FROM THE DEPARTMENT HEAD

Part of the task of any department head is to plan for the future. I am happy to say that in the case of the School of Mathematics this is an exciting and positive activity, though not always easy. The stature of our department and the importance of mathematics in science and engineering mean that we will play a central role in the new scientific initiatives of the University of Minnesota such as the new Digital Technology Center and the interdisciplinary program in Computational Biology. Our own Minnesota Center for Industrial Mathematics, directed by Professor Avner Friedman, continues its development at the forefront of innovative collaboration with industry. The Institute for Mathematics and its Applications (IMA), directed by Professor Willard Miller, is moving ahead with new plans to advance research in diverse fields. The IMA is one of two research centers in mathematics nationwide which are funded by the National Science Foundation; we are presently awaiting the result of the recompetition for support for the next five years beyond the year 2000. Discussing our reports and proposals to the National Science Foundation gave me a chance to review with pride the tremendous contributions our faculty have made to the success of this research center over the last fifteen years.

The engine that drives all our plans for the future is of course the success of our faculty in their individual research programs in pure and applied mathematics. I am also reminded very frequently that the distinction between pure and applied mathematics is rather artificial. Many people have heard by now of the importance of cryptography in the new world of the internet, and the role played in this area by number theory, and now also algebraic geometry, subjects often labelled as “pure”. Other examples could be given to demonstrate the unity of mathematics and the need to foster research in all areas, not just what is currently trendy. Incidentally, several of our Ph.D. graduates from diverse fields now work in industry on problems of computer security. It seems that the clarity and insight of mathematical thinking is well suited to the analysis of complex computer systems.

The School of Mathematics continues to make progress in updating courses and curricula to meet the needs of students. You will see some details of this elsewhere in this newsletter. Broadly speaking, our goal is always to foster the kind of conceptual thinking that will never become obsolete, and at the same time to provide exposure to appropriate new technology and relevant applications of mathematics. Our special calculus courses aimed at students in engineering, science and biology and our curricula in applied and industrial mathematics are examples of this. We also try to meet the need for top-quality teachers in the public schools through our innovative undergraduate and graduate courses and programs in mathematics education. There is much work to be done here, and indeed I think we will never be in a position to rest on our laurels, but the energy and creativity of our faculty have already made a big difference. I take great satisfaction as head in supporting this work and look forward eagerly to the next steps.

Naresh C. Jain, Head

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INCOMING FACULTY

We welcome the following new members of the School: Assistant Professor Dihua Jiang, whose specialty is number theory, and the new Dunham Jackson Assistant Professors Matthew G. Killough, in numerical analysis, Vladimir Markovic, in complex analysis, and David P. Nicholls, in applied mathematics. The Dunham Jackson Assistant Professor appointments are for a term of three years.

- Assistant Professor Dihua Jiang received his Ph.D. from Ohio State University in 1994 and came to us from Yale University where he was a Gibbs Instructor. He also held a Postdoctoral Research Fellowship at the Mathematical Sciences Research Institute in Berkeley as well as an NSF Postdoctoral Fellowship, and spent a term at the Institute for Advanced Study in Princeton. His research is on application of representation theory to number theory, especially to automorphic forms and L-functions.

- Assistant Professor Matthew G. Killough received his Ph.D. from New York University in 1998, where he held a Sloan Doctoral Dissertation Fellowship. His research areas are scientific computing, partial differential equations, and materials science.

- Assistant Professor Vladimir Markovic received his Ph.D. from Belgrad University in 1998. His research area is complex analysis, especially quasiconformal mappings, Teichmuller theory of Riemann surfaces and harmonic mappings.

- Assistant Professor David P. Nicholls received his Ph.D. from Brown University, where he held a National Science Foundation Graduate Fellowship. His research, in applied mathematics, is on water waves, fluid dynamics, and numerical methods for partial differential equations.

MAJOR HONORS AND RECOGNITIONS

- Professor Maury Bramson was an invited speaker at the International Congress of Mathematicians held in Berlin in August 1998. Professor Bramson’s main research area is probability theory.

- Professor Dihua Jiang was awarded a Sloan Research Fellowship. Professor Jiang’s specialty is number theory.

- Regents’ Professor Avner Friedman was elected a foreign member of Real Academia, the Spanish equivalent of the U.S. National Academy of Sciences, adding another honor to his already very long list of major honors and recognitions. A symposium to celebrate Professor Friedman’s 65th birthday was held May 1-3, 1998.

