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# FOCUS

Volume 24 Issue 9

## *Inside*



On the cover: Bennett Battaile, *Spin One Half,* 2000. Lampworked glass, 26x27x23," Photograph by Bill Bachhuber. From the Exhibitition and Catalogue *Contemporary Art and the Mathematical Instinct,* organized by the Tweed Museum of Art, University of Minnesota, Duluth. See article on pages 4-5.

# Alexanderson, Higgins, and Hughes Hallett Receive Haimo Awards

*By Fernando Q. Gouvêa*

Gerald L. Alexanderson, Aparna Higgins, and Deborah Hughes Hallett are this year's recipients of the MAA's most prestigious award for teaching, the Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics. As happens every year, the three winners have been invited to speak about "the secrets of their success" at the Joint Mathematics Meetings. This year, these presentations will happen on Friday, January 7, from 2:30 to 4:00.

*Jerry Alexanderson*

Jerry Alexanderson is well known to MAA members. He has been Secretary and President of the Association, has been editor of *Mathematics Magazine* and associate editor of the *American Mathematical Monthly*, has headed the editorial board for MAA's *Spectrum* series of books, and has served as director of the Putnam Competition. He has also written books and a huge number of articles and reviews (including an article in this issue of FOCUS).

It is for his teaching, however, that Alexanderson receives the Haimo award. During his 45 years teaching at Santa Clara University he has consistently held the reputation of being simultaneously one of the best teachers and one of the most demanding. His classes are described as "amusing, entertaining, and highly informative." One of his students says that "Memories of my classes with Jerry include a tour of complex numbers and De Moivre's theorem in the first week of a freshman calculus class, a cast of colorful mathematicians (dueling and scratching graffiti on bridges), impossible exam questions (which somehow we were able to answer), fast chalk, bow ties, and eyes peering over glasses in (mock?) surprise that some cultural or intellectual fact had slipped our minds." Alexanderson's talk at the Joint Meetings is entitled *What Secrets? Confessions of a Curmudgeon.*

*Aparna Higgins*

Aparna Higgins has been described as "one of the dynamos of the American mathematics community." Her contributions to the MAA have been extensive. As co-director of Project NExT, she helps lead one of the MAA's most visible and most successful programs. As a member of the Committee on Undergraduate Student Activities and Chapters and the subcommittee for Research by Undergraduates, she has been deeply involved in attracting undergraduates to mathematics and especially to research in mathematics. She has directed REU summer programs at the University of Dayton and given many talks at mathematics meetings, including minicourses on how to engage undergraduate students in research. Her smiling picture appears regularly in FOCUS, often in connection to the Undergraduate Poster Session at the winter meetings.

Higgins' teaching is marked by her easy and genuine connection to students, which extends far beyond the classroom, even beyond graduation. She teaches "with passion and high expectations, and her students respond." During her 20 years at the University of Dayton, she has developed new courses and introduced pedagogical innovations. All her work reflects what she says on her web page: "I love mathematics, and I love teaching. I enjoy reading mathematics and reading about it, I enjoy discussing mathematical things — even jokes, and I enjoy spending time with mathematicians and with students who are interested in mathematics." Higgins' talk at the Joint Meetings is entitled *Teaching Mathematics in the Classroom and Beyond.*

Deborah Hughes Hallett is also a recognizable name: she is one of the authors of a successful calculus book (often referred to as the "Harvard" calculus book) developed by the Harvard-based Calculus Consortium. She has also been involved with *Mathematics for Business Decisions*, by Richard B. Thompson and Christopher G. Lamoureaux, a successful new course developed at the University of Arizona and published as an electronic text by the MAA.

*Deborah Hughes Hallett*

Hughes Hallett is known for her superb classroom skills. She is said to have an uncanny ability to make mathematical ideas clear and to communicate "the remarkable and beautiful nature of mathematics." She has been involved in teaching at an amazingly wide range of levels, from courses for under-prepared freshmen needing remediation to courses for government officials from developing countries and officials from NGOs. In terms of curriculum and pedagogy, she has been prepared to buck the trend, and so has started trends of her own. "To Deb, no question is annoying, and no student is beyond help." Both in the classroom and on the national scene, Hughes Hallett has been a leader and has had an enormous impact. Hughes Hallett's talk at the Joint Meetings is entitled *The "Soft Power" of Teaching.*

The Mathematical Association of America first instituted Awards for Distinguished College or University Teaching of Mathematics in 1991, with the goal of honoring college or university teachers who have been widely recognized as extraordinarily successful and whose teaching effectiveness has been shown to have had influence beyond their own institutions. In 1993 the MAA Board of Governors renamed the award to honor Deborah and Franklin Tepper Haimo. Each year at most three college or university teachers are honored with this national award. Typically, all are selected from the recipients of MAA section teaching awards (see the August-September issue of FOCUS), but each year one of the winners may be selected from another source.

# Art – Instinct – Math

*By Peter F. Spooner*

I am a curator of contemporary art, not a mathematician. I admit that the forty-three artists included in the exhibition *Contemporary Art and the Mathematical Instinct* were selected by just that — my own instincts about their mathematical correspondences, together with a visceral attraction to their works as aesthetic objects. For me, that has come to mean that the object clearly exhibits a certain economy of means that readily sparks a dialogue between form and content. In other words, the artwork does not trip itself up by relying too heavily on what it is made of (its perceivable physical properties), nor by laying claim to ideas and concepts that simply can't be supported by what one can perceive in it. Of course, the sharpness of an individual viewer's perceptual skills, their prior knowledge and experience, and their familiarity with the idea of "talking and listening" to objects, all play an important role in the process as well.

The *New Math: Contemporary Art and the Mathematical Instinct* exhibition brings together artists creating in many different media, whose works are variously and sometimes loosely related to the operations, theories, and cultural history of mathematics. It does not claim to be an overview of the history of mathematics in art, or even a survey of mathematics in contemporary art practice. Rather, it presents a sampling, from one curator's point of view, of the possibilities that arise from the marriage of visual art and various mathematical ideas, by practitioners who consider themselves artists first. Given the great numbers of artists and curators in the U.S. alone who are now exploring content once limited to historians, sociologists and "hard" scientists, I am the first to admit that another curator in another place at another time might have selected a completely different, yet entirely appropriate, group of artists to satisfy this theme.

Exhibitions, especially those of contemporary art (which expands its boundaries almost daily) are akin to organic entities. This one grew out of an intuition that many artists working today create "on the fringes" of mathematics, some barely aware — or perhaps purposefully suppressing their awareness — of theorems, algorithms, and mathematical properties that a trained mathematician might see in their productions. As the exhibition took its shape, the importance of the word "instinct" in its title became more pronounced, and became the guiding principle around which it organized itself.

The exhibition was not developed from a rigidly defined theme, but instead from a very broad sensibility about the nature of contemporary artistic production. Artists are often guided by something akin to instinct, and a part of that instinct has to do with sensibilities that could also be described as mathematical.

As the title suggests, the viewer or reader might come away with the feeling that perhaps there is an underlying "mathematical instinct" at play in the work of these artists, who are otherwise not affiliated. Despite, or perhaps because of, the vast differences in forms and processes employed by these artists, the notion of "mathematical instinct" supports quasi-mystical harmonies between nature, human thought, and mathematical constructs such as $\pi$ and the Fibonacci series.

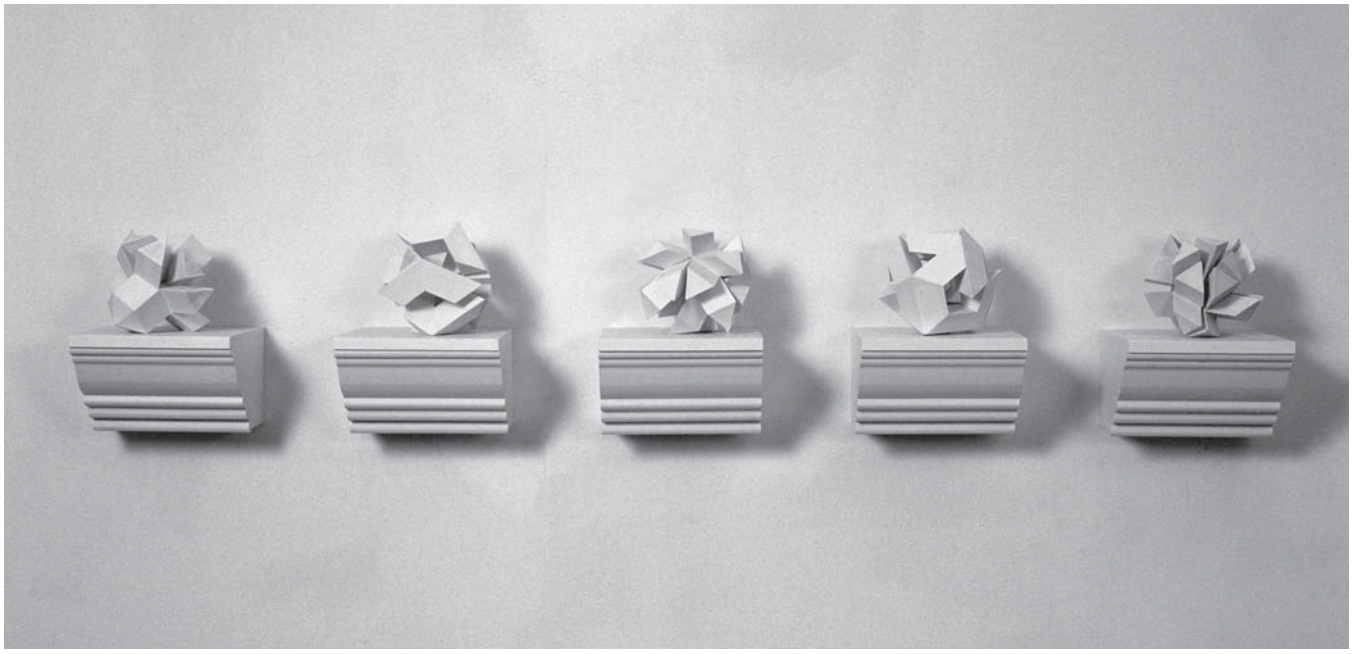
Mathematics is described by many as a search for patterns, and as the roster of artists for this exhibition grew, I naturally found myself wanting to categorize and group them somehow. The exhibition is therefore organized around four broad categories: Mathematics – History, Science and Culture; Algorithms – Instructions for Making; Geometry and Topology: Shapes, Forms, Surfaces; and Probability, Statistics, and Measurement. In the end, these categories theoretically encompass just about every operation artists or mathematicians might undertake.

I first thought about developing this exhibition at the time I was the curator of *Botanica: Contemporary Art and the World of Plants*, a group show of over sixty artists whose works pictured, emulated or commented on plant life. My thinking about *Botanica* was based on the idea that plants are so integral to human survival that we had empathetically internalized their forms and life cycles, and that artists consistently and universally modeled their productions after them, as if by a kind of unspoken urge.

The process of organizing any large group exhibition involves looking at literally hundreds of artists, and while doing so for *Botanica*, it became just as obvious that large numbers of contemporary artists used the systems, theories, and historical models of mathematics as a starting point, and that measurement, proportion, patterning, iteration, and geometry were equally "instinctual" and incredibly rich as a grounds for artistic production. The curatorial impetus behind both *Botanica* and *Mathematical Instinct* has been to present, in common space and time, a great variety of the products of a contemporary art practice that is increasingly connected to extra-aesthetic themes — sociology, spirituality, psychology, as well as the "hard" sciences.

