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MAA FOCUS

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MAA FOCUS Deadlines

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Editorial Copy	September 16	October 16	November 17
Display Ads	September 24	October 27	November 21
Employment Ads	September 10	October 13	November 10

MathFest 2008: Record Crowd, Great Talks, Great Meeting

With over 1,400 attendees present, MathFest 2008 was one of the biggest ever, bringing to Madison a broad range of mathematicians, from students to seasoned professionals. Most of the events were held at the beautiful Monona Terrace conference center, located in downtown Madison on Lake Monona. Eric Demaine gave a brilliant series of Hedrick Lectures, attracting a very large audience. Many other events helped make it a special meeting, from Chris Stevens' Leitzel Lecture to a special appearance of Elvis, the dog who knows calculus.

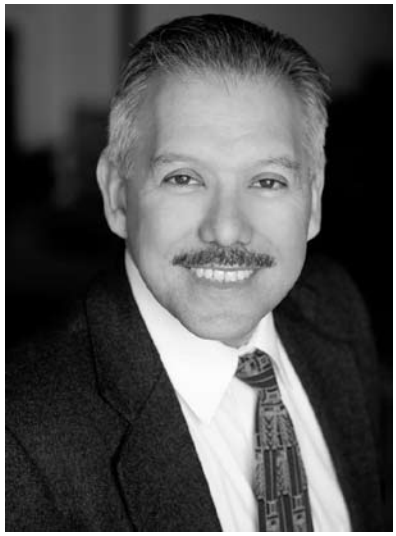
The Monona Terrace Community and Convention Center.

In this issue, you will find four pages dedicated to news from MathFest. On pages 12 and 13, we report on the MAA's main writing awards, given every year for the best articles in MAA publications. Then, on pages 14 and 15, we present a selection of MathFest Short Takes. In the October issue, we will both look back to MathFest and forward to the Joint Mathematics Meetings, to be held in January in Washington, DC.

Juan C. Meza Receives 2008 Blackwell-Tapia Prize

Juan C. Meza, a senior scientist at the High Performance Computing Research Department at Lawrence Berkeley National Laboratory, will be awarded the 2008 Blackwell-Tapia Prize at the Fifth Blackwell-Tapia Conference, to be held November 14–15, 2008 at the Statistical and Applied Mathematical Sciences Institute in Research Triangle Park, N.C. The prize is awarded every two years in honor of David H. Blackwell and Richard A. Tapia, two distinguished mathematical scientists who have inspired and mentored African-Americans, Latinos/Latinas, and Native Americans in the mathematical sciences.

The prize recognizes Meza's service to under-represented groups in mathematics. Among many other activities, he has chaired the Mathematical Sciences Research Institute's Human Resources Advisory Committee, co-chaired SIAM's annual Diversity Day workshops, and worked with young mathematics students at functions such as MSRI's 2007 Undergraduate Program. He has also done significant mentoring, giving presentations to student groups on how they can be effective speakers and presenters themselves and working directly with early-career mathematics students from under-represented groups.



An accomplished researcher, Meza heads a department doing cutting-edge work in computational science, computational mathematics, and future technologies. His current research focuses on nonlinear optimization, with an emphasis on parallel computing. He has also worked on scientific and engineering applications involving scalable methods for nanoscience, power grid reliability, molecular conformation problems, optimal design of chemical vapor deposition furnaces, and semiconductor device modeling. He is a much sought-after speaker, both nationally and internationally, on topics ranging from his own research, through major invited talks on the importance of diversity such as his presentation at the 2008 Marjorie Lee Browne Colloquium, part of the University of Michigan's Martin Luther King, Jr. celebration.

The Blackwell-Tapia Conference is held every two years to showcase mathematical excellence by minority researchers, recognize successful work to address under-representation, and to provide career information and networking opportunities for minority students and mathematicians. The conference will include scientific talks; poster presentations; a panel on career opportunities in mathematics, and a panel on recruitment and retention of a diverse mathematics workforce.

See http://www.samsi.info/workshops/2008Blackwell-Tapia.shtml for more information on the Blackwell-Tapia Conference and the prize.

USAMO Winners Celebrated in the Nation's Capital

By Ryan Miller

The 12 winners of the U.S.A Mathematical Olympiad (USAMO) were honored on Monday, June 9 at the 37th annual USAMO Awards Ceremony and Dinner in Washington, D.C.

MAA President Joe Gallian presided over the awards ceremony at the National Academy of Sciences, where he introduced the students and presented them with their USAMO medals.

The 2008 USAMO winners are:

David Benjamin, Harrison High School, West Lafayette, IN.

TaoRan Chen, Bayside High School, Flushing, NY.

Paul Christiano, The Harker School, San Jose, CA.

Samuel Elder, Poudre High School, Fort Collins, CO.

Shaunak Kishore, Unionville High School, Kennett Square, PA.

Delong Meng, Baton Rouge Magnet High School, Baton Rouge, LA.

Evan O'Dorney, Berkeley Math Circle, Berkeley, CA.

Qinxuan Pan, Thomas Sprigg Wootton High School, Rockville, MD.

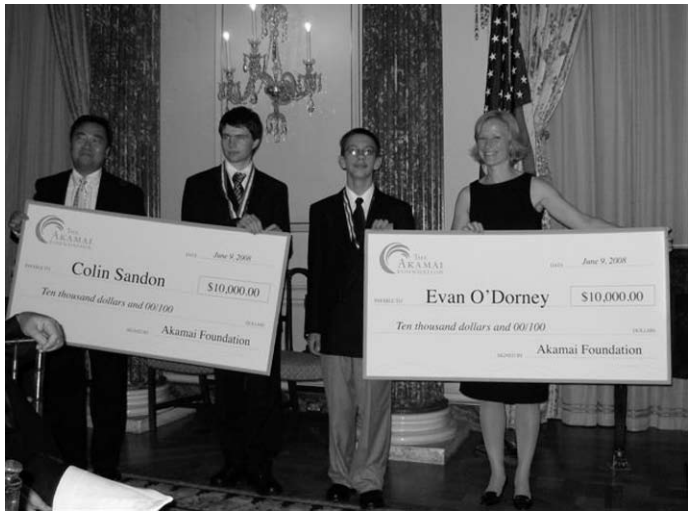
David Rolnick, Home School, Rupert, VT.

Krishanu Sankar, Horace Mann School, Riverdale, NY.

Colin Sandon, Essex High School, Essex Junction, VT.

Alex Zhai, University Laboratory High School, Urbana, IL.

The 2008 USAMO winners pose for pictures around the Albert Einstein Memorial Statue outside the National Academy of Sciences. From left to right – Front: Evan O'Dorney, Paul Christiano, and TaoRan Chen. Middle: Alex Zhai, QinXuan Pan, Delong Meng. Back: David Benjamin, Sam Elder, Shaunak Kishore, Krishanu Sankar, David Rolnick, and Colin Sandon.



First place winners (Colin Sandon and Evan O'Dorney) receiving the Akamai Scholarships. David Yoon, left and Sandy Smith, right from the Akamai Foundation.

Two-time USAMO winner Melanie Matchett Wood delivered the invited address, "The Chemistry of Primes." Currently a graduate student at Princeton, Wood is the first student to give the invited address at the USAMO awards ceremony. Wood spoke about the privilege of winning the USAMO and encouraged the students to pursue the amazing mathematical opportunities awaiting them.

Moving to the Department of State building for the awards dinner, the students and guests were escorted to the Diplomatic Reception Rooms where they could view famous paintings of American statesmen or marvel at belongings of some renowned historical figures.

Dr. Sharon Hays, from the President's Office of Science and Technology Policy, praised the USAMO winners and stressed the importance of mathematics in today's world. She concluded by reading a letter from President George W. Bush congratulating the 12 winners.

Awards and scholarships were handed out after dinner. All 12 USAMO winners received a $500 U.S. savings bond for winning the Robert P. Balles U.S.A. Mathematical Olympiad Prize. O'Dorney and Sandon were honored with the Samuel L. Greitzer/Murray S. Klamin Award for Mathematical Excellence for their first place finish. The pair also received $10,000 each in scholarship money from the Akamai Foundation as a result of tying for the highest score on the USAMO.

O'Dorney was also recognized with the Clay Mathematics Institute Olympiad Scholar Award for the most original solution to a USAMO problem.

Pan and Sankar both received Akamai Scholarships in the amount of $7,500 for their tie for second place, and Kishore and Meng each earned $5,000 for their third place finish.

MAA Executive Director Tina Straley capped off the evening by thanking everyone who made the evening possible and wishing the students who will travel to Madrid for the International Mathematical Olympiad (IMO) the best of luck.

Robert P. Balles Awards for IMO Team Participants

In 2005, Robert P. Balles, a mathematics instructor and businessman from California, created an award for members of the USA team at the International Mathematical Olympiad. Balles admires the brilliance and dedication of these outstanding "mathletes," so he made a fund at the MAA to honor and reward their achievement in mathematics with a $1000 "Einstein" Series I savings bond.

Alex Zhai Earns Perfect Score as U.S. Finishes Third

By Ryan Miller

Alex Zhai earned one of only three perfect papers as he helped lead the U.S. team to a third place finish at the 2008 International Mathematical Olympiad (IMO) in Madrid, Spain. The gold medal marks the second for Zhai who competed in last year's IMO in Vietnam.

Also earning gold medals for the U.S. team were Shaunak Kishore, Colin Sandon, and Krishanu Sankar. Evan O'Dorney and Paul Christiano both earned silver medals for their efforts.

China's 217 team points were enough to take home first place ahead of 2007 champion Russia, who finished second with 199 points. South Korea finished fourth with 188 points. The third place finish is the highest for the U.S. since the 2005 team finished second in Mexico City.

"Many thanks to Team Leader Zuming Feng, and Deputy Leader Razvan Gelca for their very hard work in preparing the team so well, and advocating for the team's individual scores in the coordination phase," MAA Director of Competitions Steve Dunbar said.

The IMO team left to right: Alex Zhai, Shaunak Kishore, Krishanu Sankar, Paul Christiano, Evan O'Dorney, and Colin Sandon.

While in Spain, the team got a chance to explore Madrid and take a sightseeing tour of Toledo.

