers use this system. The latest version includes algorithms for a large number of useful operations in algebraic geometry (written with D. Eisenbud).

Selected Publications:

A Criterion for Detecting m-regularity (with D. Bayer), Invent. Math. **87** (1987), 1–11.

A Theorem on Refining Division Orders by the Reverse Lexicographic Order (with D. Bayer), Duke Math. J. **55** (1987), 321–328.

Determinantal Equations for Algebraic Curves of High Degree (with D. Eisenbud and J. Koh), Amer. J. Math. **110** (1988), 135–147.

On the Complexity of Computing Syzygies (with D. Bayer), J. Symbolic Comp. **6** (1988), 135–147.

Computing the Equations of a Variety (with M. Brundu), Trans. AMS (1991), to appear.

Some Matrices Related to Green's Conjecture (with D. Bayer), Sundance Conference Proceedings on Free Resolutions (1991), to appear.

Robert S. Strichartz

Professor of Mathematics

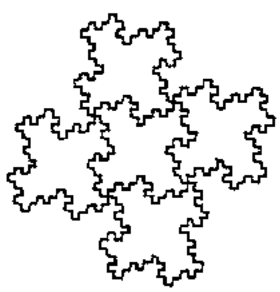
I am interested in a broad spectrum of mathematics centered around harmonic analysis. One can describe harmonic analysis roughly as the study of how complicated functions are built up by superimposing simple pieces. There are many different kinds of harmonic analysis, depending on the space on which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

In my thesis I studied Sobolev spaces, an important class of function spaces useful in the theory of partial differential equations, and gave an important characterization of Sobolev spaces with smoothness coefficient not equal to an integer. (*Multipliers on Fractional Sobolev Spaces*, J. of Math Mech. **16** (1967), 1031–1060)

In my early work I studied applications of harmonic analysis to wave equations (*Convolutions with Kernels Having Singularities on Spheres*, Trans. Amer. Math. Soc. **148** (1970), 461–478; *A Priori Estimates for the Wave Equation and Some Applications*, J. Func. Anal. **5** (1970) 218–235; and *Restrictions of Fourier Transforms to Quadratic Surfaces and Decay of Solutions of Wave Equations*, Duke Math J. **44** (1977), 705–714) and made contributions to the theory of pseudo-differential operators (*A Functional Calculus for Elliptic Pseudo-Differential Operators*, Amer. J. Math. **94** (1972), 711–722) and harmonic analysis on semi-simple symmetric spaces (*Harmonic Analysis on Hyperboloids*, J. Func. Anal. **12** (1973), 341–383).

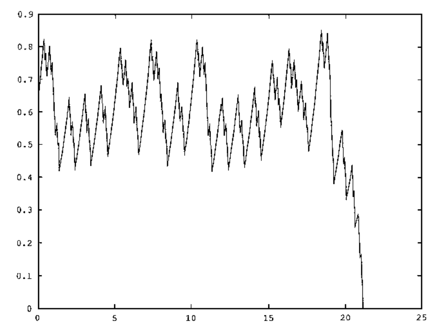
Beginning in the 1980's, my work became more geometric. I applied harmonic analysis to integral geometry (*L^P Estimates for Radon Transforms on Euclidean and Non-Euclidean Spaces*, Duke Math J. **48** (1981), 699–727), in which the central problem is to reconstruct a function from its integrals over geometrically simple sets such as straight lines or planes. This is the mathematical theory that underlies the modern advances in X-ray diagnoses. I used Riemannian geometry as a kind of metaphoric prism to understand the significance and relationships among the basic concepts and constructions of harmonic analysis (*Analysis of the Laplacian on a Complete Riemannian Manifold*, J. Functional Anal. **52** (1983), 48–79, and *Harmonic Analysis a Spectral Theory of Laplacians*, J. Func. Anal. **87** (1989), 51–148). My idea is that in order to understand a theorem in harmonic analysis on Euclidean space you have to find its proper "context," the most general class of geometric spaces for which there is an analogous theorem. I also studied a generalization of Riemannian geometry which I am trying to call "Sub-Riemannian" (as opposed to the unwieldy name "Carnot-Caratheodory"). This geometry is related to sub-elliptic differential equations, and arises naturally in the theory of nilpotent Lie groups (*Sub-Riemannian Geometry*, J. Diff. Geom. **24** (1986), 221–263).