- Professor John Lowengrub received the 1998 Francois Frenkel prize from the American Physical Society, Fluid Dynamics Division. The Frenkel prize is an annual award given to young researchers for an outstanding paper published in the Physics of Fluids journal during the previous year. John was recognized, together with Thomas Hou (Caltech) and Michael Shelley (Courant Institute of Mathematical Sciences), for their joint paper titled The long time motion of vortex sheets with surface tension. This paper used a novel numerical algorithm (based on a careful mathematical analysis of the equations of motion at small spatial scales) to completely characterize the effect of surface tension on interfaces between two ideal immiscible fluids in two dimensions. This solved an outstanding classical problem in the field. In addition, Professor Lowengrub participated in President Yudof’s Unparalleled Minds Symposium held in October, 1998. This symposium showcased the work of McKnight Professors at the University of Minnesota; Professor Lowengrub held a 1994-96 McKnight Professorship. At the exhibit, Professor Lowengrub displayed results from his most recent research which includes the investigation of computational problems in fluid dynamics and materials science.

- Professor Mikhail Safonov was an invited speaker at the International Congress of Mathematicians held in Berlin in August 1998. Professor Safonov’s main research area is partial differential equations.

- Professor Vladimir Sverak was awarded the 1998 Keith Medal of the Royal Society of Edinburgh for his paper Rank-one convexity does not imply quasiconvexity, published in the Proceedings of the Royal Society of Edinburgh. In the late 1940s, C.B. Morrey formulated his quasiconvexity condition which guarantees the lower semicontinuity of certain variational integrals. This condition is difficult to verify in practice, and thus he asked whether quasiconvexity is equivalent to the much more manageable algebraic condition of rank-one convexity. Professor Sverak’s paper answers C.B. Morrey’s question in the negative. The problem was of special interest to researchers in the theory of elasticity.

ACADEMIC VISITORS AND POSTDOCS

The following mathematicians are spending all or part of the 1998-99 academic year here:

Assistant Professors: • Santiago Betelu (University of Buenos Aires, fluid dynamics, nonlinear diffusions, WS 1999), • Dongho Chae (Seoul National University, fluid mechanics, FWS), • Marco Fontelos (Ph.D. Universidad Complutense de Madrid, PDE, fluid mechanics, FWS), • Cynthia Kaus (Ph.D. Brandeis, education, applied mathematics, FWS), • Radha Kessar (Ph.D. Ohio State, group theory, FWS), • Mike Lawler (Ph.D. Brandeis, education, differential equations, FWS), • Hyeong-Gi Lee (Ph.D. New York...
University, computational fluid dynamics, FWS), •Norman Levin (Ph.D. University of Chicago, algebraic geometry, FWS), •Peng Lu (Ph.D. SUNY at Stony Brook, differential geometry, FWS), •Takao Nambo (Kobe University, control theory, S 99), •Daniel O’Loughlin (Ph.D. University of Minnesota, education, differential geometry, FWS), •Doug Shaw (Ph.D. University of Michigan, education, coding theory, FWS), and •Moxun Tang (Ph.D. University of Alberta, differential equations, FWS).

Associate Professors: •Xinfu Chen (University of Pittsburgh, PDE, F98), •Markus Linckelman (University of Paris 7, group theory, F98), •Rolando Magnanini (University of Florence, PDE, S99), •Zikica Perovic (University of Nis, Boolean algebras, FWS).

Professors: •Blaise Morton (Honeywell, MCIM, FWS), •James Olsen (North Dakota State University, ergodic theory, WSF 99).

Other Visitors:

Professors
•David Bressoud (On sabbatical from Macalester College, combinatorics, F98),
•Jaeduck Jang (Hankuk University, PDE, WSF 99),
•Soon Yeun Jang (Yonsei University, PDE, FWS),
•Boris Levitan (Minneapolis, inverse problems for Sturm-Liouville systems, FWS),
•Jing Ping Wang (Ph.D. Free University, Amsterdam, mathematical physics, FWS).

Distinguished Ordway Visitors:

The Ordway Visitors Program of the School brings highly distinguished mathematicians to Minneapolis for one month, or longer, to lecture and interact with faculty and students. The 1998-99 academic year visitors are Professors Michel Broué (University of Paris 7, representations of groups, S99), Albrecht Dold (University of Heidelberg, algebraic topology, October 98), Carlos Kenig (University of Chicago, harmonic analysis, May 99), Fang Hua Lin (Courant Institute, PDE, May 99), Philip Rosenau (Tel Aviv University, PDE, March 99), Lee Segel (Weizmann Institute, mathematical biology, F98), Michael Vogelius (Rutgers, applied mathematics, March 99), and Thomas Zink (University of Bielefeld, algebraic geometry, March 99).

RETIREMENTS

Professor Alfred Aeppli retired in December 1998. Alfred received his doctorate from ETH - Zürich in 1957 and spent three years at Cornell University before joining the School of Mathematics, as an Assistant Professor, in 1961. He was promoted to Associate Professor in 1962 and to Full Professor in 1966. He held visiting positions at the University of Oxford and the University of Heidelberg.

Professor Aeppli’s research areas are algebraic topology and differential geometry. Eight students received their doctorate under his guidance. Alfred has also been active in professional societies, serving as President of the North Central section of the Mathematical Association of America, 1970-71, and President of the University of Minnesota Education Association, 1976-80.