For a glimpse of what happens at an International Mathematical Olympiad see the film *Hard Problems*, a documentary on the 2006 IMO in Slovenia.

Maeve McCarthy Named AWM Executive Director

The Association for Women in Mathematics (AWM) has named Maeve Lewis McCarthy as its new executive director. McCarthy will support the work of the AWM Executive Committee and will work with AWM's managing director Jennifer Lewis. McCarthy's duties will include representing the AWM at various national meetings, dealing with grants and committees, and carrying out new initiatives for AWM.

A native of Ireland, McCarthy received her PhD from Rice University in Houston and is currently Professor of Mathematics at Murray State University. Her research is in applied and computational mathematics. She admits to "an addiction to eigenvalues that began in secondary school in Ireland." Her research interests include the application of eigenvalues to population dynamics and mechanical design. Her work in differential equations and inverse problems focuses on the identification of parameters in biological and physical applications.

Beginning in 1998 when she was a NExT Fellow, McCarthy has been active in the MAA, in particular as a member of the editorial board for MAA FOCUS. She has also been active for many years in SIAM and in AWM. She received an AWM Mentoring Travel Grant in 2000, which she says helped her kick-start her post-PhD research career.

"I am incredibly excited to be appointed as Executive Director of AWM," said McCarthy. "Being a woman mathematician is not enough. I want my daughter to know that I have done everything I could to enhance opportunities for women in mathematics and academia."

Halmos River of Bricks Reaches 250

Visitors to the Carriage House Conference Center at the MAA headquarters in Washington D.C. have a new conversation piece to discuss during breaks from meetings and events. Since its dedication in April 2007, MAA supporters have bought more than 250 inscribed bricks for the **Paul R. Halmos Commemorative Walk** outside the entrance to the Conference Center.

The walk, which is in the form of a map of the confluence of the Potomac and Anacostia Rivers in the District of Columbia, has 1200 bricks that the MAA is using to raise funds to support programs at the center. The cost of a brick was set at $303 because Paul Hamos' birthday was on March 3.

Bricks have been bought by MAA sections, departments, programs and professional organizations. Individuals have bought the bricks to honor friends, colleagues, teachers, and family members.

Many of the bricks are memorials. One brick was bought to honor an REU program, another has Lambert's Prime Number Formula and one says "Take it to the Limit." John Kenelly has a brick for each member of his family and Tom Apostol has honored 20 people with bricks.

Brick order forms are available at http://www.maa.org/news/052307bricks.html. These are installed in lots of 100. The next batch will be installed soon. Order yours today!

Suggestions Sought for New MAA Officers

National elections for the offices of MAA President, First Vice-President, and Second Vice-President will be held in the spring of 2009. The Nominating Committee soon will be preparing ballots, which will contain a slate of three or more nominees for each office. Suggestions of potential nominees are eagerly sought.

Please send your suggestions by **October 1** to the chair, Barbara Faires at faires@westminster.edu, or to one of the other Nominating Committee members: Jean Bee Chan at jbchan1@yahoo.com, Carl Cowen at ccowen@iupui.edu, Ron Graham at graham@ucsd.edu, or Deanna Haunsperger at dhaunspe@carleton.edu. The person elected president will serve as president-elect during 2010 and will take office for a two-year term as president in January 2011. The two newly-elected vice-presidents will take office in January 2010.

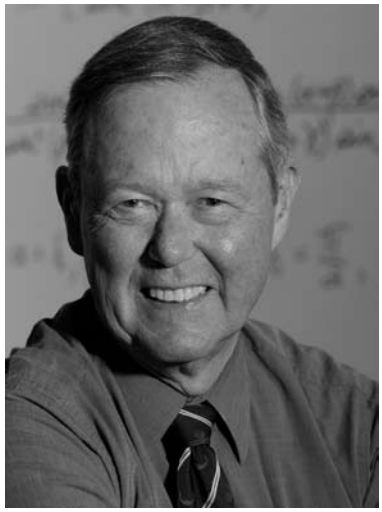
Jeremy Kilpatrick Wins 2007 Felix Klein Award

Jeremy Kilpatrick, MAA's Governor-at-Large for Teacher Education, has won the Felix Klein Medal for 2007. He received the award at the International Congress on Mathematical Education (ICME 11), in Monterrey, Mexico, in early July.

A professor of mathematics education at the University of Georgia, Kilpatrick is being recognized for his "more than 40 years of sustained and distinguished lifetime achievement in mathematics education research and development," according to the citation from the International Commission on Mathematical Instruction (ICMI). Kilpatrick's contribution to mathematics education—he calls it a "field of theory and practice" — has centered on his ability to reconcile its varying and conflicting aspects.

A characteristic feature of Jeremy Kilpatrick, says the ICMI award citation, is that he "has always embraced a very cosmopolitan perspective on mathematics education." He has worked in Brazil, Colombia, El Salvador, Italy, New Zealand, Singapore, South Africa, Spain, Sweden, and Thailand.

Kilpatrick has written about problem solving, the history of research in mathematics education, teachers' proficiency, curriculum change and its history, and assessment. He co-edited the following: *Soviet Studies in the Psychology and Teaching of Mathematics* (1969–1975); the *Proceedings of the Fourth International Congress on Mathematical Education* (1983); the *International Handbook of Mathematics Education* (1996); the *Second International Handbook of Mathematics Education* (2003); the ICMI study *Mathematics Education as a Research Domain* (1998); *Adding It Up* (2001); *A Research Companion to Principles and Standards for School Mathematics* (2003); *A History of School Mathematics* (2003); and *Meaning in Mathematics Education* (2005). Kilpatrick also served as editor of the *Journal for Research in Mathematics Education* (1982–1988).



Kilpatrick's service to mathematics education has included terms on the Executive Committee of the International Commission on Mathematical Instruction. From 1991-1998 he was an ICMI Vice-President. He was a charter member of the U.S. Mathematical Sciences Education Board (1985-1986), on which he now serves again. He has served on committees and boards of the MAA, AERA, the College Board, the Educational Testing Service, the NCTM, NAEP, the National Academy of Education, the National Research Council, and the National Science Foundation.

Kilpatrick earned an A.B. in mathematics from the University of California, Berkeley in 1956, then an M.A. in education in 1960 while teaching mathematics in a junior high school. At Stanford University, he worked with Ed Begle and George Pólya during the years 1962-1967 as a Research Assistant in the School Mathematics Study Group. After earning an M.S. in mathematics (1962), a PhD in mathematics education (1967), and teaching (1967-1975) at Teachers College, Columbia University, Kilpatrick joined the University of Georgia, in Athens, as a Professor of Mathematics Education, in 1975.

The Felix Klein medal, named for the famous mathematician and first president of ICMI (1908-1920), honors a lifetime of achievement in mathematics education research. It has been handed out every two years, starting in 2003. Awardees receive a medal and certificate and are invited to speak at ICME.

Found Math

Those godless communist tykes have had their creativities and self-esteems destroyed by geometry, algebra, and even calculus, for God's sakes! And not one lousy mini-course in baseball fiction or the poetry of rock and roll! You talk about elitism? Now there's your elitism.

Mitchell, Richard, *The Leaning Tower of Babel*
(Thanks to Charles Kerpelman)

Teaching Time Savers: Keeping Homework at Home

By H. Smith Risser

Many new mathematics professors encounter the dilemma of how much time to spend in each class going over homework problems. In my first semester, I was teaching a service course that was so large that collecting and grading the homework was impractical. This meant that my students often did not get feedback on what they were doing incorrectly before the test. I also would answer all of their homework questions in class. This meant that I was often bogged down working homework problems and had to rush through the new material. Even the questions students asked gave me no way to determine what students knew and understood. Students would ask questions like "Could you work number 23?" that gave me no real idea what mistakes students were making. After grading the first test, I discovered that although I was going over homework problems in class, I wasn't addressing student misunderstandings by doing so.

Going over homework can be one of the most time consuming and frustrating activities in any mathematics class. There are several difficulties to the standard approach of going over homework in class. While there are some problems that the majority of the students need the instructor to discuss, most of the problems on each assignment are missed by very few students. Also, since there is no way to know how many students had difficulty with each particular question, the instructor may spend precious class time answering a question for only one or two students rather than focusing on concepts that the majority of students in the class are struggling with.

In service courses especially, the classes may be large and collecting or grading homework impractical. If homework isn't collected, it can also be difficult for the instructor to ascertain why students were having difficulty working those particular problems. Did they have difficulty setting up the problem or did they make an algebra mistake while they were working it? Did they get the correct answer and have trouble simplifying it? If students don't know where they are making their mistakes, they cannot correct them. Finally, many college students are procrastinators. This means that not all of the students in the class have attempted the homework from the previous class. So, these students miss the chance to ask questions on that homework assignment.

This semester I decided to take a different approach to homework. I no longer spend class time answering homework questions. Instead, I ask students to post their questions on the class discussion board. Many academic institutions have invested a lot of time and money in making online course delivery software available to their faculty. The ways in which faculty use this software varies widely both between and within departments. Traditionally, mathematics departments have had a difficult time using features like the discussion board because of the lack of mathematical symbols. However, in the current software, equations can be inserted into discussion threads. This makes it much easier to use the discussion software in mathematics courses. As an added benefit, you can assign grades for the posts using the built in gradebook.

At the end of each class period, I post a new thread for that night's assignment. Students post their questions on the thread and answer questions from other students. I moderate the discussion and sometimes post answers.

The discussion helps me gauge how many students are struggling with a particular problem. I often see posts like the following:

> mathstudent1: i dont get how to set up #67
> mathstudent 2: me neither
> mathstudent 3: me too

If several students have posted that they don't understand a problem, I discuss that problem in class. Many times, however, a single student will post their question and the accompanying incorrect work. Either another student or myself then will answer the post and correct the work:

> mathstudent 1: How come the book got $x = 1 \pm \sqrt{2}$ on #55?
>
> $x^2 - 2x = 1$
> $\sqrt{x^2 - 2x} = \pm\sqrt{1}$
> $x - 2x = \pm 1$
> $-x = \pm 1$
> $x = \pm 1$

mathstudent 2: you can't work it that way. You have to get zero on one side and use the quadratic formula to get the answer

$$x = \frac{2 \pm \sqrt{4 - 4(1)(-1)}}{2(1)}$$

once you get it you can simplify to get what the book got.