As the *Mathematical Instinct* exhibition begins its tour, the third in what has become a triad of exhibitions is now in the incubation stage. Tentatively titled *Music to Your Eyes* and scheduled for 2007, its intention is to explore a variety of relationships between recent art, sound, and music.

Interestingly, the same curatorial dilemma arose with the Math exhibition as had with *Botanica*, and I expect, will with Music — specifically, how to distinguish between art that is somehow related to a scientific discipline, and art



Steven Luecking, *Icosi I-V*, 2003. Five sculptures on individual shelves; cast polyurethane, oil paint, each approximately 8x8x14". From the exhibition and catalogue *Contemporary Art and the Mathematical Instinct*, organized by the Tweed Museum of Art, University of Minnesota, Duluth. Photograph courtesy of Tweed Museum of Art.

that wants only to illustrate some aspect of it. In botany and natural history, a fairly clear distinction can be made, and there I opted not to include botanical illustration per se. Since I am a curator of art and not a botanist or a mathematician, it was important to me that the works included in these exhibitions be developed first and foremost as art — that the science of them be transformed somehow through the filter of an individual artistic sensibility, and that their first intention be as art and not as an illustration or a by-product of a scientific operation.

Despite the beauty of scientific illustrations and the technical skills of illustrators, and despite the superior aesthetic and visual qualities of fractal images, geometric configurations, or even mathematical formulas themselves, a difference in intent is obvious, and it is the notion of intent that I have used to distinguish between contemporary artists who use mathematics in their work, and mathematicians whose operations result in visual images. Computers have significantly increased our ability to immediately create clear visual models from what would otherwise be hopelessly dense tangles of numbers and symbols. This change is explored by Stephen Leucking in an essay he wrote for the exhibition catalogue. Tracing the current fascination with 3D computer modeling back to geometric surface models of the early 1800s, Leucking cites the profound influence that physical mathematical models had on the development of modern non-objective abstract sculpture.

Computers are a tool that artists use as well. I am the first to admit that the results of these differently intended practices may be virtually indistinguishable as images or objects, and I agree strongly with those who advocate for expanded views of both contemporary science and art that allow for more communication between the two.

At the same time, I feel it is important to maintain a distinction between art as a product of the artistic process and the visual by-products of scientific and mathematical operations. But where to draw the line? I admit that it is sometimes difficult to tell, without prior knowledge of the creator's background, which images might have been made by a visual artist and which by a trained mathematician. The methods, procedures, and techniques of production employed by these artists are often the same ones used by engineers, mathematicians, and other scientists, further adding to the complexity of this question.

The exhibition has appeared at the following venues: Tweed Museum of Art, University of Minnesota Duluth, Nov 4, 2003 – Jan 11, 2004; Stedman Gallery, Center for the Arts, Rutgers University, Camden, NJ Feb 2 – March 27, 2004; Marsh Art Gallery, University Museums, University of Richmond, Virginia, Oct 26 – Dec 12, 2004.

A catalogue with color illustrations of the 43 artists and essays by Stephen Luecking, John Sims, Dennis White, and Peter Spooner is available from the Tweed Museum of Art. Contact Museum Store manager Kim Schandel by phone at (218) 726-8750 or email ksawin@d.umn.edu.

*Peter F. Spooner* (pspooner@d.umn.edu) *is Curator for the Tweed Museum of Art, University of Minnesota Duluth, and the organizer of the exhibition* Contemporary Art and the Mathematical Instinct.

# ICME-10 in Copenhagen

*By Annie Selden*

The Tenth International Congress on Mathematical Education (ICME-10) met last summer from July 4–11 in Copenhagen. Held once every four years and alternating with the International Congress of Mathematicians (ICM), this gathering of mathematicians, researchers in mathematics education, curriculum developers, and teachers at all levels is an activity of the International Commission on Mathematical Instruction (ICMI). Organized this time by the Nordic countries of Denmark, Finland, Iceland, Norway, and Sweden, its venue was the immense campus of the Technical University of Denmark (DTU) in the suburban town of Lyngby. Indeed, the campus was so large that it often took the entire half hour, set aside for coffee breaks, to reach the next session.

*MAA members Andy Magid, Vena Long, Susanna Epp, and Annie Selden at ICME-10. Photographs courtesy of Annie Selden.*

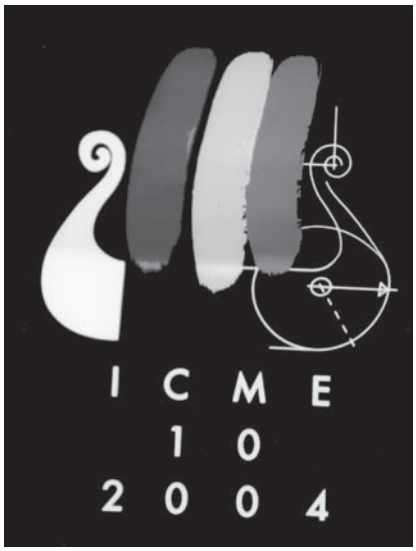
There were approximately 2300 participants from over 100 countries, nearly half of them presenters in a vast smorgasbord of activities. These included plenary lectures, regular lectures, topic study groups (somewhat like mini-conferences), discussion groups, poster sessions, national presentations, reports on recent ICMI Studies, presentations from ICMI-affiliated study groups, a thematic afternoon, and a mathematical circus.

Much of the program would have been familiar to anyone attending previous ICMEs, but this congress included some interesting innovations. In particular, there were reports from Survey Teams that had been asked, as much as two years in advance, to find out and report on changes in mathematics education occurring within the last five years. There was also a lively plenary interview, much like one might see on TV, in which Michèle Artigue of France deftly questioned four senior mathematics educators —Ubiratan D'Ambrosio of Brazil, Gila Hanna of Canada, Jeremy Kilpatrick of the U.S., and Gérard Vergnaud of France — regarding how they got into the field, their research, and the main problems yet to be solved.

New this year was the establishment and presentation by ICMI of two awards, with accompanying medals. The Klein Award for life-long achievement went to Guy Brousseau of France. The Freudenthal Award for substantial advances in the last ten years went to Celia Hoyles of the United Kingdom.

This was an expensive congress. Meals and hotels were pricey; the dollar was down. Ten percent of the over $500 registration fee went to support 175 participants from 50 countries. Indeed, it is hard to see how some participants from such places as Iran or India could have afforded it otherwise. Some 45 U.S. participants, chosen from over 600 applicants, obtained significant travel funds from an NSF-grant to the National Council of Teachers of Mathematics (NCTM). This U.S. contingent, selected by a committee with representatives from NCTM, MAA, AMATYC, AMS, and the U.S. Commission on Mathematics Instruction, contained teachers of all levels, mathematics education researchers, and mathematicians. A number of MAA folks, including those pictured, were grant recipients.

One session of note was the report of Survey Team 1 presented by Anna Sfard of the University of Haifa and Michigan State. The team collected 74 surveys from mathematics education researchers around the globe, asking: How would you describe your work over the last five years? Findings included: there has been a change of emphasis from considering students to considering teachers, with two-thirds now focusing on the teacher, whereas previously their focus had been almost entirely on student understanding. Also, most of the research has been qualitative with the data coming from classroom interactions. Most respondents were motivated by the condition of mathematics education in their countries, describing it as bad, dire, bleak, or reactionary. They complained about classroom practices that refuse to change, about the explosion of testing, and the flourishing private lessons industry. Sfard characterized 1960-1980 as the era of curricula, 1980-2000 as the era of the learner, and 2000 onwards as the era of the teacher. She is wary of "what works" research, noting that measurement has an "irresistible allure" for politicians. She considers it dangerous to use quantitative methods without qualitative meth-




*The ICME-10 Banner*

ods as doing so might gloss over individual differences.

The Russian national exhibit was huge, featuring enormous banners around the DTU campus and a truly impressive display of books and materials. I was told they sent a very large lorry load one month early. There were also more modest national exhibits from Korea, Mexico, Romania, and the Nordic countries.

One of the pleasures of such large conferences is meeting old friends and making new ones. Often this happened on the combination train and bus rides from the center of Copenhagen to the DTU campus or on the middle-of-the week excursion day. While the weather was uncooperative with some rain every day, it could not dampen the enthusiasm.

A proceedings volume will be available in two years. However, many of the papers for Topic Study Groups are available now at http://www.icme-10.dk/. This website will be maintained for four years. The next Congress, ICME-11, is being planned for July 6–13, 2008 in Monterrey, Mexico.

*Annie Selden is Professor Emerita of Mathematics from Tennessee Technological University and a member of the FOCUS Editorial Board. She is currently affiliated with the Department of Mathematical Sciences, New Mexico State University.*

## AAAS Meeting to Offer Strong Mathematics Program

*By Warren Page*

The 2005 Annual Meeting of the American Association for the Advancement of Science, to be held next February 17 –21 in Washington, D. C., will feature many outstanding expository talks by prominent mathematicians. These include the following three-hour symposia (listed with their organizers) sponsored by Section A (Mathematics) of the AAAS:

*Mathematical Oncology: Bridging the Scientific Divide* (Kristin Swanson, University of Washington)

*Understanding the Interaction of Noise in Complex Systems* (Rachel Kruske, University of British Columbia)

*Mapping the Human Brain from Infancy to Old Age* (Paul Thompson, UCLA School of Medicine)

*Finding and Keeping Graduate Students in the Mathematical Sciences* (Amy Cohen, Rutgers University)

Other symposia that will be of interest to the mathematical community include: *Mathematics and Human Infectious Disease, Something from Nothing? Scientific Inference and Missing Data, Complex Adaptive Systems: Advances in Theory and Practice, Mathematics and Biology 2010: Linking Undergraduate Disciplines, Einstein in Historical and Philosophical Perspective, Astrotomography, and Continuing to Learn from* TIMSS *and Now Also from PISA*.

The above symposia are only a few of the 150 or so AAAS program offerings in the physical, life, social, and biological sciences. For further details about the 2005 AAAS program, see the October 8th, 2004 issue of *Science*.

AAAS annual meetings are the showcases of American science, and they encourage participation by mathematicians and mathematics educators. (AAAS acknowledges the generous contributions of AMS for travel support and SIAM for support of media awareness.) In presenting mathematics-related themes to the AAAS Program Committee, I have found the committee to be genuinely interested in offering symposia on mathematical topics of current interest. Thus, Section A's Committee seeks organizers and speakers who can present substantial new material in an accessible manner to a large scientific audience. Toward this end, I invite you to attend our Section A Committee business meeting 7:45 – 10:00 p.m. Friday, February 18th, 2005 at the Marriott Wardman Park hotel (room to be determined). I invite you also to send me, and encourage your colleagues to send me, symposia proposals for future AAAS annual meetings.

*Warren Page* (wxpny@aol.com) *is Secretary of Section A of the AAAS.*

## HOLIDAY SCHEDULE

The MAA headquarters office
will be closed
December 27 through December 31, 2004

The MAA customer service department
(800) 331-1622
will be open except for
December 24 and December 31, 2004

# Archives of American Mathematics Spotlight: The R. L. Moore Papers

*By Kristy Sorensen*

A cornerstone collection of the Archives of American Mathematics at the Center for American History is the R. L. Moore Papers. These papers consist of correspondence, research notebooks, drafts, teaching material, mathematical notes, printed material, photographs, and other material documenting the life and career of Robert Lee Moore.

