



Purview Math



Newsletter of the

Department of Mathematics ♦ Purdue University ♦ West Lafayette, Indiana

Summer 2001

Distinguished Mathematics Alumnus

Paul Garrett and eight other School of Science alumni received Distinguished Alumni Awards from Dean Harry Morrison at an awards banquet held April 28, 2001.

Garrett is Professor of Mathematics at the University of Minnesota, where he has been a member of the faculty since 1982. After receiving his B.S. and M.S. degrees from Purdue and a Ph.D. from Princeton, he took a position as Gibbs Instructor at Yale. He was a National Science Foundation Post-doctoral Fellow at the University of California, Berkeley in 1979-80, and he joined the faculty at Stanford University in 1980 as an assistant professor of mathematics.



Paul Garrett

Professor Garrett's research interests include automorphic forms, representations, L-functions, and number theory. He has authored or co-authored a number of publications, both on-line and in refereed professional journals. In summer 2000, he sponsored six students in Research Experiences for Undergraduates, and he has written a proposal for an NSF grant to support 20 students and several faculty in such projects in future summers. Professor Garrett has prototyped on-line software for calculus and other courses, and was the designer, implementer, chief programmer, and coordinator of a demo CD-ROM giving examples of interactive animated graphical software useful in teaching calculus. §

New Director Heads Actuarial Science Program

Professor Richard Penney became the third Director of the interdisciplinary Mathematics/Statistics Actuarial Science Program last fall, replacing Professor Steve Samuels.

Penney joined the mathematics faculty in 1971, having received his B.S. degree from Tulane University in 1968 and his Ph.D. from MIT in 1971. He is a noted and active researcher who has published in numerous scientific journals and gives lectures worldwide. He also is an award



Professor Richard Penney with former Beering Scholar Paul Schultz (B.S. mathematics, 1996) of Towers Perrin.

winning teacher and an experienced administrator, having served as Chair of the Undergraduate Majors Committee from 1993-1997. Among his first services to Purdue was writing, along with Dr. Keith Schwingendorf, one of the early actuarial programs for the Math Department.

As Director, one of Penney's major challenges is to continue to adapt the program to meet the demands of the new

actuarial exam system. This past winter, he attended a meeting hosted by Towers Perrin in Chicago for the directors of twelve of the major actuarial programs in the nation. Professor Penney was honored to be invited and found the meeting to be quite informative and beneficial. §

Other News

- The web site (www.math.purdue.edu/actuary) has been redesigned. It includes more career information as well as the current (new) plan of study.
- The bulletin board for the program is now on-line at the above mentioned web site.
- There is now an undergraduate newsletter for the program "Purdue's Risky Business." (See the On-Line Bulletin Board for a copy.)

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Transitions

by Carl Cowen

It's Commencement weekend at Purdue as I write this—an exciting time on campus as families and friends gather to congratulate and celebrate this year's graduates. We're certainly proud of our grads and wish them well as they leave Purdue to face new challenges.



Carl Cowen, Head

Graduation is a major transition—as formers students leave the campus behind and step forward into what lies beyond, we hope the education they received here helps them feel confident in facing the future. But this year also marks a transition for those of us who remain at Purdue. We are nearing the end of the first year of

Martin Jischke's term as President and the beginning of the first year of Sally Frost Mason's tenure as Provost. A feeling of anticipation permeates the University as we begin to discover the changes that are in store for us.

While President Jischke and Dr. Frost Mason clearly value Purdue's educational standards and the contributions that faculty and students make to the discovery and dissemination of new knowledge, they are identifying new goals, too. For example, more emphasis will be placed on interdisciplinary work in all fields, which will affect the work we do as mathematicians to solve problems, as well as the programs we run for our students. Departments and faculty members will be offered incentives to work with others on campus, and we will be expected to provide a foundation for our students working on multi-disciplinary problems. Like the new graduates, we are uncertain how we will meet the new challenges, but our previous successes—some of which are described in these pages—give us confidence that we will be able to do so.

As you read this issue of *Math PURview*, I hope you will recall your graduation and how you felt then. Look how far you've come! Purdue played a part in your accomplishments, and we're always proud to tell new students about your successes—we hold you and your classmates up as models for them to follow! With your help, we will continue the traditions of excellence in the Mathematics Department as we face the challenges of the future.

Developments

by Grady Jones

Benjamin Franklin is credited as one of the first fundraisers in U.S. history. While living in Philadelphia in the 1750's, Franklin helped raise money for diverse causes that included building a hospital and funding an “out-of-work industrious citizen” to be Philadelphia's first street sweeper. Franklin was so adept at raising money that others sought his advice on the topic. This is what he shares in his *Autobiography*: “First, I advise you to apply to all those whom you know have a reason to give something; next, to those whom you are uncertain whether they will give or not, and show them the list of those who have given; and, lastly, do not neglect those who you are sure will give nothing, for in some of them you may be mistaken.” Essentially, Franklin advises, “Ask everyone!”



Grady Jones, Director
Corporate/Alumni Relations

The Department of Mathematics recently established a new fund called the “Mathematics Opportunity Fund” to enable the Department Head to provide special opportunities to mathematics students — opportunities that will contribute to their intellectual and professional development, but which cannot be paid for from the department's state-funded budget. Examples of such activities include student participation at math conferences, faculty supervised outreach projects to middle and high school students, and the purchase and distribution of mathematics publications to high school students. The fund would also be used by the Department Head to support other activities that contribute to the improvement of the department and its programs.

In the next few weeks, each of you will receive a letter about this fund because we believe you fit Franklin's first category, “...those whom you know have a reason to give something.” When you reflect on your Purdue experience, you perhaps will recall a special experience outside the classroom that challenged and motivated you.

We are confident that you will want to join our effort to insure that mathematics students have access to the kinds of special opportunities that will enhance their ability to learn, to network, and to excel.



is published for alumni and friends of the
Purdue Department of Mathematics.