This has the benefit of telling me both where the student was making their mistake and how serious the mistake was. In this case, mathstudent 1 did not understand how to correctly solve a quadratic equation. If the mistake is fairly serious, I send the student a message directly and ask them to make an appointment to come in during office hours. I also go back and read the new posts on previous nights' assignments. That way, even students who procrastinate still get feedback before the tests.

During the semester, I did discover the need for some ground rules. First, you have to give students an incentive to post. I required students to post to the discussion board in order to have an opportunity to drop their two lowest quiz grades. However, this approach had some drawbacks. Students that did well on their quizzes didn't need to drop grades. That meant that many of the students doing well in the class weren't participating in the discussion. Dropping the two lowest quiz grades also did not have much of an effect upon the overall average. So, even students that were not doing well on their quizzes did not have much of an incentive to post. In the future, I will count participation in the discussion boards as a much more significant part of the overall grade in the course.

Second, students have to know what content and how often they are required post. For my course, I asked students to post once per homework assignment. However, I didn't include any requirements on what they were supposed to post. When I first started having them post, they were posting questions like "Can someone work #25?" Answering this type of question on the discussion board was no more effective than answering the question in class. After the first few assignments, I required students to post a detailed question about a problem, with the relevant work. If they didn't have a question, I asked them to respond to another student's question.

Third, you have to consider what types of homework problems to assign. At first, I assigned problems with answers in the appendices of the book. Students knew whether or not their answer was correct before they posted. Students with correct answers had no reason to post or to participate in the discussion. The more valuable discussions occurred on homework problems not answered in the appendix. On these questions, every student had a reason to participate in the discussion.

Finally, you have to tell students how quickly they can expect answers. At first, I was getting twenty posts on each thread the night before the test. Students were waiting until the night before the test to do their homework and ask questions. By the end, I required students to post within four days after the homework was assigned in order to receive credit for participating. I also instructed students to expect their question to be answered no less than 36 hours after their post. By waiting to post myself, I gave the other students in the class a chance to post answers before I stepped in and answered the question. I also tell students that they should have finished posting at least two days before the test. This gives me time to respond to any last minute questions.

I have found this technique to be particularly effective in my college algebra course. I am spending the majority of each class on the new material rather than answering homework problems. As an added benefit, this strategy has helped me to learn how my students think, which has helped me to be a more responsive and proactive teacher.

Time Spent: 10–40 minutes per week outside of class reading and responding to student posts.

Time Saved: Up to 20 minutes of class time per class

H. Smith Risser is Assistant Professor of Mathematics at Texas Woman's University. She can be reached at hrisser@twu.edu

Found Math

A colorful mass mailing insert advertising a five-day sale during November 14–18, 2006 at Best Buy Auto & Finance in Morehead, KY included a drawing for certain prizes. The following is an excerpt from the small print at the bottom of the advertisement, where the odds of winning are reported:

"Grand Prize $2,500 Cash odds of winning 39,995:40,000 value $2,500. *Jackpot is a $1,000 internet shopping spree, consumer responsible for shipping and handling and $5.00 per order, odds of winning are 39:995:40,000 value up to $1,000, depending on consumers orders. No purchase necessary. Odds of winning Free Oil Change 1:40,000 value $29.95."

(Thanks to Robin Blankenship)

FOCUS on Students: When Time Begins

By Robert W. Vallin

The beginning of the fall semester is always an exciting time for students. There are new classes to take, new people to meet, and new things to learn. Perhaps you are about to fall for the charms of complex integration, or begin an independent study which culminates in your first-ever talk at a meeting, or, best yet, you are about to finish your last year of school and are excited to get on with your life. Whatever the reason, this is the start of something.

As for myself, I am returning to academic life after a year in Washington, DC working at MAA Headquarters. Now I am juggling two jobs: Professor in the Department of Mathematics at Slippery Rock University and MAA Associate Director for Student Programs. I am more than happy to continue my role with the MAA. I enjoy writing this column, administering grants, helping out with events at the Joint Meetings and MathFest, and (there's a hint here) speaking at Section meetings. But during my year away I missed my colleagues back in PA and I am excited to get back to my new office, do some research, and, most importantly, return to the classroom.

In honor of returning to the classroom, I am going to write this column about the students. I want to do this now, at the beginning of the year, when all is new and good. Soon enough there will be the other stories to tell; the ones that begin, "You will not believe what happened in class today." No, this is the time to look at the positives.

Let's start with the energy throughout the university on the first day of classes. Yes, it is a nervous energy, but it is still something to be enjoyed. People who have not seen each other for four long summer months get a chance to catch up. Freshman, needing to find a building on campus, pull out their maps while trying to look like they are not pulling out their maps. Inside the classroom students arrive early to get a good seat and look around thinking, "Please let there be someone I know." Pockets of low conversation erupt with the same topics: What do you know about this professor? Will this class be difficult? I can't believe how much this book costs, we better use it. Then the professor walks into the room and silence falls over everyone. This is the only time that will happen. After that first class they'll know she's not an ogre and will continue chatting after she walks into the room.

When I first walk into a classroom I get a strange, intriguing, exhilarating vibe. After all, here is a room full of people that I will get to know really well. There are the over-achievers, the Hermione Granger types, whose hands shoot up before I'm finished asking the question. There are the nervous ones, afraid to be wrong, but really very good in the subject. There are the slackers (okay, they're not that hard to locate — back row, looking out the window for 50 minutes). And there are the delights. These are the students who one day have "de light" in their heads go on. I get to watch them develop confidence and strength that comes from mastering a topic. They become eager to learn. Who would not love helping them find that light switch?

I once had a student in a Calculus III class (and by his own admission not paying attention) who figured out how to do a problem shown on the board in his own way. He came to me after class and asked if his method would always work. It worked on every example, so I asked him to figure out a proof. He found one, showing his intuition was right on target. He ended up presenting his results at the Section Meeting. What's my point? A new year means new projects. Not just for me, in my own research, but also with students.

Student research is the new, hot topic, but it's really been around for a long time. As the new academic year dawns, now is the time to talk, talk, talk with students about starting projects. It's important to let them know that it requires hard work and time, not genius, and that research for them will not be about discovering new worlds, but expanding their own. I'll entice them with stories about the Joint Meetings, MathFest, and the Section Meetings. Posters and papers will give them the chance to participate. There are even more places for students to speak and the MAA website has a nice list of them (www.maa.org/students). Some of these meetings have money available to help defray the students' expenses. In addition, there are several online brochures the MAA puts out (Giving a Good Presentation, A Student's Guide to Large Meetings, A Guide to Writing an Abstract) available to help students do their best and get the most out of going to a meeting.

What does all this amount to? I'm letting loose with something that too many people keep secret. I really like students. Sure, I can whine about students with the best of them, but all in all, this is a totally cool gig. I like the bright student who you can talk to after class and say, "Have you ever seen something like this?" and watch her become intrigued and ask to learn more. I like the hard-working student who struggles to make the lesson something he owns and is so proud when he succeeds. I like watching people move from disengaged student in the classroom to leaders in the Math Club, encouraging their peers. Finally, I like the students who learn that they are having a grand adventure in college and make the most of it. So to all those students who see themselves or their future in this paragraph and to all those I forgot to mention, I say thank you. You're the reason I come to work excited every day. Thomas Boswell of the *Washington Post* wrote a book on baseball many years ago entitled: *Why Time Begins on Opening Day*. I say time begins again when the new semester starts, when all is new and the possibilities are endless.

It's why time begins on the first day of classes.

Robert W. Vallin is the MAA's Associate Director for Student Programs.

Two New Posters Launched

The MAA unveiled two new posters at MathFest 2008. *Women of Mathematics* was originated by Stan Burris as a counterpoint to IBM's well-known (but now rather rare) *Men of Mathematics* poster. This poster was funded by the MAA and Sun Microsystems and will be distributed to mathematics departments across the country.

The second poster is *Ethnomathematics: Exploring the Role of Mathematical Thought in Traditional and Indigenous Societies*. Created by Amy Shell-Gellasch as part of the History of Mathematics SIGMAA's sessions on ethnomathematics at the 2008 Joint Mathematics Meetings, this poster was funded by HOMSIGMAA and the MAA for distribution to all MAA members.

MAA Prizes and Awards at MathFest 2008

Every year, the MAA announces several prizes and awards at MathFest, including the Alder Awards for distinguished teaching by a beginning college or university mathematics faculty member and the various awards for expository writing published in one of the Association's publications. This year's winners are listed below. More information can be found on the MAA web site, including citations, responses, and photographs of the winners. More photographs will appear in the October issue of FOCUS.

Lester R. Ford Awards
For expository articles published in *The American Mathematical Monthly.*

Tom M. Apostol and Mamikon Mnatsakanian
"Unwrapping Curves from Cylinders and Cones"
The American Mathematical Monthly
Vol. 114, no. 5, May 2007, pp. 388–416.

David Auckly
"Solving the Quartic with a Pencil"
The American Mathematical Monthly
Vol. 114, no. 1,
January 2007, pp. 29–39

Tanya Leise

Andrew Cohen and Tanya Leise
"Nonlinear Oscillators at Our Fingertips"
The American Mathematical Monthly
Vol. 114, no. 1, January 2007
pp. 14–28.
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Thomas C. Hales
"The Jordan Curve Theorem, Formally and Informally"
The American Mathematical Monthly
Vol. 114, no. 10, December 2007
pp. 882–894.

Katherine Socha
"Circles in Circles: Creating a Mathematical Model of Surface Water Waves"
The American Mathematical Monthly
Vol. 114, no. 3, March 2007
pp. 202–216.

George Pólya Awards
For expository articles published in the *College Mathematics Journal*.

Roland Minton and Timothy L. Pennings
"Do Dogs Know Bifurcations?"
College Mathematics Journal
Vol. 38, no. 5, November 2007, pp. 356-361.

Roland Minton

Timothy L. Pennings

Andrew J. Simoson
"Pursuit Curves for the Man in the Moone"
College Mathematics Journal
Vol. 38, no. 5, November 2007
pp. 330-338.