R. L. Moore (1882-1974) was a professor of mathematics at The University of Texas at Austin for almost fifty years. He is well known for his work in point-set topology, but is most remembered for his work as an educator. During his long career, Moore supervised over 50 doctoral students, including three members of the National Academy of Sciences, three presidents of the American Mathematical Society and four presidents of the Mathematical Association of America.

*Back row, left to right: R.E. Bayse, E.C. Klipple, F. Burton Jones; Front row, left to right: C.W. Vickery, R.L. Moore, R.G. Lubben; ca. 1935, from the R.G. Lubben Papers, Archives of American Mathematics, Center for American History, The University of Texas at Austin.*

*Undated notes by R.L. Moore. From the R.L. Moore Papers, Archives of American Mathematics, Center for American History, The University of Texas at Austin.*

Moore regularly taught undergraduate calculus and pre-calculus courses in addition to his more advanced classes. In his advanced classes, Moore's way of teaching, known as the "Moore Method" or the "Texas Method" began with the careful selection of students who did not have an extensive knowledge about the topic to be discussed. He would then give the students some basic axioms and definitions and ask them to construct proofs and examples for different theorems. The students were not allowed to read any texts, discuss the problems among themselves, or seek help from other professors in the department. Instead of lectures, the classroom experience consisted of a student explaining his or her proof at the board while other students asked questions. If the student got stuck, or if a flaw was found in his or her proof, another student would take his or her place at the board.

The majority of the collection pertains to Moore's professional career, including sections on correspondence, mathematical works, teaching, professional organizations and honorary societies, and general material. Moore's professional correspondence provides a rich look into his career and his relationship with his contemporaries. The section on mathematical works includes published and unpublished items by Moore and others. It also contains an extensive collection of Moore's notes and drafts. Insight into Moore as a teacher can be gained from many of the papers. Administrative correspondence and departmental business, as well as class records and notes and correspondence about the 1967 MAA film about Moore's teaching style, *Challenge in the Classroom*, are included. Other sections of Moore's professional life, including his presidency of the American Mathematical Society, and his relationship with Professor George Bruce Halsted are also represented in this series.

The personal series documents Moore's family life, hobbies, health, and finances, and includes subseries on: correspondence, family, education, health, finances, genealogy, automobiles and motoring, rezoning, notes, printed material, and photographs. Moore corresponded with many of his family members, but the deepest correspondence was with his brother, Jennings Moore. In general, only the letters received by Moore are present, although in some cases, drafts or copies of Moore's letters are included in the collection.

In addition to his papers, the archives also has books, offprints, and journals from Moore's personal library, as well as a set of dissertations from some of Moore and H. S. Wall's graduate students.

A biography on R. L. Moore, utilizing sources from the Archives of American Mathematics will be published by the MAA later this year. The finding aid for the R. L. Moore Papers is available on the Texas Archival Resources Online webpage: http://www.lib.utexas.edu/taro/utcah/00304/cah-00304.html.

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 Kristy Sorensen, Archivist, k.sorensen@mail.utexas.edu, (512) 495-4539. The archives web page is at http://www.cah.utexas.edu/collectioncomponents/math.html.

# Why *You* Should Take a Mathematical Study Tour

*By Herbert E. Kasube*

On the first day of class this fall I stood in front of my calculus I class giving them the "usual" spiel. I talked about what calculus was about and made a few historical remarks. I told them of Isaac Newton's contributions and a bit about the Newton-Leibniz controversy. The students all looked rather bored and were probably wondering if they would be tested on this drivel.

*Newton's birthplace at Woolsthorpe. Photo courtesy of Herbert E. Kasube*

Then I mentioned how this past summer I had walked in Newton's footsteps. I had toured his birthplace at Woolsthorpe, seen his elementary school in Grantham, visited his halls of Cambridge and finally had visited his final resting place in Westminster Abbey. As I was telling this tale I noticed a change in my students' expressions. Suddenly they seemed more interested in my historical comments. I had got their attention! What afforded me this wonderful teaching opportunity? I had traveled with the MAA's study tour of England and had the chance to visit places I might not have been able as a "typical" tourist: Stonehenge at daybreak, the Wren Library at Cambridge, and the Royal Society in London.

This was the MAA's second annual mathematical study tour. The first visited Greece and Pythagoras' island of Samos while the third is planned for the land of the ancient Mayan civilization. The scenario described above is just one indication as to why one should consider taking such a study tour. Realize that the word "study" is included here. The world can be your library, your research center. Professional development is a goal for many faculty members. Depending on your particular mathematical interests, such study may be difficult to find. This is often true in studying the history of mathematics. Participating in a mathematical study tour offers an opportunity to see first hand where mathematical history was made. What could be better?

Another outcome of such a trip could be an opportunity to offer a similar experience to students at your institution. Many schools offer study abroad programs for students to visit foreign lands and study subjects such as theatre, art, or music. Seldom is a mathematics course offered. I received a grant from Bradley University's Office of Teaching Excellence and Faculty Development to help fund my trip with the possibility of someday offering such a course.

Benefits from participation in a mathematical study tour reach beyond the classroom.

*Herb Kasube teaches at Bradley University in Peoria, IL.*

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# The MAA Reviews Are Coming!

As noted in the November issue of FOCUS, the MAA is about to launch *MAA Reviews*, a new component of the Mathematical Sciences Digital Library (MathDL). The goal of *MAA Reviews* is to serve as a full-service books database for MAA members. It will take some time before that dream becomes fully realized, but we're working toward it with hope and vigor.

What will the new site contain? First of all, it'll contain a full searchable database of all books that we receive for review. Even if we decide not to review a book, you'll still be able to find the basic bibliographic information. Many books, however, will receive "brief reviews." These will be very much like the ones that now appear in the "Briefly Noted" column. A few books (around nine a month, we hope) will receive the full treatment, with long reviews much like the ones you now find in *Read This!* Finally, the MAA's committee on the *Basic Library List* plans to use the *MAA Reviews* database to present and update their recommendations.

We hope to go live with all of this in February. Meanwhile, we are busily soliciting books, identifying reviewers, and building the database. MAA members who want to join the fun and contribute reviews should contact Fernando Gouvêa (wearing his Secret Master of MAA Reviews hat) at fqgouvea@colby.edu.

# But How Do I *Do* Mathematical Research?"

*By Jeff Suzuki*

Many schools include a research project as part of the graduation requirements for their mathematics majors. But most students are at a loss to create their own research questions, leaving this task to their advisors. It would be better if the student came up with their own research question that involved significant mathematical investigation and the creation of original mathematics. This is a daunting task: most *graduate* students are unable to do this, and rely on their advisors to frame a suitable area for investigation. The task is further complicated by the fact that many questions relating to undergraduate mathematics have "already been solved," while many of the unsolved questions require so much specialized background to understand or so much existing research to review that the preparation needed to tackle the problem is itself a major project.

So how can students be guided to create a question that is non-trivial but amenable to investigation? One guide to the process of creating a question is to look at what mathematical research *is*. The vast majority of mathematical research falls into one of five (non-exclusive) categories which, after some thought, fit nicely into the acronym PEACE: Proof, Extension, Application, Characterization, and Existence.

**Proof:** Of course, every mathematical research project involves proof; in this context, proof is the focus of the project. For example, "Prove Fermat's Last Theorem." More generally, though, we note that *reproof* is also a valid line of mathematical research: Gauss, for example, earned his doctoral dissertation by providing a *new* proof of the Fundamental Theorem of Algebra. It might be argued that no rigorous proof existed before Gauss, but clearly Gauss felt that proving a theorem once was insufficient: he eventually gave four proofs of the Fundamental Theorem of Algebra and six proofs of the Law of Quadratic Reciprocity.

**Extension:** This takes some existing concept and extends it. For example, Newton took the expansion of $(a+b)^n$, where $n$ is a whole number, and extended it to the expansion of $(a+b)^n$ where $n$ was a positive or negative rational number. The Lebesgue integral is another example of an extension.

**Application**: We may take an existing idea and apply it to a new area. This is frequently the focus of projects in applied mathematics, but it also can be used to originate new areas of pure mathematics: the application of algebra to problems in geometry led to Descartes's creation of analytic geometry, while the application of power series techniques to problems in number theory led to Euler's creation of analytic number theory.

**Characterization**: We can try to characterize or classify a mathematical object or concept. For example, Cauchy's great contribution was to characterize what was really meant by continuity, differentiability, and integrability, while Cantor characterized the naive notions of "infinity," and the Enormous Theorem is a classification of finite simple groups.

**Existence**: Strictly speaking, this is part of "characterization," since one quality of an object is whether or not it exists. However, existence (or non-existence) theorems tend to be treated separately: this is reasonable, since unless the object exists, there is no point investigating its mathematics! Examples of existence results are Euclid's proof of the existence of an infinite number of primes or Gödel's incompleteness theorem (a non-existence proof).

With these five lines of research as a guide, students at both graduate and undergraduate levels may find it easier to generate their own research questions.

*Jeff Suzuki is Visiting Assistant Professor of Mathematics and Director of Quantitative Support at Bard College.*

## Correction

The triaxial tritorus design on the MAA tattoo pictured on page 29 in the November 2004 issue of FOCUS was created by Paul Bourke of Swinburne University. We regret the omission of the author's name.

## FOCUS Deadlines

| | March | April | May/June |
|---|---|---|---|
| Editorial Copy | January 18 | | March 10 |
| Display Ads | January 14 | February 11 | March 10 |
| Employment Ads | January 28 | February 25 | March 24 |

# The Student Activities Zone

*By John Holte*

If, when you are attending a national MAA meeting, you wander off from the rooms where the "usual" math sessions are held, you may find yourself among throngs of undergraduate students. They will be in meeting rooms listening to math talks by other students, talking math excitedly in the hallways, being amazed by a mathemagician, or working puzzles and socializing in a student hospitality center. You will have wandered into the MAA student activities zone, a realm of enthusiasm and imagination, where the aspirations of young mathematicians to engage in genuine mathematical activity is nurtured. What is this all about? And who organizes all this activity?

Behind the scenes, CUSAC is working. CUSAC is the Committee on Undergraduate Student Activities and Chapters. As a committee of the MAA, it directs a host of activities at the summer and winter meetings each year.

On the eve of each MathFest, the MAA, in cooperation with Pi Mu Epsilon, sponsors an opening reception for students attending the meeting. It is a relaxed, fun event at which students can meet each other and be welcomed by established mathematicians. During the following days, many students will participate in the MAA Student Paper Sessions — typically about eight sessions scheduled over two days in which students will present short talks on their research papers. These high quality talks are quite varied, ranging from applied mathematics through recreational mathematics to very pure mathematics. Sometimes a team of students who have been working with an advisor on cutting edge research will present their findings in a series of talks. Pi Mu Epsilon offers parallel student paper sessions during these same days, ensuring that a critical mass of students is achieved.

*Professor Martelli as Brunelleschi*

At MathFest 2004 in Providence, 113 students made presentations.

CUSAC arranges other sessions specially aimed at the students. At the Providence MathFest, the MAA Student Workshop focused on fractals, with the founder of fractal geometry, Benoit Mandelbrot, leading the session. The Boulder MathFest workshop was "Problems, Problems, Problems," conducted by Clayton Dodge, Professor Emeritus at the University of Maine and former editor (for more than two decades!) of *The Pi Mu Epsilon Journal*. Richard Neal, Professor Emeritus at the University of Oklahoma and chair of CUSAC, organizes the National Collegiate Mathematics Championship as the closing event of each MathFest and the culmination of the year's monthly Problem Solving Competition conducted locally at 500 colleges and universities in the United States.