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

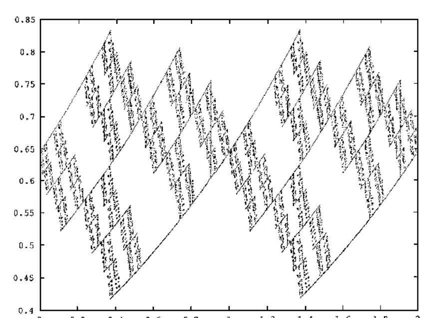


I have developed the idea of a Fractal Plancherel Theorem, both in the general case (*Fourier Asymptotics of Fractal Measures*, J. Func. Anal. **89** (1990), 154–187) and for self-similar measures (*Self-Similar Measures and their Fourier Transforms I, II, III*, Indiana U. Math. J. **39** (1990), 797–817; **42** (1993), 367–411; Trans. Amer. Math. Soc. **336** (1993), 335–361), in which I showed how the fractal properties of a measure show up in the asymptotic behavior of its Fourier transform.

In connection with this work I have become involved with what might be called "experimental 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, to appear; and *Nonlinear Self-Similar Measures and their Fourier Transforms* (with D. Glickenstein), Indiana U. Math. J. **45** (1996), 205–220.). For example, the following is a graph of the density of the standard Cantor measure at a point x chosen at random, graphed on a logarithmic scale (the density is $\mu([x-r,x+r])/(zr)^{\alpha}$ where $\alpha = \log 2/\log 3$ is the dimension of the Cantor set, μ is the Cantor measure, and the horizontal axis variable s is related to r by $r = 3^{-s}$, so that $r \to 0$ as $s \to \infty$).



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



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

My experimental research has been done in collaboration with undergraduate students, with the support of the REU Program (Research Experiences for Undergraduates) sponsored by the NSF. Starting in the summer of 1994, I have directed an REU site program at Cornell that involves 10 undergraduate students and 3 faculty members.

In addition to my research, I have maintained an interest in mathematical exposition. I received a Lester Ford Award from the Mathematical Association of America in 1983 for expository writing, and in 1982 I won the first prize in the French Museum Competition sponsored by the Mathematical Intelligencer. I have recently published two textbooks. *A Guide to Distribution Theory and Fourier Transforms*, CRC Press, 1993 and *The Way of Analysis*, Jones and Bartlett, 1995, based on course notes that have been used at Cornell for many years in Math 413, 414, 422 and 515.

Moss Sweedler

Professor of Mathematics

Over the years I have conducted research in the areas of: Hopf algebras and coalgebras, commutative algebra and algebraic geometry, semi-algebraic geometry, homological algebra, algebraic groups, purely inseparable field extensions and general positive characteristic phenomena, simple algebras and generalizations of the Brauer group, differential algebra, Buchberger theory (Groebner bases) and other constructive methods in algebra and general algorithms. My research in computer related mathematics involves development in theory, algorithms and applications.

For several years I have headed ACSyAM, the national computer-algebra or mathematical computation center founded and supported by the Army Research Office. ACSyAM is concerned with the mathematics and computer science relating computer science and mathematics, or in James Davenport's terms, the field underlying: "Computers doing mathematics not just arithmetic." The ACSyAM program includes: long and short term visitors, technology transfer, research, and development. ACSyAM participation includes personnel from many Cornell Departments, as well as collaborating scientists beyond Cornell.

Professional Activities: Member of ACM/SIGSAM, AMS and SIAM/AG on Discrete Mathematics. Director of the Army Center of Excellence for Symbolic Methods in Algorithmic Mathematics.

Invited Lectures:

Computational commutative algebra, NSA.

Selected Publications:

A Theory of Stabilizing Algebraic Algorithms (with Kiyoshi Shirayanagi), submitted JSC.

Why You Cannot Even Hope to Use Groebner Bases in Public Key Cryptography: an Open Letter to a Scientist Who Failed and a Challenge to Those Who Have Not Yet Failed (with Deh Cac Can, Julia Ecks, Theo Moriarty, R. F. Ree), JSC **18** (1994), 497–501.

Using Gröbner Bases to Determine the Algebraic and Transcendental Nature of Field Extensions: Return of the Killer Tag Variables, Applied Algebra, Algebraic Algorithms and Error-Correcting Codes (G. Cohen, T. Mora, O. Moreno, eds.), Springer LNCS 673 (1993), 66–75.

Low Degree Solutions to Linear Equations with $K[X]$ Coefficients (with Michael Kalkbrener and Lee Taylor), JSC **16** (1993), 75–81.

Maria S. Terrell

Adjunct Associate Professor of Mathematics

Assistant Dean for Advising in the College of Arts and Sciences

Maria Terrell's recent interests have included tensegrities, the history of Mathematics, and Mathematics education. With the help of an NSF curriculum development grant she has developed an introductory level course which explores geometry, optics and perspective.

Robert E. Terrell

Adjunct Associate Professor of Mathematics

Bob Terrell enjoys teaching Mathematics, and has written software for teaching partial differential equations. He has also written introductory notes on differential forms, and a paper and software on stereograms. He was once an engineer, and might be the only member of the department with patents on machinery.

