Berkeley
Mathematics
Newsletter

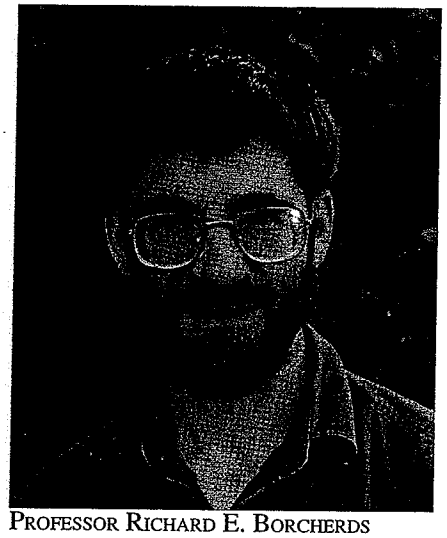
A newsletter of the Department of Mathematics and Center for Pure and Applied Mathematics at the University of California, Berkeley

Fall 1998 - Spring 1999, Vol. VI, No. 1

"MONSTROUS MOONSHINE" WINS FIELDS MEDAL

By Robert Sanders (Berkeleyan Staff Reporter)

The Fields Medal, often called the Nobel Prize of mathematics, was awarded Aug. 18, 1998 at an international conference in Berlin to a professor at the University of California, Berkeley, and to three other mathematicians.



Professor Richard E. Borcherds

Richard Ewen Borcherds, a professor of mathematics at UC Berkeley since 1993, received the medal for his work in the fields of algebra and geometry, in particular for his proof of the so-called "Monstrous Moonshine" conjecture. He joins two previous Fields Medalists at UC Berkeley, Steven Smale and Vaughan Jones.

The medal, the highest scientific award for mathematicians, is awarded every four years at the International Congress of Mathematicians to a mathematician no older than 40. The medal and a prize of 15,000 Canadian dollars were presented at the opening ceremony of the congress in Berlin to Borcherds and to mathematicians Maxim Kontsevich, William Timothy Gowers and Curtis T. McMullen.

Until recently, Kontsevich and McMullen also were on the UC Berkeley faculty. Kontsevich left UC Berkeley in 1997 to become a permanent professor at the Institut des Hautes Études in Paris. McMullen resigned in July 1998 to accept a position at Harvard University.

Gowers is a lecturer at Cambridge University in England and a Fellow of Trinity College. *(continued on page 11)*

NEW DEVELOPMENTS IN THE DEPARTMENT

Let me extend my warmest greetings to the faculty, students, staff, graduates, and friends of the Department of Mathematics and the Center for Pure and Applied Mathematics. There have been many new developments during the last year, and I want to bring you up to date on our programs and activities.

UNDERGRADUATE EDUCATION

Our innovations in our calculus courses are entering their third year and we are expanding them to include nearly all of the courses in the Engineering and Science track. The three hours of lecture by a senior faculty member are largely unchanged, but we have replaced the two hours of Graduate Student Instructor (GSI)-led discussion sections with three hours of workshop where students work in groups on hard and challenging problems. The role of the GSI for these workshops has changed from working

(continued on page 2)

Chair Calvin Moore

Highlights

What's inside:

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homework problems to circulating among the groups of students, asking and answering questions, and keeping the group focused in the right direction. This becomes a much more active learning experience for the students, applying the very successful model developed by Uri Treisman for students who were at risk of failure in these courses. In some of the classes, we have the students work in the computer laboratory for three hours a week, employing the same mode of active learning.

One common complaint about calculus courses is the lack of realistic applications. We are addressing this by having a mathematics faculty member (Alan Weinstein) and mathematics graduate students work with an engineering faculty member (George Johnson) and engineering graduate students to jointly develop curricular materials for these workshops. These activities have been supported by a grant from the General Electric Foundation.

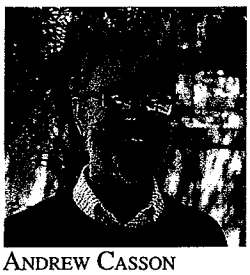
At the upper division level in spring 1999, we will be starting a new program of Undergraduate Research Seminars. A small group of students (5-8) will work under a senior faculty member and will read a series of research papers on current literature selected to be accessible to advanced undergraduates. During the term, they will present the results to the other seminar participants. The faculty member in charge will carefully supervise these presentations. We expect that the participating students will be able to get a direct sense of the research literature, how to access and use it, and, in addition, improve their communication skills. Students will also have the opportunity to continue work on a topic for a summer research project under the supervision of the faculty member. Students who complete a summer research project will receive a stipend of $2500. We are providing these stipends initially from gift funds and hope to expand the program with support from the National Science Foundation. The first Undergraduate Research Seminar will be offered by Professor Bernd Sturmfels on the topic "Solving Systems of Algebraic Equations."

FACULTY NEWS

We have added three regular faculty members this year. **Professor Maciej Zworski** joined us this year from the University of Toronto. He works in linear partial differential equations, micro local analysis, and scattering theory; areas not previously represented at Berkeley. **Associate Professor Alan Edelman** joined us from MIT and began duties January 1, 1999. He works in numerical linear algebra. **Assistant Professor Andrei Okounkov** will be joining us from the University of Chicago where he is completing a Dickson Instructorship. He works in combinatorics and representation theory and will begin duties July 1, 1999. We have been authorized to make three additional permanent faculty appointments this year. Finally, I am pleased to report that **Associate Professor Alexander Givental** was promoted to the rank of Full Professor effective July 1, 1998.

First and foremost among faculty honors was the award of a Fields Medal to **Professor Richard Borcherds** at the International Congress of Mathematicians (ICM) meeting in Berlin. Richard is currently on leave from Berkeley and is Royal Society Research Professor at Cambridge University, but plans to return to his Professorship in Berkeley in the fall of 1999. **Curt McMullen** and **Maxim Kontsevich** who were, until very recently, on the faculty here were also awarded Fields Medals. Curt left last summer for Harvard and Maxim had left the year before to take a Professorship at the Institut des Hautes Études Scientifiques (IHES) in Paris. Congratulations to all!

Professor Andrew Casson was elected a Fellow of the Royal Society of Great Britain. He is the second faculty member so honored after Richard Borcherds.



ANDREW CASSON

Professor Marina Ratner was appointed as a Chancellor's Distinguished Professor, one of less than 30 faculty on the entire campus who have been so honored over the past several years.

MARINA RATNER

Robert Uomini and Louise Bidwell have generously established the Chern Chair in honor of his mentor Shiing-Shen Chern. It is the first named Chair in the Department. The income is dedicated for the appointment of Chern Visiting Professors. The Chern Visiting Professor for 1999-2000 will be **Professor Michael Artin** of the Massachusetts Institute of Technology (MIT). Professor Artin will split his time between the campus and the Mathematical Sciences Research Institute (MSRI) and will be in Berkeley for the entire year. MSRI has established, using a generous donation from Jim Simons, the Simons Visiting Professor, and for 1999-2000 the holder will be Mike Artin. Mike will be the first Chern-Simons Visiting Professor!