Professors Leon Green and Hans Weinberger retired in June 1998. Tributes to them appeared in last year’s Newsletter.

Deaths

Professor Jesus Gil de Lamadrid passed away on January 15, 1998, at the age of 71, after a year-long illness. He was on the faculty for 40 years and lived in Roseville.

Jesus was born in Ponce, Puerto Rico. He received his doctorate in 1956 from the University of Michigan, under the guidance of Professor E.H. Rothe. He spent one year at Ohio State University before joining the University of Minnesota in 1957. He was promoted to Associate Professor in 1964 and to Full Professor in 1967. He also held a number of visiting appointments, including at Yale University, University of Paris, University of Rennes, University of Munich, and the Indian Statistical Institute in Calcutta.

Professor Gil de Lamadrid’s specialty was Functional Analysis and Abstract Harmonic Analysis. He advised seven Ph.D. and two Master’s degree students. In recent years he was working on a Real Analysis textbook and other educational materials.

He is survived by his wife of 48 years, Elvira, sons Arthur and James, daughter Maria, sister Maria, grandchildren Meghan and Daniel, as well as several half-sisters and half-brothers.

Professor Emeritus Daniel Pedoe, passed away October 27, 1998 at the age of 87. A native of Britain, he joined the School of Mathematics in 1964 and retired from active service in 1981. In addition to the comprehensive three volume text "Methods of Algebraic Geometry", coauthored with W.V.D. Hodge, he also wrote several undergraduate textbooks and books popularizing mathematics. He is survived by two sons and six grandchildren.
CONFERENCES ORGANIZED UNDER THE AUSPICES OF THE SCHOOL

Rivière-Fabes Memorial Symposium

The second Rivière-Fabes Memorial Symposium will take place April 17 and 18, 1999. The main speakers will be Professor Carlos Kenig (University of Chicago) and Professor Jean Bourgain (Institute for Advanced Study, Princeton), each of whom will give two lectures. The symposium organizers are Professors Max Jodeit, Nicolai Krylov, Walter Littman and Wei-Ming Ni of the School of Mathematics.

For information (as it develops) please visit the School of Mathematics Web page, http://www.math.umn.edu and follow the link there to the page for the Symposium. If you have questions or comments, you may send them by email to Max Jodeit at jodeit@math.umn.edu.

The Rivière-Fabes Memorial Symposium was established in 1997 to honor two distinguished members of the School of Mathematics, the late Nestor M. Rivière and the late Eugene B. Fabes, who were close collaborators and friends. This Memorial Symposium continues, in an expanded form, the Nestor M. Rivière Memorial Lecture which has been held annually since 1987. Gene Fabes passed away on May 18, 1997. The new Symposium has been made possible by donations from friends and colleagues of Gene and Nestor to the University of Minnesota Foundation in their memory. Persons wishing to contribute to the symposium should send donations to the University of Minnesota Foundation, 1300 South 2nd Street, Suite 200, Minneapolis, MN 55455, with a cover note explaining that the donation is for the Rivière-Fabes Fund.

The first Rivière-Fabes Memorial Symposium on Analysis and PDE was held at the School of Mathematics on April 4 and 5, 1998. Due to the slightly early arrival of their daughter, Carlos Kenig was unable to attend. At short notice, Mikhail Safonov and Vladimír Sverák gave one lecture each. Despite competition for hotel rooms with a figure skating championship, everyone found a place to stay. Because of the dedicated and excellent staff we have, the Symposium went smoothly, including refreshments in the mornings and the buffet dinner Saturday evening at the Campus Club.

The lectures, in order of delivery, were: Mikhail Safonov, Estimates near the boundary for solutions of second order parabolic equations; Zhongxin Zhao, 3G theorem and its applications; Nicola Garofalo, Some recent progress in Carnot-Caratheodory geometry and in boundary value problems for subelliptic equations; and Vladimir Sverák, On the notion of global ellipticity for nonlinear systems of partial differential equations.

Pure, Applied and Industrial Mathematics: Strength through Connections

This conference, sponsored by the School of Mathematics and the Institute for Mathematics and its Applications, was held May 1-3, 1998 to celebrate the 65th birthday of Regents' Professor Avner Friedman. Professor Friedman was honored for his outstanding contributions to mathematics and his eleven year leadership of the IMA, which resulted in a major change in the culture and practice of industrial mathematics. His work has made researchers across a broad spectrum of mathematics actively aware of the intellectual challenges and practical importance of applied mathematics in industry. Because of the many successful collaborations he developed through the IMA, industry is much more aware of what mathematics can achieve. The speakers at the conference were: L. Caffarelli, University of Texas at Austin, P. Castro, Eastman Kodak Company, E. DiBenedetto, Northwestern University, W. Fleming, Brown University, J. Glimm, SUNY-Stony Brook, W. Littman, University of Minnesota, H. Ockendon, Oxford University, J. Ockendon, Oxford University, Z. Usiskin, University of Chicago, J. Velazquez, Universidad Complutense, Madrid, and Shmuel Winograd, IBM Research Division.