Henry L. Alder Award
For Distinguished Teaching by a Beginning College or University Mathematics Faculty Member.

David Brown
Ithaca College

Jacqueline A. Jensen
Sam Houston
State University

Katherine Socha
St. Mary's College
of MD

Carl B. Allendoerfer Awards
For expository articles published in *Mathematics Magazine*.

Eugene Boman, Richard Brazier, and Derek Seiple
"Mom! There's an Asteroid in My Closet!"
Mathematics Magazine
Vol. 80, no. 2, April 2007
pp. 104-111.

Eugene Boman

Richard Brazier

Derek Seiple

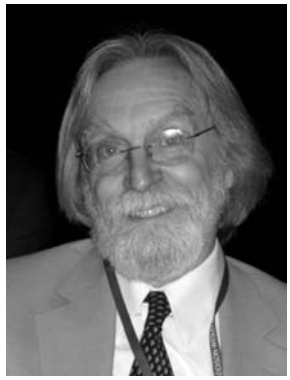
Chris Christensen
"Polish Mathematicians Finding Patterns in Enigma Messages"
Mathematics Magazine
Vol. 80, no. 4, October 2007
pp. 247-273.

The Selden Award
Honors a researcher who has established a significant record of published research in undergraduate mathematics education and who has been in the field at most ten years.

Marilyn P. Carlson
Arizona State University

Trevor Evans
Awarded to authors of exceptional articles that are accessible to undergraduates and published in *Math Horizons*.

William Dunham
"Euler's Amicable Numbers"
Math Horizons
Vol. 15, November 2007
pp. 5–7.



Robert K. Moniot
"The Taxman Game"
Math Horizons
Vol. 14, February 2007
pp. 18-20.

MathFest Short Takes

By Fernando Q. Gouvêa

The MathFest Opening Banquet, held in the Madison Concourse Hotel, was well-attended and a lot of fun. Jenny Quinn (University of Washington at Tacoma and co-editor of *Math Horizons*) served as MC. Sporting a tattoo of an MAA Icosahedron on her left shoulder, Jenny welcomed MathFest attendees to Madison, which she described as her "mathematical home town." She urged everyone to visit the Farmer's Market on Saturday, where they could try cheese curds "so fresh they squeak!" and other local products.

After dinner, banqueters were treated to a Math Song Sing-Along by "mathemusician" Larry Lesser, who is Associate Professor of Mathematics at the University of Texas at El Paso. Lesser, who is also a songwriter, presented several of his mathematical parodies of well-known songs, including "We Will Graph You," "We Are the Mathletes," and "Knowin' Induction." (See his web site at http://www.math.utep.edu/Faculty/lesser/Mathemusician.html for the lyrics.) He even got Art Benjamin (Harvey Mudd College, and the other co-editor of *Math Horizons*) to sing "American Pi." At the end, he was thanked with a song by MC Jenny Quinn.

Editorial transitions are coming soon for several MAA journals. Michael Henle (Oberlin College), editor-elect of the *College Mathematics Journal*, will become editor in January, replacing Lowell Beinecke. Both Henle and Beinecke were present at the meeting of the MAA Board of Governors. At *Math Horizons*, Art Benjamin and Jenny Quinn will be replaced, also in January, by editors-elect Steve Abbott (Middlebury College) and Bruce Torrence (Randolph-Macon College).

Michael Henle

Mathematics Magazine will also see changes soon. Frank Farris will be editor until the end of 2009. The Board of Governors chose Walter Stromquist (Swarthmore College) as the new editor. See his web page at http://walterstromquist.com for more about Stromquist, who will serve as editor-elect in 2009 and become editor in January 2010.

Walter Stromquist

At the center of every MathFest are the three Hedrick Lectures. This year's speaker was Erik Demaine, a serious candidate for the title of youngest-ever Hedrick Lecturer. Demaine's overall title was "Fun with Algorithms and Folding," and his presentations ranged all the way from puzzles and magic to reconfigurable robots and hinged dissections. Demaine is both mathematician and artist, and many of his slides were impressive demonstrations of how good mathematics can lead to beautiful art. Copies of *Geometric Folding Algorithms: Linkages, Origami, Polyhedra*, by Demaine and Joseph O'Rourke, and *Tribute to a Mathemagician*, co-edited by Demaine, seem to have sold well at the exhibit hall, providing more evidence of how popular his lectures were. To learn more about Erik Demaine and his work, visit http://erikdemaine.org/.

The James R. Leitzel Lecture was given by T. Christine Stevens (Saint Louis University), the director of MAA's Project NExT. Since this meeting marked the 15th year of Project NExT, Stevens spoke about "Building Mathematical Communities," with special reference to the network of more than one thousand NExT Fellows that she has helped build over the years. NExT is one of the MAA's most successful programs, a model for many other early career professional development opportunities. It even has its own *Wikipedia* entry!

NExT Fellows were everywhere at MathFest. Since many NExT activities take place either during or just before the meeting, many fellows are around. But former fellows and NExT mentors (two categories with quite a bit of overlap, of course) are also a strong presence. In fact, several of this year's award winners were NExT Fellows, a fact to which President Gallian did not fail to call attention.

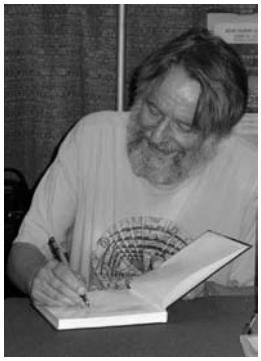
Gavin LaRose, Emily Puckette, T. J. Murphy, Carolyn Yackel, Lara Pudwell

Katherine Socha thanks the MAA for one of her awards as MAA President Joe Gallian looks on.

Salah-Eldin A. Mohammed

This year's NAM-Blackwell Lecturer was Salah-Eldin A. Mohammed (Southern Illinois University Carbondale). Mohammed spoke on "Random Dynamics with Memory: Structure within Chaos," describing both the dynamics and the long-term evolution of stochastic processes with memory, that is, stochastic processes whose evolution depends not only on the current state (as in Markov Processes) but on past states as well. The NAM David Blackwell Lecture is sponsored by the National Association of Mathematicians and held every year at MathFest.

The Pi Mu Epsilon J. Sutherland Frame Lecture was given by John Horton Conway, who spoke on "The Symmetries of Things." Aimed at students and sponsored by the Pi Mu Epsilon honor society, Conway's lecture was such a hit that publisher A K Peters ran out of copies of Conway's book *The Symmetries of Things* at the signing the next morning.



John H. Conway signs books.

There is no doubt that Katherine Socha was one of the stars of MathFest. In addition to winning *both* a Lester R. Ford Award and an Alder Award (see pages 12–13), Socha was one of the panelists for "Writing for MAA Periodicals," organized by Lowell Beinecke (editor of *College Mathematics Journal*) and Ivars Peterson (MAA Director of Publications for Journals and Communications). At the panel, Socha explained the ten-year process that led to the writing of her award-winning article in the *American Mathematical Monthly*. Also on the panel were Andrew Simoson, another double prize winner: the Chauvenet Prize in 2007 and a Pólya Award this year (see page 12). Filling out the panel were Dan Velleman (editor of the *American Mathematical Monthly*), Michael Henle (editor-elect of *College Mathematics Journal*), Steve Abbott (co-editor-elect of *Math Horizons*) and Fernando Gouvêa (editor of *MAA FOCUS*).

MAA Secretary Martha Siegel is a familiar presence in our pages, notably for her reports on MAA business (watch for one next month covering the Board of Governors and Business Meetings at MathFest). The big news, however, is that Siegel's term will end in January 2010, and the search for a new Secretary is on. One of the most important officers of the Association, the Secretary has many roles (see page 30 for the details) in the governance of the MAA, making this a significant transition.

As more and more students and younger mathematicians attend meetings, one sees more and more children as well. Maila Brucal, a graduate student at the University of Kansas, caught the attention of the MAA FOCUS photographer because of her cute daughter.

Traditionally, the final event in every MathFest is the Silver and Gold Banquet, in honor of long-term members of the MAA but open to all members of MAA. (In fact, Frank Morgan tends to come every year with his posse of undergraduates.) Silver and Gold is the only dinner at which members receive a party favor; this year, it was a blue (MAA blue, they say) plastic box with candy inside. The event began with MC Richard Askey calling on all of those present who had been members of MAA for 25 years or more to stand. Special pins were given to members in their 25th year (Edward Keppelman, Carolyn Mahoney, and Therese Shelton) and to members completing 50 years (Roland Di Franco, John Kenelly, Sylvester Reese, and George Rosenstein). Paul Sally gave the talk, showing how mathematical questions can be traced from "roots to research," generating interesting questions along the way.

2008 Award Winners for

Northern California, Nevada, Hawaii

John B.Thoo
Yuba College

Southern California-Nevada

Bruce Yoshiwara
Los Angeles Pierce College

Intermountain

Michael Dorff
Brigham Young University

North Central

Jason Douma
University of Sioux Falls

Rocky Mountain

Steven Janke
Colorado College

Southwestern

David Pengelley
New Mexico State University

Iowa

Lynn Olson
Wartburg College

Indiana

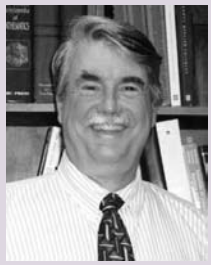
Ken Luther
Valparaiso University

Texas

Dawn Slavens
Midwestern State University

Distinguished Teaching

Northeastern



Dave Carhart
Bentley College

Allegheny Mountain

Antonella Cupillari
Penn State Eric

Seaway

Laura J. Person
State University of
New York at Potsdam

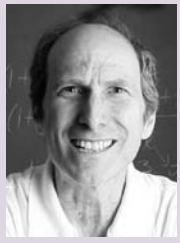
Metro New York

David Seppala-Holtzman
St. Joseph's College

EPADEL

Robert Boyer
Drexel University

New Jersey



Bruce Bukiet
New Jersey Institute
of Technology

Ohio

Judy Holdener
Kenyon College

MD-DC-VA

Bruce Torrance
Randolph-Macon College

Kentucky

Pat Costello
Eastern Kentucky University

Missouri

Shing So
University of
Central Missouri

Southeastern

Ronald J. Gould
Emory University

Louisiana-Mississippi

Galen E. Turner III
Louisiana Tech

Oklahoma-Arkansas

Danny Arrigo
University of Central
Arkansas

Florida

Marilyn Repsher
Jacksonville University

National Mathematics Advisory Panel Releases its Final Report

The final report of the National Mathematics Advisory Panel was made available on March 13, 2008. In April 2006, President Bush had created the panel and charged it to consider how to make sure that young Americans receive the kind of mathematics education that would "help ensure our nation's future competitiveness and economic viability." The panel was asked to provide recommendations on how to improve the teaching and learning of mathematics. They were to base these on "the best use of scientifically based research." The report and ancillary materials can be found at http://www.ed.gov/about/bdscomm/list/mathpanel/index.html. A list of panel members can also be found online.