We welcome your comments and
suggestions for future newsletters.

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Events

Advisory Councils

The Mathematics, Actuarial Science, and Statistics Advisory Councils met September 8-9, 2000. The annual event included a joint banquet for members of the three councils on Friday evening and an opportunity for them to attend the Purdue-Kent State football game on Saturday. Members of the Mathematics Advisory Council are all alumni of the Mathematics Department. The councils are scheduled to meet again in September 2001.



Mathematics Advisory Council members Patricia Hufford (M.A. 1972), Marcia Hausman (B.S. 1973), Donna Osborn (M.S. 1977), and Mary Jane Elmore (B.S. 1976) chatted informally as the 14-member group gathered for its annual meeting in the Math-Science Building on September 8, 2000.



Above, Actuarial Science Advisory Council members Chris Ruckman (B.S. mathematics, 1987) of Lincoln National and Dan Rubin (B.S. actuarial science, 1988) of Nationwide Insurance.

At right, Professor Leonard Berkovitz (far left) and two of his former Ph.D. students, William Browning and Tom Banks, visit with Professor Jim Douglas, Jr.



Special Lecture



Nobel Prize winning economist and mathematician **John Nash** lectured in Fowler Hall on November 20, 2000. Nash was invited to Purdue by Professor Roko Aliprantis of the Department of Mathematics and School of Management.

Nash, who works in game theory, spoke about his efforts to solve a complex set of equations that determine the possible nature of cooperative behavior and bargaining.

Nash's life and work will soon be the subject of a film directed by Ron Howard entitled *A Beautiful Mind*, based on the book *A Beautiful Mind: A Biography of John Forbes Nash, Jr.* by Sylvia Nasar.

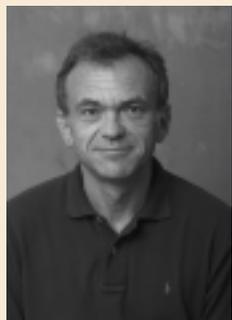


Math student award winners and scholarship recipients were formally recognized by the Mathematics Department on April 19, 2001. Above, Professor Emeritus Michael Golomb (second from the right) is pictured in the Math library lounge with several Purdue students who contributed solutions to the "Problem of the Week" competition. Professor Golomb started "Problem of the Week" in 1985 and has provided the problems and solutions through the years.

A list of student award and scholarship recipients appears on page 10. Eric Tkaczyk's (above far left) report on the Math Club's activities appears on page 11.

Eremenko Awarded Humboldt

Professor Alexandre Eremenko was awarded a Humboldt Research Award for Senior Scientists last fall. Eremenko was nominated for the award by Walter Bergweiler of the University of Kiel. Eremenko and Bergweiler have co-authored two papers in classical function theory.



Alexandre Eremenko

The Alexander von Humboldt Foundation annually grants up to 150 Humboldt Research Awards to foreign scholars whose academic qualifications enjoy international recognition. The awards include the invitation to undertake extended periods of research of the award winner's own choice at German research institutes.

Eremenko will use the fellowship to continue his collaboration with Bergweiler at Kiel during the next several years and to make short-term visits to various other German institutes. The award will also support his participation in European Union conferences (two this summer in Aveiro, Portugal and London). As a Humboldt Fellow, Eremenko will be entitled to invite young German researchers to visit Purdue, with postdoctoral financial support provided by the Humboldt Foundation.

Eremenko has been invited to give a 45-minute talk in the Real and Complex Analysis Section of the August 2002 International Congress of Mathematicians in Beijing.

The "Collected Papers of **Joseph Lipman**" was recently published as volume 117 of *Queen's Papers in Pure and Applied Mathematics* (Queen's University Press, Kingston, Ontario). The two-part volume, totaling around 1500 pages with an introduction by former Purdue mathematics professor Craig Huneke, comprises 43 papers dated between 1960 and 1998 on topics in algebra, geometry, and topology. Also included in the volume is Lipman's 1965 Ph.D. thesis, two reviews, and an article from the *Chronicle of Higher Education* concerning the infamous University of Rochester plan to cut mathematics. Still active in teaching and research, Lipman has published five papers since the publication of parts I and II of this volume; he looks forward to the appearance of these and additional papers in a third part sometime after the year 2010.

Professor Emeritus **Walter Gautschi** of the Departments of Computer Sciences and Mathematics has been elected a Corresponding Member of the Bavarian Academy of Sciences. He was one of two scientists selected this year from a worldwide pool of candidates to become a member of the Class of Mathematics and Natural Sciences of the Academy. The Bavarian Academy of Sciences, located in Munich and one of seven academies in Germany, has a long and distinguished history dating back to 1759. Included among its members are such luminaries as Wolfgang Goethe and the Grimm brothers in the Philosophical-Historical Class, and Albert Einstein, Max Planck, and Werner Heisenberg in the Scientific Class.

Brooke Shipley received the "2001 School of Science Faculty Award for Outstanding Contributions to Undergraduate Teaching by an Assistant Professor." Shipley will receive \$2,500 in discretionary funds to be used for her research in topology. The award was created six years ago to annually recognize an assistant professor who has combined outstanding teaching with research excellence.

Associate Professor **David Goldberg** was named one of the "Ten Best Teachers in the School of Science" for 2001 by junior and senior science students.

Professor **J. J. Price** was the featured speaker in Purdue's "Focus on Teaching" lecture in February. The monthly series features some of Purdue's top teachers, who share their insights and approaches with other Purdue faculty members.



Patricia Bauman

Professor **Patricia Bauman** has been elected to serve as a Member-at-Large of the Council of the American Mathematical Society for a three-year term ending in 2003. The AMS Council includes 15 members-at-large, 11 representatives of committees, and 10 officers. New members-at-large are chosen each year by members of the AMS in a contested national election.