Yamabe Memorial Lecture

The eleventh annual Yamabe Memorial Lecture was given by Professor Peter Sarnak of Princeton University on May 28, 1998. He spoke on "Zeros of zeta functions and symmetry". This lecture series has been established jointly by Northwestern University and the University of Minnesota in memory of Hidehiko Yamabe (1923-1960) whose work on topological groups and geometry was an outstanding contribution to modern mathematics. The twelfth annual Yamabe Lecture will be given this spring at Northwestern University. The lectures are given in alternate years at the University of Minnesota and at Northwestern University.
Nonlinear Partial Differential Equations and Continuum Mechanics Conference

The conference was held June 8-12, 1998 to celebrate Professor John Ball's 50th birthday and was organized by Professors Richard James from the University of Minnesota Aerospace Engineering Department, Stefan Müller from the Max Planck Institute (Germany) and Vladimir Sverak of the School of Mathematics. The invited speakers were S. Antman (Maryland), K. Bhattacharya (Caltech), P. Constantin (Chicago), B. Dacorogna (Lausanne), C. Dafermos (Brown), Weinan E (Courant), L.C. Evans (Berkeley), M. Esteban (Paris), J. Erickson, G. Friesenecke (Oxford), P. Holmes (Princeton), I. Kukavica (Chicago), D. Kinderlehrer (CMU), M. Luskin (U of M), J. Marsden (Caltech), F. Murat (Paris), L. Nirenberg (Courant), F. Otto (UCSB), F. Reitich (U of M) and L.C. Young.

IT Alumni Society Lecture

The School of Mathematics, jointly with the IT Alumni Society, sponsored a lecture by Dr. Tony DeRose of Pixar Studios, titled "How Geometry is Changing Hollywood". The lecture, in the IT Public Lecture Series, took place May 21, 1998 in the Willey Hall Auditorium on the West Bank, and was attended by more than 200 people.

Dr. DeRose, formerly a professor at the University of Washington, talked about the digital revolution in film-making brought on by advances in computer technology, computational physics, and geometry. He provided a behind-the-scenes look at how fully digital films like Pixar's Toy Story, Geri's Game and A Bug's Life are made. He used computer graphics and video segments from Geri's Game to illustrate two technical advances. The technique of Recursive Subdivision Surfaces, which utilizes advanced tools of computational linear algebra, is used in modeling objects delineated by complex curved surfaces (such as the human head, hand, etc.). Simulated Cloth Dynamics, which utilizes so called beta-spline representation for curves and surfaces, is used to model the tension due to gravity, which is responsible for the natural appearance of clothing when worn by people.

Workshop on PDEs and Materials

Professors Robert Gulliver and Fernando Reitich are organizing a conference to be held April 30 to May 2, 1999 at the University of Minnesota on the topic, "Nonlinear PDE and Applications to Materials". The workshop is supported by the Participating Institutions of the IMA, by the Midwest Partial Differential Equations Seminar and by the National Science Foundation. Funds are available to support participation by qualified graduate students.

The workshop will bring together researchers in materials science, applications of PDEs, analysis of PDEs and numerics in a setting which will allow informal interaction as well as a selection of hour talks by leaders in the respective fields. In this manner, issues of intense interest in materials science will be brought to the attention of modelers, theoretical analysts and numerical analysts for discussion with the expectation that they will provide ideas and insight useful for the challenges offered by materials research. At the same time, new concepts and methods currently being brought to bear on the fundamental issues in the analysis of PDEs (numerical and theoretical) will be presented in a way which may open new paths of inquiry for modelers and for materials scientists.

Topics which will be discussed include level-set methods, viscosity solutions of scalar PDEs and of systems, nonlinear homogenization, multiple time scales, widely varying length scales, fast numerical methods, and mesoscale models derived from microscale with their relations with the macroscale viewpoint.

A distinguished list of scientists have accepted invitations to speak, including Oscar Bruno, Avner Friedman, Richard James, Robert Kohn, John Lowengrub, Mitchell Luskin, Geoff McFadden, Graeme Milton, George Papanicolaou, Michael Ortiz, Stanley Osher, Mete Soner and Vladimir Sverak.