Lloyd N. Trefethen

Professor of Computer Science
Director of Graduate Studies

My field is numerical analysis or scientific computing: the study of algorithms for solving the problems of continuous applied mathematics. Much of my work within this area concerns non-normal matrices and operators and their eigenvalues and pseudospectra. Among my recent collaborators are Cornell graduate students Divakar Viswanath, Yohan Kim, Vicki Howle, Gudbjorn Jonsson, Joe Flaherty and Vijay Menon.

Rather than survey our recent activities, let me mention one project with Divakar Viswanath that has given us particular pleasure. Everybody knows the Fibonacci sequence $f(n+1) = +f(n) + f(n-1)$, whose solutions grow asymptotically at the rate $1.618034\ldots$. Now, what if the + signs are replaced by + or − signs chosen at random? Experiments still show exponential growth — but how fast? By relating the problem to a continuous-state Markov chain with a fractal invariant measure, Viswanath has managed to prove that with probability 1, the exponent lies between 1.1319880 and 1.1319884. This seemingly specialized problem has connections with Stern-Brocot sequences, random matrix products, dynamical systems, continued fractions, ergodic theory, Kleinian groups, condensed matter physics, and wavelets — and, of course, non-normal operators.

Professional Activities: Member of the editorial boards of SIAM Review (lead section editor), SIAM Journal on Numerical Analysis, Journal of Computational and Applied Mathematics and Numerische Mathematik. Member of the SIAM Council. Member of the Fox Prize in Numerical Analysis committee.

Administrative Activities: Member of the Applied Mathematics Program and Colloquium Committees. Acting member of the General Committee of the Graduate School.

Invited Lectures:

The Chebyshev polynomials of a matrix; SIAM annual meeting, Kansas City (July 1996).

Non-normality, nonlinearity, and transition to turbulence, SIAM annual meeting, Kansas City (July 1996); invited lecture at AIChe annual meeting, Chicago (Nov. 1996).

The condition number of a random triangular matrix, Argonne National Laboratory (Nov. 1996).

Should numerical stability be defined by interpreting $O(\epsilon)$ literally?, invited address, Foundations of Computational Mathematics, IMPA, Rio de Janeiro (Jan. 1997).

Random triangular matrices, Foundations of Computational Mathematics, IMPA, Rio de Janeiro (Jan. 1997); Courant Institute, New York University (Apr. 1997).

Stability of Gaussian elimination, invited address, 17th Biennial Dundee Conference on Numerical Analysis (June 1997).

Selected Publications:

Pseudospectra of the Wave Operator with an Absorbing Boundary (with T. Driscoll), Jour. Comp. Appl. Math. **69** (1996), 125–142.

Pseudospectra of Linear Operators; in ICIAM '95: Proceedings of the Third International Congress on Industrial and Applied Mathematics, Akademie-Verlag, Berlin, 1996, 401–434.

Low-Dimensional Models of Subcritical Transition to Turbulence (with J. Baggett), Physics of Fluids **9** (1997), 1043–1053.

Numerical Linear Algebra (with D. Bau, III), SIAM, Philadelphia, 1997.

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 and surfaces.

Awards and Honors: NSF Visiting Professorships for Women, Cornell University (1984–85). Invited hour address, AMS Summer Meeting, Provo, Utah (1986). NSF Career Advancement Award, MSRI (1989). Research Professorship, MSRI (1995).

Professional Activities: Member-at-large of the Council of the AMS. Referee for professional journals.

Selected Publications:

Spherical Posets and Homology Stability for $O_{n,n}$, Topology **20** (1981), 119–132.

Moduli of Graphs and Automorphisms of Free Groups (with M. Culler), Inventiones **84** (1986), 91–119.

Equivariant Outer Space and Automorphisms of Free-by-Finite Groups (with S. Krstic), Comment. Math. Helvetici **68** (1993) 216–262.

A Group-Theoretic Criterion for Property FA (with M. Culler), Proc. AMS **124** no. 3 (1996), 677–683.

Cerf Theory for Graphs (with A. Hatcher), Jour. London Math. Soc., to appear.

Lars B. Wahlbin

Professor of Mathematics

At present one can compute "solutions" to very tough nonlinear, singular problems on, say, a supercomputer. Most often, numerical analysis does not furnish theorems that cover a practical situation, but it provides insight into the behavior of the relevant numerical method on carefully chosen model problems with, at best, some of the most pertinent difficulties of the real problem present.

My work in numerical analysis is aimed at gaining a fundamental understanding of numerical methods. Such insight is also necessary for constructing better algorithms. My particular interest is in methods for partial differential equations, and lately I have been studying the precise and detailed behavior of the finite-element methods in a variety of problems; the most interesting ones contain singularities of various degrees of nastiness.

Professional Activities: Managing editor for Mathematics of Computation.

Selected Publications:

Local Behavior in Finite Element Methods; In Handbook of Numerical Analysis (P. G. Ciarlet and J. L. Lions, eds.), Vol.II (Part 1), North Holland (1991), 353–522.