GRADUATE PROGRAM

This fall we welcomed our entering class of 30 new students plus six new students in the Program in the Logic and Methodology of Science (L&MS). This is a very strong class and was selected from among over 300 applicants in Mathematics and 20 in L&MS. This is a slightly smaller entering cohort in Mathematics than last year, and we expect to have a slightly larger cohort in the fall of 1999. Six new entering students in L&MS represent a healthy increase from the previous year because of excellent recruiting efforts — six students were offered admission and all six accepted. We continue our policy of offering entering students support for five years provided they continue to make good progress in the program. The Department is committed through outreach,

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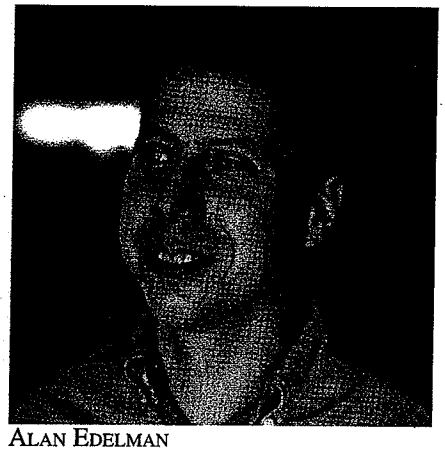
WELCOME NEW FACULTY

Alan Edelman is an associate professor, previously from MIT. He believes for pure mathematics to be appli-



ALAN EDELMAN

cable, much more work is needed over and above what is required to prove the difficult theorems. He works on high performance computing and numerical linear algebra and is currently excited about reviving his interest in eigenvalues of random matrices.

Some of his prizes include the Chauvenet Prize for a mathematical paper (1998), the Householder Prize for best thesis in numerical analysis (1990), the Gordon Bell Prize for supercomputing (1990), two Leslie Fox Prizes (1989, 1993), NSF Career Award (1995) and a Sloan Fellowship (1994). He received his BS and MA from Yale (1984) and PhD from MIT (1989), and held positions at UC Berkeley and LBL (1990-1993), as well as IBM's T.J. Watson Research Center, Thinking Machines Corporation and CERFACS in Toulouse, France. In younger days, he participated in the Hampshire College Summer Studies in Mathematics and was tenth in the 1980 USA Olympiad Mathematics Competition.

He loves to travel (and earn frequent flyer miles), indulge in the New York Times (especially on Sunday,) run, and hopes to enjoy the outdoors more now that he has escaped the New England winter.

Maciej Zworski received his PhD from MIT in 1989, with Richard Melrose as his advisor. He then accepted a position as Benjamin Peirce Assistant Professor at Harvard. In 1990, with research interests in resonances, Zworski began a fruitful collaboration with Johannes Sjöstrand. After receiving an Alfred P. Sloan Research Fellowship, Zworski decided to use this award by spending the academic year 1992-93 in Paris.

In 1991, Zworski accepted a position at The Johns Hopkins University. He began in 1993 and was promoted to full professor in 1994. He started his collaboration with Steve Zelditch and remains very interested in the problems of "quantum chaos." In 1995, Zworski accepted a position at the University of Toronto and in 1998 moved to Berkeley. This year Zworski was selected by the Canadian Mathematical Society as the CMA Coxeter-James Lecturer. He will give a lecture at the meeting held in Montreal in December 1999.

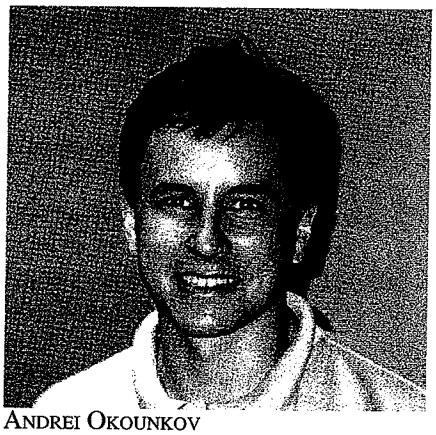
In a very broad sense, Zworski's research interests are motivated by quantum mechanics and he considers microlocal analysis to be its mathematical manifestation in the theory of partial differential equations. Scattering theory, semi-classical analysis, wave

MACIEJ ZWORSKI

propagation, and the study of resonances (which, roughly speaking, replace eigenvalues for problems on non-compact domains) are special interests.

Zworski is an associate editor of *Duke Mathematical Journal* and an editor of *International Mathematics Research Notices*. In 1994-95, with M. Ikawa, he organized a special year in "Linear and Non-linear Scattering" at the US-Japan Mathematics Institute at Johns Hopkins and, in fall 1997, with V. Ivrii, he organized a program in "Microlocal Analysis" at the Fields Institute in Toronto.

Andrei Okounkov graduated with his PhD from Moscow State University in 1995. Okounkov was a member of the Institute of Advanced Study at



ANDREI OKOUNKOV

Princeton during 1996. In the fall of 1996, he accepted a Dickson Instructorship in Mathematics at the University of Chicago. In spring of 1997, he was an MSRI member in Berkeley. Okounkov's field is in combinatorics, representation theory, and their interconnections. However, he also reaches out to a variety of problems and topics in representation theory, as well as mathematical physics and other areas. While at Moscow State University, he taught for six years in an outreach program aimed at gifted 11th and 12th grade students.

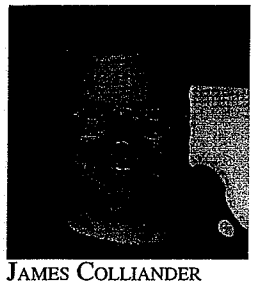
WELCOME VISITORS

By Haruko Bruce

Charles B. Morrey, Jr. Assistant Professors:

The following individuals have been appointed to serve as a Charles B. Morrey, Jr. Assistant Professor. These prestigious positions were created in honor of the late Professor Morrey who was one of America's premier analysts.

James Colliander received his PhD from the University of Illinois, Urbana-Champaign, in spring 1997. His research interests are in nonlinear dispersive wave equations and geometric structures in harmonic analysis. In addition to the Morrey appointment, he has received a distinguished NSF Postdoctoral Fellowship. Colliander has received other awards including a Department of Education National Needs Fellowship and an Alfred P. Sloan Doctoral Dissertation Fellowship. Before beginning his appointment in fall of 1998, he visited MSRI during the fall of 1997, and the University of Chicago during the spring of 1998.

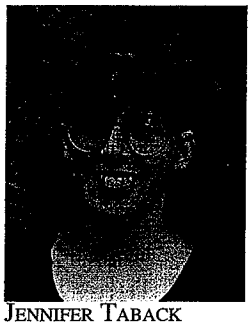


James Colliander

Zvezdelina Stankova-Frenkel received her PhD from Harvard University in 1997 and spent a year at MSRI on a postdoctoral fellowship prior to beginning her appointment with the Department in fall 1998. Her research interests are in the areas of algebraic geometry, specifically moduli spaces of curves, and combinatorics. Her thesis, "Moduli of Trigonal Curves," has been accepted for publication in the *Journal of Algebraic Geometry*. Since arriving in Berkeley, Stankova-Frenkel has founded the Bay Area Math Olympiad and the Berkeley Math Circle. As an undergraduate, she received an Alice T. Schafer Prize honoring the best woman undergraduate in mathematics.

Z. Stankova-Frenkel

Jennifer Taback received her PhD from the University of Chicago in spring 1998. Her specialty is geometry, in particular the study of groups as geometric objects. Her thesis was praised by faculty in her area at Chicago and by other specialists. She taught pre-calculus as a lecturer in Chicago; her skills were highly praised by her faculty supervisor.



Jennifer Taback

NSF Postdoctoral Fellowship Recipient:

Thomas Scanlon received his PhD from Harvard University in 1997. Prior to coming to the Department, he spent a year at the Mathematical Sciences Research Institute. While at MSRI, he participated in special research in the model theory of fields. His current research interests include algebraic geometry and number theory, as well as the traditional subjects of logic.

Thomas Scanlon

NSF POWRE Recipient:

Alice Silverberg, professor of mathematics at Ohio State University, is visiting UC Berkeley and MSRI on an NSF Professional Opportunities for Women in Research and Education (POWRE) grant during the academic year 1998-99. Silverberg is the author of numerous research articles which study interrelated questions in number theory and arithmetic algebraic geometry. She is especially interested in the arithmetic of abelian varieties and Shimura varieties.

Alice Silverberg

Visiting Assistant Professor:

Claire Chan is visiting the Department for the academic year, 1998-99. Chan received her PhD from Stanford University in 1995. She held a three-year teaching appointment at the University of Utah before coming to Berkeley. Her research interests include geometric analysis, using partial differential equation methods, as well as geometric measure theory.