Organizers are Robert Gulliver and Fernando Reitich. For registration and further information: http://www.ima.umn.edu/~gulliver/conf/pdemat.html

New Joint Mathematics/Physiology Seminar

Several members of our department have a deep interest in mathematical biology, including Professors Don Aronson, Avner Friedman, Claudia Neuhauser, Wei-Ming Ni and Hans Weinberger. Furthermore, mathematical biology is the focus of IMA activity during the 1998-1999 academic year. Thus last spring Professors Avner Friedman, Naresh Jain, Willard Miller (the Director of the IMA), and Hans Weinberger, contacted Professors Robert Miller, Richard Purple, and George Wilcox in the Physiology and Pharmacology Departments to explore the possibility of establishing a venue for discussion of issues of mutual interest. A two-hour highly successful seminar was held in the spring in which several faculty members of the Physiology and Pharmacology Departments discussed some of their research interests with a substantial mathematical component. It was then agreed that a joint seminar will be held monthly during the 1998-1999 academic year. The topics presented in the seminar thus far include mathematical modeling of dendritic spines in nerve cells, of wound healing, and of the dynamics of heart defibrillation.
OTHER CONFERENCE ACTIVITIES OF OUR FACULTY

Computability and Complexity in Analysis Workshop

Professor Marian Pour-El was a co-organizer, with K. Ko, A. Nerode, K. Weihrauch and J. Weidemann, and speaker, at the Workshop on the Computability and Complexity in Analysis, held on August 24-27, 1998, in Brno, Czech Republic. The workshop was held in connection with the 23rd International Symposium on the Mathematical Foundations of Computer Science (MFCS '98) and Computer Science Logic (CSL '98). Professor Pour-El also was an invited speaker at the Workshop on Real Number Computation held June 19-20, 1998 in Indianapolis, Indiana in connection with an IEEE (Institute of Electrical and Electronics Engineers) meeting.

International Symposium on Discontinuous Galerkin Methods

Professor Bernardo Cockburn is one of the organizers of the International Symposium on Discontinuous Galerkin Methods which will take place at Newport, Rhode Island, May 24-26, 1999. The other organizers are George Karniadakis and Chi-Wang Shu from Brown University. The Scientific Committee consists of F. Brezzi (Pavia, Italy), J. Flaherty (RPI), C. Johnson (Chalmers, Sweden), K. Morton (Oxford, UK), and J.T. Oden and M. Wheeler, both of the University of Texas at Austin. Discontinuous Galerkin methods have been developed only recently but have found use quickly in such diverse applications as aeroacoustics, semiconductor device simulation, turbomachinery, turbulent flows, materials processing, magneto-hydrodynamics and plasma simulation, and image processing. The purpose of the meeting is to bring together mathematicians, physicists, computer scientists, and engineers working in this area, to facilitate the exchange of ideas in this rapidly growing area. For more information see the Web site: www.cfm.brown.edu/dgm

Differential Geometric Methods in the Control of Partial Differential Equations

Professors Robert Gulliver and Walter Littman of the School of Mathematics, and Professor Roberto Triggiani (University of Virginia), are the organizers of a conference on "Differential Geometric Methods in the Control of Partial Differential Equations" to be held at the University of Colorado, Boulder, June 27-July 1, 1999. This is one of seven "Joint Summer Research Conferences in the Mathematical Sciences" chosen competitively from a large number of proposals, by a committee representing the AMS, the Institute of Mathematical Sciences and the Society for Industrial and Applied Mathematics.

Boundary control and stabilization of partial differential equations has been a very active area of research during the last twenty or so years, and has given rise to many new developments in the theory of partial differential equations itself. Very recent research supports the expectation that differential geometric techniques, when brought to bear on certain PDE modeling and control problems, will yield significant mathematical advances.

The conference will feature high caliber speakers from both fields, geometry and PDE's, and seeks to attract a mixed audience of geometers and PDE control theorists. A particular effort will be made to include a representative group of young mathematicians from both fields.

For more details see the November issue of the A.M.S. Notices, p. 439.

UNDERGRADUATE PROGRAM

Calculus Initiative

The Calculus Initiative, which is now in its fourth year of operation, provides students with an enriched experience, including smaller sections, active learning, and group work and lab based projects focused on applications. Graphing calculators are an integral part of first year instruction and Mathematica and Matlab are used in the second year, thereby permitting work on problems and projects that cannot be done in a traditional course. The lecturers and workshop leaders report a high degree of communication and cooperation among themselves and with the students, making this course a more pleasant experience than the standard course for both instructors and students.

This year essentially all IT freshmen who were placed into first-quarter calculus at orientation have enrolled in the Initiative. Hence almost no IT freshmen are beginning with the "standard" calculus course. Next year we expect the enrollment in the freshmen course to be about the same as this year (somewhat over 400), and we expect the sophomore course to grow from 215 students to about 300. The course began in 1995 with 100 IT freshmen.

Writing Intensive Courses

All of the major disciplines at the U of M, including mathematics, will be adding writing intensive courses to their curricula in 1999. Writing will be integrated into the work of each course. In many cases these will be existing courses with a writing component added, such as an exposition of the solution to some difficult problem. The exposition will be graded for the quality of the mathematics, and of the written English.
Under consideration in the School of Mathematics will be the course “Sequences, Series, and Foundations”, frequently taught by Professor Wayne Richter. This comes at the end of second-year Calculus, and includes some proofs. Also under consideration are one or more 1-credit courses offered in the “Interim”, a three-week period in late May and early June which is a short term that will be added to the University calendar in spring of 2000.