Superconvergence in Galerkin Finite Element Methods, Springer Lecture Notes in Mathematics 1605, Springer-Verlag New York, 1995.

Beverly H. West

Senior Lecturer of Mathematics

My chief interest is in mathematics teaching, using interactive computer graphics, particularly in differential equations, multivariable/vector calculus, and dynamical systems (both real and complex).

I've spent a fantastic year '96–'97 as Visiting Professor of Mathematics at Harvey Mudd College of Science and Engineering, in Claremont, CA. Half my time was devoted to teaching differential equations to 10% of the student body (full of amazing students) and co-advising a team of seniors solving a real-world problem in the industrial "Mathematics Clinic" for which Harvey Mudd is famous. (I'll speak on that at Cornell in the fall.)

The other half of my time was spent coordinating, with Courtney Coleman, the final development of the *ODE Architect*, an NSF-sponsored laboratory resource package for differential equations. *ODE Architect* combines 14 multimedia modules with an open-ended solver and a companion book. Since the modules and chapters are being written by colleagues at nine different institutions in the CODEE/NSF Consortium, with a publisher in NYC and programmers in New Jersey, coordination has been a pretty demanding challenge!

Awards and Honors: Invited address, *Computer graphics in mathematics education*, at the Grand Opening of Fields Institute, Waterloo, Ontario (1992). Plenary address, *Computer graphics in differential equations*, at Seventh Int'l Congress on Mathematical Education (ICME7), Quebec (1992). Guest Editor of The College Mathematics Journal for November 1994 issue devoted to innovations in the teaching of differential equations.

Professional Activities: Member of the MAA, SIAM, AWM, NYAS, and CODEE (NSF Differential Equations Consortium with Harvey Mudd College, Rensselaer Polytechnic Institute, St. Olaf College, Washington State University and West Valley Community College to promote computer graphics experimentation in differential equations courses and provide workshops). Editor of the CODEE newsletter. Software reviews editor for the College Mathematics Journal.

National Advisory Board for a University of Connecticut NSF project on Computer Graphics in Calculus (1992–93), for Ed Dubinsky's NSF project on Collaborative Learning (1994–96), and for Silvia Heubach's

California State University at Los Angeles NSF project on An Innovative Modeling Approach at the Freshman/Sophomore Level (1997–99). Committee to review the Mathematics Department, Southern Oregon State College (1995).

Invited Lectures:

ODEs in the lab and on the web and *Highlights and pitfalls in ODE reform*, two panels; and a workshop on Interactive Differential Equations & Dynamical Systems, all at International Conference on Technology in Collegiate Mathematics (ICTCM), Reno, NV (1996).

Differential equations come alive without a cookbook, University of Southern California (1997).

Empowering students in differential equations, University of Redlands (1997).

Chaos and control, Claremont Colleges (1997).

Teaching ordinary differential equations, a survey of laboratory resources and ways to use them, daylong workshop, NSF Faculty Enhancement Conference in Linear Algebra and Ordinary Differential Equations, SUNY at Oswego (1997).

Teaching differential equations dynamically, organizer for minisymposium, SIAM Conference on Applications of Dynamical Systems, Snowbird, UT (1997).

Selected Publications:

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

*Analyzer** (with D. Alfors), an exhaustive software package for studying functions of a single variable (1990 EDUCOM/NCRIPTAL Distinguished Mathematics Software Award), Addison Wesley, 1992.

MacMath (with J. Hubbard), 12 interactive graphics programs for the Macintosh, to accompany the Differential Equations texts, second edition, Springer-Verlag, 1994.

A New Look at the Airy Equation with Fences and Funnels (with J. Hubbard, J. McDill and A. Noonburg), College Mathematics Journal (1994); Proceedings of the Organic Mathematics Project (1996); CECM at Simon Fraser University (1997).

Differential Equations: A Dynamical Systems Approach (with J. Hubbard), Springer-Verlag; Part I: One-Dimensional Equations, 1991, 1997; Part II: Higher-Dimensional Equations, 1995.

Interactive Differential Equations (with S. Strogatz, J. M. McDill, J. Cantwell and H. Hohn), a CD-ROM with laboratory workbook, Addison Wesley Interactive, 1996, 1.1 for Mac and 2.0 for Windows, 1997.

James West

Professor of Mathematics

My research has focused on the topology and symmetries of manifolds of finite and infinite dimensions, and on the related topics of polyhedra, absolute neighborhood retracts, function spaces and spaces of sets.

An example of the interplay between these theories is that manifolds modeled on the Hilbert cube appear naturally in several ways as limits of stabilization processes for finite-dimensional objects, and, unlike standard function space stabilization, retain more of their important properties, e.g., simple homotopy type. Study of the Hilbert cube manifolds has produced several of the initial breakthroughs in introducing e-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 the AMS and Fundamenta Mathematicae.