Responsibilities of the AMS Council include determining membership on the editorial boards of the Society, appointing the treasurers and the members of the Secretariat, nominating candidates for future elections, and determining all scientific policy of the Society. Each new member of the Council also serves on one of the Society's policy committees. Bauman serves on (and currently chairs) the Committee on the Profession. The charge of this committee is to provide major direction for Society activities on issues of a broad professional nature, including employment issues and opportunities, professional development, and recognition and awards given by the AMS.



A merchant has a balance scale and a 40 lb. weight. One day he drops the weight, and it breaks in four pieces. Much to his amazement, the merchant finds that with the four pieces he can now exactly measure any object of weight 1, 2, 3, ..., 40 lbs. How much do the pieces weigh?

SOLUTION

1. The pieces weigh 1, 3, 9, and 27 lbs. To see that these can measure any object in the given range, we will use ternary (also known as base 3) representation of numbers. Just like positive integers p can be represented in the decimal system in the form

$$p = a_0 + a_1 10 + a_2 10^2 + \dots + a_n 10^n,$$

with the digits a_0, \dots, a_n integers between 0 and 9, p can also be written in the ternary system as

$$p = b_0 + b_1 3 + b_2 3^2 + \dots + b_m 3^m,$$

with the digits b_0, \dots, b_m equal to 0, 1, or 2.

Suppose we are given an integer weight w between 1 and 40. Consider the number $p = w + 40$, and its ternary representation as above. Since $p \leq 80$, the ternary representation will be $p = b_0 + b_1 3 + b_2 3^2 + b_3 3^3$. Indeed, $3^4 = 81$ is already too large to be included in the representation with a coefficient $b_4 \geq 1$. Subtracting $40 = 1 + 3 + 3^2 + 3^3$ we obtain

$$(1) \quad w = c_0 + c_1 3 + c_2 3^2 + c_3 3^3,$$

with each $c_i = b_i - 1 = 0$ or ± 1 . This suggests that we collect the various 3^i pound pieces with $c_i = 1$ in one pan of the scale, those with $c_i = -1$ in the other pan; if we put our weight w in the second pan, then the scale will be in balance, according to (1). Thus this measurement successfully determines the weight of w .

Example: If $w = 25$, we write $p = 65 = 2 + 0 \cdot 3 + 1 \cdot 3^2 + 2 \cdot 3^3$ and $w = 25 = 1 - 1 \cdot 3 + 0 \cdot 3^2 + 1 \cdot 3^3$. Hence $25 + 3 = 1 + 3^3$ yields the measurement that determines the weight w .

2. While the reasoning above does verify that the weights 1, 3, 9, 27 will solve the problem, it is unsatisfactory for two reasons. First it does not reveal how we found those numbers; by trial and error perhaps? Second it leaves open the possibility that other solutions might exist. For more discussion that addresses these points, go to

<http://www.math.purdue.edu/~lempert/scalesolution.pdf>
There you can see that 1, 3, 9, 27 represent the unique solution.

Professor **Freydoon Shahidi** has been named a Fellow of the John Simon Guggenheim Memorial Foundation. Guggenheim Fellowships are awarded to artists, scholars, and scientists on the basis of unusually impressive achievement in the past and exceptional promise for future accomplishment.

Shahidi has in the past few years seen the fruition of two decades of work on developing the Langlands program that connects analytic information about L-functions with information in representation theory and number theory. This theory played a major role in the solution of Fermat's Last Theorem by Andrew Wiles, and it is expected that Shahidi's work will provide the foundation for other advances in number theory in the future.



Freydoon Shahidi

Shahidi and his collaborators, including Henry Kim, a former Purdue postdoc, have proved many cases of Langlands functoriality. These results have already been used to dramatically improve work on the Ramanujan and Selberg conjectures which give information about number theoretic questions. The techniques that Shahidi pioneered are now known as the Langlands-Shahidi method.

This work has been recognized throughout the international mathematics community. A Fellow of the Japan Society for Promotion of Science since 1993, Shahidi was appointed a Clay Mathematics Institute Prize Fellow in summer 2000 on the recommendation of Andrew Wiles. During the opening ceremonies of the 31st Iranian Mathematics Conference at the University of Teheran in August 2000, Shahidi was made one of the first three honorary members of the Iranian Mathematical Society. His work was mentioned by three plenary speakers at the American Mathematical Society's Mathematical Challenges of the 21st Century, intended to be a survey of the important work in all areas of pure and applied mathematics to be done in this century. Recently, Shahidi received an invitation to speak at the Lie Group Section of the International Congress of Mathematicians in Beijing in August 2002.

Shahidi's work has been the subject of intensive seminars at the Institute for Advanced Study in Princeton. In June, it was presented by Guy Henniart of Université de Paris-Sud (Orsay) in the Seminar Bourbaki in France, and a description of this work will be part of the National Science Foundation's annual report to Congress.

Shahidi will use the Guggenheim award to continue his work in number theory, working on further proofs of the Langlands Conjecture with other mathematicians, including Langlands himself, at Princeton University, and at other locations in the U.S. and abroad.

Congratulations!

Information Processing Operator **Betty Gick** recently completed Purdue's ACE program. She and her classmates were awarded diplomas at a graduation luncheon held in the Purdue Union on May 8.

ACE (Accomplished Clerical Excellence) is a two-year program that offers high potential clerical employees an opportunity to enhance their established skills, broaden their knowledge and perspectives, and develop a valuable peer network. Open to clerical staff with a minimum of one year continuous service to Purdue University, the ACE program teaches interpersonal, organizational, supervisory, and working relationship skills. It also provides information about University resources, general office practices, verbal and written communication, business office procedures, continuous improvement, and many other skills.



Graduate Program News

Pedro Méndez Lifts Off!

The Clay Mathematics Institute has been in the news lately because of its audacious offers to pay millions of dollars to people who solve the big outstanding problems of mathematics. Less well known is the practice of the Clay Institute to support young mathematicians who show exceptional promise.