About 25-30 students from the participating institutions are admitted to the final competition held at MathFest. For information on how students from your college or university can qualify to attend the U.S. National Collegiate Mathematics Championship held each summer during MathFest, contact Dr. Richard Neal at rneal@ascm.org or write to Dr. Richard S. Neal, University of Oklahoma Department of Mathematics, Norman, OK 73019.

Richard Neal and his wife Araceli also host the Student Hospitality Center at


*Students enjoying refreshments at the Hospitality Center.*

*Nathan Edington, Kay Somers, Dan Kalman, Jean B. Chan, Aditya Khanna, and Alicia Sevilla at a MathFest reception.*

the summer MathFests and winter Joint Mathematical Meetings. Operating throughout the meetings, the SHC provides a place for students to relax, enjoy some refreshments, get information about the program, interact with one another, play games, solve puzzles, and discuss mathematics.


*Professor Mandelbrot explains fractals.*

CUSAC also arranges the MAA Student Lecture at both summer and winter meetings. At the Providence MathFest, Professor Mario Martelli of Claremont-McKenna College, dressed as the famed 15th century architect Filippo Brunelleschi, revealed some of the secrets of his construction of the great dome on Florence's cathedral. At the January 2004 meeting in Phoenix, Dr. Mark M. Meerschaert of the University of Nevada enthusiastically presented a sample lecture of the course in "fractal calculus" that students may get at Star Fleet Academy in the future. At the 2003 MathFest in Boulder, Professor Art Benjamin, Professor and Chair of the Mathematics Department at Harvey Mudd College, presented "The Art of Mental Calculation." Mathemagician Benjamin demonstrated his wizardry in doing calculations in his head with lightning speed, getting the answers before students in the audience who used handheld calculators.

At the January meetings, CUSAC, in cooperation with the CUPM Subcommittee on Research by Undergraduates, organizes the Undergraduate Student Poster Session. Professor Martelli has arranged the recent sessions. At the Phoenix meeting, 110 student teams from across the country presented posters, and more than 115 professional mathematicians participated in the judging. Thirty-two $100 prizes were awarded to the posters getting the highest marks.

Another event that CUSAC has organized at the January meetings is the special contributed papers session, Mathematical Experiences for Students outside the Classroom. As organizers Kay Somers and Jody Sorenson noted in their call for papers, "This session seeks presentations by academic, industrial, business, and/or student mathematicians so that the audience will be encouraged to organize and run special events for their students. Descriptions of non-classroom activities could include, but are not limited to, special lectures, workshops for students, Math Days, Math Fairs, research projects for students, Math Career Days, student conferences, recreational mathematics activities, problem solving activities and contests, general community-building activities, and student consulting projects."

Yet another program that CUSAC administers is the Diversity Initiative, a special MAA fund set up to help bring students from underrepresented groups to the Joint Mathematics Meetings. Faculty may apply to this fund for small (up to $500 per institution) grants to cover the cost of registration, food, lodging, and travel for their students. CUSAC member Betty Mayfield was pleased to report that in January 2004 travel grants were awarded to six colleges and universities to send students to Phoenix — four colleges from California, one from Texas, and one from Georgia. A total of eighteen students from those schools participated in the joint meetings, attending the MAA Student Lecture, student reception, and undergraduate poster session as well as many other events. Six of the students presented their work at the poster session.

*Professor Mandelbrot poses with MAA Student Papers best-in-session winners. Front (l-r): Stephanie Hurder, Kari Lock, and Christina Brakken-Thal. Back (l-r): Matt Katschke, Robert Willenbring, Nicholas McClure, and Nathanial Burch, winner of the MAA environmental math SIG award. Not shown: Shawn Elledge and Anthony DeLegge.*

Of course, most of the time student activities in mathematics occur at the students' own colleges and universities, and CUSAC is the MAA committee given responsibility at the national level for these local chapters. The MAA Student Chapters program is designed to encourage students to continue study in the mathematical sciences, provide opportunity to meet with other students interested in mathematics, interact with prominent mathematicians at national meetings, and provide career information in the mathematical sciences. More information on undergraduate student activities may be found via the following link: http://www.maa.org/students/undergrad/.

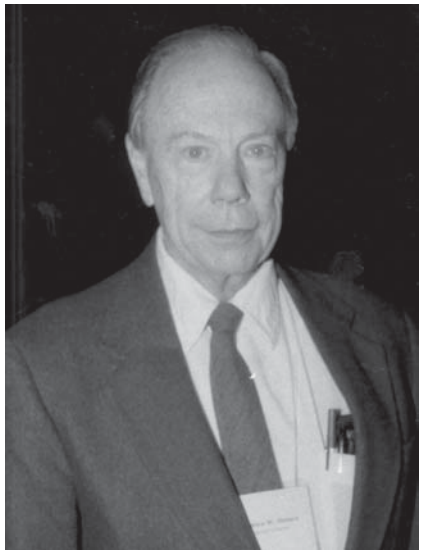
Whether you are a student interested in mathematics or a faculty member interested in encouraging undergraduates, you will find that the MAA promotes many opportunities to enter the "student activities zone."

*John Holte is Professor of Mathematics and Computer Science at Gustavus Adolphus College. Photographs courtesy of Betty Mayfield, Jody Sorensen, Hal Nesbitt, Fernando Gouvêa, and John Holte.*

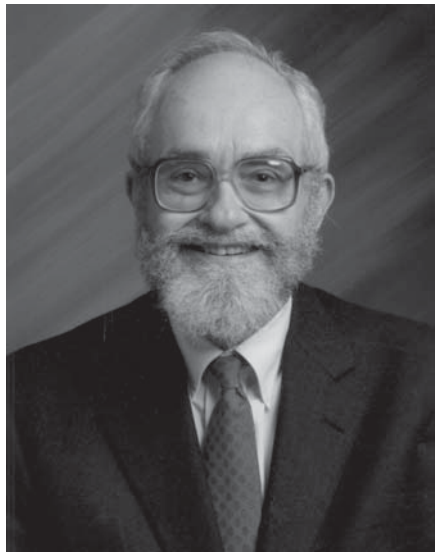
# How Putnam Fellows View the Competition

*By G.L. Alexanderson*

The William Lowell Putnam Mathematical Competition is generally viewed as the toughest problems competition in North America, possibly the world. Putnam problems are meant to be fresh — not part of the problems literature — and challenging, but, of course, written at a level appropriate for undergraduates. The list of Putnam Fellows (those who place among the top five each year among the thousands of participants) contains some very distinguished names — Fields Medalists (David Mumford, John W. Milnor, Daniel G. Quillen) and physics Nobel Laureates (Richard Feynman, Kenneth G. Wilson). Others have become presidents of the American Mathematical Society (Andrew M. Gleason, Irving Kaplansky, Felix Browder). Still others are members of the National Academy of Sciences (Elwyn Berlekamp, Felix Browder, Eugenio Calabi, Andrew M. Gleason, Melvin Hochster, Roger Howe, Irving Kaplansky, George W. Mackey, John W. Milnor, David Mumford, Daniel G. Quillen, Lawrence A. Shepp, Peter W. Shor, and Kenneth G. Wilson). It's a very exclusive club.



*Andrew Gleason*



*Felix Browder*

To find out what the Putnam Competition has meant to a few early as well as recent winners, I contacted some Putnam Fellows ranging from one in the first competition in 1938 (Irving Kaplansky) to a winner in the early 90s (Ravi Vakil). This was not a scientific survey — I just picked some Putnam Fellows and asked them some questions. Numbers in parentheses following names give dates of the contests in which they were Putnam Fellows. Here are some observations from those who responded.

I should make it clear that not all Putnam Fellows have become mathematicians; some have gone into computer science, physics, or engineering, and, of course, they don't all take academic positions. Elwyn Berlekamp ('61) claims to be the only Professor of Mathematics at U. C. Berkeley without a degree in mathematics (his degrees are in engineering). Though he attended some Putnam practice sessions at MIT he took the Putnam only once, as a senior. In his junior year he had to choose between the Putnam and a bridge tournament and he chose bridge. So in his senior year he took the contest and placed in the top five, thus attracting the attention of Gian-Carlo Rota, an important factor in his career. Had Berlekamp been on the MIT team that year, it would have placed first.

Some Putnam Fellows said they knew early on that they wanted to be mathematicians: Irving Kaplansky ('39) "felt fully committed to mathematics at a very early age." Bjorn Poonen ('85, '86, '87, '88) says that by the time he took the Putnam he "was already deeply into mathematics." Others, however, felt that the Putnam helped them decide what to do. Jeff Lagarias ('70) said that from the age of 15 he had hoped to be a mathematician but the Putnam increased his "self-confidence that [he] had talent at mathematics." Dennis Hejhal ('67) agreed: "It…influenced my choice of career, but only as a psychological boost. I knew very early I wanted to be a mathematician. Doing well in the Putnam strengthened my self-confidence." Ravi Vakil ('88, '89, '90, '91) surprisingly said that only in his senior year in college did he firmly decide to go to graduate school in mathematics — "the Putnam helped attract me into the area, by giving me a chance to think about interesting, nonstandard problems, which in some sense is what research mathematics is all about."

Poonen says that it seems that Putnam winners "are more likely to do research in algebra than in analysis, but [he thinks] that love of algebra is more the cause than the effect of winning the competition." This view might explain Kaplansky's winning the Putnam; he went on to become an internationally renowned algebraist. But he attributes his "algebraic way of looking at things to Richard Brauer." Hejhal, though, says the Putnam convinced him that his real strength was in analysis. So not everyone is moved to do algebra. (Of course, we might note that Hejhal does analytic number theory, so perhaps he's not really a counterexample to the Poonen theory.) Michael Larsen ('81, '83) noted that what the Putnam Competition might have done for him is broaden his interests within mathematics. Lagarias thinks he takes "a problem oriented approach to mathematical research. The 'big picture' is important in choosing which problems to work on, but once I like a problem, I want to solve it. The big picture becomes irrelevant." Vakil observed that many people are attracted to

combinatorics and number theory by the kinds of questions that appear on competitions, in part because these fields permit questions that can be made understandable to undergraduates. But he went on to say that "the Putnam led [him] to look for a field that was perceived to be challenging and that required broad intuition and familiarity with a nice variety of fields." It guided him in the direction of algebraic geometry.

Lagarias, who does mathematical research at AT&T Labs, remarks that being "able to formulate problems is a very useful skill … in industry [where] many applied problems do not come in a mathematical form . . . [He] attempts to formulate any question [he is] asked as a well-posed precise problem." Poonen points out that the "Putnam consists of problems for which an elegant solution is guaranteed to exist. People who spend a lot of time working on such problems become conditioned to seek and even expect such elegant solutions … They tend to seek not just any way of explaining something but the best way. On the other hand, I think some winners become frustrated when they begin research because of unrealistic expectations that real problems will admit short solutions." Vakil, however, says that he "had a simpler transition into research mathematics than many others because [he] was already used to dealing with problems that were not of the 'undergraduate textbook' variety."