Claire Chan

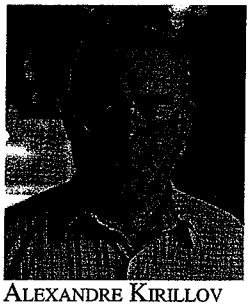
Visiting Miller Professors:

The following individuals have been awarded a Visiting Miller Professorship. The purpose of this award is to bring promising or eminent scientists to the Berkeley campus on a short-term basis for collaborative research interactions.

Rodney J. Baxter, the world's leading figure in the field of exactly solvable models in statistical mechanics, is visiting Berkeley during the spring semester. Currently a professor at the Australian National University at Canberra, Baxter's research focuses on the Chiral Potts model, work that greatly impacts both mathematics and theoretical physics. He will be participating concurrently in the Random Matrix program at MSRI.

Alexandre A. Kirillov, professor of mathematics at Moscow State University from 1965-1995, currently at the University of Pennsylvania, is visiting during the spring semester. Kirillov belongs to the group of mathematicians

whose research and pedagogical activity determined the face of Soviet mathematics starting in the early 60's. The orbit method in representation theory, invented by Kirillov in his student years, provides a fundamental link between quantum mechanics and differential geometry. His current research interest is algebra and representation theory.


ALEXANDRE KIRILLOV

Jean Taylor, a professor of mathematics at Rutgers University, is a Visiting Miller Professor spring semester 1999 in the Department of Materials Science and Mineral Engineering. She has a lengthy and important research record on geometric and analytic models for soap bubbles and crystals. She is also the president of the Association for Women in Mathematics (AWM.)

Richard Taylor, professor of mathematics at Harvard University, is perhaps most widely renown for his contribution in resolving the gap in Andrew Wile's proof of Fermat's Last Theorem. Taylor's deep knowledge of arithmetic algebraic geometry and the arithmetic of automorphic forms is a wonderful resource to the students and faculty this spring semester.

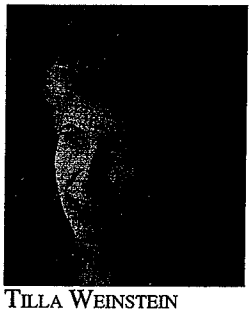

RICHARD TAYLOR

Victor Vassiliev, professor of the Moscow Independent University and Steklov Mathematical Institute, is visiting Berkeley during the spring semester. Among his areas of specialization are symplectic geometry and topology, combinatorics, integral geometry, singularity theory, complex analysis, complexity theory, knot theory, and partial differential equations.


VICTOR VASSILIEV

Visiting Scholar:

Tilla Weinstein, professor of mathematics at Rutgers University, visited UC Berkeley during the fall semester, 1998. Her interest in recent years has been conformal geometry of indefinite metrics on surfaces. She has been studying the indefinite metric analogs of Riemann surfaces, with applications to the geometry of timelike surfaces in pseudo-Riemannian manifolds. She was a guest speaker at a Noetherian Ring colloquium and spoke in the Differential Geometry seminar and in the Topology seminar.


TILLA WEINSTEIN

Math Circles

BY TAMARA KEITH (BERKELEYAN STAFF REPORTER)

Unlike math clubs, which are student run, math circles are led by mathematicians and teachers trained in Olympiad-style problem-solving. The Berkeley Math Circle is led by eight mathematicians, five of whom teach at UC Berkeley: Zvezdelina Stankova-Frenkel, Alexandre Givental, John McCuan, Bjorn Poonen, and Vera Serganova.

Math Circles are not a new concept, but they are new to the United States. First created in Hungary during the 19th century, the circles reached their peak in the former Soviet Union. They are popular all over eastern Europe. The Berkeley Math Circle was the first of its kind in California. Since its creation September 1998, math circles have sprung up in Oakland, San Jose, Palo Alto, and Irvine.

Students in the Berkeley Math Circle range from seventh- to twelfth-graders and come from as far away as Davis and San Jose to participate. Although not restricted to gifted students, the group certainly attracts them. Most participants, having advanced beyond what is available at school, want to increase their math skills and exchange mathematical creativity.

At weekly meetings, students tackle difficult mathematical analysis and work on problem-solving techniques. As the problems unfold, an amazing level of difficulty is revealed. The math circle also covers concepts taught in the standard high school curriculum, but presents them differently and at greater depth.

"In our eyes, calculus is by no means the end of the story," said Stankova-Frenkel. "It is only one of the beginnings of many stories. There are many more interesting areas where people do not require so much formal training to start working — topics like combinatorics, probability, game theory, Euclidean geometry, number theory and algebra." Stankova-Frenkel hopes that math circles will become more widely accepted and utilized in schools around the country.Ω

FACULTY HONORED

Yuri Berest was awarded the 1998 Canadian Mathematical Society (CMS) Doctoral Prize.

The CMS Doctoral Prize was inaugurated to recognize outstanding performance by a doctoral student who graduated from a Canadian University in the preceding year. The Prize consists of an award of $500, a two-year complimentary membership in the CMS, a framed Doctoral Prize Certificate, and a stipend for travel expenses to attend the CMS meeting to receive the award and present a plenary lecture. The first award was presented in 1997.

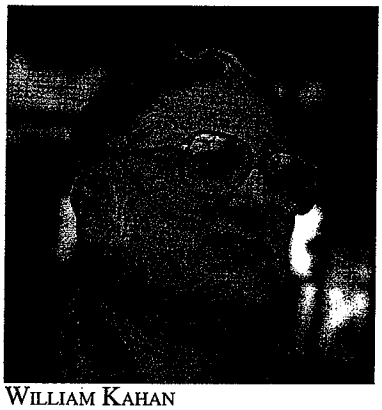

YURI BEREST

Berest received his PhD degree from the Centre de Recherches Mathématiques (CRM), Université de Montréal in May 1997. His research interests are in mathematical physics and partial differential equations. In particular, his PhD thesis was devoted to a classical problem in the theory of hyperbolic differential equations (known as the problem of lacunas). Currently, he continues to work on this problem, trying to focus on various interrelations with other areas of mathematics, especially with integrable systems and algebraic geometry.

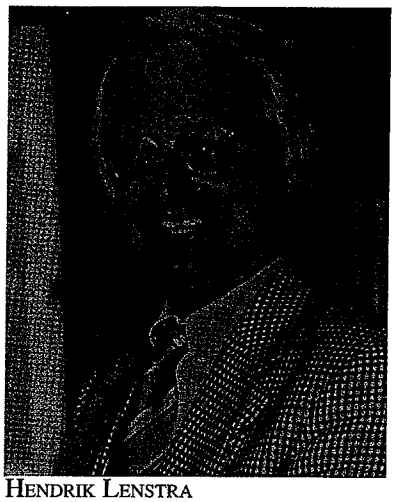
Professor William M. Kahan came to UC Berkeley in 1969 from the University of Toronto, Canada where he earned his PhD in numerical analysis in 1958. His field is the analysis and control of errors in approximate computation. Kahan's interests in mathematical support for scientific and engineering computation include the design of computer arithmetic hardware and software. He has served as consultant to IBM, Hewlett-Packard, Intel, and other companies. He devised a design for mathematically sound floating-point (approximate) arithmetic that could be built without significantly degrading computer speed. This design evolved into ANSI/IEEE standard 754 for binary floating-point arithmetic, to whose exacting specifications almost all computer manufacturers now attempt to adhere. For his contributions to this design Kahan received the Turing Award (the "Nobel Prize" of Computer Science) in 1989.

Kahan has visited the University of Waterloo often, presenting seminars and meeting with researchers to influence the development of automated algebra systems, such as in the Maple Project at Waterloo.