Selected Publications:

Infinite Products Which are Hilbert Cubes, Trans. AMS **150** (1970), 1–25.

The Hyperspace of the Closed Unit Interval is a Hilbert Cube (with R. M. Schori), Trans. AMS **213** (1975), 217–235.

Mapping Hilbert Cube Manifolds to ANR's, Ann. Math **106** (1977), 1–18.

Equivariant h-cobordisms and Finiteness Obstructions (with M. Steinberger), Bull. AMS (NS) **12** (1985), 217–220.

Non-linear Similarity Begins in Dimension 6 (with S. Cappell, J. Shaneson and M. Steinberger), Amer. J. Math. **111** (1989), 717–752.

Fibrations and Bundles with Hilbert Cube Manifold Fibers (with H. Torunczyk), Memoirs of the AMS **406** (1989), iv + 75 pp.

Visiting Faculty Program Participants

Stephen Hilbert
Ithaca College

When I arrived at Cornell, I had two specific objectives: to see how mathematical software (in particular MATLAB) was integrated into classes and to teach calculus in a different setting. In addition, I wanted to accomplish some of the following: learn more about the areas I teach; learn new (for me) mathematics, preferably some math which would fit into the undergraduate curriculum; and learn some biology and the math needed in current biology, since I think many new applications of math will come from biology, as well as look for topics for student investigation. I was eagerly anticipating a year when I could concentrate all my attention on mathematics and teaching. For me one of the most appealing parts of being a visitor was that I would not be a member of any departmental or college committees.

During the fall, I attended Biometry 451 taught by Gary Churchill. In addition to introducing several models from biology, the course included a weekly computer lab using MATLAB. This increased my facility with MATLAB as well as giving me some experience in simulation. The lab sessions were well designed and very useful. Another visitor, Mike White, was also taking this course and we were able to discuss this course as well as other topics throughout the year.

I attended Persi Diaconis' *Markov Processes* course which was superb. He did a great job of starting from an introductory idea and advancing to recent results in many topics in this field. I also was able to try some of my improved MATLAB skills to run simulations for a problem from this course.

I also attended the lectures in Biochem 331. I started with no background but still learned a lot and saw some applications of mathematics that I hope to incorporate in my undergraduate classes. I was particularly impressed with the electronic support for this course. (Web pages included previous quizzes and exams, lecture notes for each lecture from graduate assistants and even a few short animations in addition to the usual list of assignments and office hours.)

In the spring I attended the OR&IE 361 lectures given by Rick Durrett. These were excellent and also helped fill in background for some of the models I had seen in the Biometry course in the fall.

I attended Nick Trefethen's course in mathematical software, CS 422/522, and did some of the programming assignments. This course was a fabulous resource. The course was divided into 7 sections, each dealing with a different type of mathematical software. The lectures provided lots of background, references and thought provoking ideas. The programming assignments used a tool of that type to solve a particular problem.

I also attended Theoretical and Applied Mechanics 578, *Nonlinear Dynamics and Chaos*, taught by Prof. Steve Strogatz. This was a great course which covered a lot of concepts that can be used in the undergraduate curriculum. This course also made very good use of technology to demonstrate these concepts.

During the spring I also participated in History 443 (a seminar on the history of gifts and exchanges). This was an excellent and stimulating course. I was taking it because I enjoy history, not for its mathematical content. Some of the readings did involve statistics and kinship diagrams but nothing like a mathematical theory of equity. This course also gave me an appreciation for the workload of humanities courses. The participants had to read and discuss 300–400 pages of fairly dense analysis each week.

Looking back it appears I had a plan, but most of this was serendipity made possible by the rich intellectual resources available at Cornell. One suggestion that might help future visitors would be to make available some listing of courses that involve mathematics offered by other departments. (I attended courses in Theoretical and Applied Mechanics, Biometry, Computer Science and Operations Research, as well as Mathematics, and I'm sure there are other departments that contain courses of interest to visitors.)

Outside of class I also participated in a few of the Occasional Seminars on Undergraduate Education and attended a mix of the many seminars available on the campus.

I taught two sections of project-oriented second-semester calculus (Math 112) in the spring. I appreciated the opportunity to use projects in a different setting. (I am part of a group that has been using projects and activities in calculus at Ithaca College since 1989.) I enjoyed these classes, and the department's commitment to student learning was demonstrated by keeping these classes small enough for the students to know each other as well as the instructor. Debra Boutin and Nat Miller, who were teaching the other sections of project-oriented calculus, helped me adjust to a different university. We also had some interesting discussions about the objectives and pedagogy of the course.

One of the methods I use to improve my teaching is to observe other teachers and see what I think works.