Kaplansky was not only a Putnam Fellow in the first competition, he was also on the winning team from the University of Toronto. And he won the first Putnam Scholarship to Harvard. He commented, though, that there is "one thing I can say with certainty: I am glad I wrote then and not now. The examination has become so much harder." Kaplansky was pleased when Vakil (from the University of Toronto) won the Putnam and chose to study algebraic geometry at Harvard. He commented that the field "is red hot and Harvard has an impressive tradition in algebraic geometry. [Oscar] Zariski is the only mathematician who fathered two students (Hironaka and Mumford) who won Fields [Medals], and this happened at Harvard." The celebration of 150 years

*Ravi Vakil*

*Bjorn Poonen*

of mathematics at the University of Toronto featured Kaplansky and Vakil, the "first and most recent" Putnam winners from Toronto; they both spoke. He says "the gap of fifty-five years melted away."

Abraham P. Hillman ('39), when he didn't do as well as he wanted to on the first Putnam Contest in 1938, organized a group of students at Brooklyn College to meet regularly and do problems. The following year he was a Putnam Fellow, as was one of his classmates. (Another Putnam Fellow that year, from M.I.T., was Richard P. Feynman, the physicist.) This experience convinced Hillman that he could influence performance by extending students' experience with problem solving. He was involved throughout his career in organizing contests and problem seminars and became Director of the Putnam Competition in 1973. Berlekamp, Larsen, and Vakil comment on their having organized problem seminars to prepare students for the Putnam. Kaplansky says coaching for the Putnam helps and he has been involved in coaching participants at Harvard, Chicago, and Berkeley. Hejhal also offered for some years Putnam type problem seminars at Columbia and Minnesota. Noam Elkies ('82, '83, '84) each year speaks at an undergraduate mathematics colloquium at Harvard, after he has reviewed the most recent Putnam, and addresses "at least one or two problems that lead to topics of wider mathematical interest."

Almost all of those contacted assert that they have a continuing interest in problems and the Putnam Competition in particular, trying the problems each year when they become available. Several indicated that they continue to solve and pose problems in the *American Mathematical Monthly* or *Mathematics Magazine*. Further, some of those contacted have served on the Putnam Questions Committee to make up problems for the Contest: Hillman, Hochster ('60), Kaplansky, and Larsen. Vakil says: "One real strength of the competition is that it attracts many people into mathematics, not just the winners. The beauty of the problems gives a glimpse of the beauty of mathematics in general. And I really see the competition as not a competition between individuals, but as a competition between the participants and the problems. Because the Putnam is so difficult, simply struggling with the problems for six hours is praiseworthy, and I consider getting anywhere on any of the problems an achievement."

*Respondents contributing to this article were Elwyn Berlekamp, University of California, Berkeley; Noam Elkies, Harvard University; Dennis Hejhal, University of Minnesota and the University of Uppsala; Abraham P. Hillman, University of New Mexico; Melvin Hochster, University of Michigan, Ann Arbor; Irving Kaplansky, University of Chicago and the Mathematical Sciences Research Institute, Berkeley; Jeff Lagarias, AT&T Labs; Michael Larsen, Indiana University, Bloomington; Bjorn Poonen, University of California, Berkeley; and Ravi Vakil, Stanford University. Those wishing to know more about Putnam Fellows are referred to the lists in the three volumes: The William Lowell Putnam Mathematical Competition: Problems and Solutions, published by the MAA in 1980, 1985, and 2002.*

# What We Have Learned From Our Undergraduate Research Program

*By Jacqueline A. Jensen and Julie C. Jones*

During the 2002–2003 academic year, we invited undergraduate students to present talks for the meeting of the Texas Section of the MAA. We were overwhelmed by the enthusiasm of our students, and surprised that we had nine volunteers for that first meeting. Since then, we have had students present papers at one other meeting of the Texas Section of the MAA and two MathFests, and have also had students present posters at EUReCA (Exhibit of Undergraduate Research and Creative Accomplishments) on the Sam Houston State University campus and at the Joint Mathematics Meetings in 2004.

Our students have never received course credit or been part of an organized research program, but they have continued to work with energy and vigor on projects, ranging from historical and biographical accounts of mathematics and mathematicians to "real" research problems. Two of the students have submitted their work for publication, and others are headed in that direction. As expected, our students have learned a great deal of mathematics and history. However, we have also learned many things, some of which are mathematical, but some of which are not. The following is a sampling.

We have learned that encouraging students to undertake this sort of project — just asking them to assemble a fifteen-minute talk — and allowing them to choose their topic will help them find an aspect of mathematics which inspires them. For instance, we had a student whose topic for the last meeting of the Texas Section of the MAA was "Hispanic Mathematicians." This allowed the student to seek out and find role models — many of whom are working in Texas, and at least one of whom attended her presentation. This provided the student with extra motivation and drive. The fact that she also won an award for best talk in her session didn't hurt either. We have also had students give talks about African-American and female mathematicians and this has always inspired them.

We have learned that our students will continue to volunteer and participate in these activities, despite the amount of work and stress involved in preparing a presentation and giving a good talk. We were a little afraid that after the first conference that we would have fewer volunteers. This was far from true! During the first year, nine students gave presentations at the Texas Section Meeting and five students gave talks at MathFest. During the second year, four students presented posters at the Joint Meetings, thirteen students gave talks at the Texas Section Meeting, and eight students attended MathFest, all of whom presented.

We have learned that our students will give wonderful presentations, no matter how discombobulated they seem beforehand. We have had students who were Kings and Queens of Procrastination, or who could not make it through a practice presentation without giggling, stand in front of a room of mathematicians and give phenomenal presentations — better than any practice version! We have learned to relax a little, and let the students prepare in their own way, while still having very high expectations and holding them to strict deadlines.

We have learned that holding soup, soft drink, and bake sales in the atrium of the math building can bring in money for most of the expenses required for an in-state trip to a conference. We have also learned that there are many other sources of funding to take students to meetings. Among these are our dean, the MAA, and the Tensor Foundation. It surprised us that when we asked for money, we often received money. Many university administrators believe that it is important to get students involved in the mathematical community, and they are willing to spend money to get this to happen.

Because we have been able to take many students to meetings, we have learned that our students can be dispersed throughout a large number of sessions at a conference. We send the students on a divide and conquer mission, then ask them to report to each other and to the mathematics club at the university about interesting presentations that they saw. This gives other members of the community access to their experiences, although not as fully as if they had attended themselves. During student reports given after MathFest 2004, we learned that a certain teaching method worked "only when the teacher knows the students intimately, as they do here — not 'intimately'… but this would work here". The method being discussed involved having a course with no exams — clearly a suggestion for our faculty.

We have learned that starting an undergraduate research program is harder than maintaining one. Two years ago, when we started our program, our students had never been to mathematics meetings and had never given talks on mathematics. As our undergraduate research program has continued to develop, we have recruited new students. Working with these new students has been much easier, because the veterans now help the rookies with their presentations.

We are not the only ones learning things from this experience. One student had a family member (her aunt) accompany her to the 2004 Joint Mathematics Meetings in Phoenix. Her aunt learned that neighborhoods don't have houses, groups aren't always made up of people, and "Lie" is pronounced "lee" not "lie" and is not a falsehood.

Most of all, we have learned how much fun it can be to watch enthusiastic students study mathematics. We have learned that our students are intelligent, motivated, dedicated, and willing to work as hard as we are. They are curious and want to know more than we can teach them in a class. They ask great questions, and spend hours and hours thinking about the answers. They are ready, willing, and able to do the work.

*Jacqueline A. Jensen and Julie C. Jones are both assistant professors of mathematics at Sam Houston State University.*

# FOCUS on Development: Robert P. Balles Mathematics Award Established to Honor IMO Team

*By Lisa Kolbe*

Robert P. Balles has established an award that will honor the student participants in the annual International Mathematical Olympiad (IMO) with a $1,000 Series I U.S. Savings Bond. Each Series I U.S. Savings Bond features a prominent American who has contributed to the history of this country. Appropriately, this particular denomination features Albert Einstein.

The IMO is a rigorous two day competition which had its roots in Romania in 1959. The U.S. has competed since 1974, having captured first or second place ten times. In 1994 the U. S. team did what no other team has ever done — they turned in six perfect papers, thus receiving six gold medals. Mr. Balles, fascinated and humbled by the extraordinary talents of the high school students who year after year compete in the world's most difficult exam, has established this annual award for the team members. His primary mission is to recognize and reward high achieving students of mathematics.

Robert P. Balles is a lifelong student of mathematics, former community college instructor, and retired businessman. He is an alumnus of Fordham University, Harvard University, and California State University. The MAA gratefully thanks Mr. Balles for his generosity in the recognition of the six extraordinary student mathematicians who compete annually on behalf of this country against the rest of the world's student mathematical power.

More information about the IMO can be found on the *American Mathematics Competitions* website. Additional giving opportunities are available. Contact Lisa Kolbe, Development Specialist (Office: 202-293-1170 or lkolbe@maa.org), to discuss ways in which you can contribute to MAA or to its American Mathematics Competitions program.

*Robert P. Balles*

*Lisa Kolbe is Development Specialist at the MAA. This is the first of a series of articles which will feature articles about extraordinary efforts and activities by members and friends of our mathematical community that enhance the MAA's mission in special ways.*

# Return of the CBMS Survey

*By David Lutzer*

Every five years since 1965, the Conference Board of the Mathematical Sciences (CBMS) has sponsored a national survey of undergraduate mathematical and statistical sciences in the nation's universities and colleges, both four-year and two-year. With National Science Foundation support, there will be a new CBMS survey in 2005, called CBMS2005.

The CBMS2005 project is supervised by a steering committee with members representing AMATYC, AMS, ASA, and MAA. CBMS2005 will use carefully designed random sampling to study curriculum, pedagogy, enrollment levels, number of bachelor's graduates, and faculty in the nation's undergraduate mathematical and statistical sciences departments and programs. In addition to continuing numerous long-term studies, CBMS2005 will investigate certain "topics of opportunity," i.e., issues identified as being of timely interest to the national mathematical and statistical community. The final survey report will follow the general pattern of the CBMS2000 report (available for free download at http://www.ams.org/cbms/).

The CBMS2005 steering committee will finalize the list of topics of opportunity early in 2005. Professional society committees and officers have suggested several topics as deserving of further study, including: the growing dichotomy (detected in CBMS2000) between doctoral and bachelor's-only mathematics departments, in the availability of advanced undergraduate courses; growth and quality-control issues associated with dual-enrollment courses; changes in calculus pedagogy; the mathematical education of pre-service K-8 teachers; the statistical background of faculty who teach statistics in mathematics departments; the apparent shift away from tenure-stream appointments in mathematical sciences departments and toward faculty appointments outside of the tenure stream; and self-assessment methods used by mathematical science departments. The steering committee welcomes further suggestions from the mathematics and statistics community about important issues that might become part of the 2005 survey. Please send suggestions to David Lutzer at Lutzer@math.wm.edu.

Increased coordination with the Joint Data Committee of AMS/ASA/IMS/MAA will allow considerable simplification of the questionnaires used in CBMS2005, compared to previous years. Survey questionnaires will be mailed to selected departments and programs in September 2005. There will be an intense follow-up effort in the fall of 2005, in the hope of matching the roughly 65% response rate for the CBMS2000 project. Responses will be analyzed in the spring and summer of 2006 and the final CBMS2005 report will be published by the American Mathematical Society in the spring of 2007.