Purdue Math graduate student, **Pedro Méndez** (Ph.D. 2001), was awarded a “Liftoff Fellowship” by the Clay Institute to spend the summer months at the University of Utah to begin the next phase of his research career in earnest among a group of distinguished mathematicians in residence there, including Professor Davar Khoshnevisan who will serve as mentor to Dr. Méndez. After this intense summer experience, Dr. Méndez will start his first job as a Wylie Research Instructor at Utah where he will continue to work with Professor Khoshnevisan. In addition to a considerable reduction in teaching, this three-year postdoctoral position provides a research fund of \$4,000 per year.

Dr. Méndez wrote an outstanding Ph.D. thesis at Purdue under the direction of Professor Rodrigo Bañuelos. During his five-year stay at Purdue, Dr. Méndez wrote five research papers in which he developed some general techniques to solve various extremal (isoperimetric-type) problems which lie at the interface of probability and the spectral geometry of Laplacian (Brownian motion), the fractional Laplacian (symmetric stable processes), and the relativistic Laplacian (relativistic Brownian motion). Some of these problems had been open for a number of years.

Dr. Pedro Méndez has made a spectacular liftoff, and the Math Department is as proud of him as any other of Purdue’s more traditional astronauts!

Excellence in Teaching Awards

In keeping with its commitment to excellence, the Mathematics Department annually recognizes Graduate Teaching Assistants for their outstanding teaching.



Standing left to right: Professor Steve Bell, Graduate Committee Chair, with 2000-2001 Excellence in Teaching Award recipients Trent Pancake, Taskin Padir, Sergio Fratarcangeli; seated left to right Melissa Reiff, Oana Veliche, Kayla Dwelle.

Six Purdue graduate students were selected last fall to receive the Department of Mathematics “2000-2001 Excellence in Teaching Awards.” Teaching assistants Kayla Dwelle, Sergio Fratarcangeli, Taskin Padir, Trent Pancake, Melissa Reiff, and Oana Veliche each received cash prizes of \$250 at an awards presentation in the Math Library on November 16, 2000. Winners of the annual award are selected on the basis of student evaluations and the evaluations of their faculty teaching mentors.

Alumni News

Former Purdue graduate students **Luca Capogna** (Ph.D. 1996) and **Loredana Lanzani** (Ph.D. 1997) organized a an NSF supported conference on “Solutions of Partial Differential Equations in Periodic Media,” held at the University of Arkansas April 26-28, 2001. Capogna and Lanzani are faculty members at Arkansas.

Wo-Sang Young was one of five faculty members to receive the University of Alberta’s 2001 Rutherford Award for Excellence in Undergraduate Teaching. Young received her Ph.D. in mathematics in 1973 under the direction of Richard Hunt.

Andy George (M.S. 00) has accepted a position at Penn State Behrend, a 4-year school in the Penn State system.

HOW I FOUND A JOB: ADVICE TO FINISHING STUDENTS

by *Charlie Tabor*

Even with the student-friendly job market of recent years, the task of searching for employment in the “real world” can be intimidating. Nonetheless, don’t let uncertainty or self-doubt become an obstacle to your success. With patience and a carefully constructed plan of attack, your job search will be successful and maybe even exciting.

When looking for a job, I found the career fairs to be a great opportunity. They provided a good forum to meet one-on-one with representatives from potential employers, and these contacts set the stage for future interviews and site visits.

I feel it was beneficial to have an angle when approaching a potential employer. Armed with a bachelor’s and master’s degree in mathematics, I didn’t have the broad technical background that engineering students have. What I did have was expertise in an applied field of interest (signal/image processing). That, when combined with some programming knowledge (C/C++), a background in mathematics, and the skills gained from teaching at Purdue, provided for a successful sales pitch.

The job I accepted with Lockheed Martin was one of three offers I received from the company. As a systems engineer in their Sensor Technology and Image Analysis group, my contributions will be centered on the image processing aspects of remote sensing, in this case, satellite design.

So, to those of you who will soon be starting a job search of your own, don’t sweat it. Good luck and be sure to join me next time for a discussion on topics near and dear to all recent college graduates: “Higher taxes and student loan payments. Will we ever be rich?”

Fellowships Galore!

For fall 2000, the Math Department was able to offer more fellowships to newly admitted graduate students in the Ph.D. program than ever before. We awarded eight GAANN fellowships and three VIGRE fellowships. These fellowships carry a stipend of \$15,000 per year for five years. We also awarded one Andrews Fellowship and two Graduate Opportunity Fellowships that carry a stipend of \$17,000 per year for two years. All fellows receive a regular teaching assistantship at the end of their fellowship term if they need more time to finish their degrees. We expect to be able to award similar numbers of fellowships to new students in the coming year.



GAANN and VIGRE Fellows gather for a photo in the Math Library Lounge. Back row, left to right: Chris Fraser, John Stevens, Mike Kenig, Tom Garrison, Scott Simon, Luis Lomeli, Sarah Ruppert, Ruth Enoch. Front row, left to right: Miriosh Higgs, Andrea Brian, Natalie Kleinfelter, Sandra Richardson. Not pictured: Jessica Edrington, Michael Jackson, and Ralph Shines.

The graduate program in Mathematics/Applied Mathematics was one of five Purdue programs selected this year to receive additional funds from the Graduate School for the recruitment of excellent graduate students. Initiated in 1999, the Supplemental Award provides \$9,000 to supplement three to four existing assistantship offers to attract students who show exceptional promise in applied mathematics.

A “Special Initiatives Fellowship” awarded by the Graduate School will fund summer fellowships for four new students in summer 2001.

Graduate student **Liana Segă** has been awarded a one-year Puskas Memorial Fellowship by the Graduate School. The fellowship is designated for Purdue students who are citizens of Romania. Recipients are chosen on the basis of academic excellence by a selection committee comprised of faculty and administrators chosen by the Office of Research and Graduate School. Segă came to Purdue in August 1997. She has passed qualifiers, advanced topics, and is working with Professor L. Avramov on research in commutative algebra.

