ContinuUM

Newsletter of the Department of Mathematics at the University of Michigan Summer 2001

*On July 31, 2001, **Al Taylor** stepped down as department Chair after six successful years in the postion. **Trevor Wooley** has been selected as the new Chair. Due to Trevor's scheduled sabbatical leave for the 2001-02 academic year, **Alejandro Uribe**, the current Associate Chair for Academic Affairs, will serve as the interim chair for the coming year. You should hear about Alejandro's experience as Chair in the next ContinuUM. In the two "Notes from the Chair" columns, Al reflects on his chairmanship, and Trevor lays some plans for the future of the department.*

Reflections on Six Years as Chair

This is a piece I've looked forward to writing for some seven years now, my final one for the "Notes from the Chair" column. At the end of July, I'll have finished my two terms as Chair and am excited about returning to my normal career of teaching and research. **Alejandro Uribe** will assume the chairmanship next year, filling in for **Trevor Wooley,** who has agreed to serve a 3-year term as Chair, the 2002-2005 academic years, after he returns from a year's leave in Cambridge and Bonn.

I don't believe the Dean could have made any better choice of Chairs to keep the department on its upward trend. My opinion is confirmed by the selection of three new Associate Chairs to join the leadership team, **Tony Bloch** for graduate affairs, **Dick Canary** for education, and **Mel Hochster** for faculty appointments. Other major leadership jobs are being filled by **Toby Stafford** (Chair of the Faculty Recruitment Committee), **John Stembridge** (Doctoral Chair), and **Ralf Spatzier** (Undergraduate Chair). This leadership team is remarkable for its youth and vitality!

While we have for decades been a democratic department with important decisions being made on a near consensus basis, the new team reflects the fact that administrative work and responsibility must be shared to a much greater degree than ever before. The youth of the team reflects the fact that the department has improved to one in which almost every faculty member has an active research program, most of which are increased in impact by receiving highly competitive external research funding. Faculty, especially young faculty, can't afford to de-emphasize their research work for several years to spend large amounts of time on the important administrative work that is necessary to keep a large department functioning smoothly. Therefore, the new Chairs have obtained some incremental resources to enable active young faculty to take on these tasks while maintaining their research

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The Future of the Mathematics Department

The Mathematics Department at Michigan has experienced extensive change in virtually all aspects of its mission over the past several years, and we are fortunate indeed that, through **Al Taylor's** commitment and balanced leadership through six of the last seven years, almost all of these developments have been for the good. As Al begins some well-deserved relief from administrative duties, it seems an opportune moment to highlight some of the developments and challenges that we expect to see in the future. Fortunately for me, the "future" does not begin until July of 2002! The Department is very fortunate that **Alejandro Uribe** has agreed to serve as Chair during my long-awaited year of leave next year.

Competing with Peer Departments

One of my regular complaints in recent years has been that the resources provided to us by the College barely enable us to maintain our status within the *Big Ten*, let alone compete with the *top ten* departments. The good news is that this situation is changing for the better. In the final years of Al's term as Chair, increased resources were forthcoming from LS&A. In addition, we have just secured a significant new package of resources that, starting next year, will incrementally address issues involving salary and teaching so crucial in a competitive hiring environment. Taken together, these resources will allow us to concentrate our competitive energy on the top ten departments, and offer prospects of entering the elite five departments nationally.

As one contemplates the difficulties of competing with the very strongest departments, one is struck by the scale of financial resources available to highly endowed private schools. However, the size and quality of the department at Michigan provides a critical mass of excellence that offers an extraordinarily stimulating environment unavailable to smaller departments, no matter how well-endowed. What we seek to do in the future is to exploit this

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Bioinformatics:

Math's Role in the Life Sciences Initiative

Bioinformatics sits at the intersection of molecular biology and computer science, two disciplines which have undergone revolutionary scientific-technological development during the past few decades. Positioned on the interface of two rapidly developing intellectual arenas, bioinformatics is experiencing intensive development as well as explosive growth in interest and demand.

Improving techniques in molecular biology yield extensive information about the molecular components of living cells. This information includes determination of the genetic make-up (the DNA) of organisms and provides precise information about proteins that are active in cells. This information about DNA and proteins comes as exact information about molecular sequences, and also as information about three-dimensional structure which is very important in determining the way in which the DNA or protein functions. Technological advances have made molecular technology commonly accessible. The result has been a flood of information about the molecular composition of DNA and proteins from a wide variety of organisms. Articles in the popular press about genome sequencing have given some indication of the revolution in available information, but give little indication of the magnitude of data available as biologists worldwide produce a constant flow of information about the molecular structure of the genes and proteins that control living cells.

As valuable and as plentiful as this information is, it only provides a "parts catalog" for a variety of organisms without explaining how these parts work or fit together. Little is known about the integrated system—what makes a living cell, or how a cell will respond to a novel environment or a specific change in its genome. DNA gives the blueprint for the design of various proteins, but what controls the process whereby proteins are expressed from this blueprint under different conditions? Given the DNA blueprint for a protein, how do we predict the three-dimensional shape that this protein will eventually assume, a shape which largely governs its function in the cell? This growing bank of molecular information leaves us well short of understanding the principles that govern the interactive biological system.

A key goal of bioinformatics is to construct the integrated behavior of the intact organism in relation to its underlying molecular determinants (the genome). Molecular biology takes the first step towards such an understanding with the measurement of molecular features of a living cell. The next few steps lie more on the informatics side, steps that may be most readily made by mathematicians, computer scientists and statisticians. These include mining of the molecular data to filter and select out interesting features. Then mathematical modeling of how the cell/organism, as an integrated system, is acting on the molecular information identified in the previous step as lying in the genome and in protein structure. Computer science is providing us with more and more powerful tools to do this analysis— hardware architectures and efficient algorithms for symbolic analysis, scientific computation, graphical interpretation and data management.

Michigan is one of a few institutions that are playing a leadership role in bioinformatics. With a truly interdisciplinary effort rooted in the Medical School but including faculty in the Departments of Mathematics, Biology, Chemistry and the Colleges of Pharmacy, Engineering and Public Health, we are launching a graduate degree in bioinformatics and expanding the number of bioinformatics faculty positions by ten to fifteen campus-wide. More about the newly formed program can be found at its web site www.bioinformatics.med.umich.edu.

-Professor Phil Hanlon

Professor Phil Hanlon

Collegiate Chair and LSA Associate Dean

As described in the article to the left, **Phil Hanlon** is spearheading Math's participation in the Bioinformatics portion of UM's life sciences initiative. In addition to these activities, Hanlon has been named the Donald J. Lewis Collegiate Professor of Mathematics, 2000-05. He has also been selected to be the Associate Dean of Finance and Planning for the College of Literature, Science and the Arts, a position he assumed in the winter of 2001.

Hanlon completed his undergraduate degree at Dartmouth and received his Ph.D. from the California Institute of Technology in 1981. He taught at Massachusetts Institute of Technology and California Institute of Technology before joining UM in 1986. He became a professor in 1990. Hanlon is an extremely well regarded mathematician, and has received recognition over the years to include the NSF Presidential Young Investigator Award, a Sloan Fellowship, a Guggenheim Fellowship, and University honors including the Henry Russel Award, the LS & A Excellence in Education Award, and a Thurnau Professorship.

Considered a world leader in algebraic combinatorics, Hanlon's expertise has been used in various arenas. Combinatorics describes the study of patterns. Typically Hanlon applies combinatorial methods and results to problems in algebra or alternatively applies algebraic theory to combinatorial problems. His leadership and expertise in this area has been recognized by (among others) the National Security Agency. He has served on the NSA Advisory Board since 1994, and also chaired the Math Section since 1994. Hanlon served as Chair and author of a report on the technical challenges facing NSA and the role mathematics could play in addressing the fundamental

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Successful MLK Day Colloquium

The second annual Marjorie Lee Browne Colloquium was presented as part of the department's recognition of Martin Luther King Day. The event honors Dr. Marjorie Lee Browne, the University of Michigan's first and the nation's second African-American woman to earn the Ph.D. in mathematics.

The department was honored to host Dr. **Evelyn Boyd Granville** as this year's speaker. Dr. Granville is the nation's first African-American woman to earn the Ph.D. in mathematics.

Dr. Granville has led an inspirational life as a scientist, educator and person. She was born in Washington, DC in 1924, the second child of William and Julia Boyd. She came of age in segregated Washington during the Depression, but reports never having been aware that her family lacked the basic necessities of life. Instead her parents emphasized to her the value of hard work and education.

After graduating summa cum laude from Smith College in 1945, Dr. Granville began graduate school in mathematics at Yale. (Although she'd also been accepted at UM, Yale offered her a scholarship.) At Yale, she was twice awarded a Julius Rosenwald fellowship and was also honored with a U.S. Atomic Energy Fellowship for her final year. Her doctoral dissertation on the properties of Laguerre series in the complex domain was supervised by Professor Einar Hille, a distinguished analyst. In 1949, Dr. Granville became the first African-American woman in the history of the United States to be granted the Ph.D. in mathematics.

Following the receipt of her Ph.D., Dr. Granville enjoyed a remarkable career working as a mathematician and educator in academia, government and industry. She held academic positions first at the New York University Institute of Mathematics (now known as the Courant Institute) and Fisk University, before moving to a position as a mathematician at the National Bureau of Standards, and later at IBM. At IBM, Dr. Granville played an exciting and fundamental role in the dawn of the computer age, especially as it was being applied to celestial mechanics. For example, she was part of the team of scientists responsible for writing the computer programs that tracked the paths of vehicles in space on NASA's Project Vanguard and Project Mercury.

In 1967, Dr. Granville made a major career change by accepting a professorship in mathematics at California State University, Los Angeles. Here she discovered a new passion: the education of K-6 teachers and students. She was a key participant in several special projects for K-6 education, including the Miller Mathematics Improvement Program. Her textbook (with Jason Frand), *Theory and Applications of Mathematics for Teachers* (Wadsworth, 1975, 1978) became a standard for the "new math" and was adopted at over 50 colleges and universities.