**Calculus for Biologists**

A new section of calculus, especially intended for students entering the College of Biological Sciences and College of Natural Resources, is being developed and taught by Professor Claudia Neuhauser. New concepts are motivated through biological applications and word problems are based on facts from the life sciences, sometimes taken directly from research papers. See the note by Professor Neuhauser below.

**Update on the Elementary School Teachers’ Course**

The sequence Math 3105-6-7, designed for prospective elementary school teachers, will become the two semester sequence Math 3113-3118 in Fall 1999. The population in these courses has continued to grow this academic year with the enrollment in Math 3105 at 101 in Fall Quarter and approximately 46 for Winter Quarter.

These are labor intensive courses in which both a faculty member and a teaching assistant work simultaneously with a group of 22 to 28 students. As a result of this effort we think there will be many very good elementary school teachers entering the school systems in this state carrying with them enthusiasm for mathematics and justified confidence in their mathematical understanding and ability.

Faculty teaching these courses this past summer and the current academic year are: Dennis White, who developed the notes used in the courses, Ben Chow, David Frank, Bert Fristedt, Lawrence Gray, Radha Kessar, Chester Miracle, Richard Moeckel, Karel Prikry, and Dennis Stanton. And, as indicated above, there have been approximately the same number of teaching assistants involved.

**Good Teaching Awards**

The following Teaching Assistants received the Good Teaching Awards for the year 1998: Elisa Ferretti, Tina Garrett, Jennifer Madland, Ivan Osiplkov, Mireille Boutin, Yonghui Koo, Dominic Lanphier, Martin O'Hely, Luis Roman, Xiang-Rong Yang.

**Scholarships**

The School of Mathematics awarded approximately $39,000 in scholarships for the 1998-99 academic year. In addition to Department Scholarships, the School also awarded named scholarships honoring Halbert Christofferson, Ian Richards and Ella Thorp.

*John A. Eagon, Director of Undergraduate Studies*

**Actuarial Program**

The Actuarial Program continues to provide a clear cut path to potential employment for math majors, and as such also provides a modest incentive to being a math major. The program welcomes students from three colleges, and in consequence has three slightly different sets of graduation requirements. But all program participants take the same actuarial classes in the same room and at the same time. The differences lie entirely in the supporting courses: more business courses for CSOM, more math courses for IT or CLA.

There is no documented preference among the employers, but I do have one anecdote to relate. At a Twin Cities Actuarial Club meeting where I was an invited speaker, I asked for a show of hands as to how many had been math majors, and how many had been business majors. There was quite a bit of laughter, and the count came in about 50 to 2. Many have said to me “I don’t do much pure mathematics any more, but I could never have gotten where I am without my math training.”

This much said, how do we measure the success of the program? I still consider the bottom line to be placements, and in this respect I’m gradually learning three things: there will be cycles in academic supply; there will be cycles in professional demand; and these cycles will tend to be out of phase. In the early 1990s we had sometimes 35 graduating seniors, lately more like twenty. Jobs were scarce then, but things are really hot right now. I have eighteen documented hires for 1998, probably an all time single-year record already, and there will be more. Our Ph.D.s who have forsaken other careers for the profession this year include Tim Finnegan, Gary Hatfield, and Doris Chiang.

*Steve Agard, Actuarial Program Coordinator*

**Calculus for Biology Majors**

Biology majors at the University of Minnesota are required to take one year of calculus. The regular calculus sequence is geared towards a rather broad audience and does not adequately address the topics biology majors need in their science courses. Specifically, it does not cover differential equations in the way they will encounter them later on and it never shows them where calculus is used in their major. I
designed a calculus course for biology majors which still teaches them most of the traditional topics but with a strong emphasis on biological applications. The most important difference is that considerable time is spent on differential equations. However, this is a serious calculus course, not a recipe course: I strongly believe that students should see the relevant theorems and learn how things are logically connected. Due to a lack of suitable books, I wrote my own book which I am trying out this year.

The following examples will give an idea how this course differs from a regular calculus course. Differential equations are introduced simultaneously with the definition of derivatives. Thus students learn immediately that differential equations can be used to model per capita growth rates. New topics are frequently motivated using biological examples. For instance, to motivate related rates, I used an allometric equation which relates skull length to backbone length in a group of marine reptiles. It followed from the equation that juveniles have relatively larger heads than adults--a fact students were familiar with. The integration part of the course focuses on understanding what integrals are used for. Students see age and size structured models, they learn that integrals can be used to express a cumulative rate of change and they learn about probability densities. Less time is spent on integration techniques than in a traditional course.

The book contains a large number of word problems, some of them quite challenging. These problems are either adapted from the biological sciences courses, or are taken directly from research papers. They help students to understand concepts and to learn how to use calculus to describe biological observations.

When asked, students reported that the biological applications made the course more interesting... "a wonderful link between biology and calculus."