Travis Lee and **Prabhu Janakiraman** were selected to receive \$500 Graduate Student Fellowship Incentive Awards from the Graduate School for applying for NSF Graduate Research Fellowships.

Mathematics teaching assistant **Anantha Sundararajan** was appointed to the Executive Council of the Teaching Academy for 2000-01. Only one graduate student/instructor is selected to serve on this committee at any given time—it is the highest recognition for a Graduate Teaching Assistant at Purdue. Sundararajan is an Associate Fellow in the Teaching Academy and has served on various university level committees including CETA (Committee for the Education of Teaching Assistants), CPFF (Committee for Purdue Future Faculty Preparation) and CETA/CIE panel of experienced TAs. Sundararajan earned an M.S. in mathematics in May 2000 and since then has been a student in Purdue’s School of Industrial Engineering.

Four mathematics graduate students were honored for their dedication to Purdue students and their outstanding teaching contributions at the annual “Celebration of Graduate Student Teaching” on April 10. **Kayla Dwelle**, **Taskin Padir**, **Oana Veliche**, and **Dahae You** received engraved plaques recognizing their contributions at a banquet held in the Purdue Memorial Union. This was the third year for the Celebration of Graduate Student Teaching, sponsored by the Committee for the Education of Teaching Assistants, the Teaching Academy, and the Office of the Executive Vice President for Academic Affairs.

Research Conferences

A “Conference on Algebra and Algebraic Geometry with Applications” in celebration of Professor **S.S. Abhyankar’s** 70th birthday was held at Purdue July 19-26, 2000. Sponsored by Bell Labs, the Office of Naval Research, and Purdue’s School of Science and Mathematics Department, the week-long meeting brought together a distinguished group of internationally renowned mathematicians. Talks covered a range of topics in algebraic geometry, group theory, singularities, Galois theory, combinatorics, Drinfeld modules, and affine geometry and the Jacobian problem.

The “Second International Conference on Deterministic and Stochastic Modeling of Biointeraction (DESTOBIO 2000)” convened at Purdue August 23-27, 2000. Professor **Fabio Milner** organized the meeting, which attracted scientists from many nations including Argentina, Bulgaria, Finland, France, Israel, Italy, the Netherlands, Russia, and Sweden. The conference kicked off with opening remarks by Purdue President **Martin Jischke**, who welcomed participants to Purdue. Several topics were covered including biostatistics, population dynamics, epidemics, genetics, aquatic populations, ecology, and cancer.

Professors **Laszlo Lempert** and **Sai Kee Yeung** organized and hosted the “Midwest Several Complex Variables Meeting” October 7-9, 2000. Included in the program were one-hour invited speakers S. Baouendi (UC San Diego), J. Duval (Univ. Paul Sabatier, Toulouse), J.E. Fornæss (University of Michigan, Ann Arbor), B. Hall (Notre Dame University), T. Ohsawa (Nagoya University), E. Poletsky (Syracuse University), Y.T. Siu (Harvard University), J. Włodarczyk (Purdue University). Funding was provided by the University of Minnesota’s Institute for Mathematics and its Applications and Purdue University.

The Purdue Mathematics Department hosted three conferences last year. Below are some candid shots from Professor S. Abhyankar’s 70th Birthday Conference and DESTOBIO.

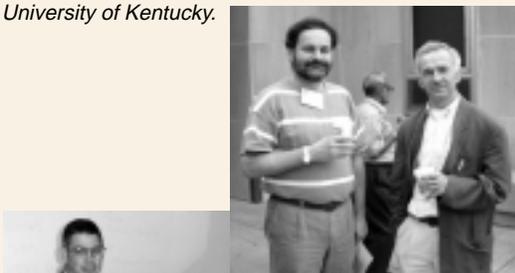
Abhyankar 70th Birthday Conference



Michael Artin of MIT, Shreeram S. Abhyankar, and Avinash Sathaye (Ph.D. 1973) of the University of Kentucky.



Above, Paul Loomis (Purdue Ph.D. 1999) of Bloomsburg University and Purdue math professor Donu Arapura chat informally with conference participants outside the Math Auditorium.



Above, F.V. Kuhlmann of the University of Saskatchewan and Herbert Popp of Universität Mannheim.



Conference Coordinator Chris Christensen (Purdue Ph.D. 1977) of Northern Kentucky University did a phenomenal job organizing the conference, which was attended by approximately 100 mathematicians.



Heisuke Hironaka (Purdue Honorary D.Sc. 1989) of Yamaguchi University and Robin Hartshorne of UC Berkeley.

DESTOBIO 2000

Conference organizer Fabio Milner (below left) chats with participant R. Villella at the opening program of DESTOBIO 2000.

Purdue President Martin Jischke officially welcomed participants to Purdue. Also on hand to greet participants were (above right) School of Science Dean Harry Morrison and Michael Stohl, Dean of International Programs.



I. Nasell, R. Sennerstam



PURDUE MATH ALUMNI RECEPTION

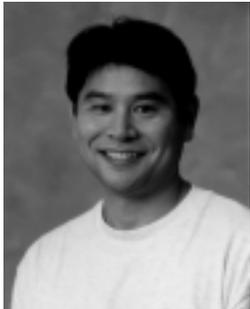
Where: Joint Mathematics Meetings
San Diego, CA
When: January 2002

Consult the conference program schedule for time and location.

Factorization of Birational Maps

by Prof. Kenji Matsuki

“You must be Kenji. I’m Jarek (Jaroslaw Włodarczyk).” I still remember that big smile, which welcomed me at the train station on the way to Oberwolfach. It is probably another not-so-rare instance of the Cyberage, where you meet your collaborator for the first time in person only after many months and tons of e-mails. The following is my personal story of



Kenji Matsuki

how our solution (with Dan Abramovich and Kalle Karu) to the problem of factorization of birational maps brought us together that day in Germany.