Upon retiring from CSULA in 1984, Dr. Granville and her husband moved to a community near Tyler, Texas. Her talent and energy did not go unnoticed: She received invitations to join the faculty at a local public school, at Texas College, a small historically black college in Tyler, and also at the University of Texas at Tyler.

Bob Megginson presents a framed poster to Evelyn Boyd Granville. Math Department photo.

In her Colloquium talk entitled "Strengthening the K-12 Curriculum in Science and Mathematics: An Absolute Must," Dr. Granville detailed some of her personal experiences in past and recent years concerning mathematics education in this country. Private industries and government agencies in the United States are finding it impossible to recruit enough technically qualified personnel to fill existing job openings. Dr. Granville recounted how in 1998-99, she partcipated in an outreach program to middle school students. The program, sponsored by Dow Chemical, emphasized to the students the importance of math and science in their future careers. Dr. Granville stressed that math provides students with the skills employers look for when hiring workers: logical thinking, problem solving abilities along with a variety of problem solving strategies, and creative thinking.

While Dr. Granville was showing the middle school students why math was important, she wondered if there were enough well trained math and science teachers to help them develop these skills. The effectiveness of the math and science curricula was also in question. Are the teacher training programs designed to produce effective teachers in math? Considering that the test scores of U.S. students in mathematics and science rank low in comparison with student performance in many other countries, the answer is likely *NO*, particularly in urban schools.

Students develop an attitude toward math, good or bad, at an early age. There is a scarcity of well trained, inspiring teachers to help foster positive attitudes at an early age. Effective teacher training is a must, combined with continued career development opportunities.

Dr. Granville believes that a strong nation needs a first rate public educational system starting in kindergarten. "Strength comes from…an intelligent citizenry trained to think rationally and equipped to solve problems."

Institutions of higher learning must work with local and state agencies responsible for the K-12 curriculum in math and science and with those institutions responsible for teacher training standards to effect changes that ensure that the pool of qualified workers will be sufficient to meet future demands.

Bass Delivers Collegiate Chair Lecture

Professor **Hyman Bass** presented the inaugural lecture of the Roger C. Lyndon Collegiate Professorship in Mathematics. He began with biographical remarks about the man for whom this collegiate chair is named, **Roger C. Lyndon**. Lyndon was educated at Harvard, where he earned a B.A. in 1939, an M.A. in 1941, and a Ph.D. in 1946. He was an instructor and assistant professor at Princeton University prior to joining the faculty at the University of Michigan as assistant professor. He was promoted to associate professor in 1956 and to professor in 1959. Lyndon retired in 1988 and died in June of that year.

During his career, Lyndon gained worldwide recognition for his seminal contributions to logic and group theory. As an undergraduate he found and corrected a flaw in philosopher Willard Quine's foundations of mathematical logic. His contributions to group cohomology were initiated in his thesis, where, among other things, he anticipated spectral sequences, which are of fundamental importance to group cohomology.

Both Bass and Lyndon devoted much of their research careers to group theory, sometimes described as the mathematical theory of symmetry. Group theory measures the symmetry of an object as the set of all ways that we can change that object and yet leave it the same. While mathematical symmetry may seem a somewhat exotic notion, it finds its way into virtually all branches of mathematics and science.

In his lecture "Mapping the Borderlands between Mathematics and Education," Bass explored instances where researchers have crossed the boundary between mathematics and education, much as he is doing in his position at UM. His work with **Deborah Ball** of the School of Education, crosses the borderlands between the mathematical knowledge and practices of the discipline, and those of the mathematics classroom, particularly at the elementary level. He presented three historically significant examples of work in the borderlands, and their impact on the discipline.

Felix Klein, Turn of the 20th Century

Felix Klein was notable for his deep and enduring interest in mathematics education at the turn of the 20th century. He was a great mathematical synthesist working at Göttingen, where he devoted substantial attention to developing ideas about the pre-college mathematics curriculum. He hoped to provide a vision of school mathematics that would offer teachers a perspective on the discipline that would enable them to make better choices about presentation and representation of important mathematical topics. Klein appreciated the special cognitive complexity of teaching. When addressing university-trained mathematicians, he declared "…what high regard one must have for the performance of the elementary school teachers. Imagine what methodical training is necessary to indoctrinate…children with the principles of arithmetic! Try it with your university training; you will not have great success!"

In his extensive work on the school mathematics curriculum, Klein exemplified what Bass calls the cultural exchange model of interaction. He was respectful and humble. He sought to bring a unifying disciplinary perspective to considerations of curriculum, but did not seek to determine that curriculum.

Bourbaki and the New Math

This example also involves mathematicians developing visions of the curriculum. In the 1930s, a group of mathematicians recognized the need to modernize mathematics instruction in the French universities. They undertook to reform the basic courses of instruction. What began modestly quickly escalated into a monumental enterprise to write collectively a comprehensive account of the foundations of all of contemporary mathematics. These volumes were published under the pseudonym of Nicolas Bourbaki. Unlike earlier influential encyclopedic productions, Bourbaki undertook to actually develop the mathematics, from the foundations up, with detailed rigorous proofs, and a globally unified conceptual and linguistic structure. Bourbaki serves as an incomparable reference work that has greatly influenced university level mathematics education around the world.

None of the brilliant mathematical developments of the post WWII period manifested themselves in the school curricula. In the 1960s, a number of mathematicians turned their attention to efforts to export to schools the new kinds of mathematical thinking, such as that exemplified by Bourbaki. This was the period that is now referred to as the "new math." Elementary versions of university level courses were developed, founded on the formalism of set theory, with prominent attention to naming and studying the properties of algebraic operations. Calculus descended to the high school curriculum. While the new math was not entirely misguided, pedagogically, it

Chair Al Taylor, Professor Hy Bass and LS&A Dean Shirley Neuman prior to the Collegiate Chair lecture. UM Photo Services.

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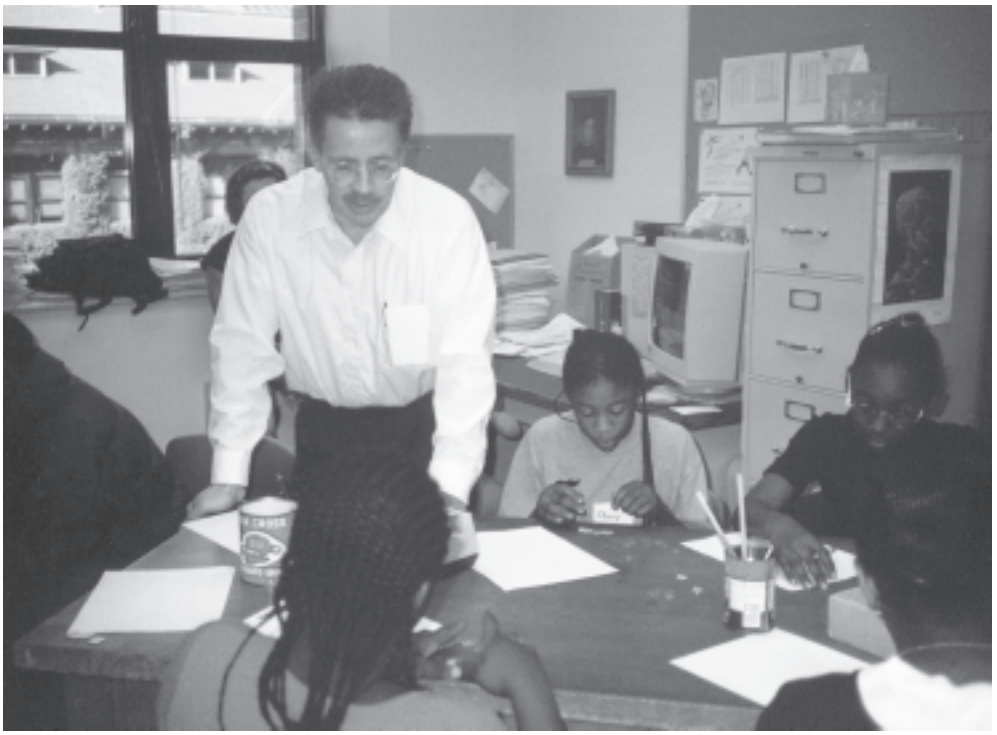
Department Hosts Middle School Students

Each fall, the echo of their voices and energetic footsteps can be heard around East Hall. These groups are not incoming freshmen, but middle school students visiting the department in conjunction with the University's King/Chavez/Park (K/C/P) Program. The K/C/P Program is run by the University's Office of Academic Multicultural Initiatives. The goal is to help underrepresented students prepare for college by learning about college admission requirements and procedures, attending presentations by staff and faculty in selected academic units, and engaging in other activities designed to expose them to the campus environment. K/C/P is a large state initiative with many programs and components.

Students from middle schools in Detroit, Ann Arbor, Willow Run, Ypsilanti, Pontiac, Flint, Adrian, Hazel Park, Monroe, Van Buren Township and other school districts in southeastern Michigan, visit the University of Michigan for a day long series of activities. Students also have the opportunity to participate in a classroom setting at UM.



A group of students from Barbour Middle School in Detroit work with Bob Griess on a combinatorics problem. Math Department photo.

Professor **Robert Griess** organizes the Mathematics Department's components of the program. Griess sees the opportunities presented by the program to be long range. "Minorities are not greatly represented in mathematics and math-related fields. There are many interesting career possibilities. If we and our math presentations catch the imagination of these kids, we would expect to see increasing numbers of minorities in mathematics."

Once a week during the fall, groups of approximately 15 students arrive at the Mathematics Department for their hour-long visits. Department hosts for the program range from graduate students to professors. Each host is responsible for creating a program for the students that can include a tour of the building, a visit to the library, visiting classrooms, viewing and discussion of the computer facilities, and usually a demonstration or exercise in mathematics. It is important that the students understand the significance of a mathematics education, and how it can be used in many professions. The host can also thwart any misconceptions the students have about studying math in their college careers.