## Writing for FOCUS

*By Fernando Q. Gouvêa*

As the MAA's news magazine, FOCUS belongs to the members of the Association. We are always looking for interesting articles by and for MAA members. Whether it's a cool bit of mathematics, an account of some recent event or accomplishment, or an article sharing a new insight about the profession, consider writing it up and sending it to us.

I often get asked about what kind of things I'm looking for. Here are some hints:

**FOCUS is a news magazine,** not a journal. Articles for us should be interesting and informal. Don't use footnotes, and only include a bibliography if you absolutely must. If at all possible, include photos and illustrations. Keep in mind that you are writing for a wide audience of MAA members.

**FOCUS articles are short.** With few exceptions, none of our articles runs more than two pages, which comes out to less than 2000 words. Most of our articles are actually considerably shorter, about half that size.

**We like mathematics.** That's why we're members of MAA. So don't be afraid to include some mathematics. On the other hand, we're not usually interested in publishing new proofs of old theorems (or, for that matter, new proofs of new theorems!). If you write should be about a new result, tell us the kind of thing you'd say to a colleague in the hallway to explain "what's really going on." If you write about a new result, embed it in a historical account or a personal reminiscence or something else. Think magazine, not journal.

**We like pictures.** If you have an interesting photo, we'd be glad to consider it for publication. If the central point is the picture, a one-paragraph caption will do instead of a full-blown article.

**Remember our series.** Over the years, we have started several article series. Many of them haven't had more than a couple of articles. But we're still interested. Send us a *What's the Best Textbook* article, or one about *What I Learned from…* Tell us about the latest technological toy you're excited about. Send us a bit of *Found Math* (a paragraph or less, from some news source or magazine or book that deals with mathematics in some interesting way).

**Consult the editor.** If you're wondering whether something will work, ask me!

**Don't format too much.** FOCUS has its own house style, so it's useless for you to add heavy formatting (fonts, font sizes, paragraph layout, etc.) to your article. You'll only make the editor spend time removing it. Also, avoid features (such as bulleted lists and enumerations) that don't work well in a format with narrow columns.

**Use email.** All of FOCUS's production is done electronically. Feel free to use email to send me things. Email attachments are acceptable, but be careful about huge attachments, because many email servers will refuse them.

**Be patient.** The editor of FOCUS wears lots of other hats. Sometimes it'll take a while for me to respond to your email, and it may take quite a while before an article appears. Please be patient. If you're worried that I forgot or lost your article, send me a note.

I'm looking forward to reading what you write!

## NSF Beat

*By Sharon Cutler Ross*

The National Science Foundation expects that projects it supports will have an impact beyond the original grant. In some cases, this goal is explicitly fostered as in the Adaptation and Implementation component of the Course, Curriculum, and Laboratory Improvement program of the Division of Undergraduate Education. Recent awards in the CCLI-A&I program support the adaptation and expansion of course materials from three projects, the development of two new courses, and three other initiatives.

Project INTERMATH, a 12-member consortium led by the United States Military Academy, has produced a set of Interdisciplinary Lively Application Projects, ILAPs. The ILAPs are being adapted and added to by new A&I grants to the University of Tulsa (S. Pomeranz, PI), the University of Colorado at Denver (L. Bennethum, PI), and Central Washington University (S. Boersma, PI). At Tulsa, the emphasis will be on strengthening connections among science, technology, engineering, and mathematics (STEM) through the development and use of ILAPs. These ILAPs will be linked to course-independent mathematics modules available on-line. The modules will also help coordinate curricula across the STEM disciplines.

The adaptation at Colorado will support spiraling of subject material, incorporate appropriate technology use, and utilize ILAPs developed with other disciplines. This will be the first non-traditional, urban, comprehensive institution to adapt INTERMATH for use by part-time students and faculty. A feature of the Central Washington project is the creation of an open-access website for ILAPs. New ILAPs will be produced for precalculus and calculus courses and be based on actual uses of mathematics in other disciplines.

The Oregon State University project (M. Flahive, PI) will adapt the Dartmouth course Introductory Combinatorics that uses guided group discovery for use in larger classes with more heterogeneous student preparation and motivations and with a slightly different syllabus. The aim is to maintain the discovery aspect while expanding discussion and encouragement. It is hoped that more exposition will reduce dependence on the instructor and foster the collaborative and communication skills needed by all mathematics majors, especially pre-service teachers.

Linear algebra materials developed in the ATLAST program will be adapted for use with WeBWorK system by the project at The College of New Jersey (T. Hagedorn, PI). Faculty involved will produce new exercises and assess the explanatory parts of the existing problems. The teaching and learning of linear algebra will benefit from the open-access WeBWorK library of these exercises and problem sets.

Projects at Olin College of Engineering (S. Spence, PI) and at Sweet Briar (B. Kirkwood, PI) will develop new courses. A bridge course in cryptology and coding theory at Olin will draw on NSF-funded projects at several schools that resulted in a textbook. The project team includes faculty at Babson, Wellesley, and Brandeis as well. Students from participating institutions will also work together. Sweet Briar's new course in biostatistics will complete the curriculum in two new minors, statistics and biomathematics. These are part of an initiative to integrate mathematics and biology. Undergraduate students at many schools are doing more research than before; the biostatistics course will prepare students to do research in the area of biology.

The Algebra Pathways project at San Diego Mesa College (M. Teegarden, PI) addresses the almost universal need to improve the mathematical skills of undergraduates, particularly those in high-risk populations. The purpose of the project is to adapt and evaluate three approaches: a specialized mathematics study skills course, a peer tutoring training program, and computer-aided instruction. The evaluation will focus on which strategies are most effective for specific student populations.

The Georgia Institute of Technology (E. Carlen, PI) will host a conference on a relevant mathematics curriculum for science and engineering students. Participants will explore the influence of the growing role of symbolic and numerical computation in research and the increased interdisciplinary nature of advances in the physical sciences and engineering.

The American Mathematical Association of Two-Year Colleges, AMATYC, (S. Wood, PI) has received an award to plan the digital products needed to accompany the updated AMATYC Standards 2006 document. The project will seek to determine the most important areas where products are needed, research media to select those most appropriate, and develop a production and dissemination plan to place these digital products within the reach of faculty.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# Calculus Qualms Comraderie

*By Marion D. Cohen*

Amy Babich's letter in the August/September issue about her calculus woes struck a chord in me, along with her suggestion that calculus not be a required first math course in college. I myself did *not* have calculus woes, but I can very well understand what she means.

There's lots of math besides calculus, and calculus certainly wasn't what first floated my math-boat. (Instead it was more "fundamental" stuff like "number tricks," points and lines, and some logic/philosophy ideas.) It's only in the past few centuries that calculus has been such an important part of math-on-earth. Of course, nowadays, calculus is such an integral (so to speak) part of mathematical *applications* that we tend to think of it as something that mathematics can't exist without, so of course in many people's minds it "has" to be the first math course that college students take.

In fact it's so truly tied in with applications that Amy Babich seems to divide math courses into "calculus" and "pure math." But calculus (without the applications) *is* pure mathematics, and, since every field in mathematics is (probably) connected with every other field in mathematics, calculus find its way into (and often much facilitates) pretty much every mathematical field. But again, calculus is so often *associated* with applied practical mathematics, and thought of and taught as a sort-of "get-down-to-business-no-fun" area. For this reason (among others) calculus involves negative vibes among many students.

I do think that Babich's suggestion is a good one. It might not be necessary for all students, but as she says, "it would do no harm to try it." As a "pure mathematics person," I tend, in my calculus teaching, to stress the pure-mathematics aspects of calculus (even while including the major application concepts), and how much it can tell us about functions, ordinary and pathological.

I would like to share a couple of poems that I wrote, a while back, while preparing to teach calculus for the first time (after having, for many years, taught "Advanced Engineering Math" — meaning Differential Equations, PDEs, Complex, and Vector Analysis — all subjects which use calculus but to teach which I didn't need to include, or even *know* (of course I did know.) the *concepts* of calculus. Of course, like most poetry, these poems aren't *literally* true. But Amy Babich's letter reminded me of them.

---

**Ambivalence towards Calculus**

I love the difference quotient.
I love all quotients.
And I love epsilon.
And lim.
And little arrows
when they aren't vectors.
But I don't know about slope.
Or integrals.
Especially definite integrals.
And when I love triangles
is when they don't mean increment.

But yes, I love difference-quotient.

But what about quotient-difference?

When I learned calculus, what did I not learn?
When I gained calculus, what did I lose?

Calculus makes math begin to become business.
Calculus makes math begin to become physics.
Maybe they invented calculus
to avoid the ultimate math.

*Marion Cohen teaches at the University of the Sciences in Philadelphia, PA.*

**Ambivalence towards Calculus #2**

I love setting f-prime equal to zero
and then hoping f-double-prime doesn't equal zero.
And I love that, give or take funny business
rel min and rel max must alternate.
And I love taking two increasing functions
and then, with but a hint of mischief, putting a minus sign between them.

But I also remember straight lines.
I mean straight lines without axes.
Straight lines without slope.
Straight lines that aren't tangents.
I remember proving that the shortest distance from A to B
is the shortest distance from B to A.
I also remember trying to prove Euclid's Fifth Postulate
and coming close
finding smaller and smaller triangles
little lights passing through a diamond
eensy weensy triangles
climbing up the wall.

Oh, I can deal with parabolas
and scallops and loops
and sin 1/x with its big and little fusses.
Yes, calculus says that curves are okay
and they are
(I agree).
But I haven't forgotten straight lines.
I keep coming back to straight lines.
I'm still not finished
with straight lines.

# Letters to the Editor

**Must Calculus Come First?**

I applaud Amy Babich's Call for Reform (Letters, August/September, p. 31). At the high school level, linear algebra is much more appropriate than calculus. One rough way of accessing how accessible mathematics is: propositions are easy, single predicates are hard, double predicates are out of sight. As soon as we say that for every epsilon there is a delta, which is the heart and soul of understanding calculus, we've lost most people. All you need in elementary linear algebra is a single predicate: every linear transformation can be modeled by matrix multiplication. So, I second the motion. Linear Algebra in high school, calculus in college. It would be a lot easier for me to explain what a linear operator was if my students knew some linear algebra.

Rick Norwood
East Tennessee State University

*See also Marion Cohen's article on page 21 of this issue.*

**OOOPS!**

As several readers pointed out to me, the student's solution to the problem that appeared on page 5 of the August/September issue is incorrect. The answer is indeed 3, but the student has identified the wrong three: the 1000th digit is the 3 from 370 and not from 371.

Mara Neusel
Texas Tech University

*We too heard from several FOCUS readers. We apologize for the mistake.*

**More Points and Counterpoints**

With 24 of my 39 years in the classroom spent at the high school level, I felt a need to respond to *Point: A Call for Action*, by Rick Norwood, and *Counterpoint: A Call for Reflection*, by Bill Berlinghoff, both in the August/September issue.

As for the lack of qualified teachers, I do agree that unqualified teachers exist in the classroom. But, in all my years of teaching, I have only once been aware of someone who actually taught something wrong. I was young, new in the public school classroom, and the teacher was the department chair; I chose to explain the correct way to the students and let it go. I have seen poor and ineffective teachers, but none who would not help a student if asked. I also agree with Berlinghoff that overwork is more of a problem in the public schools than incompetence. With three to five preparations, maybe one conference period, and in excess of 100 students, there is little time for a high school teacher to keep up with, e.g., the NCTM Standards and to plan how to adapt them to the classroom.