The subject of algebraic geometry, as the name implies, studies the interaction of algebra and geometry. Thus the problem of characterizing an object of study, the zero locus of polynomial equations, by its “functions,” is as old as the subject itself. However, if we stick to the conventional notion of functions, there are too few of them: on a compact Riemann surface the only global holomorphic functions are constants. Therefore, we look at the so-called rational (meromorphic) functions, which may go to infinity at some points and hence may have poles. They form a field under the usual addition and multiplication, called the field of rational functions. An amazing theorem of compact Riemann surfaces (or equivalently a nonsingular complete algebraic varieties of dimension one over \mathbb{C}) is then that the field of rational functions characterizes a compact Riemann surface; that is to say, two compact Riemann surfaces are isomorphic if and only if their fields of rational functions are the same. (They are said to be birational when the latter holds.)

So the natural and naive question is: what happens if the dimension goes higher?

In dimension 2, unfortunately or rather fortunately enough to make the subject more interesting, the above theorem fails. There are many nonsingular complete varieties of dimension 2, birational but not isomorphic. This is due to the basic operation called “blowup,” which creates,

starting with a given variety, another which is birational but not isomorphic. One can visualize this by regarding a plane as the collection of lines through the origin and then blowing up the origin to separate these lines. The point blown up is replaced by a line which parametrizes the slopes of the lines, and hence the new variety is not isomorphic to the original plane. The celebrated theorem of Zariski states, however, that the operation of blowup is the *only* source of failure to the naively expected theorem in dimension two, namely: any two nonsingular complete varieties of dimension 2 are obtained from one another by a sequence of blowups and blowdowns (inverse operations of blowups). Proving the statement without the dimension restriction became known as the problem of factorization of birational maps. It is no wonder that some people call it the *Abhyankar conjecture*, as Abhyankar had Zariski as his advisor, and his thesis generalized the theorem of Zariski in depth.

Although condensed in one word “nonsingular,” the requirement of our varieties having no singularities has its own history known as *resolution of singularities*. (The subject has close and personal ties with the Purdue Mathematics Department in the works of Abhyankar, Lipman, and Moh.) Before the publication of Hironaka’s monumental *Annals* paper in 1964, we did not even know there exists such a nonsingular complete variety with a given field of rational functions. Hironaka addressed the problem of factorization as “Question (F)” in the paper. I learned of the problem as a graduate student in 1980’s and immediately fell in love with her, because of her beauty and simplicity in statement. However, she showed no sign of saying yes to any invitation for a date and remained largely mysterious for almost 30 years, despite the interesting and critical results of Shannon and Christensen here at Purdue under the guidance of Abhyankar, among others.



Jaroslaw Włodarczyk

New Faculty August 2001

Professor of Mathematics

Bernd Ulrich — Ph.D. 1980, University of Saarland; commutative algebra, algebraic geometry

Associate Professor of Mathematics

Gregory Buzzard — Ph.D. 1995, University of Michigan; SCV

Vesselin Gasharov — Ph.D. 1994, Brandeis University; commutative algebra, combinatorics

Irena Peeva — Ph.D. 1995, Brandeis University; commutative algebra, algebraic geometry, combinatorics

Assistant Professor of Mathematics

Donatella Danielli — Ph.D. 1999, Purdue University; PDE

Research Assistant Professors

Hala Jadallah, Ph.D. 2001, Indiana University; PDE, calculus of variations

Andrew Mauer-Oats, Ph.D. 2001, University of Illinois; algebraic topology

Mihai Pascu, Ph.D. 2001, University of Connecticut; probability theory, stochastic processes

Malgorzata Stawiska, Ph.D. 2001, Northwestern University; SCV, dynamical systems

Visiting Faculty

Daniel Assi, University of Angers, algebraic geometry

Dmitry Novikov, Ph.D. 1998, Weizmann Institute of Science, ODE

Srdjan Stojanovic, University of Cincinnati, computational financial mathematics

Continuing Lecturer in Mathematics

Renee Roames, M.S. 1989, Purdue University, mathematics

Her mood swings in the 1990’s. Dale Cutkosky solved the local version of the Abhyankar conjecture in dimension 3 and announced its proof in arbitrary dimension in *Asterisque*. It was the overwhelming body of his work, over 140 pages of tour de force in the case of dimension 3 only, that made us feel pessimistic and far from seeing the solution for the global case, which is most important in application to birational geometry. There was also a conceptual progress, inspired by the work of de Jong, which suggested that we should “toroidalize” the problem. In our case, it meant that we should reduce the factorization of general birational maps to

(continued on page 12)

Student Awards

Student awards were formally presented in the Math library lounge on April 19. Funding is provided by gifts from Purdue alumni and friends who target their contributions to departmental scholarship and award funds.

MATHEMATICS AWARDS

<i>Eugene V. Schenkman Memorial Award</i> (\$400)	Stephen Hoover
<i>Glen E. Baxter Memorial Award</i> (\$500)	Christopher Michael Ripley Yee Ching Yeow
<i>Michael Golomb Math Award</i> (\$400)	James Lee
<i>Gerald R. MacLane Memorial Award</i> (\$500)	Ruth Enoch Peng Hu
<i>Merrill E. Shanks Memorial Award</i> (\$400)	Amy Tamer
<i>Senior Achievement Award</i> (\$250)	Michael Lee Crogan Anne Elizabeth McLaren
<i>School of Science Outstanding Senior in Mathematics</i> (\$100)	James Lee
<i>School of Science Outstanding Achievement Award</i> (\$500)	Jason Dietz Sheng-Kung Yi
<i>Ruzicka—School of Science Undergraduate Research Award</i> (\$3,000)	Yee Ching Yeow
<i>Problem of the Week First Place Prize</i>	Steven Schraudner (fall 2000) Eric Tkaczyk, Yee Ching Yeow (spring 2001)