One of Griess's presentations involved combinatorics and sequences of numbers. He had the students label four pennies with the numbers 1 through 4. The students were then asked to write down how many different combinations of numbers they could make from those four numbers (1-4). Next, they were asked to take away the number 4 penny, and determine how many different combinations of numbers they could make with the numbers 1-3. They did the same for 2 pennies and one. In the end, it was the method of sequencing that the students learned, and how it was easier to determine the answers using this method than just randomly arranging the pennies.

The students who participated in the mathematics programs this fall formed a variety of opinions about the mathematics they practiced. Some of the comments on their evaluations show that the presentations were a success. Here are some of the students' responses to the question "what did you learn":

- there is more to math than plus, minus, and divide;
- that you need math for a lot of things;
- that you don't really know how to add like you really think you do, and that it is not as easy as you might see it will be.

"I think the K/C/P program offers the members of this department the opportunity to have an impact on the future of our discipline," Griess says. "If we can reach young minds and show them the value of continuing their education—in math or another subject—then we have succeeded."

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programs. It is very gratifying to me to see such high quality teachers and researchers doing the jobs that will continue to improve the quality of our education and research program.

When finishing a job, it's natural to look back and think about what's gone well, what hasn't, and what one thought of the work. Ever since agreeing to serve as Chair in 1994, I have been waiting for some very unpleasant disaster to strike that I'd have to deal with. I'm still waiting and with less than a month to go (as of this writing), it's pretty clear that none is going to happen! I attribute this to the great shape and the trends that had been put in place under **Don Lewis's** decade of chairing the department. Don has the record of being the best Chair of a math department I've ever known. If there was a theme to my years as Chair, it was to continue to support the many good things that were already happening.

It's also the case that serving as Chair is a very interesting job. The job of professor is good because one can keep learning new things every day; by this scale, the job of being Chair is very good! One gets to meet and work with colleagues from around the University to help make Michigan a better place for students and faculty. I have been very impressed with the quality and dedication of colleagues I've met, dealt with, and learned from. This includes Chairs and heads of other units as well as the Deans of our College. As a faculty member, one often shares Dean jokes—like the one where the irate parent calls to complain about the lousy teacher her child has and demands to speak with "no one lower than the Dean;" whereupon the Dean's secretary responds, "Madam, there is no one lower than the Dean." But the truth is, at least in the College of LS & A at Michigan, the Deans and Associate Deans have all been very intelligent and committed faculty who highly value and support the educational and research missions of the University.

As to what's gone well, the list is simply too long to cover except in the barest detail.

Strengthening and Broadening the Department

We've recruited outstanding faculty in both core areas of mathematics and new areas of applied mathematics. As you have read in this newsletter over the years, faculty honors and recognition for research, the analog for a math department of the All-America selections for the football team, have never been greater. Faculty honors for outstanding educational work have also never been greater.

Freshman-Sophomore Program

Many faculty continue to work hard at improving our freshman-sophomore program, being sure we have a wide array of courses so that every Michigan freshman has an appropriate course to help them learn the mathematics they need to succeed in whatever career they choose. We are working hard to find ways to use the internet to enhance and improve the courses as well as teach more of the technology students need to learn.

Junior-Senior Program

We've added many new courses (e.g. mathematical biology) and give a lot of faculty attention to the undergraduate major program, including our annual Career Day (for which we depend on the generous help of many alums) and Awards Ceremony. New degree opportunities have also been added as well as the possibility of minoring in mathematics.

Graduate Program

Much more fellowship support than ever before is available through our NSF VIGRE grant, the largest such grant in the country. A new doctoral program in Applied and Interdisciplinary Mathematics has been added along with our participation in the Masters Program in Financial Engineering, both of which give more opportunities to Michigan graduate students.

Outreach Program

Many more faculty than ever before are involved with outreach programs to high school students and teachers, with at least three such programs in place. I'm especially proud of the Michigan Math Scholars program, expanded this year to include all the natural science departments at Michigan, intended to give talented high school students a taste of the excitement of doing math and/or science research.

I'd like to take credit for all these great things happening, but the truth is that I had almost nothing to do with any of them except to serve as a cheerleader. Instead, I must thank all the people who worked as heads of major committees and programs. A far from complete list includes **Mel Hochster**, **Ralf Spatzier**, **Igor Dolgachev**, **Toby Stafford**, **David Barrett**, **Charlie Doering**, **Peter Scott**, **Dick Canary**, **Rob Lazarsfeld**, **Curtis Huntington**, **Mort Brown**, **Pat Shure**, **Phil Hanlon**, **Dan Burns** and **Carolyn Dean**. They did the actual work. As to "running the department," most of the credit for this has to go to the Associate Chairs, **Paul Federbush**, **Jim Kister**, **Andreas Blass**, **Berit Stensones**, **Alejandro Uribe**, and especially **Peter Hinman** who served so many years as Associate Chair for Education and the Undergraduate Program Director.

I can't forget **Jeffrey Rauch**, who, as he did once before for **Don Lewis**, stepped in to serve as Chair for a year, perhaps our most successful recruiting year of the last decade, when I took a sabbatical leave. In fact, Jeffrey has done a big administrative job just about every year. We have a great faculty and just about everybody pitches in to do the work.

So, you can see I've had a great time serving as Chair. Nevertheless, I am happy to turn it over to others, as it is tiring and I'm out of ideas. I'll be taking a term of leave this fall to concentrate once again on the excitement of doing research in mathematics and then return to teaching and research in January. However, I'll be here, ready to help out the new departmental leaders when called upon, just as **Don Lewis** has always been there for me when I needed help. I'll do all I can to help Trevor and Alejandro continue to make us the very best math department for research AND education in the country!

- Professor B. Alan Taylor

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competitive advantage in order to increase the number of our star-rated groups of researchers. Already, we have highly visible such groups in algebraic geometry, number theory, several complex variables, and algebraic combinatorics, and we will seek to build new groups, both on long-standing strengths as well as in new areas. The more recent moves by the department into applied, interdisciplinary and emerging mathematics (including financial mathematics, mathematical biology, computer science, mathematics education) will form an integral part of this thrust.

The increasing competitiveness in the quality of our permanent faculty has been accompanied by a corresponding increase in the vigor of our Postdoctoral program. We currently have over 50 postdoctorates working in the Department, a level one might even consider too vigorous! Such a large pool of energetic young talent provides both an attractive research scene for faculty and graduate students, but also a stimulating environment for our undergraduates—especially those taking part in our REU (Research Experiences for Undergraduates) program. It is somewhat humbling to note how large a slice of North America's future faculty members are trained here at Michigan.

Our graduate students are increasingly competitive with the very strongest in North America, and we will increasingly seek to find resources to bring the very best here to Michigan. Our new AIM (Applied and Interdisciplinary Mathematics) Ph.D. program, in particular, offers to augment the opportunities available as we look towards placing our graduates increasingly outside the academic world.

One might surmise from my comments thus far that we are on the brink of entering Elysium, and so I offer some cautionary notes (the *bad news!*). First, we certainly face increasing outside pressure for our best young faculty, and also when we seek to hire senior faculty, from well-endowed competitors. Moreover, the new applied and interdisciplinary areas, in which we increasingly seek to hire, frequently require hiring packages and resources going substantially beyond those usually available to mathematics. We will increasingly need to find outside sources, in addition to pressuring the College, in our attempts to rise to these challenges.

Similarly, at the postdoctoral and graduate level we find ourselves pressured on compensation, teaching load and resources, largely on account of the new VIGRE program funded by the National Science Foundation. This program has substantially expanded the availability of competitive postdoctoral and graduate student packages to U.S. citizens, and thus we find ourselves competing for recruits with many more well-funded programs than hitherto. To compete effectively, we will need to find a way to create additional independently funded postdoctoral and graduate positions (along the lines of our current Hildebrandt Assistant Professorships).

Education

Perhaps the biggest and most immediate issue that will influence our educational mission in mathematics is the increasing role of computers. The future will undoubtedly bring increased integration of computers and teaching. Our challenge will be to enhance the experiences of both student and instructor as this transformation occurs. It is obvious that proper use of technology can enhance our undergraduates' experiences in the classroom (and outside too!). Faculty, on the other hand, are all too familiar with the large investment of time, money and energy involved in designing courses that properly exploit available technology. However, following such initial investment, it is possible to achieve the first educational goal, and also save time for faculty to increase course development.

Computers also play a role in another important aspect of educational change that will confront us over the next several years. As a public institution, we have a duty to provide mathematical training to meet the needs of the "New Economy," broadly construed. We must train students in areas of mathematics increasingly *demanded* by employers in computer science, financial mathematics, bioinformatics, etc., both at undergraduate and at graduate levels. This obligation offers challenges, but also possible rewards. In common with departments across the nation, we are experiencing a continued decline in the number of mathematics majors enrolled in our program. Perhaps by embracing the challenge of training for the above emerging areas, we will make progress on reversing this trend.

Summary

While it is satisfying to observe that we are more competitive than ever as a department, both in research and teaching, we face serious pressure in recruitment, especially so far as postdoctorates and graduate students are concerned. We will seek to become leaders in applied, interdisciplinary and emerging areas of mathematics beyond the core areas more familiar to the department, and we will be forced to adapt to changing technology, both in terms of our teaching practices, and in order to address the increasing importance of mathematics in underpinning the new economy. This all seems quite daunting! However, all of these challenges offer excellent opportunities for the Mathematics Department to develop and improve further. Check out your copies of ContinuUM to monitor our progress!

- Professor Trevor Wooley

Math Problem

Assistant Professor Harm Derksen has developed math problems for competitions such as the International Math Olympiad. Here is one of his problems to challenge your math skills. The answer is elsewhere in this newsletter.

Suppose that $1 < x < 2$. Prove that the sequence

$$\lfloor x \rfloor, \lfloor 2x \rfloor, \lfloor 3x \rfloor, \lfloor 4x \rfloor, \ldots$$

contains infinitely many powers of 2. (For any real number y, $\lfloor y \rfloor$ denotes the largest integer $\leq y$.)