I do not agree with Norwood that there is a culture of incompetence that drives out competent teachers. I do feel, though, that older teachers can have a negative influence on new teachers in trying to bring them around to pre Standards teaching styles. Berlinghoff is probably correct in stating that university faculty in general do not place a high value on the preparation or professional development of K-12 teachers. However, fortunately, I have personally found university faculty very interested in K-12 education.

Norwood says we need safe schools — no one can argue with that! His suggestion for the MAA to give a seal of approval to texts and curricula is not necessary. As more teachers become familiar with the Standards and curricula that adhere to the Standards, more mathematically sound programs will be used in classrooms.

Now to the point that I wish to make. I feel that all the problems discussed in the Point and Counterpoint articles are due more to public opinion and parenting problems than any problems with the preparation and professional development of pre- and in-service teachers. We know what works and most of us are doing our best to bring high quality education to our students. Why then are incompetent teachers winding up in the classroom and why are teachers overworked?

We are all familiar with the adage: Those who can, do and those who can't, teach. I have been told that teachers are "lazy." And when school levies are up for vote, many letters to the editor say teachers are overpaid and "only" work nine months of the year. Of course, I do not see droves of people beating down the doors to the teacher colleges to get in on this cushy job! The general public does not hold the teaching profession in high regard. And where do they get this opinion? I feel that it comes from the home. It is currently politically incorrect to bring blame upon parents because they are the voters and hold the purse strings. But something must be done. Parents need to see to it that young children go to school well prepared. To me, that means students come to school healthy, curious, responsible, respectful, and with a high work ethic. These are personal attributes that must come from the home but that will serve them well in school. I think we would all be ecstatic and appreciative to have a classroom full of such students.

How do we get the message across to parents to become full partners with the academic community in accepting responsibility and assist in preparing students for academic life without being politically incorrect? I do not know. Bill Cosby has started a discussion that may lead to positive public dialogue. As a white colleague in education, I feel that what he has to say extends well beyond the African-American or low socioeconomic communities.

Both Norwood and Berlinghoff agree that teachers hold the future of our children in their hands. I also agree, but it would certainly be a job made a lot easier if we had positive parental help.

Raymond A. Heitger
Bowling Green State University

Professors Norwood and Berlinghoff are correct that there are numerous teachers who are teaching mathematics with an inadequate knowledge base, especially in elementary and middle schools. The *Counterpoint* article is correct that the picture is not as extreme as stated in the *Point* article. In my experience as a provider of professional development for teachers, most teachers are quite eager to gain knowledge that will help them do a better job of teaching mathematics. Too often the providers of teacher in-service training are university faculty, school district supervisors or consultants who do not have recent classroom experience in the grade levels taught by the in-service participants. At the very least, this causes a lack of credibility among the teachers. At the very worst the in-service curriculum does not match the actual needs of the teachers.

There are two significant problem areas that were not addressed in these articles. First, disruptive behavior must be removed from the classroom. It would not be allowed in a university classroom so why is it allowed in a pre-college classroom? The other problem occurs in many elementary and middle schools. Mathematics classes are populated by students with diverse mathematical abilities. A fifth grade class will have students who cannot add or subtract, students who can operate with fractions and everything in-between. Mathematics is a cumulative subject and one cannot divide unless one can add, subtract and multiply. These heterogeneous mathematics classes turn off the bright students, who are bored, and do not help the "low end" students to catch up. Some argue against ability grouping because the lower ability classes will have all the behavior problems. If we remove the discipline problems, a class of remedial students who are taught by a teacher with appropriate mathematical and pedagogical knowledge, who believes that the students can learn, will learn more than they would in a mixed-ability class. We do not place all college freshmen in a college algebra class in the interest of democratization. Some take calculus and some take elementary algebra. Why should fifth or sixth grade be any different?

Murray H. Siegel
Governor's School for Science
& Mathematics
Hartsville, SC

**Rick Norwood replies:**

As mathematicians, we know the danger of non-random samples. Of course the teachers who talk about the mathematics they teach and who take professional development courses are interested in learning more and in teaching well. But, according to Linda Darling-Hammond in *Supply, Demand, and Quality in Mathematics and Science Teaching*, "More than 12% of all new hires enter the classroom without any formal training; another 14% start work without meeting the teaching standards of their states." If you read just one book on the subject of the poor mathematical preparation of American teachers, read Liping Ma's *Knowing and Teaching Elementary Mathematics*. The evidence is there. Bad teaching is a serious problem in the United States today. It is not the only serious problem, but (unlike bad parenting) it is a problem that professional mathematicians can do something about. My school is doing something about it, by requiring Elementary Education majors to take nine hours of math courses that focus on a profound understanding of elementary mathematics.

Of course, I agree that Bill Cosby is doing good work, that teachers are often asked to do impossible jobs, that discipline in the classroom is essential. I do not agree that most of our textbooks are acceptable or that ability grouping is the answer. But those are big subjects for another day.

Rick Norwood
East Tennessee State University

**The Implications of "Found Math"**

The anecdote (on page 13 of November issue) recounting Governor Jeb Bush's answer to a student's trigonometry question is amusing but disheartening on more than one level. The Governor's response, "125, 90 and whatever remains on 180," is the amusing part because of the way it was wrong — namely guessing that one of the angles was greater than 90 degrees. Rather than guess something close or admit not knowing, he states something that is impossible. The student then says, "It's 30-60-90." The press has a good laugh. Next question, please.

Of course, it's *not* 30-60-90. Though it appears that no one noticed at the time, most of the press accounts quoted a U of Florida graduate student who gave (an approximation of) the correct answer.

Now for the disheartening part. This whole flap is about the FCAT exam which is required for high school graduation in Florida. I suppose the student was hoping to trip up Governor Bush and somehow show that most adults can't answer the math questions on these tests either. Is this question on the test? Apparently not. According to *The (Lakeland, FL) Ledger*, "This question requires the use of certain trigonometric relationships not tested on the FCAT," Education Commissioner Jim Horne wrote in a letter sent this week to nine Florida newspapers (see http://www.theledger.com/apps/pbcs.dll/article?AID=/20040715/NEWS/407150394).

"Certain trigonometric relationships?" It's one of the most basic trigonometric relationships that exists. This just reinforces the thought in people's minds that math is a mystery and no one would really be expected to answer that question anyway except maybe a graduate student or a professor. If the commissioner means that the most advanced geometry or trigonometry on the exam is the Pythagorean Theorem, then he should say so. Judging by the sample test on their web site, I'd say it probably is.

The student probably remembered 3-4-5 triangles, remembered hearing that 30-60-90 degree triangles had some special trigonometric property, maybe recalled pictures of the two triangles, and figured that they looked alike. The student had learned a collection of facts, but facts are not knowledge.

That no newspaper would dare print the exact answer to the problem: arcsin(3/5), arccos(3/5), and 90 degrees, because

so few of their readers would know what it means is disheartening too. However, the fact that a student could ask such a question, a governor could get it so wrong, the student gets it wrong too, and apparently no one in the room could catch it on the spot or even understand after the fact why the question is harder than the one the student probably wanted to ask (one that might actually be on a graduation exam) is the most disheartening part of all.

William J. Polley
Assistant Professor of Economics
Foster College of
Business Administration
Bradley University

**Credit Where Credit is Due**

I read the interview with Martin Gardner with great pleasure. I first read "Mathematical Games" as a high school sophomore when my biology teacher somehow arranged to get us cheap subscriptions to *Scientific American*. I continued to read it regularly for many years.

I hadn't known that Gardner was interested in magic. Learning that from your interview, I was not surprised that Gardner had had a long relationship with Persi Diaconis. Despite what Gardner said, that relationship began when Persi was a student at the City College of the City University of New York (CCNY), not at NYU. I never had Persi in any of my classes, but my colleagues spoke of him often enough and with such admiration that I knew his name even in the late sixties, when I was more pre-occupied with teaching my courses and completing my Ph.D. than learning the names of other people's students.

Persi has been quite generous in his thanks to City College for opening up mathematics to him. It would be a shame if the readers of FOCUS were led to believe that my colleagues had no part in it.

Michael Engber
Professor of Mathematics Emeritus
City College of CUNY

# Employment Opportunities

## ALABAMA

**UNIVERSITY OF ALABAMA, TUSCALOOSA**

The Department of Mathematics invites applications for one tenure-track position at the level of assistant professor in the area of Mathematics Education beginning in Fall 2005. Candidates must posses a doctorate in mathematics or a doctorate in mathematics education with a master's degree in mathematics (or the equivalent) by August 31, 2005. A commitment to excellence in teaching is required. Preference will be given to candidates who appear likely to establish a funded K-12 outreach program or whose research interests are concerned with curriculum reform at the K-12 or college level. It is expected that the successful applicant will, in addition to research, teach undergraduate and graduate courses and act as a liaison with the College of Education. The position is dependent upon funding and the salary will be commensurate with the successful candidate's experience. All candidates should provide a curriculum vita, publication list and research/outreach plans, and arrange for three letters of recommendation to be sent to Dr. Robert Moore, Chair of the Search Committee, Department of Mathematics, University of Alabama, Tuscaloosa, AL 35487-0350. Applications will be reviewed immediately and continue until the position is filled. The University of Alabama is an Affirmative Action/Equal Opportunity Employer. For more information about the department and university, visit our website: http://math.ua.edu/.

## ARIZONA

**ARIZONA STATE UNIVERSITY**

Mathematics Education

The Department of Mathematics and Statistics at Arizona State University invites applications for two tenure-track position at the Assistant or Associate Professor level, beginning in the fall semester of 2005. Applicants are required to have a Ph.D. in Mathematics Education or Mathematics, with a strong background in both areas.

Candidates must have a proven record of excellence in mathematics education research and teaching appropriate to rank. Candidates for an Associate level appointment must also have demonstrated potential for supervision and mentoring of graduate student research in mathematics education. The successful candidate will be expected to conduct research and publish in the area of mathematics education, actively pursue external funding opportunities for their research, and provide quality teaching of undergraduate and graduate courses. These courses will include graduate courses on research in mathematics education as well as undergraduate mathematics courses and courses for preservice and inservice secondary mathematics teachers. Candidates should expect to participate in on-campus interdisciplinary mathematics education activities and appropriate professional service.

The main campus of Arizona State University has approximately 57,000 students and is located in the rapidly growing metropolitan Phoenix area, which provides a wide variety of recreational and cultural opportunities. The Department of Mathematics currently has 49 full time faculty members and nearly 90 supported Graduate Students. The Department has high-quality and growing Ph.D., masters and undergraduate programs in mathematics education. Demand for mathematics education research and instruction at ASU is expected to continue to increase, and ASU has numerous opportunities for interdisciplinary collaboration. In particular, mathematics educators in the Department supervise Ph.D. students in the College of Education's Interdisciplinary Ph.D. program in Mathematics Education and are collaborating on grants with science educators in the College of Liberal Arts and Sciences as well as with mathematics and science educators in the College of Education.

ASU has a nationally regarded STEM education faculty with an outstanding record of securing major funding from the National Science Foundation and other agencies. Candidates who are interested in collaborating with this vibrant, interdisciplinary group are strongly encouraged to apply. Summer funding will initially be available to this position from currently funded projects involving collaborative research with other mathematics, science and engineering educators, and includes the development of graduate courses for secondary school mathematics teachers. STEM education at ASU receives recognition and support from top university leadership. The presence of the Center for Research on Education in Science, Mathematics, Engineering and Technology (CRESMET) and the Consortium for Science Policy at ASU provide exciting opportunities for interdisciplinary research.