As usually happens when it comes to discussions on mathematics education, the report has been received with intense interest, agreement, disagreement, and discussion. In the article that follows, Anthony Ralston gives his take.

A Nation Still at Risk

By Anthony Ralston

In *A Nation at Risk*, published 25 years ago, a committee of eminent Americans reported on the then well-recognized deficiencies in American school education. The report was well-received and, seemingly, quite influential. But a quarter of a century after it was published, few would claim that school education in the US has not declined still further from its state in 1983.

The *Final Report of the National Mathematics Advisory Panel* (NMAP) comes at a time when there is general agreement that mathematics education in American schools is in a parlous state. There is, however, no general agreement among the major players — mathematics educators and mathematicians — on what needs to be done. Indeed, the Math Wars that have rumbled on for some years now still involve often bitter disagreements between those I have called (in a previous article in *MAA FOCUS*) traditional math warriors (TMWs) and reform math warriors (RMWs).

It is, therefore, at first glance remarkable that the NMAP report was agreed unanimously by a committee of 19. But whereas the NMAP included among its members some heavyweight TMWs, it included no significant RMWs.

Since the committee also included a number of people not on the extremes of the Math Wars, who were able to provide leavening in the Final Report, that report is relatively restrained but still enunciates pretty clearly the TMW position. An example: The Report refers favorably to a Fordham Foundation report on state mathematical standards; but the committee that produced this report was stacked with TMWs and the six state standards that received highest grades in the Fordham Foundation report all reflect a TMW perspective. Of course, if there had been any prominent RMWs on the NMAP, there would have been no possibility of a unanimous report.

Because of the need for compromise, much of the report is unexceptionable, even bland. But there are several aspects of the Report that are neither bland nor unexceptionable. I will focus upon some of these in the remainder of this review.

Research

The NMAP "reviewed more than 16,000 studies and related documents. Yet only a small percentage of available research met the [Panel's] standards of evidence and could support conclusions." (page 82) And this was because, to meet the Panel's criteria, a study needed to be based on "methodogically rigorous scientific research" that incorporates "randomized controlled designs (i.e., designs where students, classrooms or schools are randomly assigned to conditions and studied under carefully controlled circumstances) or methodogically rigorous quasi-experimental designs." (page xxvi)

But math education (or any branch of education) is not a science and, therefore, to apply scientific standards to education research or to research in any social science is to assure that almost all research will fail to meet your criteria. There are just too many variables, most of them uncontrollable, to enable definitive results to be attained. The best research in education, as in all social sciences, has an experimental design that, at best, minimizes the effects of uncontrolled variables. The results may be insightful but there are never proofs of any hypothesis; indeed, there are no proofs in education. Yes, much research in education is of poor quality but this is not because it is not "scientific" enough.

A particularly noteworthy example of the Panel's standard for including particular pieces of research in its study occurs in the section of the report on Technology and the Applications of Technology: Calculators and Computer-Based Instruction. Here there were only "11 studies that met the Panel's rigorous criteria" and only one of these was "less than 20 years old" and that one related to secondary school. (page 50) Amazing! When it comes to a question so central in recent controversies as the use of calculators in elementary school math education, there apparently has not been a single publication in the past two decades worthy of attention by the NMAP.

Finally, I note that the Panel usefully calls for more research in many areas of math education. This is certainly needed. But it should be noted that, if this research is to meet the NMAP's standards, it will be decades — at least! — before such research is available. Can we wait?

The Standard Algorithms

The Final Report emphasizes that the standard algorithms of pencil-and-paper arithmetic should continue to dominate mathematics instruction in elementary school. Indeed, the back-to-basics approach suffuses the entire Final Report. And this would be fine so long as you don't — as the Final Report does — try to give the impression that there is no opposing point of view. The review of the literature does mention other points of view but not in an evaluative sense. (Full disclosure: I reviewed two of the preliminary papers for the report of the Task Group on Instructional Practices.)

One example — Long Division — will suffice to make my point here. It is OK to believe that the standard algorithm for long division should still be taught. But it is not OK not to mention the variety of papers that take the opposite point of view. It was suggested as far back as 1983 by a committee as eminent as the NMAP "that it is not profitable for [British] pupils to spend time practising the traditional method of setting out long division on paper, but that they should normally use a calculator." In the ensuing quarter century this perspective has been supported by many mathematicians and mathematics educators although it is a long, long way from being generally accepted due, at least, to the strenuous efforts of TRWs. But the merit of doing away with the traditional long division algorithm in schools is not my point; rather it is that not even to mention the opposing perspective in the Final Report or in its accompanying documents is intellectually dishonest.

An important question is whether mental arithmetic should be emphasized in school mathematics much more than it is now. If it were to be, this would imply some diminution of the standard emphasis on pencil-and-paper arithmetic. But such diminution is anathema to TMWs who, as noted above, successfully avoided any suggestion in the Final Report that anything other than the standard pencil-and-paper algorithms should be taught in elementary school mathematics. By not even mentioning mental arithmetic, you obviate the need to discuss whether increased emphasis on mental arithmetic might suggest some modification of the emphasis on the standard algorithms.

Teachers

Perhaps the most serious problem in American school mathematics education is the decline in quality of the cadre of elementary and secondary school math teachers. At no place does the Report discuss this crucial question. Too controversial, perhaps. In *A Nation at Risk* it was noted that "too many teachers are drawn from the bottom quarter of graduating high school and college students." I suspect that this problem has only gotten worse in the past quarter century.

The mathophobia of many current elementary school teachers is well-known. At the secondary level, the burgeoning opportunities in business and industry for those who are mathematically talented persuades only a very few such to embark on a teaching career.

A ten-page section in the Final Report is devoted to Teachers and Teacher Education but its recommendations are rather bland. Considerable attention is paid to "salary schemes." But pay is far from the only thing that makes it difficult to recruit and, even more, to retain good mathematics teachers. Deteriorating working conditions in American schools and a continuing lack of prestige given to teaching as a profession are important problems that are not mentioned in the Report.

There is an important section on Elementary Mathematics Specialist Teachers. My own belief is that such specialist teachers in elementary schools offer the best, perhaps the only route to getting effective mathematics teachers into all elementary school classrooms. But the lack of urgency in the Panel's recommendation that "research be conducted on the use of full-time mathematics teachers in elementary school" would, even if implemented, assure that any widespread use of such teachers is years, if not decades away.

The Math Wars

Since the publication of the Final Report in March, various members of the NMAP have expressed the hope that the Final Report would signal an end to the Math Wars. That is not going to happen, of course. The Math Wars will rumble on until, I believe, a new generation of mathematicians weaned on computer technology holds the major posts in American mathematics. Only then, using the terminology of Thomas Kuhn, will there be a paradigm shift from traditional elementary school mathematics to one in which technology plays a full role at all levels of instruction.

The NMAP Final Report is then largely bland and unexceptionable but, where it is not, it is seriously biased toward the viewpoint of TMWs. It also displays no sense of urgency about the serious problems of American school mathematics education. It will likely have little or no impact on the future of American school mathematics education.

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It's Easy to Get Interested in Number Theory
An Interview With Karl Rubin

By Ivars Peterson

Educated at Princeton and Harvard, Professor Karl Rubin held a number of positions before becoming the Thorp Professor of Mathematics at the University of California, Irvine. Stops at Ohio State, Columbia, and Stanford led Rubin to Irvine, where his main research focus is on number theory and elliptic curves. A former Putnam and Sloan Fellow, Rubin's accomplishments also include the AMS Cole Prize in Number Theory, a Guggenheim Fellowship, and the NSF Presidential Young Investigator Award. The author of nearly 60 published papers, Rubin delivered an MAA Distinguished Lecture in May.

Ivars Peterson: Did you become interested in mathematics at a young age? What attracted you to mathematics?

Karl Rubin: I grew up in a scientific family. My mother and sister are astronomers, and both of my brothers are geologists. My father was trained in chemistry and physics but was essentially an applied mathematician, and he especially encouraged me in mathematics.

Beginning when I was in junior high school my father would bring home mathematics books from the library for me. For a long time I just ignored them, but eventually I started reading them. *What is Mathematics*, by Courant and Robbins is one that I remember. Hardy and Wright's *The Theory of Numbers* is another. By the time I finished high school I was pretty sure I wanted to be a mathematician.

I always enjoyed puzzles, and my enjoyment of mathematics was a natural outgrowth of that.

IP: What people or experiences most influenced the direction of your studies? Your subsequent career?

KR: In addition to my parents, the Arnold Ross summer program at Ohio State had a big influence on me. In the 1970s the National Science Foundation was supporting a lot of summer programs for high school students. I think the Ross program was unique in the way it went very deeply into one subject, which happened to be number theory. For the eight weeks of the program, the daily routine Monday through Friday was a one-hour lecture at 9 a.m., followed by a problem set that took most of the next 23 hours to complete. The problem sets would lead the students from numerical discoveries to conjectures to proofs.

I spent two summers in the Ross program as a student while in high school, two more as a counselor while in college, and I have continued to be involved with the program off and on up to the present. In addition to receiving an introduction to real mathematics, and a great example of how to teach mathematics, it was very valuable to meet a group of like-minded students.

I was also fortunate to have a number of good mathematics teachers in the Washington, D.C., public schools. I had many good teachers later as well, but I was pretty well set on my path by then.