MATHEMATICS SCHOLARSHIPS

<i>Alton D. and Juanita S. Andrews Memorial Scholarship</i>	Brenda Banning Michael Elijah Huffman Jennifer Susan Kowall Justin David Mazur Yee Ching Yeow
<i>Mark Hoppy Memorial Scholarship</i> (\$1,025)	Nicholas Andrew Stark
<i>Virginia Mashin Scholarship</i> (\$2,500)	Brenda Banning Christopher Alan Drexelius Kyle Collins Harrison
<i>Arthur Rosenthal Scholarship</i> (\$2,500)	Nicholas A. John Mark R. Mishler Jeffrey D. Moser Susan C. Overstreet Jeanette E. Roell
	David Sapirstein Christopher Scheper Christopher J. Stadler Sam E. Wamack Adam Whitehead S.K. Michael Yi
<i>Helen Clark Wight Scholarship</i> (\$2,500)	Aaron Scott Clark Michelle Laura Emerson Angela Marie Jones Alison Leigh Sanders David Weissenborn Christina Marie Wettlaufer
<i>Andris A. Zoltners Scholarship</i> (\$2,500)	Rebekah Jane Hannah Brent Mathew Monroe Jeffrey Michael Payne

ACTUARIAL SCIENCE AWARDS

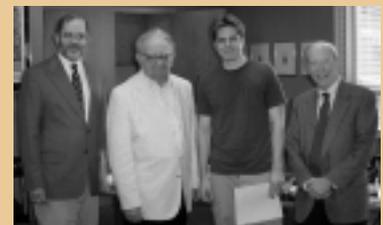
<i>Lincoln Scholarship</i> (\$2,500)	Christopher Nick Otterman
<i>Trustmark Scholarship</i> (\$2,500)	James G. Shaheen
<i>Lincoln Actuarial Achievement Award</i> (\$500)	Lauren Michelle Coleman
<i>CIGNA Freshman Scholarship</i> (\$300)	Sebastine Kleber Jeanette E. Roell
<i>CIGNA Sophomore Scholarship</i> (\$500)	Marcus Ewe
<i>CIGNA Exam Award</i> (\$150)	Jeffrey Johanningsmeier Dwane Johnson
<i>Actuarial Alumni Awards</i> (\$300)	Jacqueline Allen Jacqueline King



Incoming freshman Patrick Jessee and his mother traveled to West Lafayette from Bloomington, Indiana for the student awards program. Patrick plans to major in actuarial science and is pictured with the actuarial science program director, Professor Richard Penney.



Above, Shanks Award winner Amy Tamer and her parents, Gregory and Janet Tamer. Below, James Lee with Professors Jim McClure, Michael Golomb, and Dean Harry Morrison. James received the Golomb Award and was named the SoS Outstanding Senior in Mathematics.



Undergraduate Program News

We attended the Nebraska Conference for Undergraduate Women in Mathematics this past February. We stayed in the Cornhusker Hotel in Lincoln, a few blocks away from the University of Nebraska campus, where the conference was held. We met many undergraduate women studying mathematics, as well as several people at the graduate and Ph.D. levels.



Math majors Jessica Krafft and Tania Robbins

The conference exposed us to a variety of new topics and available opportunities in the field of mathematics. There were plenary sessions given by female professors in math and student presentations. Some of the topics discussed were “Error-Correcting Codes,” “Spindown of an Elastic Fluid,” “Elliptic Curve Cryptography,” and “Cayley Digraphs Using MAPLE.”

In addition, there were many panel discussions and question and answer sessions. We learned more about what life in graduate school would be like. Also, possible future opportunities for math students were discussed. These included careers in government, industry, and academia.

Different individuals from each of these areas discussed the benefits and challenges of their fields.

The conference gave us a broader insight into different possibilities for women in mathematics. It left us with ideas about REU’s, upcoming math conferences, and pursuing higher degrees in mathematics.

— Jessica Krafft, Tania Robbins

The Actuary Club has as its primary objective the facilitation of the recruitment process for internships and the placement of actuary graduates in full-time positions. At the same time it is our goal to heighten the awareness of the strength of our actuarial science curriculum at Purdue, while fostering new friendships among our members. In the 2000-01 academic year, we achieved our goals.

Over 20 companies visited campus during the academic year, specifically to recruit actuary students. They represented life, health, and property/casualty insurers, as well as consulting firms. All eight graduating seniors have exciting future plans. Damon Andres, Jackie Bagaloff, Amrita Bagga, Paresch Gopaldas, Dwane Johnson, Mathieu Kouame, Steven Scheibelhut, and James West either found early employment opportunities with companies such as CIGNA, PricewaterhouseCoopers, The Hartford, Unifi Network, Anthem, Milliman &

Robertson or are continuing their education at the graduate level.

Two people deserve extra credit for this success. They are Dr. Penney for all of his help and guidance and Terry Loro, our new club secretary, who accepted the task of scheduling company visits and interviews.

But all is not work in the Actuary Club. We continued our tradition of having fun by hosting an ice cream social and two dinners held at the end of each semester in honor of our graduating seniors. And often, we enjoyed pizzas and refreshments at club meetings.

Officers for the year included: Jackie Bagaloff (President), Dwane Johnson (Vice President), Lauren Coleman (Secretary), Jennifer Denis and Marcus Ewe (Treasurer), Andy Howard (Resume Book Coordinator), and Nick Otterman (Web Design).

These positions have been passed to a new team of officers including: Lauren Coleman (President), Marcus Ewe (Vice President), Jeanette Roell (Secretary), Jeff



Actuary Club

Purdue Math Club

The Math Club had another interesting and fun-filled year. New blood both in the general membership and leadership of the club brought vitality, variety, and a progressive sense of energy to the various activities.