During this year I was part of a small working seminar, a traditional chalkboard lecture class, a large lecture, a large lecture which usually included working computer examples, a class with a weekly computer lab, a class with frequent computer and film demos, and a large lecture with lots of electronic backup. I thought all the classes I attended were well taught, and several were exceptional. I am very pleased with the year and feel the program provided an exceptional opportunity for my intellectual and academic growth.

Finally, I would like to thank the staff of the Mathematics Department, particularly Cathy Stevens, for all their assistance during the year.

Kazem Mahdavi

SUNY at Potsdam

I had at least five things in minds when I got to Cornell: to secure a grant, to do publishable and quality research, to learn more mathematics, to contribute to the scholarly atmosphere of the Mathematics Department and to teach. I am glad to say that I have made progress on all fronts.

I received a grant from the NSF to create a summer research program for undergraduates at SUNY Potsdam (joint with Clarkson University) and recruited twelve students for the summer REU program at Potsdam.

I have been working on two papers this year. One is a joint paper (*Deformations of length functions in groups*) with Professor Cohen, which we hope will be published in a respectable journal. The other is a paper that I am finishing on submonoids of hyperidentities (joint with K. Denecke from Potsdam, Germany).

I presented the following talks: *Automatic group theory*, Topology Seminar, Cornell University (Fall 1996); *Relatively free groups*, Topology Seminar, Cornell University (Fall 1996); an invited talk at Ithaca College, Mathematics Department (Fall 1996) on *Humanistic Mathematics*; and *Employment at four year colleges*, Occasional Seminar on Undergraduate Teaching, Cornell University (Fall 1996).

I audited the following courses: *Algebraic Geometry*, *Applicable Analysis*, *Riemannian Geometry*, *Differential Geometry* and *Group Theory*. I also took the MAA mini course *Involving Undergraduates in Research* in San Diego, CA (Jan. 1997) and regularly attended the Topology Seminar, the Seiberg-Witten Seminar, the Oliver Club and the Olivetti Club.

Conferences that I attended were the Group Theory Conference at Montreal University (Oct. 1996), the AMS-MAA Annual meeting in San Diego, CA (Jan. 1997), the Syracuse University Graduate Mathematics Conference, and the 34th annual Cornell University Topology Festival (May 1997).

I taught two sections of Math 111 in fall 1996 and two sections of Math 112 in spring 1997. It was indeed a pleasure to teach Cornell students. In general, I do not like the word *teaching*, and I hate grading students and ranking them. I prefer to help other people by creating a great environment for learning, to motivate, to encourage and to help students to become what they have the potential to be. I like to help students to discover mathematics, and approach mathematics with the right attitude. I like to make all my students feel that they are great mathematicians. I like to help my students feel confident. I like to challenge my students. I believe our students are the best that the world has ever offered, and we need to create the best environment that we can for them to learn and enjoy mathematics.

I provided video tapes on representation theory and Donaldson theory to faculty and students who were interested in the subject.

I finished my second fictional novel. My first book is to appear soon.

I did my best to take advantage of all of the very interesting things that were going on in the Mathematics Department. Almost every day I wished that there were more than twenty-four hours in a day.

Lastly, I should add that I attended many shows, performances, etc. at Cornell. I enjoyed living in Ithaca, and I hope I will be given another chance, in the future, to be a Cornell visitor.

It was indeed a treat for me to visit the Cornell Mathematics Department for the 1996–97 academic year. A combination of excellent and helpful faculty members, highly qualified visitors, a great library holding, interesting courses, seminars, and talks helped me to learn more mathematics and do research. Who could ask for more, if one is holding a torch for mathematics?

I owe my coming to Cornell to Professor Marshall Cohen. I would like to thank Professor Thomas Rishel for his help, as well.

The Mathematics Department staff made me feel very welcome and helped me to adjust. They are the best. In particular I would like to thank Catherine Stevens, Joy Jones, Michelle Klinger, Arletta Havlik and Terri Denman for their help and support.

John Meier

Lafayette College

Most academic jobs are composed of three parts: teaching, research and committee work. During my year at Cornell I have had a wonderful (perhaps optimal) mixture of the three. In the fall I taught two sections of Math 111 where I was the *unofficial sub-czar* for the calculator based sections, and in the spring I taught a graduate course on finiteness properties of infinite groups which emphasized my favorite research topic — the Σ-invariants of Bieri, Neumann, Strebel and Renz. My research was greatly aided by having a comparitively light teaching schedule, and by being in an active department with a number of excellent scholars in geometric group theory. And finally, I served on no committees.

It was both fun and challenging to teach Math 111, a course I must have taught a half dozen times as a graduate student at Cornell. Calculus at my home institution (Lafayette College) would best be classified as *semi-reformed* with a strong emphasis on the use of *Mathematica* assignments. It was interesting to oversee the use of calculators in a very traditional calculus course such as 111. My general approach was to teach the class, not ignoring the existence of the graphing calculator. By and large it seemed successful, and I noticed that a number of the assignments I created in the fall were being used by the spring sections. While a graduate student I thought it was difficult to develop and maintain connections with Cornell students. My training at Lafayette must have improved this ability, since I was often flooded by students both in and out of office hours. I offer apologies for the noise to the faculty who tried to work in the offices around me.