When I was an undergraduate at Princeton, the professor who had the greatest influence on me was Kenkichi Iwasawa. But it wasn't until I got to graduate school at Harvard that I learned that there was something called Iwasawa theory, which has been central in a lot of my work. The direction of my research in graduate school and thereafter is due mostly to my advisor, Andrew Wiles, and to John Coates. More recently my work has been influenced by two of my coauthors, Alice Silverberg (who introduced me to cryptography) and Barry Mazur.

IP: How would you describe your main research areas? Why are these areas particularly exciting to you?

KR: I work in algebraic number theory and arithmetic algebraic geometry. A major focus of number theory is solving polynomial equations in integers or rational numbers, and algebraic geometry is a natural tool for approaching such problems. I am especially interested in elliptic curves. Elliptic curves have genus one, and are defined by cubic polynomials. They fall in between curves of genus zero (conic sections, defined by quadratic polynomials), where we know almost everything we want, and curves of genus two or more (defined by higher-degree polynomials), which are more complicated. Elliptic curves have a very rich structure, so progress is possible, but there are still many unanswered questions about them.

In recent years I have also been working on applications of number theory and algebraic geometry to cryptography.

One attractive thing about number theory is that there are many questions that are easy to state, but with solutions that are very deep. Fermat's Last Theorem is a good example. The fact that modern, highly abstract mathematics can be used to solve such an old problem indicates to me that mathematics is moving in the right direction. It's easy to get interested in number theory at a young age, because the questions are relatively accessible. In my case, I never moved away.

IP: Are applications, in cryptography, for example, now an important force in driving number theory research?

KR: Applications are one important force, but certainly not the only one. About twenty years ago people discovered that elliptic curves have applications to cryptography. I have done some work on problems inspired by cryptography, with applications to cryptography. I find it great fun when the things I'm interested in turn out to have useful and surprising applications. I suspect many other "pure mathematicians" feel the same way. But I still spend most of my time on problems with no currently known applications.

IP: What role, if any, can (computational) experiments play in number theory?

KR: Experiments are often very important, and they play some part in most of my work. One important role is as an indication of what to expect, what to try to prove. For example, in the 1950s, Birch and Swinnerton-Dyer carried out some numerical experiments with elliptic curves, which led to what is now the Birch and Swinnerton-Dyer conjecture. This conjecture is one of the Clay Mathematics Institute one million dollar Millennium problems, and has been a driving force behind a lot of modern number theory and arithmetic algebraic geometry.

Computations can also play a role after a theorem has been proved. To me, an abstract result becomes much more exciting if one can use it to produce interesting concrete examples. Examples can give a better understanding of a theorem, and can lead to a better or more useful result.

Personally, I enjoy such calculations. I'm grateful that algorithmic number theorists, clever programmers, and modern computers have given all of us the opportunity to perform computations that would have been unimaginable when I was a student.

IP: What do you see as key questions worthy of future mathematical exploration in number theory?

KR: There are lots of them. The most famous are two of the Clay Millennium problems, the Riemann Hypothesis and the Birch and Swinnerton-Dyer conjecture. Other questions that are particularly interesting to me include questions about rational points on curves.

For example, we still don't know in general how to decide whether a curve of genus one has a rational point. There are also many interesting questions about ranks of elliptic curves that we have no idea how to answer.

In another direction, there are interesting computational questions where progress would have immediate real-world impact. How hard is it to factor large integers? What is the fastest way to solve the discrete logarithm problem in a finite field, or on an elliptic curve over a finite field?

Classroom Capsules Online

The committee working to get more articles in the Classroom Capsules data bank met in the Carriage House at the MAA Headquarters June 2 – 4, 2008. The intention mirrors that of the long running section in the *College Mathematics Journal*: to offer ideas that can be used in the teaching of mainline undergraduate mathematics courses. These include new proofs, new connections to applications or other areas of mathematics, examples, historic tidbits, and more, all kept short and presented in a form ready to use.

Those working on the project, shown from left to right in the picture are Danrun Huang, Paul Zorn, Byungchul Cha, Lang Moore (Executive Editor of MathDL), Olaf Stackelberg, Sue Doree, and Wayne Roberts (Editor of Classroom Capsules).

To visit the Classroom Capsules site, go to http://www.maa.org and scroll down until you see the MAA Resources box.

Archives of American Mathematics Spotlight: The Jeanne Agnew Papers

By Michelle Bogart and Carol Mead

The Archives of American Mathematics is pleased to announce that the Jeanne Agnew Papers are now available to researchers. The finding aid for the papers is accessible at http://www.lib.utexas.edu/taro/utcah/00894/cah-00894.html.

Jeanne LeCaine Agnew was born in Ontario, Canada, in 1917. After earning her Bachelor of Arts in 1937 and Master of Arts in mathematics degree in 1938 at Queen's University in Canada, she attended Radcliffe College in Boston, where she received her PhD in 1941. G. D. Birkhoff advised Agnew's dissertation, entitled *On the Generalized Fmma Function and its Analogue for q-Difference Equations,* and acted as a mentor to her.

Jeanne LeCaine's graduation photograph, Queen's University, 1937.

This last accomplishment was a rare privilege. It is worth noting that of Birkhoff's 46 PhD students, Agnew was one of only four women. In a letter Agnew wrote to Birkhoff's son, Garrett Birkhoff, about studying with his father, she notes he was reluctant to direct her thesis: "His previous female student," she writes, "had married and had five children, and he felt that in working with her he had neglected someone who might have been more dedicated to mathematics." However, Birkoff did accept her and she completed her thesis under him. The experience had lasting effects. In the same letter, she notes that numerous former students had told her that she made them " 'work very hard, but we learned more from you than we did from any other teacher.' Perhaps this indicates one of the ways my years at Harvard prepared me for my later years."

After graduating from Radcliffe, Birkhoff helped Agnew get a position at Smith College. Although she was happy at Smith, Agnew felt compelled to help in the war effort and left the College for Ottawa (against the advice of Birkhoff), where she worked as a mathematical physicist with the Canadian Atomic Research group.

In 1942, she married an American, Theodore Agnew, who was a history graduate student at Harvard (and who studied under noted historian, Arthur Schlesinger Sr.). Her husband had enlisted in the Navy and was sent to the Pacific; during this period, Agnew found it difficult to find work in her field because "it was not easy for a female to get a really good job." Eventually, she obtained a position at Cambridge Junior College, where she stayed until 1947, when she and her husband moved to Oklahoma. In 1953, Agnew started teaching in the Oklahoma State University mathematics department, where she taught undergraduate and advanced courses until she retired.

Many of Jeanne's former students became faculty members at regional colleges and universities, and one of her students, William Pogue, went on to be a pilot in NASA's Skylab program. Correspondence from Pogue and newspaper clippings related to the Skylab program are included in the papers.

The highlight of the Agnew papers is the material related to the many National Science Foundation (NSF) grants in which she participated. She received numerous grants to gather industry-related mathematics problems for use in the classroom, both at the undergraduate level and at the high school level. For example, in the mid-1970s, Agnew and the OSU mathematics department sent a newsletter and questionnaires to the graduates of the program in the hopes of raising scholarship money. One of the questions asked, "Were you prepared for your present occupation?" The students engaged in teaching answered a resounding yes, while those who had jobs in industry had a different response: one female student responded that she wished that, while in school, she had seen mathematics put to work in real-world situations.

Jeanne Agnew in the classroom, 1972.

These responses, along with Agnew's desire to provide her students with tools to integrate the topics taught in the classroom, motivated Agnew to find industries willing to help her design a new way of teaching mathematics.

Agnew co-authored several textbooks, including *Linear Algebra with Applications*, which was one of the first linear algebra textbooks to include the use of the computer. She was also honored with several awards, including numerous Outstanding Teacher awards, the Outstanding Woman award in 1971, and an honorary doctorate from Lakehead University in 1990. Queen's University also awarded her an honorary doctorate in 1988 in recognition of her contributions to education. She was posthumously inducted into the OSU School of Education Hall of Fame in 2005.

The Archives of American Mathematics is located at the Research and Collections division of the Center for American History on the University of Texas at Austin campus. Persons interested in conducting research or donating materials or who have general questions about the Archives of American Mathematics should contact Carol Mead, Archivist: carolmead@mail.utexas.edu, (512) 495-4539. The Archives web page can be found at http://www.cah.utexas.edu/collections/math.php.

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Imagine Math Day: Encouraging Secondary School Students and Teachers to Engage in Authentic Mathematical Discovery

By Darryl Yong and Michael Orrison

> If we wish to talk about mathematics in a way that includes acts of creativity and understanding, then we must be prepared to adopt a different point of view from the one in most books about mathematics and science. When mathematics is viewed as content, it is lifeless and static...
>
> William Byers, in
> *How Mathematicians Think*

Research mathematicians and school children experience mathematics in profoundly different ways. Ask a group of mathematicians what it means to "do mathematics" and you are likely to get a myriad of responses: mathematics involves analyzing and organizing patterns and relationships, reasoning and drawing conclusions about the world, or creating languages and tools to describe and solve important problems. Students of mathematics often report "doing mathematics" as performing calculations or following rules. It's natural that they see mathematics as monolithic rather than an evolving, growing, socially constructed body of knowledge, because most mathematical training in primary and secondary schools consists of learning how to use pre-existing mathematical tools. They rarely get to see the process by which those tools came about, let alone authentically participate in the construction of those tools.

Of course, this difference in perspectives between research mathematicians and students will always exist, but there are numerous reasons why we should try to bridge the divide. In [2], Cuoco, Goldenberg and Mark argue that the goal of mathematics training should be to help students learn how to think about problems the way mathematicians do. To be able to develop these mathematical "habits of mind," students must be presented with experiences that make it possible for them to authentically create mathematics for themselves.

The need to give children rich and authentic mathematical experiences is also heightened by our current climate of high stakes testing, accountability and standardization. The questions that frequently appear on easily-gradable tests give students a false impression of the kinds of mathematical thinking and skills that are important. Overly prescriptive math curricula limit the opportunities for teachers to engage students in deep mathematical investigations and to convey beautiful but "non-essential" mathematical topics.

Mathematics teachers also need mathematical stimulation, opportunities to remind themselves why teaching, learning, and creating mathematics can be useful, rewarding and fulfilling. They need to be aware of the powerful role that mathematics can play in the lives of their students, not simply because of the mathematical content their students will be asked to master, but also because of the ability of mathematics to be an effective vehicle for teaching students valuable "habits of mind."