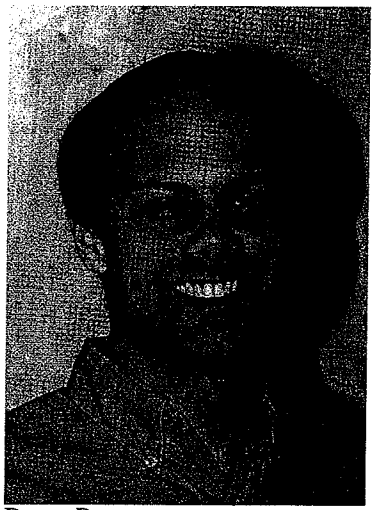
In recognition of his distinguished career as an error-analyst and his pioneering contributions to computer science, the University of Waterloo in Toronto, Canada conferred the degree of Doctor of Mathematics, *honoris causa*, on William Kahan. President and Vice Chancellor James Downey presented this honor at the seventy-sixth Convocation on May 30, 1998.


WILLIAM KAHAN

Professor Hendrik Lenstra was awarded the Spinoza Award in October 1998 of 1.6 million dollars for mathematics research in The Netherlands. Professor of Mathematics at UC Berkeley since 1986, Lenstra is renowned for his work in algebraic number theory and algorithms.


HENDRIK LENSTRA

Assistant Professor Bjorn Poonen has been awarded a five-year fellowship of $625,000 from the David and Lucile Packard Foundation. He was one of 24 researchers selected nationally from all areas of science and engineering for this honor. (The only other mathematician in this year's group was Zoltan Szabo of Princeton University.)


BJORN POONEN

In the past year, Poonen was also awarded a fellowship from the Alfred P. Sloan Foundation.

Poonen's main research is in number theory and algebraic geometry, but he has also published papers in combinatorics and probability. This is his second year as Assistant Professor at Berkeley.

On May 25, 1998, President E. Gordon Gee of Brown University (Providence, RI) proudly bestowed an honorary Doctorate of Science degree on **Professor Kenneth Ribet** of our department. An undergraduate at Brown in the late 1960's, Ribet graduated with a combined Bachelor and Master of Arts degree in 1969. He did his graduate work at Harvard, receiving his PhD in 1973. A number theorist, Ribet is especially known for his work relating modular forms to the theory of algebraic number fields. His work played a central role in the proof of Fermat's Last Theorem, a mathematical problem that went unresolved for over 350 years. In 1986, he related Fermat's Last Theorem to an unsolved conjecture about elliptic curves. When this conjecture was proved in 1994 (in articles by Wiles and Taylor-Wiles), Fermat's Last Theorem was finally solved.

KEN RIBET WITH DAUGHTERS STEPHANIE (LEFT) AND CAROLINE (LOWER RIGHT)

The Center for Pure and Applied Mathematics has been awarded $835,000 over three years by the Stuart Foundation of San Francisco to support preparation of mathematics teachers. Under the grant, a team headed by Principal Investigators Professor Calvin C. Moore and Professor Hung-Hsi Wu of the Department of Mathematics and principal writer Dr. Dick Stanley of the Professional Development Program will create a new course to be taken by math majors who are considering becoming high school mathematics teachers. The following text from the proposal describes the project:

"There is a considerable gap between the mathematics high school teachers study in college and the mathematics they will teach in high school. Future secondary teachers rarely have the opportunity to study, from a mathematically sophisticated point of view, the actual content they will be teaching. This proposal asks for funds for the creation and testing of a new type of college mathematics course designed to fill this gap, a course we have called "High School Mathematics From an Advanced Standpoint." The course is intended for college students who are considering becoming secondary mathematics teachers and for practicing secondary school teachers. An additional intention is to motivate other students, who have an interest in and flair for mathematics, to consider mathematics teaching as a career.

The course we propose to create is unusual for a college mathematics course in that it treats the actual content of high school mathematics itself, but at a deeper level than students encountered when they were in high school. Sometimes this "deeper level" means a greater level of abstraction or generalization, sometimes a more concrete treatment or an in-depth look at an application, sometimes a historical picture of the development of an idea, sometimes a connection to college-level mathematics such as calculus, abstract algebra, discrete mathematics, statistics, and computer science, and sometimes it means connecting various parts of high school mathematics in ways that could not be done when these teachers were high school students." Ω

Chern-Simons Visiting Professor

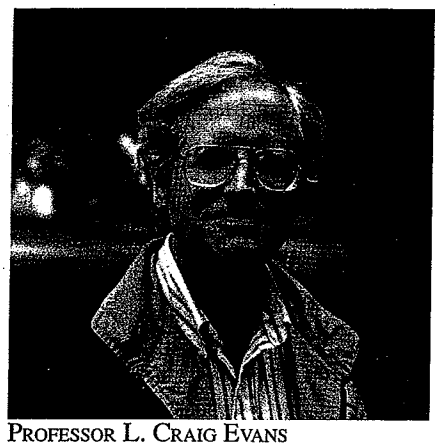
Professor Michael Artin will be visiting Berkeley the academic year 1999-2000. He will be at the Department of Mathematics in the fall as the Chern Visiting Professor and the following spring at MSRI as the James and Marylin Simons Visiting Professor for their programs in Noncommutative Algebra and in Galois Theory.

Artin, born in 1934 in Hamburg, Germany, received his AB degree from Princeton in 1955 and his PhD from Harvard in 1960. His thesis advisor was Oscar Zariski. He has been professor of mathematics at Massachusetts Institute of Technology since 1963. He was President of the American Mathematical Society from 1990-92, and is a member of the National Academy of Sciences and of the American Academy of Arts and Sciences.

Mathematic fields he has worked in are algebraic geometry and noncommutative algebra. His recent work is mainly on noncommutative projective geometry. Artin also enjoys playing the violin. Ω

RESEARCH: MOVING DIRT

BY L.C. EVANS



PROFESSOR L. CRAIG EVANS

Gaspard Monge in the early 1780's posed what turns out to be a seminal mathematical problem: *How can we move a pile of dirt or rubble ("déblais") to an excavation or fill ("remblais"), at the least cost?* To really answer this, we would presumably need to find out lots about wheelbarrows and union overtime rules in pre-Revolutionary France; but an appropriate mathematical abstraction of this question is a wonderful, if nonstandard, problem in the calculus of variations.

Hauling dirt. We begin by making a mathematical model. We are given two nonnegative functions $f^{\pm}$, where f^+ is the mass density of the dirt in the original pile X and f^- the desired density within the new pile Y. We introduce next the *admissible class* A of one-to-one mappings $\mathbf{s}$ that rearrange the density f^+ into f^-. This forces the highly nonlinear constraint that the Jacobian matrix of $\mathbf{s}$ must satisfy a pointwise identity involving $f^{\pm}$.

To further our mathematical model, we require next some way to measure the cost entailed for a given mass rearrangement plan $\mathbf{s} \in A$. So we introduce a *work* or *cost density function* $c(x,y)$, which records the effort required to move a unit mass from the position x to a new position y. Then the total *work* or *cost* for $\mathbf{s}$ is

$$(1) \quad I[\mathbf{s}] := \int_X c(x, \mathbf{s}(x)) f^+(x)\, dx.$$

Our problem is therefore to find, and understand, an *optimal mass transfer plan* $\mathbf{s}^* \in A$ which minimizes the work:

$$(2) \quad I[\mathbf{s}^*] = \min_{\mathbf{s} \in A} I[\mathbf{s}].$$

Geometry of optimal transport. To get some insight, let us now just assume that such an optimal $\mathbf{s}^*$ exists and try to figure out something about its structure. The trick is to exploit the minimization property (2), while keeping in mind the constraint on the Jacobian.

Monge himself made a remarkable observation, namely, that we can convert from the hard problem of discovering an optimal *mapping* $\mathbf{s}^*$ to the easier task of finding an associated *potential function* u^*. His argument (for $c(x,y) = |x - y|$) is geometric. First of all, we can think of each point $x \in X$ as moving along a straight line, coming finally to rest at the point $y = \mathbf{s}^*(x) \in Y$. Furthermore, these lines do not cross, as we could otherwise switch the endpoints, thereby lowering the cost.