The students who are currently taking this course were selected from the College of Biological Sciences and are typically very good and highly motivated. Their reactions were largely very positive. When asked on course evaluation forms whether they feel that learning calculus in a biology context helps them to understand concepts better, they overwhelmingly agreed: "by learning in this fashion it provides the opportunity for you to relate the information being learned to other areas of knowledge, resulting in a higher chance of retaining the information", and "yes, more of a reason to try to understand concepts rather than memorize patterns" were some of the comments. The students also expressed appreciation for being in a calculus course designed for their major: "This class is a wonderful link between biology and calculus", and "I like the fact that it actually relates to what I want to go into." When asked whether the biological applications made the course more interesting, one student commented "Yes!! Learning about ichthyosaurs is much more interesting than just calculus." Or, "Yes, they do. It's not as dry and abstract as usual, I can see where I'll actually use this." Or, "Yes, I can picture these functions as more than just numbers and variables."

Claudia Neuhauser

New Cryptology and Number Theory Course

In 1997-98 and again this year I am offering a newly-created upper-division undergraduate course, Cryptology and Number Theory, which illustrates applications of mathematics that have only relatively recently become significant. This course was designed to appeal not only to math majors but also to computer science and electrical engineering students, as well as to computer security professionals. Happily, it does appear that the course succeeds in having this sort of broad appeal.

The increased importance of cryptology is of course due to the advent of networked computers, communication by public network, commercial use of the public network, and the concomitant "electronification" of money and other commercial transactions. The subject has the additional attraction of offering engaging historical, political, military, and cloak-and-dagger material to accompany the technical aspects.

Cryptology also provides a rare opportunity to provide closure in an undergraduate course, by giving genuine applications rather than artificially contrived ones. Really getting to the point, rather than merely providing an introduction lacking a conclusion, is important as well for our undergraduate math students, most of whom are future high school mathematics teachers, future actuaries, computer science students, and other students whose future plans do not include graduate school in mathematics.

Rather than the more traditional exclusive emphasis on proof in abstract algebra and number theory courses, the computational number theory relevant to cryptology adds another element: study of algorithms. Of course, study of number-theoretic algorithms provides a pragmatic reason to look at the proofs, as well as a practical reason to understand abstract constructs. Further, many of the necessary algorithms are probabilistic rather than deterministic, inviting a rethinking of the traditional cliche that mathematics gives us "certainty". Even further, in some cases we can say nothing better about critical number-theoretic issues than to offer heuristics and raw computational evidence. Amusingly, while in the past such issues would have been considered up in the air, contemporary practical concerns demand action without waiting for proof! This casts an interesting and different light on the mathematics involved.

Paul Garrett
GRADUATE PROGRAM

We are pleased to announce the following achievements of two of our graduate students. Uli Walther received a Sloan Foundation Doctoral Dissertation Fellowship and Martin O’Hely received a Graduate School Doctoral Dissertation Fellowship, for the 1998-99 academic year. These are great honors for which the competition is severe.

We graduated 16 Ph.D.s during the period from Oct. 97 - Oct. 98. Among the best, Yu Yuan is going to the University of Texas, T.P. Tsai to Courant Institute and David Richter to McGill University in Montreal. All three received Outstanding Thesis Awards. In addition, James Riordan was hired at IBM Zürich and Ernesto Schirmacher and Doris Chiang at the Zürich Insurance Company in Cologne, Germany. In total, all but three students are employed as professional mathematicians. Of the others, one has decided to pursue a degree in another department while working part-time as a mathematician. Two others have been forced to return to their home country for military service.

We are also pleased to report that our first class of graduates in the M.S. in Math Education have now received their degrees, all of them are employed and have favorable comments on the program. The M.S. degree with emphasis in Industrial and Applied Mathematics continues to be a very successful program.

Donald Kahn, Director of Graduate Studies

MCIM

The activities of the Minnesota Center for Industrial Mathematics continue to increase. In the summer of 1998, MCIM placed nine graduate students in internships at various companies. These include local companies such as 3M, Medtronic, Honeywell, Seagate, and Lockheed Martin, as well as such national companies as Ford and Motorola. We have established contact with several smaller companies in the area including Banner Engineering and LORAM. In the fall, a team of three mathematics undergraduates started their project working with Guidant CPI on a problem arising from defibrillator design.

Our recent M.S. students have found good positions upon graduation. We now have placed former students in companies such as Medtronic, Evans and Sutherland, and Cisco Systems. In June, the department graduated its first Ph.D. student in the program in industrial mathematics. The student, Aleksandar Zatezalo, is currently an Industrial Postdoc at the Institute for Mathematics and its Applications (IMA) where he is collaborating with scientists from Lockheed Martin on a project.

We were invited to make presentations about our graduate program in Applied and Industrial Mathematics at two national meetings: at the National Institute for Science Education session "Practices That Work" in Washington, D.C., and at the mathematics departments chairs meeting organized by the Board of Mathematical Sciences. At the first meeting there were three presenters, and at the second, four. At the second meeting the presentation was about our industrial internships program.