2001 Michigan Math and Science Scholars Program

With the support of the Office of the Provost and the College of Literature, Science and the Arts, the program formerly known as Michigan Math Scholars (MMS, a.k.a., Math Camp) expanded into Michigan Math and Science Scholars (MMSS). The 2001 summer program offered high school students challenging mathematics and statistics courses as well as courses in astronomy, biology, chemistry, geology and physics. High school students (ages 14-18) from both the United States and Canada found that their courses went well beyond the basic textbooks and classroom experiences, giving them a hands-on approach along with a glimpse of the exciting research possibilities in both mathematics and scientific fields. MMSS offers high school students the opportunity to explore math and science at the cutting edge, with laboratory research, field work and computer laboratories.

The mathematics courses that were offered in MMSS 2001 included *The Nature of Infinity*, taught by Professor Andreas Blass, *Interactive Statistics*, taught by Professor Martha Aliaga, and *Mathematical Theory in Biology*, taught by Professors Trachette Jackson and Patrick Nelson. Professor Sergey Fomin taught *Codes, Ciphers and Secret Messages*, an introductory course to cryptology, and Professors Hugh Montgomery and Carolyn Dean taught number theory to aspiring mathematicians in a course titled *Exploring Number Theory: From Ancient Greece to Internet Security*.

Science courses offered included *Environmental and Medical Microbiology*, *Genome Sequences and Human Health*, *Mysteries of Embryology*, *The Large Scale Structure of the Universe*, *Michigan Rocks! The Geology of Southeastern Michigan*, *A Journey through Modern Molecular Science—an Introduction to Chemistry*, and *Roller Coaster Physics*. All of these courses were taught by outstanding University of Michigan faculty members who not only love their subjects of study, but also love teaching their subjects to enthusiastic students.

All MMSS participants get a great idea of what studying at a major research university is like along with getting to know the beautiful city of Ann Arbor and other students interested in the same subjects. Both MMS and MMSS alumni report that this program assisted them in selecting their college majors and even in selecting an academic institution to attend. Many alumni are outstanding students today at the University of Michigan and plan to pursue careers in mathematics, science, medicine and engineering.

The MMSS administration, directed by Professor **Dan Burns**, is working on finalizing the dates for the 2002 summer program and creating an exciting combination of math and science courses for the future MMSS curriculum. Some possibilities include *Introduction to Logic, The History of Science and Ethics*, *Neuro-Psychology* and *Abstract Geometry*. The more popular courses from 2001 such as *The Nature of Infinity, Cryptology*, *Microbiology* and *Roller Coaster Physics* will be offered as well in 2002. For future inquires or to be added to the Michigan Math and Science Scholars mailing list for a future brochure complete with application information, please call (734) 764-0335 or send email to mmss@umich.edu**.** Visit the MMSS website at www.math.lsa.umich.edu/mmss/ for more information and updates about this amazing summer program for high school students.

- Annie Marshak Dowling
MMSS Program Coordinator

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problems. His report is being used as the basis for attacking mission-critical issues facing the NSA for the next 10 years.

More recently, Hanlon's research has involved computational genomics, as described in the accompanying article. His work in biomathematics is bringing new ideas to search for genetic information in the huge new databases that are emerging.

Within the department, Hanlon has been a caring, challenging teacher and mentor. He has had eight students complete their doctoral theses and is currently directing four others. Students flock to his classes. He constructed a new combinatorics curriculum at both the undergraduate and graduate level, and developed an innovative class for non-mathematics concentrators (Math 175 Cryptography) that was the first to utilize the department's now widely recognized interactive group mode of instruction. In an effort to reach out to the broader Michigan community, Hanlon conceived and implemented the Michigan Math Scholars Program (Math Camp), providing an intensive summer program for high school students. This program has proved to be a superb recruiting tool.

Hanlon is committed to serving the department, college and University. In the college, he has been an Executive Committee Member, and on the Search Committee for the new Dean. He is a member of the Board in Control of Intercollegiate Athletics, and was one of two faculty asked to serve on the search committee for Athletic Director. He has been a member of the Life Sciences Advisory Committee, member and Chair of the Rackham Divisional Board, and was on the Faculty Advisory Committee on Information Technology.

MMSS Program participants study the environmental history of a glacial kettle lake by examining the sediment core at Pickerel Lake, MI. Geology Department photo.

Bass, continued from page 4

was naively conceived. It was designed mainly by mathematicians with the subordinate participation of educators. It vastly underestimated the learning opportunities that teachers would need to work with this radically new mathematical content. Hence the enactment of the new math curricula was sometimes ineffectual.

Reforms, Debates & Collaborations at the Turn of the 21st Century

We are amid a major period of educational reform in mathematics. Widespread concerns about weak mathematics achievement have led to claims about the poor quality of teachers, teaching, and curriculum. Critics also point the finger at inadequate professional education and poor assessments. A significant difference in the contemporary concerns is the proclaimed aspiration to achieve high level mathematics learning for all students.

One stream of activity in this area is a substantial effort at curricular and pedagogical reform. The major initiatives, however, did not emanate from the disciplinary experts in mathematics and science. Instead, the initiatives came from the teachers' professional organization—the National Council of Teachers of Mathematics (NCTM). Starting in 1989, the NCTM promulgated mathematics standards for curriculum, teaching, and assessment.

The National Science Foundation followed this initiative by funding projects for development of standards-based curricular materials for the schools. By the late 1990s these new curricula had been piloted and were in the first stages of adoption in schools around the country. It was only then that their nature and significance became vivid to large numbers of teachers, students, and parents. Reactions were diverse and often passionate. Suddenly educational improvement in mathematics became a widespread concern, entering politics and the media.

A second, more diffuse, and less publicly visible development is the gradual emergence of interdisciplinary collaborations of mathematicians with educational practitioners and researchers. Some of these are directed at interventions for the improvement of instruction—curriculum development, construction of assessment instruments, professional development of teachers, etc.

Others aim to generate new fundamental knowledge and understanding about the nature of mathematics instruction and its entailments. Specifically, the research Bass and Ball are leading here at UM is aimed at what has come to be recognized as one of the central problems in U.S. mathematics education: the mathematical content knowledge of teachers, particularly at the elementary level.

Research has amply documented the shallow and fragile mathematical knowledge and skills of many U.S. teachers. What is not well understood is how to address the problem of teachers' mathematical knowledge in ways that would improve student learning. The most natural sounding approaches—to require more traditional mathematics courses, for example a mathematics major—have proved disappointing.

What is the useful and usable mathematical knowledge that teachers need for effective instruction? The topics and skills specified by the curriculum offer a piece of the answer, but this is hardly enough. Traditional approaches have been to situate the school curriculum within the discipline, and to amplify the ambient mathematical ideas from a broader and deeper mathematical perspective. Although this makes sense for the curricular questions, it has not proved as useful for determining the mathematical knowledge that it takes to teach.

In the Bass and Ball work, instead of looking to the discipline, and importing its perspectives into the classroom, they directly examine teaching practice. They ask, what is the nature of the work of teaching? What mathematical resources does it draw upon, in what forms, and in what ways are they used? To mathematically prepare mathematics teachers, one should understand the mathematical entailments of their work. This is how the mathematical preparation of physicists, engineers, economists, and biologists is designed. Bass and Ball are engaged in a related endeavor by studying the work of mathematics teaching and seeking to uncover the mathematical resources—knowledge, skills, sensibilities—on which teaching depends.

This approach seems so natural and reasonable that one can well ask why it has not happened long ago. A major reason is that teaching is difficult to observe, to represent, and to analyze. What makes the work possible now is the existence of a rich, digitized data base of primary records of teaching practice, consisting of video, transcripts, student work, teacher's journal, and many other artifacts, for an entire year of teaching of a third grade class.

Analyzing these records in detail addresses the following questions:

- What kinds of mathematical knowledge—ideas and procedures, practices, sensibilities—is entailed by the work of teaching?
- In what forms do teachers need to hold such mathematical knowledge? Where and how in the course of their work do teachers use these sorts of mathematical knowledge?
- How can teachers be helped to develop such knowledge?

One focus has been the process of students learning the principles of reasoning. Here it is important to notice the moves and guidance furnished by the teacher in the direction of such performance. The children are able to reason because they had been learning to do so all year.

Among the things that Bass and Ball are discovering about the mathematical knowledge needed for teaching are:

- that what matters is its *use* (for example, in hearing and interpreting students' thinking, in revising tasks, in managing discussion, etc.);
- that it has to be substantially unpacked, in contrast with the ways that mathematicians hold such knowledge;
- that knowing connections across topics and stretching out to where students are headed matters.

The improvement of mathematics education (like that of science education and literacy) is an urgent national need. The problems are complex and they inherently demand multi-disciplinary approaches for effective treatment.

Several Outstanding Young Faculty Members Appointed

The department has made significant progress in recruiting and hiring many young faculty members. This year the department welcomed several new tenured or tenure-track faculty. Profiles of the six new department members are below.

Associate Professor **Brian Conrad** received his Ph.D. from Princeton University in 1996. He is considered one of the best young algebraic number theorists in the field today. With colleagues at other universities, he is completing the remaining cases of the Shimura-Taniyama conjecture of the rational numbers. The importance of this result was highlighted when Andrew Wiles's proof of Fermat's last theorem hinged on an incomplete proof of the Shimura-Taniyama conjecture. His research in this area is groundbreaking, and he has the potential to be a truly exceptional leader in the field. Conrad is also a superb lecturer and excellent teacher. This year he has taken over the Undergraduate Math Club. Each week numerous math majors meet for pizza and pop in the Nesbitt undergraduate commons room, and hear a presentation by a faculty member. It has grown to a truly successful endeavor.

Assistant Professor **Harm Derksen** received his Ph.D. from the University of Basel in 1997. He has done distinguished work in constructive invariant theory, representation theory, affine geometry and symbolic computation. Derksen has made three major research contributions. He obtained a polynomial bound for the degrees of generators of invariant rings of reductive groups, and introduced a new and simple algorithm for finding such generators via a Gröbner basis calculation. He found the first holomorphic actions of reductive groups on complex affine space which are not holomorphically linearizable. Recently, he gave a new proof of the "saturation conjecture" for multiplicities of irreducible representations in a tensor product of irreducible representations of the general linear group. His teaching background includes working with Dutch participants of the International Mathematics Olympiad.