Imagine Math Day (IMD) is an outreach activity designed to engage secondary school students and their teachers in authentic mathematical discovery. The Harvey Mudd College (HMC) Professional Development and Outreach Group has designed and carried out this program annually at HMC since 2006.

William Byers has written eloquently in [1] about how ambiguity catalyzes mathematical innovation. In that spirit, the mathematical investigations in each IMD have many valid interpretations and possible "correct" answers. In fact, many of the discussion questions are intentionally designed to increase the likelihood that participants will bring differing, even contradictory, ideas to the conversation; many of the activities and questions lead participants to confusing or surprising "conclusions."

Of course, for this rich and lively mathematical discourse to take place, IMD participants must collaborate with each

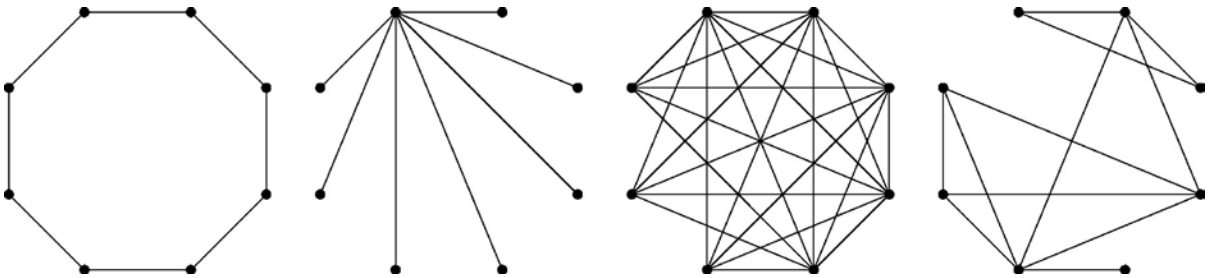

Figure 1: Which of the four graphs above would you say are complex? Can you articulate why one graph is more complex than another? Can you rank these graphs from most complex to least complex?" These intentionally vague questions formed the heart of the 2006 Imagine Math Day activity on graph complexity. There is no "right answer" to these questions, and they led students to create their own notion of the complexity of a graph.

other instead of passively receiving knowledge from others. Each IMD is organized so that no one lectures to the participants. Instead, participants are given a series of discussion questions that lead them deeper and deeper into the mathematical topic for the day.

Another distinctive feature of IMD is that no prizes or awards are given. Even though some of our participants have commented that we should give awards, we felt strongly that because the goal of this activity is to increase interest in and appreciation for mathematics, we wanted to allow *all* participants to feel successful. The atmosphere at IMD is one of sharing and debating ideas, rather than competing to see who can get the answers first.

The spirit of IMD is similar to that of math circles that can be found throughout the world, which also encourage participants to appreciate the beauty of mathematics [8]. Many math circles are also designed to cultivate mathematical talent and some include preparation for mathematical competitions among their activities. In that respect, IMD is different because it is meant to reach students of all dispositions towards mathematics. IMD activities are designed to be unfamiliar to most participants and yet have a very low learning curve so that students who don't identify themselves as "math whizzes" can still participate successfully. Another difference is that while the conversations and ideas that are sparked at IMD may last a long time, the activity itself only lasts one day. We want IMD to have a high impact on participants and to be easily replicable, but we are realistic about the activity's impact on departmental resources and personnel, especially the organizers.

The Logistics of Imagine Math Day

IMD takes place on a Saturday from about 9:30 a.m. to 3:00 p.m. All participants are served breakfast and lunch. There is no cost to participate, but participants are asked to arrange their own transportation to HMC. We send invitations to mathematics teachers and department chairs at public and private high schools around the greater Los Angeles area, and ask teachers to select up to four students to bring with them to the event.

Each of the IMDs so far has been attended by about 80 high school students (grades 9 through 12) and 20 teachers from the greater Los Angeles area. The size limit is an artificial one, imposed by the room at HMC that we use for the activity, but we suspect that any more than this number of participants would make the activity feel less intimate and too formal.

As mentioned earlier, one key to the success of Imagine Math Day has been to foster rich mathematical inquiry and dialog between students and teachers. We choose topics that are likely to be unfamiliar to both students and teachers, so that all of the participants engage in authentic mathematical discovery at the same time. Participants sit at tables of ten: on average, eight students and two teachers. We have found that this number allows for students to pick up on teachers' enthusiasm, more articulate mathematical thinking, and problem solving skills. More importantly, students see themselves as working with their teachers rather than for their teachers.

The only time one person speaks to the entire group is during the brief welcome at the beginning of the day. We encourage participants to conjecture, explore, and hypothesize with those around them while being respectful of others' ideas; we make it very clear that IMD is not a competition and that everyone is encouraged to participate. For the rest of the morning, all of the participants work through a series of carefully planned questions and discussion prompts.

During lunch, HMC math majors and faculty eat and mingle with the participants and ask them about their experiences during the morning and also talk to them about studying mathematics in college. The student participants are then organized into small groups and charged with further exploring something related to the day's activities and creating a poster summarizing their findings. During this time, the teachers are invited to talk with each other and hear more about the mathematical background on the topic for the day. At the end of the day, students put up their posters, creating a gallery of different mathematical ideas.

Figure 2: A group of pre-service teachers grapples with how to measure angles on a realization of the hyperbolic plane.

The Mathematics Behind Imagine Math Day

The main key to the success of Imagine Math Day has been the choice of highly accessible, stimulating, and engaging topics. These topics are introduced through a series of worksheets that give participants just enough

information to spark their interest and allow them to carry on conversations at their tables without limiting their creativity.

In 2006, the topic was graph complexity. After a brief introduction to graph theory, students and teachers engaged in one question — what makes a graph more complex than another? In 2007, the topic was non-Euclidean geometries. Participants explored how familiar ideas from Euclidean geometry become unfamiliar, vague, and thought-provoking when we try to conceive them on spheres, footballs, or other surfaces.

This year, the topic was the mathematics of voting, an especially appropriate topic since it is an election year. After exploring how the choice of different voting procedures can have a dramatic impact on the outcome of an election, participants were given the task of creating their own voting paradoxes. During the afternoon, they were then given the open-ended task of

Figure 3: Participants of the 2008 IMD think about alternative systems for presidential elections.

investigating a voting scheme or paradox. For example, one of the possible activities was to design "the next popular reality TV show with an interesting voting system."

Evaluating the Success of IMD from Participant Responses

At the end of each IMD, all participants (students and teachers) are asked to anonymously submit written comments about their experiences. Student comments often suggest that their view of mathematics has grown. "Math is usually considered something with one right answer," said one student, "but [I see now that] there is room for interpretation sometimes." Another commented that "The activity showed me I could have fun while doing mathematical problems."

Teachers also responded positively. One said that the activity "reminded me how enjoyable math can be for students," and pointed out how easy it is to not take the time to let students

Figure 4: A student discusses the ideas behind her group's alternative voting system to her teacher.

"live the math." Another told us that two of the students who had been to Imagine Math Day the previous year "begged to go again" despite the fact that they were not taking a mathematics course.

Some comments reflected students' fairly narrow view of mathematics. One student said that the activity on graph complexity did not change his view of mathematics "because it technically is not related to math." Another asked us to lecture more, and one commented that the activity on voting "really had no mathematics" in it.

Though these comments sound negative, they hint at IMD's success in challenging students' conceptions about doing and learning mathematics. A mathematical problem is fruitful when it leads to more questions than answers and in the same way, we think that IMD has been successful when it raises questions for participants rather than gives them the correct answers. Our hope is that participation in IMD will lead to seeds that might bloom into conversations between students and teachers about mathematical ideas and what it means to do mathematics. Through conversations like these, the gap between research mathematicians and students of mathematics might be narrowed.

Imagining IMD on Your Campus

We are confident that IMD can be easily replicated (and modified if necessary) in a variety of settings, and we are eager to share our insights and experiences with others. To that end, all of the materials created for previous IMDs are available at http://www.math.hmc.edu/pdo/imd/.

We would also enjoy learning from the experiences of others who are interested in similar outreach activities. In particular, we are always on the lookout for mathematical topics that are

accessible and inviting to secondary mathematics students, yet rich enough to encourage genuine exploration, thought, and even wonder. By meeting mathematics at its broadest, more students may recognize their aptitude for it. By working together, we can make access to high quality mathematical experiences available to all students.

Acknowledgements: The authors would like to thank Peg Cagle, Pam Mason and Rachel Levy for their helpful comments on this paper. The HMC Professional Development and Outreach Group has been supported through generous funding from the Mellon Foundation, the Park City Mathematics Institute/Institute for Advanced Study and the HMC Department of Mathematics.

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Darryl Yong and Michael Orrison teach at Harvey Mudd College in Claremont, CA.

PREP Workshop Report

By Darren Glass

A significant part of the job of a mathematician involves writing – between research papers, expository writing, grant applications, letters of recommendation, and materials for our teaching, I know that I spend much of my days writing something or other. Yet most of us are never really trained to write mathematics, and even in our jobs we rarely find time to talk about the actual writing of the mathematics which has taken place. With this in mind, I chose to attend a PREP workshop held by the Mathematical Association of America at their headquarters in Washington, DC dedicated to the art of mathematical exposition

Twenty-three participants chose to spend three and a half days at the MAA's Carriage House conference center just a couple of blocks from Dupont Circle, and I think we would all say that we learned quite a bit while having a good time. About half of the workshop was dedicated to guest speakers who came in to talk about the process of writing. The names of these speakers will be familiar to many MAA members: Keith Devlin, Underwood Dudley, Dan Kalman, Ivars Peterson, Eve Torrence, and Paul Zorn as they are all quite well-known as journal editors, journalists, and mathematicians. Their presentations gave advice on a variety of topics, ranging from their pet peeve grammatical errors to how to choose a story that will appeal to a wide audience. They also discussed issues about how to pitch stories to the media, resources that are available on the web, and how to break into textbook writing.