Teaching an upper-level graduate course is an experience I may never get to repeat. Every now and then it would become quite scary as I tried to organize a large pile of research into one coherent course. The students and faculty attending were very supportive, attentive and just a lot of fun to stand in front of twice a week. If only I had understood the material at the start of the course as well as I do now . . . .

I regularly attended the Occasional Seminar on Undergraduate Education and the Topology Seminar. I also took an upper level Archaeology course — Mesoamerican Religion, Science and History. We spent a lot of time talking about pre-conquest Mesoamerican cultures with a focus on their glyphs and calendrical systems. The added background and understanding of Mesoamerican calendrics and glyphs will end up finding its way into my *Counting and Culture* course at Lafayette.

In terms of research, Tom Rishel and I got to eat a lot of lunches together while we were (supposedly) working on our book *Adding the Words*, a text on effective narrative and cognitive strategies for teaching mathematics. I also spent a lot of time writing up projects I had been putting off and working with Noel Brady on connectivity at infinity for right angled Artin groups. Perhaps my most memorable *publication* from this year will be the first ever Topology Festival T-shirt, which sold out almost immediately.

In addition to my academic work, I took some time off to work on my hockey game. The skating improved, but I never turned into the goal scoring machine I had hoped for. I also was the co-chair of the New York Senior Women's Ice Hockey Tournament hosted by the Ithaca Sirens. This summer I should squeeze in a few hiking trips in the Adirondacks before heading back to Pennsylvania.

Thomas A. Stiadle

Cornell University

I am grateful for the opportunity I have had to participate in Cornell's Visiting Faculty Program. The benefits are many, but some that stand out are the chance to teach Calculator Calculus, the various seminars and classes I attended, and the time for pursuing research.

During the fall semester, I was able to teach two sections of Calculator Calculus. Graphing calculators allow more thorough examination of various functions than is easily done by hand. This requires interaction of theory with calculator use. Thus students must develop a better understanding of the theory. Anyone who teaches calculus soon has "seen all the possible examples." This is because there are so few problems that are algebraically tractable for students working with pencil and paper. Calculators release instructors from this constraint. One can now ask a student to, say, estimate all the roots of a rather complicated function and then justify the answer.

Ironically, some students who entered the course believing the calculator would "do all the work for them" ended up learning more than they would otherwise. In this way Cornell students can work up to the high levels of which they are capable.

My only regret regarding graphing calculators is that they are not yet in second-semester calculus (Math 112).

It seems to me that this course is rife with calculator topics such as integration, infinite series, and polar coordinates. Still, it was fun to teach these subjects to students who were fully able to understand.

Cornell's large, active Mathematics Department supports many regular seminars in various disciplines. I attended the weekly Topology Seminar. This included a healthy dose of geometric group theory, an interest of mine, as well as other topics. I also enjoyed the department's general seminar, the Oliver Club. This exposed me to a variety of mathematical subjects that I might not otherwise have had time to explore. Besides seminars there are ample classes on advanced topics, due to the large number of graduate students. I particularly appreciated Professor Hatcher's course on cohomology theories (Math 654).

Teaching only two courses per semester left me with plenty of time for research. During the fall semester, Professor Jim West helped me improve some theorems on which I had been working. In the spring, I was able to pursue related topics with the time I had.

Finally, my experience here would have been much diminished without the Mathematics Department's expert administrative staff. They all perform their duties in the most efficient yet thorough manner. While doing so, they remain pleasant, polite and helpful. I can only hope to encounter such professionals in the future.

Staff Profiles

Administration

Shirley Allen, Graduate Field Coordinator (1986): Shirley is responsible for the administration of the Mathematics Department graduate program beginning with the admissions process and continuing through graduation. She maintains matriculated student records, processes appointments and generally oversees the administrative functions of the graduate program, consisting of about 60 graduate students. For 1996–97, Shirley served as the primary resource person for the undergraduate program, which includes approximately 100 majors. She acted as liaison between faculty and their advisees, both majors and over 200 new students with undeclared majors. In addition, she coordinates, schedules, plans and oversees all department social functions.

Terri Denman, Accounts Coordinator (1985): Terri provides administrative, financial and personnel support for the Mathematics Department. In accordance with university and agency regulations, she develops research budgets and oversees proposal submissions to the Office of Sponsored Programs. She monitors account transactions, approves expenditures and maintains account information and records. She also processes non-academic appointments, maintains non-academic personnel records, oversees time collection, processes payroll vouchers, and distributes paychecks. Terri 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.