Assistant Professor **Trachette Jackson** received her Ph.D. from the University of Washington in 1998. She works in biomathematics, particularly in the analysis of systems of nonlinear partial differential equations that model problems in physiology such as cancer and cellular dynamics. She works on real biological and medical problems, using real data from experimentalists. At UM, Jackson will be developing interactions with microbiology, immunology, and the Cancer Center. She is a gifted lecturer who emphasizes interactive teaching techniques in her classes.

Associate Professor **Bruce Kleiner** received his Ph.D. from the University of California-Berkeley, in 1990. He was a faculty member at the University of Pennsylvania and the University of Utah before coming to UM. His initial field of research was differential geometry, and in his thesis he classified four-dimensional manifolds with positive curvature and a continuous symmetry. Soon thereafter he proved a major result about isoperimetric inequalities. He continued his research in the area of nonpositive curved manifolds and manifolds without conjugate points. Kleiner's recent work is in the field of combinatorial group theory. His main result in the field is the proof of the Margulis conjecture, concerning quasi-isometries of higher-rank symmetric spaces.

Assistant Professor **Peter Miller** received his Ph.D. from the University of Arizona in 1994. He studies applied mathematics, in particular nonlinear waves. His major work has dealt with the nonlinear Schrödinger equation, particularly in connection with optics and nonlinear waves. His study of optics is important and timely, and constitutes one of the main scientific foundations of the computer and communications revolution. Miller will have the opportunity for interdisciplinary interaction with faculty from electrical engineering and computer science.

Associate Professor **Chris Skinner** received his Ph.D. from Princeton University in 1997. He is considered one of the most outstanding young number theorists practicing today. Skinner has been publishing in mathematics since 1989, his freshman year here at UM. His undergraduate thesis was solicited for publication in the Duke Mathematical Journal. Upon completion of his Ph.D., he received a three-year appointment at Princeton's prestigious Institute for Advanced Study, where he was awarded an Ostrowski Fellowship and a Clay Mathematics Institute Fellowship. Skinner's most significant contributions are to the theory of diophantine equations in many variables over number fields, non-vanishing of twists of L-functions, and Galois representations and their application to modularity questions associated especially with elliptic curves.

Three-Year Faculty Appointments

The department welcomed 29 new assistant professors for the 2000-01 academic year—a record! New assistant professors are listed here with their doctoral institutions and area of speciality. Hildebrandt and VIGRE apointments are also indicated

Mahdi Asgari - Purdue, Number Theory (Hildebrandt)

Tibor Beke - M.I.T., Topology

Thomas Bieske - University of Pittsburgh, Geometric Function Theory (VIGRE)

Gilberto Bini - Universita La Sapienza di Roma, Commutative Algebra/Algebraic Geometry

Marcin Bownik - Washington University, Harmonic Analysis

Ana Bravo - Autonomous University of Madrid, Commutative Algebra

Stephen Bullock - Cornell University, Differential Geometry

Daniel Chan - M.I.T., Algebra

Mark Dickinson - Harvard, Algebraic Geometry (Hildebrandt)

Anton Dzhamay - Columbia University, Partial Differential Equations/Math Physics

Gavril Farkas - University of Amsterdam, Algebraic Geometry

Tatyana Foth - Pennsylvania State University, Automorphic Forms

Angela Gibney - University of Texas-Austin, Algebraic Geometry (VIGRE)

Hans Johnston - Temple University, Numerical Analysis

Boris Kalinin - Pennsylvania State University, Dynamical Systems

Tao Luo - Institute of Mathematics, Academia Sinica, Non-Linear Dynamical Systems

Patrick Nelson - University of Seattle, Math Biology

Thomas Nevins - University of Chicago, Algrbraic Geometry

Ronghua Pan - Institute of Mathematics, Academia Sinica, Partial Differential Equations

Benjamin Richert - University of Illinois, Commutative Algebra/Algebraic Geometry

Oliver Roth - University of Würzburg, Complex Analysis

Victoria Sadovskaya - Pennsylvania State University, Differential Geometry

Eric Schippers - University of Toronto, Complex Analysis

Mark Skandera - M.I.T., Permutation Statistics (VIGRE)

Michael Sullivan - Stanford University, Differential Geometry (VIGRE)

Kaushal Verma - Indiana University, Complex Analysis

Thomas Weston - Harvard, Algebraic Number Theory (Hildebrandt/NSF Postdoctoral Fellow)

Ming Yang - Columbia University, Probability

Gang Yu - University of Georgia, Number Theory

Faculty Kudos

Several faculty members received promotions this year. To Professor: **Alexander Barvinok**, **Dick Canary**, **Sergey Fomin** and **Karen Smith**. To Associate Professor: **Brian Conrad**.

The following faculty members have been invited to speak at the next International Congress of Mathematicians to be held in the summer of 2002 in Beijing: **Tom Hales**, **Juha Heinonen**, **Toby Stafford**, **Trevor Wooley**.

Hyman Bass was awarded the Excellence in Research Award from LS&A.

Anthony Bloch is co-chairing the 2001 SIAM Conference on Control and its Applications.

Daniel Burns and **Robert Megginson** received Excellence in Education Awards from LS&A, acknowledging their special contributions to undergraduate education.

Brian Conrad was awarded an NSF CAREER Award.

Brian Conrad and **Chris Skinner** were named Alfred P. Sloan Research Fellows. An extraordinarily competitive award, Fellows are selected from the very best scientists of their generation.

William Fulton was elected a Foreign Member of the Royal Swedish Academy of Sciences.

Angela Gibney was awarded an outstanding dissertation award from the University of Texas for her thesis, one of only four so honored out of over 800 graduates from the University of Texas.

Gene Krause received the Excellence in Concentration Advising Award from LS&A. This award recognizes his long and exemplary record as a concentration advisor for students pursuing a teaching certificate in mathematics within the College.

Robert Megginson was inducted into the Native American Science and Mathematics Wall of Fame. This is an honor site maintained at the Southwest Indian Polytechnic Institute in Albuquerque to recognize Native Americans whose careers have made significant contributions to both their fields of study and the advancement of other Native Americans in science and mathematics. The site currently honors twelve Native Americans.

Kristen Moore was awarded the American Fellowship from the American Association of University Women Educational Foundation. This award is highly competitive, with only 18 fellowships for all of the arts and humanities, social sciences, and natural sciences.

Krishnan Shankar received the Margaret and Herman Sokol Postdoctoral Fellowship Award in the Sciences, recognizing his outstanding work in research and teaching.

Pat Shure was awarded the 11th Annual Louise Hay Award for Contributions to Mathematics Education by the Association for Women in Mathematics. The award cites Pat "not only on the breadth of her contributions to mathematics education, but also on her reputation as a superb teacher and an inspiring role model for her colleagues and students."

Karen Smith won the 2001 Ruth Lyttle Satter Prize from the American Mathematical Society. The prize honors outstanding contributions to mathematics research by a woman in the previous five years. She received the prize for her work in commutative algebra, and her more recent work that builds new bridges between commutative algebra and algebraic geometry.

Faculty Profile

Several Complex Variables

For the past few years the department has been fortunate to have a special group of assistant professors who are extremely active in the general research area of several complex variables. These four have been responsible for some exciting collaboration with senior faculty as well as other assistant professors. Each has a unique background and area of interest. Here we include brief profiles of the four faculty members.

Mattias Jonsson received his Ph.D. from the Royal Institute of Technology in Sweden. His current research interests are in the areas of dynamical systems, financial mathematics, complex analysis and ergodic theory. His research in higher-dimensional complex dynamics involves the ergodic properties of iterates of holomorphic maps of complex manifolds, in particular complex projective space $\mathbf{P}^k$. Jonsson has worked on joint projects in this area with colleagues at Notre Dame, Penn State and in Paris. In the area of financial mathematics, he is studying optimal trading strategies and other stochastic control problems.

During his work here, Jonsson has been able to participate in numerous international conferences, including the Ph.D. Euroconference on Complex Analysis and Holomorphic Dynamics in Spain, and the International Conference on Dynamical Systems in Brazil. Jonsson was part of the organizing committee for the 1999 Midwest Several Complex Variables conference honoring **Al Taylor's** 60th birthday. He is active in the Ann Arbor Juggling Arts Club, and can often be spotted on the Diag plying his art with other club members.

"Michigan has a good research environment for postdocs," Jonsson said. "I have benefited from the extremely active research and the many seminars and oportunities for mathematical discussions."

The department is fortunate that Jonsson has accepted an offer of a tenure-track position.

Dror Varolin received his Ph.D. in 1997 from the University of Wisconsin. He is interested in many areas of mathematics, all centered around some aspect of geometry. His primary work has been in several complex variables, complex dynamics, algebraic and analytic geometry, and some control theory and Lie theory (mostly connected to geometric problems). Varolin has collaborated with several people in the department and elsewhere, including **John Erik Fornæss, Mattias Jonsson, Rob Lazarsfeld, Alex Schuster, Karen Smith** and **Arpad Toth**.

In addition to his many teaching responsibilities during his time at UM, Varolin has organized numerous seminars, including the weekly Several Complex Variables seminar, the Quantum Mechanics seminar and the Nevanlinna Theory seminar. He was an organizer for two Midwest SCV conferences in 1999. "Michigan has a very active faculty, and I've developed some great research topics with other faculty members," Varolin says.

Varolin is active with the Ann Arbor Soccer Association. His team placed third last year, and he hopes to have better luck this year.

He will stay in the department next year to participate in the Special Year in Complex Analysis.

Sophia Vassiliadou received her Ph.D. from the University of Notre Dame in 1997. Before coming to UM in 1998, she was a postdoctoral fellow at the Max Planck Institute in Germany. Her research interests are in the areas of several complex variables and partial differential equations. In particular, she is interested in proving the existence and regularity results for solutions to the $\overline{\partial}$, $\overline{\partial}_b$, and $\overline{\partial}$-Neumann problems on nonsmooth domains. Vassiliadou has worked with **John Erik Fornæss** on a question of local L^2-solvability for $\overline{\partial}$ on a singular surface and with **David Barrett** on a problem related to the Bergman kernel of a nonsmooth model domain. She credits these collaborations with opening some new horizons in her research and forcing her to think in a more geometric way. Vassiliadou's future research projects involve trying to understand the geometry of singular varieties and analyzing symmetric spaces.