The club enjoyed two conference trips during the year. The Miami University Mathematics Conference in September featured mathematical pictures worth a thousand words. In the spring, a delegation of about fifteen students attended the IN MAA meeting at the University of Indianapolis. There, the dubious real estate agent Mel Slugbate (portrayed by Professor Colin Adams from Williams College) delighted everyone with a hilarious and educational promulgation on the merits of investing in hyperbolic space. Additionally, four Purdue teams competed in the annual Indiana Collegiate Math Competition held in conjunction with the meeting. In the course of Saturday afternoon practices held in the preceding months, we were able to solve many of the problems from the early years of competition whose solutions had been lost. James Lee of Purdue will be awarded the winning plaque in October for this contest, whose problems are found on the web at: <http://www.valpo.edu/home/faculty/rgillman/icmc/icmcfnd.htm>

The customary series of talks broadened students’ knowledge by expounding on a variety of themes. The year began with a talk by Professor Fred Lytle from chemistry on mathematical Braille—something most mathematicians seldom think about, but a very important topic for many brilliant and productive scientists. At another meeting, Professor David Moore helped us differentiate between facts and artifacts in statistical thinking. Next we were enlightened when Professor Aaron Yip spoke

(continued on page 12)



Professor Penney and Jackie Bagaloff, Actuarial Science Club president

Johanningsmeier (Treasurer), Aaron Kock (Resume Book Coordinator), and Nick Otterman (Web Design).

I wish them continued success. I thank all of the members who participated in our activities and particularly those who devoted their valuable time to fulfilling our mission.

— Jackie Bagaloff

(*Birational Maps, continued from page 9*)

that of toric (or toroidal) birational maps, where Morelli brought in a revolutionary idea of “cobordism” and solved the combinatorial problem in a brilliant way. (Morelli’s paper was as full of discrepancies as it was new ideas, and my graduate student Suliman (Rashid) and I spent three years clearing those up.) Dan and I were suddenly awakened in December of 1998 from daydreaming about a global solution of the factorization problem along the line of this “toroidalization,” when Kawamata sent a preprint of Włodarczyk, which revealed the true nature of Morelli’s idea as an algebraic version of Morse Theory, a powerful and well-known tool in differential geometry to study the transformation of homotopy types. This gave us a guiding principle in approaching the problem, missing for 30 years, to study the transformation of birational types via birational cobordism. However, the paper was still one final step short of reaching the complete solution. We felt as if thrown into a black hole one day in January 1999, when Jarek sent us an e-mail “I must say I have a proof,” while we were frantically working toward that final step via the method of “torification.” Nevertheless, we continued our effort and saw a complete proof in the following three months, due mainly to powerful ally Kalle, who (according to Dan, his advisor) would “prove any statement in a couple of weeks if not days as long as it’s correct.” Jarek was definitely the first to reach the top of the Everest. But our effort was not in vain to provide a simpler and independent proof to appear in the *Journal of AMS*, whereas Jarek’s proof, which is just a small portion of his grand theory of “stratified toroidal varieties,” will appear in *Inventiones Mathematicae*.

Is this the end of the story? Not quite.

As our proof went through the scrutiny of many mathematicians, notably people in Kyoto who listened to my lectures in the summer of 1999 (four hours every day for three weeks, the Japanese style), the main body of the proof was checked and confirmed. However, a critical error was found in our correction of Morelli’s argument. This does NOT affect the statement or proof of our factorization theorem, as long as we allow the order of blowups and blowdowns to be arbitrary, known as the weak factorization. This DOES bring back the strong factorization conjecture, where we are required to take blowups first immediately followed only by blowdowns, to ground zero, even for the toric case. (This also brings the local version of the strong Abhyankar

conjecture back to open in dimension 4 or up, as Cutkosky’s proof in *Asterisque* relies on the Morelli’s argument in the final step.)

While our recent attempt to fix the gap indicates that the problem may have something to do with solvability of certain Lie Algebra, the strong factorization conjecture remains a mystery. Our solution to the weak factorization conjecture is a “slick” shortcut depending upon Jarek’s theory of birational cobordism. What happened to our original approach of “toroidalization?” It is beginning to reveal its genuine feature as the problem of resolution of singularities of morphisms in the logarithmic category. I had the fortune of Villamayor visiting Purdue for the spring semester of 2001, who convinced me that this is the right way to approach the problem, ultimately yielding a canonical and constructive algorithm and a solution to the strong factorization conjecture.

So the saga continues in the Purdue Mathematics Department, where Donu (Arapura) is always ready to answer my stupid to not-so-stupid questions and where we can see that big smile (of Jarek) across the hall (not in Germany or Poland). We are happy to report that Jarek will join us as Associate Professor starting fall of 2002.

(*Math Club, continued from page 11*)

about PDE’s and their applications. The final talk of the fall semester was given by Professor Deanna Haunsperger, the editor of the mathematics magazine *Horizons*, visiting from Carleton College for the event. The theme of the mathematics of voting could not have been more appropriate to the current events of November 2000. The second semester’s talks commenced with Professor Fabio Milner’s exposition on models of population dynamics. Next, Professor David Goldberg gave an entertaining lecture about the history of Fermat’s Last Theorem. Eric Tkaczyk finished the year’s series by describing his efforts to understand pressure hallucinations with models of neuron networks in the brain.

Abstracts, informational links, and fun photographs from all of the talks and activities of the year can be found on the club webpage, which was completely revamped this year by webmasters Jeff Moser and Paul Kuliniewicz. From the Purdue Math Club, please visit it, and keep in touch.

—Eric Tkaczyk*

*Math Club Public Relations Director
Competitions and Conference Coordinator*

*Editor’s Note: Eric is a Beering Scholar majoring in mathematics and biomedical engineering. He submitted his report via e-mail from France, where he is participating in a summer exchange program for laser and optics students.



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