Thus the region between the dirt piles X, Y is filled with these nonintersecting lines, which in turn, Monge argues, naturally sweep out two families S_1, S_2 of surfaces. Next, he deduces that the surfaces in S_1 are all orthogonal to the surfaces in S_2; whence there exists a third family of surfaces S_3, perpendicular to both. And the surfaces in S_3 contain useful information, as the optimal transport of the dirt particles is through, and perpendicular to, them. We may finally introduce u^* as that function whose level sets are the surfaces in S_3.

It is difficult in reading Monge's work to comprehend precisely how much of this lengthy geometric argument is really "proved," but the undertaking was of great historical importance for differential geometry. The families of surfaces S_1, S_2 comprise so-called *developable surfaces*, the study of which Monge thereby initiated. The assertion that the third family of orthogonal surfaces S_3 exists is *Dupin's Theorem*, named for Monge's student who carefully examined just when this deduction is valid.

Calculus of optimal transport. I explain next a newly discovered analytic argument, which replaces, and generalizes to any $c(x,y)$, the tricky-to-confirm geometric assertions above. The plan is to read off useful information from a "twist variation." For this, let us first introduce a closed curve C, lying within the original pile X. Now the image C^* of C under the mapping $\mathbf{s}^*$ will be a closed loop within Y. Think now of a small tube T about C, which in turn maps to a small tube T^* about C^*. If we "twist" T^* by a small amount t, we are in effect rearranging the dirt within Y; and so, since the original placement of dirt was optimal, we cannot possibly have decreased the total work involved. Consequently, once we write $i(t)$ to denote the cost of moving the dirt to the configuration with the tube T^* twisted by an amount t, it must be that $i(0) \le i(t)$ for all t.

Hence, $i'(0) = 0$. It turns out that upon our (very carefully) shrinking down the tube T to the curve C, and thus T^* to C^*, we can compute

$$(3) \quad 0 = i'(0) = \int_C \nabla_x c(\cdot, \mathbf{s}^*(\cdot)) \cdot d\mathbf{r}.$$

This is true for all closed loops C. Remembering our multivariable calculus, we deduce that the vectorfield here is a gradient:

$$(4) \quad \nabla_x c(x, \mathbf{s}^*(x)) = \nabla u^*(x)$$

for some real-valued function u^*. This extends Monge's deduction, and is especially interesting in those cases for which we can invert (4), to solve for $\mathbf{s}^*$ in terms of ∇u^* and c. We have switched the unknown from the *mapping* $\mathbf{s}^*$ to the *potential function* u^*.

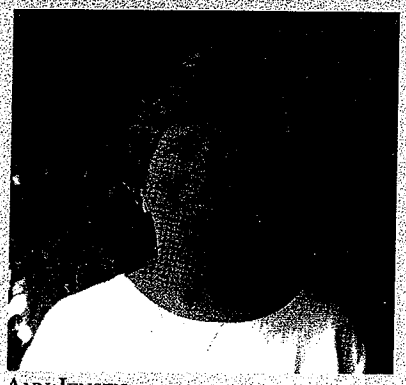
Some applications. I do not have space enough here to explain very well the full significance of the potential function u^*, whose existence is sketched above. I will just note that careful studies of u^*, and the differential equation it satisfies, have in the last several years opened up several new subareas of research within nonlinear partial differential equations theory. It turns out to be especially interesting to look out for Monge mass transfer effects on "fast time scales" in certain dynamic problems:

* **Meteorology.** Two British meteorologists, M. J. P. Cullen and R. J. Purser, in the 1980's, intensely studied the so-called "semigeostrophic" equations for weather, a very compli-

(continued on page 9)

Old Meets New in the Math Library

By Ann Jensen (Librarian of the Astronomy/Mathematics/Statistics Library)



Ann Jensen

Many of you are aware of the growing number of current journals that are available electronically. Mathematics is one of the few scientific disciplines which also has a substantial electronic archive of some of its core journals.

Eight major mathematics journals (including the *Journal, Proceedings, and Transactions of the AMS*) are available electronically from the past five years — back to their first volumes. In the case of *Annals of Mathematics*, that's 1884!

All the electronic journals that are available to you through Library licenses are listed at the library web site: http://www.lib.berkeley.edu/AMS/.

The next time you need a paper from a 1901 volume of the *Transactions of the AMS*, or a 1998 volume of the *American Journal of Mathematics*, remember that you can obtain them both without leaving your office. You may also search MathSciNet on the Web, and the electronic version of Science Citation Index.

I will be happy to show you how to take advantage of these new versions of old and valued resources. Stop by the library, or if you prefer, I will make campus office calls to show you at your own workstation. Ω

MSRI

By David Eisenbud, Director

MSRI's program during spring 1999 is Random Matrix Models, an area that involves such far-ranging topics as statistics, number theory, mathematical physics, and integrable systems. The semester began with an introductory workshop that brought together members of all these fields. Craig Tracy pulled these threads together in his survey talk at the first MSRI-Evans seminar of the term. Next fall MSRI will host a program on Galois Groups and Fundamental Groups which will be replaced in the spring by Numerical Applied Mathematics. Throughout the year there will be a program in Noncommutative Algebra. Something for every taste!

There are some new categories of members coming to MSRI. The James and Marylin Simons Visiting Professor next year will be Mike Artin, but he will only wear this hat for one semester; the other semester he will be the Chern Visiting Professor in the Department of

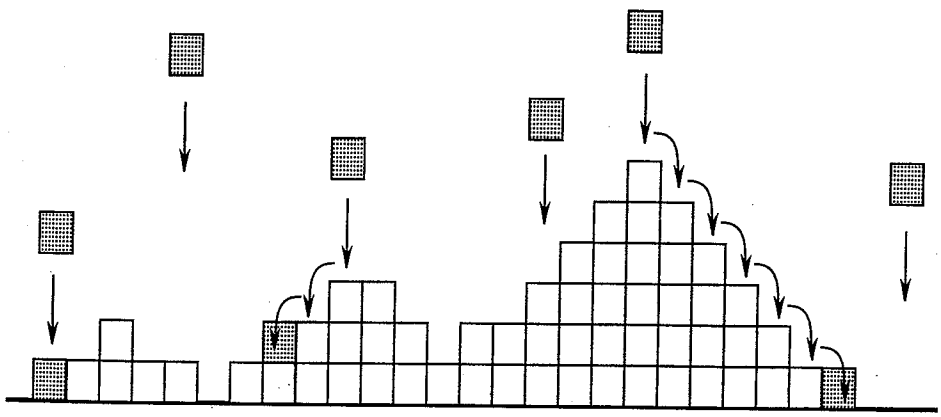
(continued on page 16)

RESEARCH: MOVING DIRT

(continued from page 8)

cated system of nonlinear PDE. They discovered that in proper coordinates these can be interpreted as showing that "air parcels" continually and quickly redistribute themselves according to an optimal Monge transfer plan (for $c(x,y) = |x - y|^2$), as other physical parameters slowly evolve.

* **Sandpile models.** A completely different, if highly idealized, physical example is this. Think of a pile of sand growing above a flat plane, as sand is continually added to the pile at various sites and falls downhill to stable resting places. For such a landscape with many hills and valleys, the newly added sand will redistribute itself in a complicated way. In fact, this can all be understood as a Monge mass transfer for the cost $c(x,y) = |x - y|$: the height is none other than the Monge potential u^* and the sand optimally rearranges itself by just falling downhill.



F. Rezakhanlou and I have exploited this last interpretation to find the continuum limit of a complex random process, whereby lots of small cubes are added to a growing stack and each newly added cube falls downhill, so that the resulting pile has no "unstable steps" with height greater than one. Especially in three (or more) dimensions, we can generate this way a very complex, random, evolving configuration of cubes, with "long range interactions."