Vassiliadou is impressed with the stimulating atmosphere of the department. "What I really liked about Michigan is that you can feel that math is being done in this place. There are so many seminars and actvities on various subjects that you can get an idea of what's going on in many fields, not just your own."

Vassiliadou plans to stay in the department for one semester next year, then she will join her husband in the Mathematics Department of the University of Toronto.

Kaushal Verma is completing his first year here at UM, after receiving his Ph.D. from Indiana University in 1999. His main research interests include mapping problems in $\mathbf{C}^n$, holomorphic correspondences, pluripotential theory and complex dynamics. His thesis work involved understanding the reflections principle in several complex variables and its applications to studying the boundary behavior of holomorphic mappings and analytic sets. More recently his interests have broadened to include the dynamical study of Henon mappings in $\mathbf{C}^2$, in particular their structural stability.

Verma is also impressed and enthused by the research environment at Michigan. "There are many dynamic researchers in the department, and I am impressed by the number and variety of seminars and talks."

l-r: Kaushal Verma, Sophia Vassiliadou, Dror Varolin, Mattias Jonsson. Math Department photo.

Two Faculty Members Retire

Jack Goldberg, Associate Professor of Mathematics, retired from active faculty status in May, 2000. He received his B.S. degree from the City College of New York and his M.S. and Ph.D. degrees from the University of Illinois at Urbana-Champaign. Goldberg joined the UM mathematics faculty in 1961.

Goldberg's research has been in complex variables and special functions. He directed four dissertations in these areas. In 1969-70, Goldberg was a visiting associate professor at Robert College in Istanbul, Turkey. In 1981-82, he returned to Turkey as a Fulbright Scholar at Bugazici University in Istanbul.

Best known as a popular, dynamic teacher involved in curriculum development, Goldberg was active in bringing computers into the classroom. In 1980 he received the Amoco Foundation Good Teaching Award from UM. He has written four textbooks stemming from his teaching on linear algebra, matrix theory, differential equations and other topics in applied mathematics.

An active member of the department, Goldberg was an Associate Chair from 1975-77, and served on several University committees, including the Board in Control of Intercollegiate Athletics. He has been granted emeritus status by the Regents.

Donald J. Lewis, Professor of Mathematics, retired from active faculty status in May, 2000. Lewis received his B.S. from the College of St. Thomas and his M.S. and Ph.D. from UM. Prior to joining the UM faculty in 1961, he was an instructor at Ohio State, an NSF fellow at the Institute for Advanced Study in Princeton, and a faculty member at Notre Dame. Lewis was promoted to Professor in 1963.

Lewis's research lies in the area of number theory concerned primarily with Diophantine problems, and encompasses the theory of algebraic number fields and function fields, and arithmetic geometry. While a number of his results have been improved in recent times, it is characteristic especially of his earlier work that he was the first to obtain any kind of result on a problem, and that this decisive progress cleared the way for subsequent developments. The work in his thesis concerning the local solubility of cubic forms, however, remains definitive. One of Lewis's main interests was the development of young mathematicians, and he directed 24 doctoral theses.

Lewis served as Chair of the department from 1984-94. He was noted for his leadership in University affairs. This included service on the Executive Committee of the College of Literature, Science and the Arts, on the University Budget Priority Committee, and on search committees for the Deans of Literature, Science and the Arts, of Engineering, and the Vice President for Research. He has received numerous awards, including a Distinguished Faculty Achievement Award from UM, an Alexander von Humboldt Pries Award, and the Distinguished Public Service Award from the American Mathematical Society. As Chair of the Math Library for many years, Lewis was instrumental in getting it classified as a Level 5 library.

From 1995-99, Lewis was based in Washington, D.C., as the Director of the Division of Mathematical Sciences of the National Science Foundation.

He has been granted emeritus status by the Regents.

Emeritus Faculty and Friends Gather

In May, 2001, the department hosted a luncheon for emeritus faculty and friends of the department. More than 45 people attended the luncheon, which was an opportunity to renew acquaintances, greet long-time colleagues, and find out about current departmental happenings.

The program for the day began with current Chair **Al Taylor** and incoming Chair **Trevor Wooley** sharing recent departmental highlights, and future plans. (See the Chair's Notes columns for further details.) Associate Professor **Chris Skinner** presented the mathematical portion of the program "Right triangles, a million dollars, and number theory at Michigan."

Everyone in attendance agreed that the luncheon was a wonderful opportunity to share current achievements with the faculty who helped to make the department what it is today. Hopefully, an event such as this will be repeated on an annual basis.

Jack McLaughlin 1923-2001

Professor Emeritus **Jack E. McLaughlin** passed away on January 12, 2001. Born in Idaho in 1923, McLaughlin received his B.S. from the University of Idaho in 1944, and his Ph.D. from the California Institute of Technology in 1950.

McLaughlin joined UM as an Instructor in 1950, was promoted to Associate Professor in 1958 and to Professor in 1963. He retired from the Department in 1994. He was considered an excellent and demanding teacher, especially of honors students who sought his courses to measure their ability. McLaughlin guided these students as chair of the honors program for several years. He had a unique success in impressing undergraduates with the beauty of math and the pleasure of discovery after intense effort. He directed nineteen doctoral theses, and many of his students have become leaders in their fields of interest.

In 1986, he received the Amoco Foundation Good Teaching Award. In the letters of recommendation submitted by his former students, a great number of them cited McLaughlin as the best and most inspiring teacher they had in their academic careers. The mastery of the subject he displayed in his teaching influenced many of his students to pursue a career in mathematics.

McLaughlin's research ranged widely, encompassing several subfields of algebra—lattice theory, finite groups, and commutative algebra. He discovered one of the sporadic finite simple groups, that of order 898,128,000, which now bears his name. He also participated in the discovery of a module of finite projective dimension with a negative intersection multiplicity. His work on group cohomology, most of which passed on through the writings of his students, has had an important impact on the field. He was well respected by his colleagues in the field. Paul Halmos, his UM colleague, once said that there are a number of ways to tackle a mathematical problem, but when all else fails, ask McLaughlin.

While enjoying the intellectual challenges of mathematics, McLaughlin had to overcome the physical challenges of multiple sclerosis. He lived with the disease for the last 30 years of his life. McLaughlin's physical challenges rarely limited him in his teaching, research or academic activities.

VIGRE Activities Enrich the Department

Fall 2000 marked the first full semester of activities for the VIGRE (Vertical Integration of Research and Education) program in the department. The current program provides financial support for 30 graduate students and 4 postdoc assistant professors, and allows the department to offer professional development activities designed to foster close contact between students, postdocs and permanent faculty. The program reduces the teaching responsibilities for participants, allowing them to profit more fully from the rich mathematical life of the department. Additional activities, including a large number of research experiences, will be offered to undergraduates. While the activities described below are designed for and supported by the VIGRE program, they clearly are of benefit to all members of the department.

Numerous activities have been designed and implemented to foster interaction between graduate students, postdocs and senior faculty within the department, and include opportunities for undergraduate participation in research. Here is a description of the current seminars and groups developed as part of the VIGRE program:

VIGRE Seminar: Intended for advanced undergraduates and graduate students, these talks by internal and external speakers are related to diverse applications of mathematics, career possibilities in the mathematical sciences and important trends within mathematics itself.

Open Problem Seminar: Intended for postdocs and advanced graduate students, participants present open problems in their area of research. The goal is to help younger colleagues develop independent research agendas. Seminars are held in each of four areas: algebra, analysis, applied mathematics and geometry-topology.

Graduate Student and Postdoc Proseminars: The two separate seminars are informal meetings under the leadership of a senior faculty member. The basic idea of the graduate student seminar is to expose participants to different aspects of the mathematical profession, and are largely cultural and non-technical in nature. The postdoc seminar leader helps younger colleagues development professional "street smarts," with topics including how to submit papers for publication, how to apply for grants and jobs, what the American Mathematical Society does, etc.

Integrated Working Groups: Faculty, postdocs, graduate students and undergraduates meet to work on a common area of mathematics or a problem. The two groups that were held this year focused on the topics of Mathematical Fluid Dynamics and Non Linear Systems, and Numerical Analysis.

Undergraduate REU Summer Program: Undergraduate math majors work on research projects with faculty members. The participants met once a week during the summer and coordinated with two VIGRE graduate trainees. The graduate coordinators gave talks on mathematics, gave advice on applying to graduate school, and organized guest speakers.

Undergraduate Math Club: This group of undergraduate math majors meets with a faculty mentor who facilitates mathematical discussion and organizes guest speakers.

Graduate student **Jesse Otero** is an upper level student participating in the VIGRE program. He was a graduate student in the department in 1994-5, and returned to his graduate studies in 1998. During his hiatus, Otero taught high school algebra and geometry in Florida. He and **Jessica Sidman** were the coordinators of the undergraduate REU program last summer.

Otero embraced mathematics because he excelled in the subject and enjoyed studying it. He is currently working with **Charlie Doering** and has benefited greatly from the various VIGRE activities. "The support provided by the program allows me more time to work on research and other activities. I have particularly enjoyed the Integrated Working Group in Mathematical Fluid Dynamics and Non Linear Systems. The group is class-like, and allows for participation of all levels. I found it a very beneficial way to learn." Otero is currently developing a student applied math seminar. He plans on continuing research with Professor Doering in the area of mathematical fluid dynamics and problems of heat transport in turbulent flows.

Assistant Professor **Angela Gibney's** interest in math was fostered at a young age, since her mother studied the subject. She understood early that mathwas interesting, and was at the heart of most sciences. Gibney received her Ph.D. from the University of Texas, Austin. She was recently awarded UTA's Outstanding Dissertation Award.