Rachel Engler, Network Administrator (1996): Rachel provides organizational and administrative computer support for the Department of Mathematics. She is responsible for the departmental computer servers including networking, backup, software and hardware installation, operations, and security. She designs and maintains departmental web pages, provides maintenance for the department computer systems — including UNIX, SUN, Macintosh, and PC operating systems — and provides computer consulting, diagnostic and troubleshooting support for department members. During the 1996–97 academic year, she also coordinated the faculty recruitment effort.

Arletta Havlik, Department Registrar (1968): Arletta provides secretarial and administrative support for the instructional and research programs of the Mathematics Department faculty. Her responsibilities include coordinating the paperwork, course enrollments and inquiries pertaining to enrollment in math courses, and she oversees the department's presence at the central course exchange each semester. In her role as department registrar, she coordinates course enrollments, evaluations, and grade submissions. She is the primary technical typist for the department, and prepares complex documents involving sophisticated typesetting software (TEX) which involves designing, editing and formatting.

Joy Jones, Building Coordinator (1980): Joy is the building coordinator and copyroom specialist for the department. She coordinates the day-to-day service operations provided to faculty, visitors, staff and students. She orders supplies and performs records and facilities maintenance, information gathering and data input. Joy assists the accounts coordinator with department bookkeeping, the chair's assistant with the academic appointment process, and foreign nationals with housing. She oversees the mailroom operations, maintains repair and renovation records and secures the building at night. During the past year she was also the backup department receptionist.

Michelle Klinger, Teaching Program Coordinator (1993): Mikki provides administrative support for the mathematics teaching program, assisting the associate chair and the director of undergraduate teaching. She coordinates assignment changes for teaching assistants and graders and oversees course room assignments and changes. She is responsible for course file management and screens inquiries pertaining to courses offerings. She also acts as back-up technical typist, processing original entry and editing of highly technical mathematical manuscripts. Mikki works with the administrative manager to compile information for the annual report and is the editor of departmental newsletters. She was also the department receptionist for the 1996–97 academic year.

Catherine Stevens, Assistant to the Chair (1969): Cathy provides executive, administrative and secretarial support to the chair and faculty of the Mathematics Department. She assigns office space and works with the associate chair to compile teaching and committee assignments. Cathy coordinates searches for the faculty recruitment process, processes academic personnel forms and maintains academic personnel files. She assists foreign nationals in obtaining proper visa status, arranges lectures and accommodations for prospective faculty/visitors, and schedules benefits counseling for new academic employees. She also hires, assigns and supervises undergraduate graders. 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 and long range aspects of the department. She assists the chair (and others) in administering selected academic activities including the course count, budget process, leave replacement funding and TA budget. She maintains, monitors and reconciles departmental appropriated, gift, and endowment accounts, and acts as liaison with major university offices. She oversees and participates in the publication of newsletters, the annual report and various external surveys, and generates a variety of department/college/university reports. Colette interviews, hires, assigns workloads and supervises the administrative support staff.

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 assists in the instruction each fall of Math 105 (Finite Mathematics), and 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. Often graduate students from other departments will benefit from his counsel on the use of a variety of mathematical techniques in their field of research. Dick also assists in the instruction each fall of Math 105 (*Finite Mathematics*) and each spring of Math 106 (*Calculus for Biologists*).

Mathematics Instructional Computer Lab

Douglas Alfors, Associate Director (1993): Doug works with Director Allen Back in hosting lab visits from a variety of classes (particularly Math 111) and helping to plan and prepare computer instructional materials.

Allen Back, Director (1993): Allen is responsible for the primary computer instruction laboratory for the teaching of mathematics. The lab is a teaching arm of the Mathematics Department, and the director addresses pedagogic issues in appropriate instructional uses of computers, acting as a resource person in all related areas. He is responsible for the installation and upkeep of both hardware and software as well as addressing all personnel issues of the lab including selection, training and supervision. Allen also contributes to the development of sample materials, assignments, help documentation and software of interest to faculty and staff. He gives demonstrations, helps with software use, serves as an advisor on technical issues and assists in relevant grant proposals.

Mathematics Library

Michelle Paolillo, Administrative Supervisor/Network Administrator (1995): Michelle is the library's network administrator and web master. She is also responsible for personnel management and records. She deals with problems related to the library management system including bills. Michelle is an experienced professional with reference questions and interlibrary loans.

Steven Rockey, Mathematics Librarian (1972): Steve is in charge of the library and makes all policy, management and budget decisions. He is the contact for questions about book, journal or other format purchases for the library. Drawing on twenty five-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.

Raj Smith, Circulation Supervisor (1994): Raj is in charge of circulation and reserve services. He is the operator of the library FTP server and is very involved in the library's computer services. Raj also trains and supervises student employees. He can help with many reference questions and is often your friendly first contact with the library.