Yet the height u^* of the continuum limit, had by taking more and more, smaller and smaller cubes, added faster and faster, in fact satisfies a simple nonlinear evolution equation. And once again we have a Monge problem, with potential u^* and cost $c(x,y) = |x_1 - y_1| + \ldots + |x_n - y_n|$.

This article is a variant of a talk I gave during the spring semester 1998 to the Mathematics Undergraduate Student Association, MUSA. Ω

MUSA Lecture Series

On August 26, MUSA kicked off its fall 98 lecture series with a bang. Serge Lang, professor of mathematics at Yale University, gave two undergraduate talks during the first week of classes. His first lecture, titled "Counting Prime Numbers," centered on the Riemann hypothesis and drew a crowd of 150. His second talk, aimed at seniors in math, exposed the power of the innocent looking semi-parallelogram law.

After his lectures, Lang kindly autographed his books, including his latest, "Challenges," which uses case studies collected by Lang himself to expose the failures of scientific journalism.

G. I. Barenblatt continued the lecture series in the '98 fall semester and was followed by Bernd Sturmfels and Chad Schoen of Duke University. Other speakers featured from UC Berkeley were Robin Hartshorne, F. Alberto Grünbaum, Aaron Abrams, and Charles Fefferman of Princeton University. Abstracts can be found on our website: **http://math.berkeley.edu/~musa** .

Past lecturers of the series include Ken Ribet, Stephen Diliberto, L. C. Evans, Alex Gottlieb, Aaron and Heidi Ashih, Vinay Kathotia, H.W. Lenstra, Jr., Brad Chin, Elwyn Berlekamp, and Kurt Kreith (UC Davis.)

The MUSA lecture series provides math undergrads and other students an opportunity to see different aspects of mathematics aside from what they are usually exposed to in the classroom. It also gives them an opportunity to learn more about different fields that spring from a math major. Past topics have varied from historical mathematics and current research to recruitment for various graduate school programs and a career day. (Yes, there is life after college.) Professors and graduate students interested in giving a lecture, on a topic on which they are currently working or a fascinating gem of a theorem, should contact **MUSA, 1064 Evans, email: musa@math.berkeley.edu.**

MATH T-SHIRTS FOR SALE!

Our 100% cotton shirts, featuring the classic design by Professor D. Auckly, come in six colors: natural, gray, navy blue, moss green, burgundy, and black, and in four sizes: small, medium, large, and extra large. Ω

THE NOETHERIAN RING

In 1997-98, the members of the UC Noetherian Ring continued to provide a setting of mathematical mentorship, community, and space for women to present mathematical research. Activities were organized to answer prospective graduate students' many questions about UC Berkeley, including the transition to graduate school in general, and to welcome incoming women. Outreach activities, such as weekly luncheons, were initiated. This year's welcome event started with a visit from Constance Reid who signed copies of her book *Julia* for first-year women.

The heart of this organization continues to be weekly meetings in which a member gives a half-hour talk on mathematics preceded by refreshments and socializing.

In fall 1998, the Noetherian Ring had the great pleasure of inviting Dusa McDuff (of SUNY Stonybrook) who also gave the departmental colloquium. Dusa was integral in starting the Noetherian Ring Colloquium Series and continues to be a great support to Noetherian Ring members.

Other guest speakers in 1997-98 included Lynne Walling, Abby Thompson, Kate Okikiolu, Joan Feigenbaum, Jennifer Chayes, Rekha Thomas, and Tilla Weinstein. Ω

GRADUATE PROGRAM

BY DON SARASON

Thirty students entered our graduate programs this fall, 24 in the PhD program and six in the MA program. Four of the MA students hope to advance to the PhD program next year. The entering class includes nine international students from eight different countries: England, Israel, Germany, Ukraine, Japan, Columbia, Singapore, and Canada.

The Department was fortunate to receive a three-year grant from the Department of Education under its Graduate Assistance in Areas of National Need program. The grant, together with departmental matching funds, provides fellowships for eleven beginning graduate students. This year, thanks to the GAANN money and other fellowships, all of our entering domestic students have non-teaching support. (The GAANN money is restricted to domestic students.)

The Graduate Program Policy Committee, initiated last year, is continuing this year under a new name: the Graduate Program Advisory Committee. The committee consists of three faculty members chosen by the Chair, three graduate students chosen by the Mathematics Graduate Student Association, and one staff member. The committee's charge is to advise the Department on all matters pertaining to our graduate programs. Last year the Committee was particularly concerned with the quality of the guidance we provide to our PhD students before they enter the dissertation stage. As a result, several steps are being taken to improve our pre-dissertation advising. A new lecture series, the Mentor Program Lecture Series, was started last spring and is being continued this year. In these lectures, which take place every other week, faculty members explain their areas of research in terms understandable to first-year graduate students. The lectures have proved very popular. Ω

MATH MODELING TEAMS COMPETE

LEFT TO RIGHT, BACK ROW: JOHANNA MANGAHAS, ALICE ZHENG, PROFESSOR SACHS, ILYA SHPITSER. FRONT CENTER: EDWIN O'SHEA, SETH SULLIVANT
INSERT: MIKHAIL KHLYSTOV

The Mathematical Contest in Modeling is a world- wide competition which offers undergraduates the opportunity to use applied mathematics in solving real world problems while competing in a team setting. Each team is comprised of three students and has 89 hours from the time they are handed the problem to model a real-life solution and turn in the finished paper. The Department of Mathematics at UC Berkeley sponsored two teams with faculty advisor, Professor Sachs. The contest took place February 5-8, 1999. Rankings of the teams' efforts will be announced in April. Ω

"MONSTROUS MOONSHINE" WINS FIELDS MEDAL

(continued from page 1)

Borcherds, 38, is best known for his proof of a conjecture so outlandish that people had given it the name Monstrous Moonshine. Formulated at the end of the 1970s by the British mathematicians John Conway and Simon Norton, the conjecture presented two mathematical structures in a totally unexpected relationship. One of these structures is the so-called Monster Group, and the other is the theory of modular functions.

In 1989, Borcherds was able to cast more light on the mathematical background of the topic and to produce a proof for the conjecture.

"When first formulated, the conjecture seemed extraordinarily outlandish, hence its unusual name," said Calvin Moore, professor and chair of the Department of Mathematics at UC Berkeley. "But Richard established the connection between modular functions and the Monster Group and proved it to be true using algebraic objects called Kac-Moody Lie Algebras."

"He has made critical contributions to mathematics, and the prize is a well-deserved recognition of his achievements."

Borcherds, who has been on leave from UC Berkeley since 1996 as Royal Society Research Professor in the Department of Pure Mathematics and Mathematical Statistics at Cambridge University, is due to return to campus in 1999. A native of South Africa, he began his academic career at Trinity College, Cambridge, where he obtained his PhD in 1985, and subsequently became Morrey Assistant Professor at UC Berkeley in 1987-88. He is married to mathematician Ursula Gritsch.

He was made a Fellow of the Royal Society in 1994, and also received the John Whitehead Prize from the London Mathematical Society and the Prize of the Society of Paris in 1992.

The Monstrous Moonshine conjecture provides an interrelationship between the Monster Group and modular functions. Modular functions are used in modeling structures in two dimensions, and can be helpful, for example, in the description of molecular structures. The Monster Group, in contrast, seemed to be of importance only to pure mathematicians.

Groups are mathematical objects which can be used to describe the symmetry of structures. Expressed technically, they are a set of objects for which certain arithmetic rules apply. (For example all whole numbers and their sums form a group). An important theorem of algebra says that all groups, however large and complicated they may seem, consist of the same components — in the same way as the material world is made up of atomic particles. The Monster Group is the largest "sporadic, finite, simple" group and one of the most bizarre objects in algebra. It has more elements than there are elementary particles in the universe (a number approximately equal to 8 followed by 53 zeroes). Hence the name "monster."