The other half of the workshop was spent in small groups critiquing manuscripts. Each group had a leader and six participants who brought in a piece of writing which we would discuss and critique. In our group, there was a wide diversity in these writings, in terms of their content, their target audience, and their stage in the writing process: some people had nearly completed papers that they essentially wanted proofread while other people had barely formed outlines. For each of these papers, the group's goal was to help people flesh out the details or figure out what types of publications they would fit well in.

I know writing groups are common for writers of fiction or poetry, but I had never heard of such a thing for mathematical writing. I found it enormously helpful to hear feedback about the piece I presented to the group, on issues both small, such as punctuation, and large, such as the structure of the article. Our small groups will continue to 'meet' virtually over the next year or so using email and a wiki that was set up for the workshop, as we all refine our manuscripts and see them through the publication process.

Even as I write these sentences, I think that my writing has improved due to the many tips that I picked up during the PREP workshop, and I highly recommend the experience to anyone who has an interest in writing mathematics that people actually want to read.

The top three tips that I learned from the workshop:

1. Editors are good people.
2. Know the audience you are writing for.
3. Keep straight when to use 'that' and when to use 'which.'

Personal Recollections of the PREP Workshop on Expository Writing

By Charles Coppin

My PREP experience was outstanding. Imagine what it would be like to attend a basketball camp, only to find that Michael Jordan was your teacher. Our workshop was similarly blessed and quadruply so. Our teachers were Keith Devlin, Ivars Peterson, Paul Zorn, and Underwood Dudley, all great presenters and great teachers. Each offered a different but valuable perspective. The plenary presentations, aptly led by Ivars Peterson, covered every imaginable area of mathematical communication such as grammar, presentations, internet resources, and the ins-and-outs of publishing books and papers. Each presenter led groups of about six participants. Our group, led by Paul Zorn, worked very well together but I expect all groups worked well.

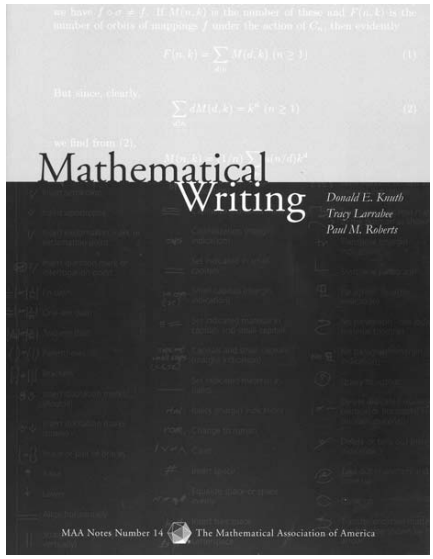
I enjoy writing; however, throughout my career as chair, teacher and researcher, my writing consisted only of reports, class notes, letters, memos and research papers. I am a teacher by nature; appropriately, at this point, in my career, I see expository writing as an extension

of teaching. In fact, as we were reminded many times, good writing should find its way into all our writing. As a result, my research papers will improve and, on reflection, my teaching should improve as well as all my communications.

The experience was intensive. My attention span can be very short; I bore easily, especially with daily sessions covering seven hours. I was not bored at all! Ivars Peterson's presentations were focused and pertinent. I had written a rough draft of a paper to bring to the PREP workshop for criticism. I knew my paper had problems; however, my group gave me excellent input, most of which I have incorporated into my revised paper. I believe each of us worked hard to give good input into each other's writing. Amazingly, I seem to remember much of what we were taught. Application is another matter! I know I won't become a great expositor overnight, but I do believe that with hard work, much practice, and input from colleagues, I will improve greatly.

Our group, led by Paul Zorn, will communicate by a Wiki created by the PREP workshop. We will exchange papers and supply edits. This is a yearlong exercise, which I personally appreciate. The follow up will be critical to our success. I really appreciate Paul's laid back attitude; his leadership led to vigorous and useful edits.

I highly recommend this PREP workshop to all who want to learn how to communicate their mathematics to colleagues and the general public. It should be a required experience for all graduate students in mathematics.



Secretary of the Mathematical Association of America: Nominations Sought

After twelve years of distinguished service, Martha Siegel will be leaving the position of Secretary of the Association in Janaury 2010. The Search Committee for MAA Secretary, chaired by former President and Secretary, Gerald L. Alexanderson, seeks suggestions and nominations of candidates for this office. The many critical roles that the Secretary fills require that candidates have previous experience in MAA governance, projects, and/or programs. The position will begin as Secretary-elect in Fall 2009 after election by the Board of Governors.

The Secretary of the MAA is responsible for all official correspondence, keeps the seal of the Association, assists the President in matters of governance and in the operation of all business meetings of the MAA, meetings of the Board of Governors, and meetings of the Executive Committee. The Secretary is one of the five Officers of the MAA and is a member of the Board of Governors and the Executive Committee.

In particular, responsibilities and duties include, but are not restricted to, the following actions:

• Prepare the agenda for two meetings per year of the Board of Governors and four meetings per year of the Executive Committee; the Secretary requests and assembles all reports and other documents to be presented at the meetings. At the meetings, the Secretary assists the President in presenting agenda items.

• Keep the minutes of all meetings of the Executive Committee, the Board of Governors, and Business Meetings of the Association. These minutes become the official record of the governance of the organization and have legal significance. Report on these meetings in MAA FOCUS and/or electronically.

• Oversee elections and votes by the general membership and by the Board of Governors and the Executive Committee.

• Oversee governance by organizing the meetings and business of the Committee on Committees and appointments to councils, committees, editorial boards, and other assignments.

• Manage all matters relating to MAA prizes and awards.

• Monitor policies and practices of the Association, including relationships with other organizations. The Secretary is responsible for fulfilling requirements of incorporation of the Association in the State of Illinois. Monitor the bylaws of the Association and suggest revisions as needed.

• Answer historical questions and provide information on precedents and policies since the Secretary maintains all minutes dating back to the founding of the organization.

• Serve ex officio on some MAA committees and some joint committees with other organizations.

• Represent the MAA as needed at meetings, events, and to other organizations.

• Keep a MAA office and supervise a part-time assistant.

• Compensation for release time, summer support, and other technical support are negotiable.

Send a letter of interest in the position addressing specific qualifications for the position and a resume to: Secretary Search Committee, c/o Calluna Euving, Mathematical Association of America, 1529 18th Street N.W., Washington, DC 20036 or email ceuving@maa.org. Nominations should be sent directly to Professor Gerald L. Alexanderson [galexand@math.scu.edu]. To guarantee consideration applications should be received no later than January 15, 2009.

Applications from individuals from underrepresented groups are encouraged. Additional information about the MAA may be found on MAA's web site: www.maa.org. AA/EOE.

Found Math

The eel came out to see, and remained out, turning, turning in his infinite Möbius eight, showing his teeth as he breathed.

Thomas Harris, Hannibal, Chapter 76, p. 442.
(Thanks to Charles Kerpelman)

Employment Opportunities

MASSACHUSETTS

Williams College
The Williams College Department of Mathematics and Statistics invites applications for one tenure track position in mathematics, beginning fall 2009, at the rank of assistant professor (in an exceptional case, a more advanced appointment may be considered). We are seeking a highly qualified candidate who has demonstrated excellence in teaching and research, and who will have a Ph.D. by the time of appointment.

Williams College is a private, coeducational, residential, highly selective liberal arts college with an undergraduate enrollment of approximately 2,000 students. The teaching load is two courses per 12-week semester and a winter term course every other January. In addition to excellence in teaching, an active and successful research program is expected.

Applicants are asked to supply a vita and have three letters of recommendation on teaching and research sent. Teaching and research statements are also welcome. Applications may be made on-line (http://www.mathjobs.org/jobs). Alternately, application materials and letters of recommendations may be sent to Olga R. Beaver, Chair of the Hiring Committee, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. Evaluation of applications will begin on or after November 15 and will continue until the position is filled. For more information on the Department of Mathematics and Statistics, please visit http://www.williams.edu/Mathematics.

Williams College is committed to building and supporting a diverse population of faculty, staff and students, to fostering a varied and inclusive curriculum, and to providing a welcoming intellectual environment for all. As an EEO/AA employer, Williams encourages applications from all backgrounds. To learn more about Williams College, please visit http://www.williams.edu.

New Titles from the Mathematical Association of America

Sink or Float? Thought Problems in Math & Physics

Keith Kendig

Sink or Float: Thought Problems in Math and Physics is a collection of problems drawn from mathematics and the real world. The book's aim is to show just how much can be learned by using everyday common sense. The problems are all concrete and understandable by nearly anyone, meaning that not only will students become caught up in some of the questions, but professional mathematicians, too, will easily get hooked. The more than 250 questions cover a wide swath of classical math and physics. Each problem's solution, with explanation, appears in the answer section at the end of the book.

A notable feature is the generous sprinkling of boxes appearing throughout the text. These contain historical asides or little-known facts. The problems themselves can easily turn into serious debate-starters, and the book will find a natural home in the classroom.

Catalog Code: DOL-33
ISBN: 9780883853399

List Price: $59.95
MAA Member: $47.95

Proof and Other Dilemmas: Mathematics and Philosophy

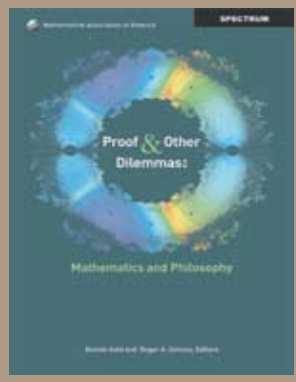
Bonnie Gold & Roger Simons, Editors

During the first 75 years of the twentieth century almost all work in the philosophy of mathematics concerned foundational questions. In the last quarter of the century, philosophers of mathematics began to return to basic questions concerning the philosophy of mathematics such as, what is the nature of mathematical knowledge and of mathematical objects, and how is mathematics related to science?

This book of 16 essays, all written specifically for this volume, is the first to explore this range of new developments in a language accessible to mathematicians. Approximately half the essays were written by mathematicians, and consider questions that philosophers are not yet discussing. The other half, written by philosophers of mathematics, summarize the discussion in that community during the last 35 years. In each case, a connection is made (in the article itself, or in its introduction) to issues relevant to the teaching of mathematics.

Catalog Code: POD
ISBN: 9780883855676

List Price: $53.95
MAA Member: $43.50



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