Fadil Santos, Associate Director, MCIM

Mathematics Library

Developments in the mathematics library have been very positive during the last year.

Kris Fowler (librarian) and Lynn Tran (assistant librarian) have been doing a first rate job both in the day to day operations and in long term planning.

The news about journals is also good, at least for the very short term. Last year the library committee drew up a list of journals to be cut due to estimated price increases. For a variety of reasons (smaller increases than anticipated, strength of the dollar,...) we did not have to make any cuts. In fact, there is now a limited amount of money available to order new journals.

However, the problems of strong upward trend in the pricing of journals and the role of electronic journals are not solved. The University Senate is now concerning itself with the funding of the libraries and hopefully the administration will give a higher priority to this problem.

Jay Goldman
Chairman of the Library Committee

Recent Developments at the IMA

The Institute for Mathematics and its Applications (IMA) was established in 1982 by the National Science Foundation. The IMA is affiliated with the School of Mathematics, the Minnesota Center for Industrial Mathematics, as well as with about 40 participating organizations worldwide (universities and corporations).

The mission of the Institute is to close the gap between mathematics theory and its applications. The IMA hosts annual programs, each program chosen with the purpose of encouraging interaction between mathematicians and scientists from academia, industry and government laboratories. The IMA also runs a series of shorter duration programs during the summer.

Industrial programs also form a very important part of IMA activity. The Institute runs a biweekly Seminar on Industrial
Problems in which industrial scientists present problems to academic mathematicians. There is also an Industrial Postdoctorate program, half funded by the NSF and half funded by the sponsoring companies.

In a new program this year, the IMA is launching a series of workshops under the heading of HOT TOPICS. These workshops are created in response to industry's special needs that represent areas of new opportunity to mathematicians. Many of the organizers and speakers in these workshops will be from industry. The first three of the HOT TOPICS workshops are: “Challenges and Opportunities in Genomics: Production, Storage, Mining and Use”, April 24-27, 1999, “Decision Making Under Uncertainty: Energy and Environmental Models”, July 24-27, 1999, and “Scaling Phenomena in Communications Networks”, October 22-24, 1999.

The 1997-98 annual program “Emerging Applications of Dynamical Systems” was highly successful. In the fall, focus was on numerical analysis aspects, in winter on applications to chemistry and physiology with workshops on topics such as Computational Neuroscience and Cardiac Rhythms, and in spring on symmetry and pattern formation including applications to oceanography. The 1998 summer program was on Coding and Cryptography.

The 1998-99 annual program is “Mathematics in Biology.” The program's organizers are: Lisa Fauci (Tulane University), Simon A. Levin (Princeton University), James D. Murray (University of Washington), Alan Perelson (Los Alamos National Laboratories) and Michael Reed (Duke University). In consultation with the organizers, the IMA has chosen nine postdoctoral members for the period September 1, 1998 to August 31, 2000. For the first time, all postdocs were offered two year appointments. These postdocs will be active participants in all activities of the Biology year. The fall component (Sept.-Dec. 1998) of the program was Theoretical Problems in Developmental Biology and Immunology. The winter component (Jan.-March 1999) is Mathematical Problems in Physiology, and the spring focus is Dynamic Models of Ecosystems and Epidemics (Apr.-June 1999).

The fall program included workshops on Immune System Modeling and Cell Signaling, Mathematical Models of AIDS and a minisymposium on cancer. On November 11, 1998, Alan S. Perelson delivered an IMA and Institute of Technology public lecture on Mathematics and AIDS: How Mathematics Coupled with Experiment Revealed the Nature of HIV Infection. Winter 1997 workshops included Cell Adhesion and Motility which is vital to many physiological processes such as inflammation, wound healing and metastasis, Computational Modeling in Biological Fluid Dynamics as well as a workshop on Audition which brought together mathematicians, biologists and engineers who work on different aspects of the auditory system. Two examples of the spring workshops are: Mathematical Approaches for Emerging and Reemerging Infectious Diseases (May 17-21, 1999), and From Individual to Aggregation: Modeling Animal Grouping (June 7-11, 1999). The 1999 Summer Program is Codes, Systems and Graphical Models, Aug. 2-13, 1999, with the aim to bring together mathematicians, computer scientists, and electrical engineers in the area of coding theory, systems theory, and symbolic dynamics. The 1999-2000 Annual Program is “Reactive Flow and Transport Phenomena.”

On September 1, 1998 the IMA expanded into new administrative, visit and laboratory facilities on the 4th floor of Lind Hall. This space was remodeled by the University (summer 1997) for mathematics research, at a cost of nearly $2 million. It has an open architecture that is ideally suited for industrial research teams and other group research activities, and an indoor connection to the IMA conference facility. IMA space has nearly doubled and we can now house many more participants. The IMA website: http://www.ima.umn.edu

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