In his proof, Borcherds uses many ideas of string theory — a surprisingly fruitful way of making theoretical physics useful for mathematical theory. Although still the subject of dispute among physicists, strings offer a way of explaining many of the puzzles surrounding the origins of the universe. They were proposed in the search for a single consistent theory which brings together various partial theories of cosmology. Strings have a length but no other dimension and may be open strings or closed loops. Ω

ACTING MANAGER'S REPORT

BY LOU MAULL

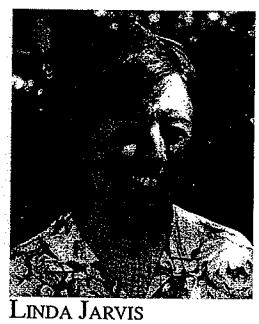
I have been Acting Manager for the past 17 months while Carolyn Katz has been out on disability leave for repetitive stress injuries. I am very sorry to report that she has decided to not return to her position as Department Manager.

Carolyn returned to work last March (on special projects for Chair Moore) at a reduced work-load, but her recovery has been slow. Carolyn will be launching a career as an independent Management Consultant. She has nearly 25 years of campus experience with university policies, systems, and procedures. She will use her wealth of experience to help other university departments and units to implement organizational and operational change. Her focus will be to help managers identify problems, create effective options, develop training plans, and implement change. Her collaborative approach to management and her ability to foster team spirit and communication will serve her well in her consulting career.

Carolyn made enormous contributions to the Department during the nearly seven years she has been Manager. We have benefited greatly from her managerial expertise, her good judgment, and her wisdom. She has set an example that will be hard to follow. It has been my personal and professional pleasure to work with Carolyn. I had the good fortune to join the Department early in Carolyn's tenure and participated in much of the change that has prepared the Department to move into the next century. All of us here wish her the very best success. We will miss her greatly.

WELCOME NEW STAFF

Linda Jarvis joined the Department in mid-May 1998 as our Academic Personnel and Chair's Assistant replacing Bibi Basha who took employment off-campus. Linda has many years experience working on campus. She started her Cal career working in the School of Education, but most recently worked in Molecular and Cell Biology as an Academic Personnel Assistant. We are pleased to have her with us.


LINDA JARVIS

Catherine Pauling came to Mathematics in December 1997 to handle our undergraduate advising. She replaces Christina Hong who took a promotion with the College of Letters and Science. Catherine also has a long employment history on campus. She came to the Department after seven years as an undergraduate advisor in Peace and Conflict Studies which became a part of International and Area Studies about two years ago. She is a Cal alum, Poli Sci '98, though math was her first love. But that's another story...


CATHERINE PAULING

FAREWELL AND BEST WISHES

With mixed feelings we said goodbye to the following staff members:

Kathleen Valerio left early last February. She handled the faculty and graduate student evaluations, as well as coordinated various projects for the Department Manager, and was our first webmaster. She took a promotion as Manager of the Haas Business School's Computing Services Customer Support Unit. Kathleen's bubbly good humor and hard work are missed.

Bibi Basha, Academic Personnel and Chair's Assistant, left at the end of last February for employment off campus. Bibi had worked in the Department for about 3 years. In addition to her AP work and assisting the Chair, she threw a terrific Departmental Dinner. Her charm and lovely British accent are missed.

Sui Hing Jen, I am very sorry to announce, our superb Payroll/Personnel/Travel Assistant, left us last September to take a promotion in the payroll office at Lawrence Berkeley National Laboratory. Sui began her tenure in the Department May 1988 when she was an undergraduate student in Linguistics. In those 10 years she completed her AB, moved into a career appointment in the Department, started an MBA program at Hayward State, and bought and sold a restaurant where she worked all her spare time. She became a landmark in the Department. There was great sadness in the halls when she left. At our Annual State of the Department meeting, faculty, staff, and students joined in a rousing standing ovation to thank Sui for her many years of dedicated service to this Department. We embarrassed her socks off, but we also touched her deeply.

SOME JOB CHANGES

Over this past summer we realigned the work-loads of 3 staff members.

Marsha Snow has assumed the ordering of textbooks, as well as the evaluations of faculty and graduate student teaching. This is in addition to some of her other Front Office duties. She remains Front Office Manager and finds her new tasks challenging and rewarding. Her office is now in room 968 Evans Hall.

Gail Yoshimoto, who last year worked half-time in Faculty Services and half-time in Student Services, is now full-time in Student Services. She has taken on more Front Office duties so that Marsha could take on her new tasks. Gail can now be found in room 970. Gail and Marsha have significantly increased the variety of work that is handled by Student Services and we are very grateful for their efforts.

Catalina Cordoba is dividing her time between 912 Evans and 731 Evans. 912 Evans is part of our Graduate Student Office suite. She is available to assist Math grads with all aspects of their program. Her hours in 912 are from 8:30 am to 2:30 pm daily. From 2:30 to 4:30 daily she is in 731 Evans where she serves as Graduate Assistant and the Group Chair's Assistant for the Group in Logic and the Methodology of Science. We appreciate her efforts on be-

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B. C. Wong Endowment

The Department is very pleased to announce the establishment of an endowment in honor of the late Emeritus Professor Bing Chin Wong. The endowment was established on behalf of the California Alumni Association Chinese Chapter by the UC Chinese Alumni Foundation.

One of the first Asian faculty members of the University of California system, Professor Wong was affiliated with Berkeley throughout his adult life. He received three degrees from UC Berkeley, BA '17, MA '18, PhD '22. He taught in the Department from 1922 until 1942. He died in August 1947.

His primary mathematical interest was algebraic geometry, and his ground-breaking research was widely published. He developed his own branch of numerical analysis, the framework of his later studies. He was the beloved advisor to many undergraduate students in analytic geometry and calculus and to graduate students in non-Euclidean geometry.

The endowment will provide fellowship support for graduate students in the Department. Ω

New Walt Hill Fellowship

Walter L. Hill, a UC Berkeley Mathematics graduate, worked at Microsoft for a number of years. Now retired, he has created the Walter L. Hill Graduate Fellowship Fund with a gift of $138,000 plus matching funds of $12,000 from Microsoft. Ω

New Nelson-Smith Scholarship

The Department is pleased to announce the establishment of the Dorothy E. Nelson-Smith scholarship. The scholarships, of $1,000 each, are to be awarded to female students who are expecting to teach college level mathematics. The premise of this scholarship fund is that drastic changes must be made at all levels of the teaching of mathematics in order for the mathematical community to ensure the expectation of success for women and minorities in mathematics.

The first recipient of a Nelson-Smith scholarship is senior mathematics major, Fumei Lam. In addition to a rigorous undergraduate program, Fumei is active in MUSA and was the creator of the MUSA webpage. Fumei is undergoing intensive mathematical training with Hungarian professors at the Technical University of Budapest during the spring '99 semester, and having a great time. Ω

ACTING MANAGER'S REPORT

(continued from page 12)

half of both the graduate program in Mathematics and the Logic Group.

OUTSTANDING STAFF IN MATH

The staff for the Department has again been honored for outstanding work and achievement. I am proud to acknowledge four of our staff who received **1997-98 Distinguished Service Awards**. These are cash awards; two were given by the College of Letters and Science, two were given by the Vice Chancellor for Research. In addition, one staff member also received a **1997-98 Chancellor's Outstanding Staff Award** (a non-monetary award). We thank faculty, staff, and students who submitted nominating letters in support of these colleagues. It is our goal to ensure that all deserving staff are recognized for their accomplishments.