Gibney feels that the VIGRE program offers an ideal opportunity to teach, while still having the time to participate in the intellectual life of the department. The department houses some of the premiere faculty members in her area of interest, algebraic geometry. "Teaching only one class per semester makes scholarship easier. I want to get as much as possible out of my experience here, and this allows for the time to do research, as well as exposure to the other mathematicians." She has also enjoyed the non-math presentations about job seeking and the career planning process, that can benefit all members of the department.

Gibney is currently working with Assistant Professor **Gavril Farkas** on research. She would like to develop a Saturday morning math group designed to reach the general public, including high school students. "Since VIGRE emphasizes participation of all levels in the field of mathematics, this would allow us to reach students prior to their enrollment in college, as well as emphasize to the community the significance of math in all areas of science."

Recent PhD Recipients

Dariush Ehsani completed his dissertation *"The Solution of the d-bar Neumann Problem on Non-Smooth Model Domains"* under the direction of David Barrett. He will be an assistant professor at Texas A&M University.

Florian Enescu completed his dissertation *"A Study of F-Rationality and F-Injectivity"* under the direction of Mel Hochster. He will be an assistant professor at the University of Utah.

Sara Faridi completed her dissertation *"Closure Operations on Ideals"* under the direction of Karen Smith. Faridi is an assistant professor at George Washington University, in Washington, D.C.

Patrick Hagerty completed his dissertation *"Radiation Induced Instability"* under the direction of Anthony Bloch. He will be an assistant professor at the University of Arizona.

Eric Hall completed his dissertation *"Generic Extensions of Permutation Models of Set Theory"* under the direction of Andreas Blass. He is a postdoc at Purdue University.

Jason Howald completed his dissertation *"Calculations with Multiplier Ideals"* under the direction of Robert Lazarsfeld. Howald will stay on as a lecturer at Michigan for one more year.

Melinda Koelling completed her dissertation *"Dynamics of Generalizations of the Toda Lattice"* under the direction of Anthony Bloch. She will be an assistant professor at Rensselear Polytechnic Institute.

Ian Pulizzotto completed his dissertation *"Heat Flow in a Random Medium and Homogenization"* under the direction of Joe Conlon.

Mihnea Popa completed his dissertation *"Linear Series on Moduli Space of Vector Bundles on Curves"* under the direction of Robert Lazarsfeld. He will be an assistant professor at Harvard.

Kimberly Retert completed her dissertation *"Noncommutative Curves in Grothendieck Categories"* under the direction of Toby Stafford. She will be an assistant professor at Texas A&M University.

Timothy Schwider completed his dissertation *"The Classification of Essential Laminations in Dehn Surgeries on the Figure Eight Knot"* under the direction of Peter Scott.

Kendrick Smith completed his dissertation *"The Mod 2 Cohomology of some Classifying Spaces of Compact Lie Groups"* under the direction of Igor Kriz. He is an assistant research scientist in the University of Michigan Information Technology Division.

Craig Sutton completed his dissertation *"Applications of Representation Theory to Dynamics and Spectral Geometry"* under the direction of Ralf Spatzier. Sutton will be an assistant professor at Dartmouth University.

Rachel Weir completed her dissertation *"Canonical Divisors and Invariant Subspaces in Weighted Bergman Spaces"* under the direction of Peter Duren. She will be an assistant professor at Virginia Polytechnic Institute.

Outstanding Dissertation Recognized

Dennis Keeler received the **Sumner B. Myers Prize** for the best Ph.D. thesis in mathematics for the year 2000. He was also one of only nine recent Ph.D. recipients university-wide to receive a **Rackham Distinguished Dissertation Award**. Keeler is currently a Moore Instructor/NSF Postdoctoral Fellow at MIT.

For his dissertation "*Noncommutative Ample Divisors,*" Keeler examined ample divisors in ordinary commutative algebraic geometry. The ample divisor is used to represent the variety in a particularly useful form and can be used as an analytical starting point. Keeler tackled the following questions that have been raised regarding ample divisors: Under what conditions can an algebraic variety be expected to have a divisor? Are "left-handed" and "right-handed" noncommutative ample divisors different? Keeler proved that there are no differences between these two types of noncommutative ample divisors. He also outlined criteria for an ample divisor. Many of his results have been published in the Journal of the American Mathematical Society.

Graduate Program News

The Mathematics Graduate Program continues its success in recruiting and retaining students. For the 2000-01 academic year, there were 116 active students in the Ph.D. and Masters programs. In March 2001, the Department hosted another Graduate Recruiting weekend. Fourteen students attended the weekend, and ten additional students visited the department at other times. Twenty students have been accepted to the graduate program for fall 2001.

Rackham Predoctoral Fellowship

A mathematics student has again been awarded a Rackham Predoctoral Fellowship for the 2001-02 year. An extrememly competitive fellowship, only 60 are awarded each year. **Eduard-Wilhelm Kirr**, who is studying under the direction of Anthony Bloch, received the fellowship for his dissertation *"Resonance Phenomena in Hamiltonian Partial Differential Equations."* Kirr is developing a method of investigating autonomous Hamiltonian systems subject to time dependent perturbations. His study analyzes the coupling between the bound states and the radiation modes of the unperturbed Hamiltonian. Instability of the natural oscillations and their decay rate is obtained, and concrete applications in quantum mechanics, optics and telecommunications are presented.

Outstanding Graduate Student Instructors

Elliot Lawes and **Rachel Weir** were awarded the department's Outstanding Graduate Student Instructor award for the year 2000-01. Elliot has taught three different introductory calculus classes during the past four years. He is studying under the direction of Tom Hales. Rachel, who successfully defended her dissertation under the direction of Peter Duren, has also taught three different intoductory calculus classes during various semesters in her academic career.

Million Dollar Friend

Graduate student **Haggai Elitzur** was the "phone a friend" for a contestant on "Who Wants to be a Millionaire" this year. He correctly answered the final $1,000,000 question and his friend won the top prize!

New Undergraduate Program in Risk and Finance

The Departments of Mathematics and Economics have developed a new interdisciplinary undergraduate concentration in financial economics and mathematics. Modern finance uses mathematical methods to study the behavior of firms and individuals in asset markets, the market determination of asset prices, and links between financial market outcomes and the overall economy. Finance addresses how firms and households manage their affairs when faced with risk and uncertainty. It also addresses how risk affects overall economic outcomes.

The area of risk and finance is a natural subject for a joint program between economics and mathematics.

The disciplines share a common methodological perspective that uses rigorous modeling in the formulation and solution of problems.

The economic questions of finance—which involve the simultaneous modeling of risk and choices over time—require specific advanced mathematical techniques.

Finance is an area in which the application of mathematics to understanding human behavior has been especially successful. Principles derived from mathematical reasoning have become a standard part of the tools used on Wall Street and in financial centers around the world.

A concentration in risk and finance links well with the departments' existing strengths in areas such as actuarial science and macroeconomics.

The Departments of Mathematics and Economics have collaborated to develop a new curriculum. It will be directed at top students who combine an interest in risk and finance with strong motivation for rigorous analysis. A special feature of the program, which distinguishes it from business school programs, is that it will be situated within a broader liberal arts context.

The program will be staffed by economics and mathematics professors who have an interest in finance, but who are closely integrated into their respective disciplines.

Students in this program will receive the benefits of a liberal arts degree, which include exposure to a wide range of disciplines and the central role of language and expression as part of the educational experience.

The new concentration will require substantial resources. Funding is needed to hire faculty with broad interests in teaching and research in finance and the analysis of risk.

New specialized courses and a program of internships will be offered to build on the departments' strong base of existing courses and programs.

There is widespread student interest in the economics and mathematics of risk and finance, and our alumni/ae have urged us to develop such a program to respond to and support that interest.

Solution to Math Problem

by Harm Derksen

Define $a_n := 2^n/x - \lfloor 2^n/x \rfloor$ for all n. Then $0 \le a_n < 1$ for all n and we have

$$a_{n+1} = \begin{cases} 2a_n & \text{if } a_n < \frac{1}{2}, \\ 2a_n - 1 & \text{if } a_n \ge \frac{1}{2}. \end{cases}$$

If $a_n = 0$ for some n, then

$$\lfloor 2^m/x \rfloor x = 2^m$$

for all $m \ge n$ and we are done.

We may assume that $a_n \neq 0$ for all $n \ge 0$. Suppose that there exists a constant N such that $a_m \le 1/2$ for all $m \ge N$. This leads to a contradiction because $a_m = 2^{m-N} a_N \to \infty$ as $m \to \infty$ and $a_m < 1$ for all m. Thus we conclude that $a_m > 1/2$ for infinitely many positive integers m.

If $a_m \ge \frac{1}{2}$, then

$$0 < (\lfloor 2^m/x \rfloor + 1)\, x - 2^m$$
$$= (1 - a_m)x < \tfrac{1}{2}x < 1.$$

and $\lfloor b_m x \rfloor = 2^m$ where $b_m = \lfloor 2^m/x \rfloor + 1$.

Career Day 2000

The department hosted another successful Mathematics Career Day conference in October. Over 75 students participated in the event. Both graduate and undergraduate students were able to meet with representatives from business, education and academia, and discover the opportunities available in business for mathematicians. Everyone involved in the event agreed that it was a successful and worthwhile afternoon.

Alumni participants:

Eric Breck '98 - Computational Linguist, Boston, MA

Julie Frohlich '97 - Math Teacher, Troy School District

Kimberly Hartzfeld '93 - Manager, Anderson Consulting

David Kaprelian '85 - Consultant, Towers Perrin

Ed Kimball '71 - Principal Consultant, PricewaterhouseCoopers

Daniel Maki '66 - Chairman, Mathematics Department, Indiana University, Vice-President, CDT

Dick McLaughlin '62 - Technical Supervisor/Software Engineer, Bell Laboratories (retired)

Robert Nelson '75 - President, Airflow Sciences Corp.

Andrew Nobel '97 - Consultant, Anderson Consulting

Carmen Saleh '95 - Management Consultant, PricewaterhouseCoopers

Undergraduate Award Recipients

The department's team for the William Lowell Putnam Mathematics Competition placed 14th out of more that 434 teams participating in the event. The individual competition included 2818 students from across North America. This year's team was comprised of **Chetan Balwe**, who received an honorable mention distinction for placing in the top 50 in the individual competition, **Robert Easton**, who individually placed in the top 500, and **Rishi Raj,** who also received an honorable mention distinction for placing in the top 50 in the individual competition. UM student **Thomas Dunlap** also placed in the top 500.

Winner of the 18th Annual University of Michigan Undergraduate Mathematics Competition was **Tomas Sirgedas.** Tied for second place were **Justin Altman**, **Amy Kimball**, and **Vivek Shende**.

The William LeVeque Award in Number Theory was presented to **Jesse Kass**. The award recognizes a student who is at most a junior and excels in the study of number theory.

The following students received Evelyn O. Bychinsky Awards, designed to recognize underclassmen who show exceptional promise in mathematics:

Jeffrey Allotta
Robert Easton
Andrew Johnson
Kalman Nanes
Vivek Shende

The award for Outstanding Graduating Senior went to **Gabriel Kerr**.

Bertrand Guillou received the Sumner Myers Award in Analysis, which recognizes a student who is at most a junior and excels in the study of analysis.

Stacey Barbosa received the Leon P. Zukowski Prize for outstanding service in the Math Lab.

Outstanding Achievement in Mathematics Awards went to the following seniors:

Nicholas Ehart
Alan Grant
Joseph Marsano
Diana Murray
Jonathan Ng
Megan Powell
Brian Reed
Belal Sabki
Jennifer Single
Ludmilla Teng

The Margaret S. Huntington Prize in Actuarial Science was awarded to the following first year students:

Kristen Barbosa
Brian Chi Yan Chan
Valerian Jone
Zubin Kapadia
Jessica Lobenherz
Fatih Ozsolak
Anne Piontek
Marina Polishchuk
Tyler Richardson
Shiu May Young

The Irving S. Wolfson Award in Actuarial Science was presented to **Gary Levenbach**.

Paul Kardosh received the Otto Richter Memorial Prize in Actuarial Science.

Benjamin Singer received the Wirt and Mary Cornwell Award, recognizing a student who, during the four previous years, has demonstrated the greatest intellectual curiosity, given the most promise of original study and creative work in math.

Actuarial Program Highlights

It was another eventful academic year for the Actuarial students. A record number of firms visited the campus during the fall semester providing a number of interesting information sessions. The second annual "Mathematics Pizza Party for Undergraduates," sponsored by CIGNA, was held in October. In addition, students went on a day trip to visit Lincoln National in Fort Wayne in November (after the examinations!). Recruiting was very active during the winter semester with most employers emphasizing summer internship programs.

In conjunction with the 50th Anniversary of the Conference of Consulting Actuaries, the American Academy of Actuaries sent a gift to the University of Michigan, which was used to help fund fees for the professional examinations of the Casualty Actuarial Society and the Society of Actuaries. Because of gifts like this, we are able to encourage more students to start their professional examinations.

The students helped to organize tutoring sessions at a middle school in Ann Arbor in the fall, and participated in the Detroit project during the winter semester. In addition, there was active participation in a number of intra-mural sports. Unlike previous years, the "Underpaids" were victorious for the first time in a new sport for us—co-ed inner tube water polo—where we won some richly deserved IM t-shirts.

- Professor Curtis Huntington

Undergraduate Degree Recipients: December 2000, May 2001, August 2001

Yamina Acebo
Daniel Allen
Justin Altman
Keith Andrews
Daniel Berebitsky
Rebecca Branch
Matthew Buckman
Jennifer Cha
Emily Cheng
Hendrik Doorn
Jonathan Efron
Nicholas Ehart
Nathan Fredericks
William Gifford
Dana Goldberg
Anjela Govan
Alan Grant
Lamont Hamilton
Tawni Harrington
Nobuya Hayashi
Kimberly Henlotter
Carl Horwitz
Ryan Hutchinson
Edwin Jung
Rebecca Jurva
Kathy Kam
Paul Kardosh
Gabriel Kerr
James Kim
Emily Konzen
Garret Koski-Budabin
Lok-Yi Kwok
Paul Lam
Susan Lee
Joseph Marsano
Marcus Matthews
Tim McMillen
Michael McNamara
Cherianne Milne
Brian Monteith
Siwatu Moore
Diana Murray
Jayjit Nandwana
Stefan Neboyskey
Jonathan Ng
Sara Parent
Himani Patel
Matthew Perry
Brian Poppen
Megan Powell
Anish Ramachandran
Joe Ray
Brian Reed
Belal Sabki
Richard Schierloh
Joshua Schore
Susan Shortreed
Jennifer Single
Sarah Snyder
Sarvesh Soi
Jeffrey Steinkraus
Bradley Stetson
David Stirrup
Junichi Takayama
Kuang Tan
Sze Tan
Ludmilla Teng
Nicholas Trombetta
Wei Voo
Nicole Vulcano
Chad Williams

LeVeque Gift Funds Number Theory

William (Bill) J. LeVeque, former UM professor of mathematics (1949-1971) and department Chair (1967-1970) has made a gift to the department to establish an Excellence in Number Theory Fund. This endowment will be used to enhance the number theory program at Michigan by providing funds for travel, seminar speakers, conferences and related activities.

LeVeque, the first number theorist on the faculty, was instrumental in recruiting the second, **D. J. Lewis**. Together they developed a very strong program that is now one of the world's best. A steady stream of long term visitors from England, Hungary and Poland gave decided breadth and international impact to the program.

LeVeque's research areas included transcendental numbers, uniform distribution, and Diophantine approximation. His two volume 1956 monograph "Topics in Number Theory" was highly influential in the development of number theory in this country, as was the MAA monograph "Studies in Number Theory" that he edited.

In 1960 he conceived the idea of updating L. E. Dickson's "History of the Theory of Numbers" that covered the subject from antiquity to 1910. LeVeque assembled a *Who's Who* in number theory, including Davenport, Mahler, Erdos, Linnik, Turan, Renyi, and Deuring to work on the project, but the effort failed for lack of funding. In 1974 he accomplished part of his goal by publishing a six volume collection "Reviews in Number Theory" containing all reviews in number theory that appeared in Mathematical Reviews (MR) from 1940-1972 assembled by topic, for easy reference and for ease in seeing historical developments. The Special Libraries Association gave him an award for this effort.

The Reviews were updated in 1984. This collection had a profound impact on the subject and was referenced almost daily by researchers.

In 1964, when Ann Arbor was chosen as the new site for MR, LeVeque took on the task of relocation, finding space, as well as recruiting and training a staff. In June 1965, MR moved and LeVeque served as Executive Director for the next 15 months, guiding MR to stability.

In 1977, LeVeque became Executive Director of the American Mathematical Society—a position he held until his retirement in 1988. As Director he led the society to become a major publisher of books and journals, thereby putting it on sound financial standing. He pioneered the use of computers in printing, funded the development of LaTex, and played an encouraging role in the computerization of the MR data base, which made MathSciNet possible.

While an immensely imaginative and successful administrator, LeVeque never lost his love and interest in number theory. His generous gift will help number theory to flourish at Michigan, and the current faculty members in number theory greatly appreciate his contribution.

Alumna Receives Medal

Alumna **Karen K. Uhlenbeck** (BS '64, PhD '68 Brandeis) was awarded the National Medal of Science. She was one of 12 American scientists and engineers to receive the medal, that was presented at a ceremony in December in Washington, D.C.

In announcing the National Medal of Science winners, former President Bill Clinton declared "These exceptional scientists and engineers have transformed our world and enhanced our daily lives. Their imagination and ingenuity will continue to inspire future generations of American scientists to remain at the cutting edge of scientific discovery and technological innovation."

Uhlenbeck, who holds the Sid W. Richardson Foundation Regents Chair in Mathematics at the University of Texas at Austin, conducts research in geometry and partial differential equations and studies applications of geometry to large-scale problems in high-energy physics. She is interested in the ways complex mathematical concepts find uses in research in other areas of science, such as ecology, molecular biology and the structure of materials.

Uhlenbeck received the National Medal for Honor, the highest honor conferred on U.S. scientists, for her pioneering contributions to global analysis and gauge theory resulting in advances in mathematical physics and the theory of partial differential equations. Cited as one of the founders of geometry based on analytical methods, she was also recognized for her leadership as a mentor for women and minorities in mathematics education.

"I feel very humble, as many greater scientists have received this award," Uhlenbeck said. "I hope that my acceptance will serve as encouragement to young women scientists and mathematicians."

Uhlenbeck has taught at UT Austin since 1987. She was born in Cleveland and grew up in New Jersey. Prior to her appointment at UT Austin, she held faculty positions at University of California Berkeley, University of Illinois and University of Chicago. In addition to receiving numerous awards, honors and fellowships, including most recently a Guggenheim Fellowship for 2002, Uhlenbeck received the UM Alumna of the Year Athena Award in 1984.

New Graduate Fellowship Established

Professor and **Mrs. Cameron Courtney** have established the Cameron and Jack Courtney Graduate Fellowship in the Department of Mathematics. The fellowship is named after Cameron Courtney, who received his Ed.D. in 1965, and his son **John (Jack) Courtney**, who received his Ph.D. in 1993. Funded through a charitable remainder trust, the fellowship will provide financial assistance to a deserving graduate student.

Cameron was a student of **Phil Jones** at UM, and spent 24 years teaching at UM-Flint and Dearborn campuses. When he decided to pursue his graduate education at UM, he was married with a child. He is grateful for the financial assistance he received during his studies, and that is the reason he has established a graduate fellowship.

Jack Courtney worked with **Christoph Borgers** in Numerical Analysis. Jack was the first student to finish in the Scientific Computing option that had just been established. He is now on the faculty of Michigan State University.

Considering a Donation to UM?

If you are contacted by the University of Michigan for a donation, you can earmark your gift to the Department of Mathematics. Simply tell the caller to designate your gift to Mathematics or write Mathematics Department on the pledge card you are sent. We greatly appreciate all of your support, and we hope we can count on you to support future fund-raising projects.

Estate Gifts

You can include the Department of Mathematics in your estate plan. For information on charitable trusts and bequests to the department, contact:

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