Jeanne Coffee received a Distinguished Service Award from the Vice Chancellor for Research. Jeanne was recognized for the additional work she voluntarily took on, some of it new which required her to learn new skills, so that her supervisor could focus on preparing an enormous and complex NSF proposal for a new Center for Turbulence. Jeanne also volunteered her assistance in preparing the proposal. Her supervisor was extremely grateful for the teamwork attitude Jeanne demonstrated.

Bernice Gangale also received a Distinguished Service Award from the Vice Chancellor for Research. Bernice was recognized for the tremendous effort she put into the preparation of the NSF proposal for a new Center for Turbulence while she continued with as much of her regular work-load as possible. The proposal involved six other departments on this campus, as well as three other universities, private institutions, and several governmental laboratories.

Dave Hernes received both an L&S Distinguished Service Award and a Chancellor's Outstanding Staff Award for his efforts on behalf of the Department and the Campus. He was nominated by several of his colleagues for the COSA. His nominations recounted his varied good works not only performing his regular job duties, which he does to the utmost of his abilities, but also for the work he does on several campus-wide committees, with staff organizations, and on community projects . We are pleased to have Dave recognized and proud to count him as one of our own.

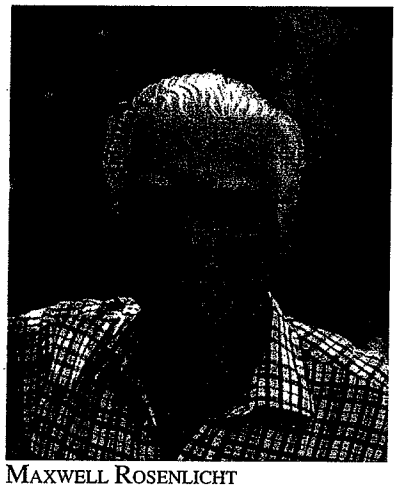
Lou Maull received an L&S Distinguished Service Award for stepping in as Acting Manager of the Department and the Center during Manager Carolyn Katz's extended medical leave. She has performed her regular duties as supervisor of the Personnel and Finance Unit, as well as the managerial duties, and was recognized for performing both jobs exceptionally well.

In closing, I humbly thank all of the Mathematics staff. Without their stalwart support, I certainly would not have survived. I also thank the faculty and students for their steadfast patience and understanding as we have made our way through some trying times and difficult decisions. We will continue to do our best to support the mission of the Department. Ω

FAREWELL TO MAXWELL ROSENLICHT

Maxwell Alexander Rosenlicht, a distinguished mathematician and Professor Emeritus of Mathematics at the University of California Berkeley died January 22 while visiting Hawaii. He was 74.

Professor Rosenlicht was born in Brooklyn, New York on April 15, 1924 and attended public schools in Brooklyn, in particular Erasmus High School. He received a bachelors degree from Columbia University before going on to Harvard for his doctoral degree. There he studied under the noted algebraic geometer Oscar Zariski. He also considered Solomon Lefschetz as a mentor. Rosenlicht was awarded a National Research Fellowship and in 1952 joined the Mathematics faculty at Northwestern University. In 1958, he joined the Mathematics faculty at the University of California, Berkeley.



MAXWELL ROSENLICHT

Rosenlicht was widely known for his many research contributions to algebraic geometry, algebraic groups, and differential fields. In 1960, he was awarded the Frank Nelson Cole Prize in Algebra by the American Mathematical Society for his seminal 1954 paper on generalized jacobian varieties. This prize is awarded every five years by the Society for outstanding research contributions in algebra.

Rosenlicht was the recipient of a Fulbright Research Professorship and a Guggenheim Fellowship, as well as a Miller Fellowship and a Fulbright Teaching Fellowship. During his career he served as Visiting Professor at the University of Rome, the University of Leiden, the Institut des Hautes Études at Bures-sur-Yvette, France, the University of Catalunya, the National University of Mexico, and Harvard University. He served a term as Chair of the Department of Mathematics at UC Berkeley from 1973-1975. Calvin Moore, current Chair of the Department of Mathematics at Berkeley said, "Max Rosenlicht was one of the leaders of the Department and contributed during his many years of distinguished service to building the Department to its premier status. He trained many fine students." Professor Rosenlicht retired from UC Berkeley in 1991.

Professor Rosenlicht is survived by his wife of 45 years, Carla Zingarelli Rosenlicht; son Nicholas of Berkeley, his wife Barbara and granddaughters Elizabeth and Chloe; daughter Elizabeth Regan of Oakland and her husband Don; son Alan of Seattle; and daughter Giovanna Marley of Davis, her husband Kevin and grandson Jesse; his sister Estelle Stolovy of Washington, DC and her three children.

To the last, he maintained his burning interest in travel, art, music and history. He died rereading "Anna Karenina."

A Memorial Service was held on February 28. Contributions may be made to the UC Berkeley Foundation for the Maxwell Rosenlicht Graduate Fellowship Fund and sent to the UC Berkeley Department of Mathematics, 94720-3840.

GRATEFUL THANKS TO OUR FRIENDS

The Department of Mathematics extends heartfelt thanks to all our donors over the past years for their generous support. Our donors have contributed to the strength and vitality of our students and the Department. The following is a list of our donors from 1997-99. We apologize if we have omitted anyone. Please do let us know if that is the case. A special thanks to all our donors who wish to remain anonymous.

1997-99

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Mathematics
Newsletter

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NEW DEVELOPMENTS

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admissions, financial support, and academic advising and academic support to provide opportunities for graduate Mathematics study at Berkeley. The Mathematics Opportunity Committee continues its functions of recruiting students who have demonstrated exceptional promise despite having encountered in their earlier education limited resources or other circumstances that may have affected their preparation. The Department remains especially interested in helping women and minority students successfully complete their graduate study at UC Berkeley. Ω

MSRI

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Mathematics (surely the world's first "Chern-Simons Professor"). This very significant collaboration between MSRI and the Department of Mathematics will continue in future years.

MSRI is also developing corporate collaborations. We are currently reviewing candidates for a new Visiting Research Professorship, supported by Hewlett-Packard Laboratories, which will begin next year. In residence this year are our first two MSRI/Hewlett-Packard postdocs. Next year we expect to have two new postdocs supported by Hewlett-Packard and two supported by Microsoft. In these ways, MSRI is becoming a meeting point for many streams of mathematical science.

Thanks to great support from the mathematical community, and, in particular, from the UCB Department of Mathematics, the NSF "recompetition" has been going well for Berkeley and MSRI. This comprises of some 18 consortia of universities all over the country competing for the privilege of hosting three NSF mathematics institutes. The final decision by the National Science Board will be made in May; look for a party at MSRI soon thereafter! Ω

GREETINGS FROM THE MGSA

The MGSA represents the graduate students in departmental affairs. The MGSA is responsible for recruiting students to various committees whose decisions affect graduate student life, and serves as a vital tool whereby students can get things done. The MGSA also organizes some of the fun activities in the department, such as the fall and spring picnics, creating T-shirts and mugs, putting pictures of first-year students in room 1015, etc. Officers for this year are Saul Schleimer, Megumi Harada, Wayne Whitney, and Noam Shomron; the present office czars are Christine Heitsch and Kashi Abhyankar.

In recent years, the MGSA has set up the Mathematics United Student Information Center (MUSIC) room, Evans 708 South, which holds a small non-circulating library of essential graduate-level textbooks, computer references, and departmental information. Recently received are a generous donation of an assortment of journals for this library, as well as a useful complement of pre-1970 *Mathematical Reviews*.

The current MGSA officers are continuing the recent tradition of the Graduate Student Colloquium, organized by graduate students for graduate students' benefit. More advanced students give talks for beginning students, often as an introduction to their research areas.

We would like to emphasize that the MGSA officers serve as representatives for the Berkeley graduate student community. We welcome any comments, suggestions, concerns, or advice. Please email us at **mgsa@math.berkeley.edu**, or drop by our weekly meeting, Fridays at 1:00 pm, in Evans 1041. Ω

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Printing done by UC PRINTING

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