Applicants must send i) a curriculum vitae, ii) an AMS Cover Sheet (available at http://www.ams.org/employment/coversheet-info.html, iii) a research agenda, iv) a statement of teaching philosophy v) (unofficial graduate transcripts, and vi) must arrange for at least three letters of recommendation to be sent to: Mathematics Education Search Committee, Department of Mathematics and Statistics, Arizona State University, PO Box 871804, Tempe, AZ 85287-1804

Review of the applications will begin on January 3, 2005, or if not filled weekly thereafter until the search is closed. AA/EOE

**THE UNIVERSITY OF ARIZONA**
Department of Mathematcs
Tucson AZ
The Department of Mathematics is seeking applications for tenure-track positions at either the Assistant, Associate or Full Professor level, which will begin in Fall 2005. By the time of appointment, candidates are expected to have a Ph.D. and excellent research record or potential, as well as a strong commitment to teaching. Rank and salary depend on the qualifications of the selected candidate(s).

The Department may also have postdoctoral or visiting positions for the 2005-2006 academic year (Ph.D. required).

Further information about the full range of the Department's research and educational activities may be found at http://www.math.arizona.edu.

Application review begins October 1, 2004 and continues as long as positions remain unfilled. Applications received before October 1, 2004 will receive the fullest consideration; applications received after January 2, 2005 are unlikely to be considered.

Please send a letter of interest (specifying position(s) applied for), an AMS Cover Sheet (which can be downloaded from http://www.ams.org/coversheet), a curriculum vitae with a list of publications, a statement of research interests, a statement of teaching experiences/philosophy and a minimum of three (3) letters of recommendation (enclose or arrange to be sent) to:

Personnel Committee
Department of Mathematics
University of Arizona
P.O. BOX 210089
Tucson, Arizona 85721-0089

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## CALIFORNIA

**CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA**
The Mathematics Department invites applications for two tenure track positions, one in Mathematics Education and one in Statistics, both at the Assistant or Associate Professor, beginning September 2005. To be considered in the initial review, complete applications are due by 12/8/04 for Mathematics Education and 1/20/05 for Statistics. The search continues until closed. For information about qualifications or the application procedure, visit www.csupomona.edu/~math/position, or contact the Faculty Search Committee, Mathematics Department, Cal Poly Pomona, 3801 W. Temple Ave., Pomona, CA 91768-4007; 909-869-4008; Fax: 909-869-4904; math@csupomona.edu. AA/EEO.
California State University, Fresno
The Department of Mathematics at California State University, Fresno is seeking applicants for a tenure-track faculty position in Mathematics Education (Assistant/Associate Professor/Conversion ABD) beginning in Fall 2005. For complete position description and application details visit http://www.csufresno.edu/aps/vacancy/05TSM43MathematicsEd.pdf

**CALIFORNIA STATE UNIVERSITY, FRESNO**
The Department of Mathematics at California State University, Fresno is seeking applicants for a tenure-track faculty position in Mathematics Education (Assistant/Associate Professor/Conversion ABD) beginning in Fall 2005. For complete position description and application details visit http://www.csufresno.edu/aps/vacancy/05TSM43MathematicsEd.pdf

## CONNECTICUT

**UNITED STATES COAST GUARD ACADEMY**
Faculty Position
Department of Mathematics
The United States Coast Guard Academy, located in New London, Connecticut, invites applications for one full-time, tenure-track position in the Department of Mathematics beginning August 2005. The primary responsibility for the position is to teach undergraduate courses in Mathematics, Operations Research, and Statistics leading to a Bachelor of Science degree in Operations Research and Computer Analysis.

Candidates should possess a Ph.D. in Operations Research, Statistics, or a related field. Teaching experience at the college level is preferred. Salary/rank will be commensurate with qualifications. Some citizenship restrictions may apply.

Individuals wishing to be considered should submit a letter of application summarizing specific qualifications, a current curriculum vitae, academic transcript(s), a statement of teaching philosophy, and three letters of reference to:

Mathematics Search Committee
c/o Prof. Kathy Krystinik (dm)
U.S. Coast Guard Academy
27 Mohegan Avenue
New London, CT 06320-8101.

Complete applications received by 31 December 2004 will receive first consideration. Complete applications received after this date and before 31 January 2005 may or may not be considered depending on staffing needs.

The United States Coast Guard Academy is a highly selective federal military college, providing a rigorous undergraduate program along with the professional education and training to prepare young men and women for careers as commissioned officers in the United States Coast Guard. The United States Coast Guard is an Equal Opportunity, Affirmative Action Employer. Women and minority candidates are encouraged to apply.

## GEORGIA

**COLUMBUS STATE UNIVERSITY**
The Mathematics Department at Columbus State University invites applications for a tenure track position beginning August 2005. Responsibilities include teaching four courses per semester, academic advising, service for the department and for the university, and scholarship. Required: excellent communication skills and a Ph.D. in math/statistics by the time of appointment. Preferred: teaching experience, potential for continued research, and ability to contribute to our newly designed applied math program with tracks in actuarial science and statistics. Information about the position and the university can be found on the web at http://math.colstate.edu. Review of applications begins November 29, 2004. As an AA/EEO employer, CSU is committed to diversity and equality in education and employment

## IDAHO

**BOISE STATE UNIVERSITY**
Assistant Professor
Boise, Idaho
Successful candidate to teach undergraduate and graduate students in the Department of Mathematics. Advise and mentor students. Conduct research and actively publish scholarly articles. Serve the University through committee assignments, participation in professional societies and organization, and involvement with professional presentations.

Qualified candidates must have a Ph.D. in Statistics plus knowledge and skill in semi-parametric and non-parametric regression, Bayesian analysis, modeling using wavelets and statistical computing.

To apply, send a letter of application containing a summary of research and teaching interests, a vita and graduate transcripts to:

Alan R. Hausrath, Chair
Department of Mathematics
Boise State University
1910 University Drive,
Boise, Idaho 83725-1555

and arrange to have three letters of recommendation, at least one of which addresses teaching, sent to the same address. The application period closes on January 15, 2005.

Boise State is an EEO/AA institution and applications from women and members of minority groups are especially encouraged. For more information call 208-426-1172 (tty 208-426-1436)(fax 208-426-1356) or send e-mail to hausrath@math.boisestate.edu

## ILLINOIS

**UNIVERSITY OF ILLINOIS AT CHICAGO**
Department of Mathematics, Statistics, and Computer Science
The Department has active research programs in centrally important areas of pure mathematics, computational and applied mathematics, combinatorics and computer science, statistics, and mathematics education. See http://www.math.uic.edu for more information.

Applications are invited for the following positions, effective August 16, 2005.

**Tenure track positions.** Candidates in all areas of interest to the Department will be considered. The position is at the Assistant Professor level. Applicants must have a Ph.D. or equivalent degree in mathematics, computer science, statistics, mathematics education or related field, an outstanding research record, and evidence of strong teaching ability. The salary is negotiable.

**Research Assistant Professorships**. These are non-tenure track positions, normally renewable annually to a maximum of three years. These positions carry a teaching responsibility of one course per semester, and the expectation that the incumbent play a significant role in the research life of the Department. The salary for AY 2004-2005 for these positions is $48,000, the salary for AY 2005-2006 may be higher. Applicants must have a Ph.D. or equivalent degree in mathematics, computer science, statistics, mathematics education or related field, and evidence of outstanding research potential.

Send vita and at least three (3) letters of recommendation, clearly indicating the position being applied for, to: Appointments Committee; Dept. of Mathematics, Statistics, and Computer Science; University of Illinois at Chicago; 851 S. Morgan (m/c 249); Chicago, IL 60607. No e-mail applications will be accepted. To ensure full consideration, materials must be received by January 1, 2005. However, we will continue considering candidates until all positions have been filled. Minorities, persons with disabilities, and women are particularly encouraged to apply. UIC is an AA/EOE.

## INDIANA

**INDIANA UNIVERSITY**
**PURDUE UNIVERSITY**
**INDIANAPOLIS**
The IUPUI Department of Mathematical Sciences **anticipates**, two to four tenure track positions, (pending final budgetary approval), in mathematics (pure or applied), mathematics education and in applied statistics, beginning 8/2005. A Ph.D. and a demonstrated potential for excellence in research and in teaching are required. Rank and salary will be commensurate with qualifications. For more information about each of the positions, as well as on the application process, see www.math.iupui.edu/news/employment/, or send letter of interest, AMS form, CV, statements on research and on teaching, and 4 letters of recommendation (including one on teaching) to the Search & Screen Committee, Department of Mathematical Sciences, IUPUI, 402 North Blackford Street, LD270, Indianapolis, IN 46202-3216. Screening will begin on 12/15/2004, and will continue until the positions are filled. IUPUI is an EO/AA Employer, see: www.iupui.edu.

## IOWA

**THE UNIVERSITY OF IOWA**
Actuarial science tenure-track assistant professor starting 8/05. Ph.D. required. Actuarial Fellowship or Associateship highly preferred. Industrial experience helpful. Duties include teaching and research in actuarial science and/or financial mathematics, involvement in Ph.D. program, and supervision of Ph.D. students. Selection begins 12/1/04. CV, three reference letters, and transcript for recent Ph.D.s to Actuarial Search, Statistics & Actuarial Science, Univ. of Iowa, Iowa City, IA 52242-1409. http://www.stat.uiowa.edu; Email: actuarial-search@stat.uiowa.edu Women and minorities are encouraged to apply. The University of Iowa is an Affirmative Action Equal Opportunity Employer.

## MASSACHUSETTS

**STONEHILL COLLEGE**
The Department of Mathematics at Stonehill College invites applicants for a faculty appointment at the level of Associate Professor or Professor to teach courses in mathematics and to serve as Department Chair.

Stonehill's long-range plan involves significant investment in science and mathematics. Thus, we seek an applicant with a commitment to undergraduate teaching and with administrative experience appropriate for heading a small but expanding mathematics department during a period of institutional transition.

The applicant should be professionally active and sincerely interested in working for students and with colleagues to foster student and faculty development and success.

Candidates should also have broad mathematical interests and be able to successfully teach both major and general education courses: more specifically, candidates should be interested in teaching Geometry, Logic, Algebra or Statistics and in conveying the history and significance of mathematics, as well as its methods and results.

A doctorate in mathematics and successful experience teaching at the undergraduate level is required. Candidates should submit a letter of application, a vita, three letters of recommendation, a statement of teaching and administration philosophies and all degree transcripts to: Dr. Katie Conboy, Vice President for Academic Affairs, Stonehill College, 320 Washington St., Easton, MA 02357.

Review of applications will begin November 1, and continue until an appointment is made. We will have representatives in Atlanta to interview available candidates.

Ranked #1 among the top regional comprehensive colleges in the North by *U.S. News & World Report*, Stonehill is a competitive Catholic College, located 25 miles south of Boston and within commuting distance of Providence, R.I.

Stonehill is an equal opportunity employer committed to diversity.

For more information about the position visit the department website at www.stonehill.edu

**WILLIAMS COLLEGE**
The Williams College Department of Mathematics and Statistics invites applications for one tenure track position in mathematics, beginning fall 2005, 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, 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.

To apply, please send a vita and have three letters of recommendation on teaching and research sent to the Hiring Committee, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. Teaching and research statements are also welcome. Evaluations of applications will begin on or after November 15 and will continue until the position is filled. Williams College is dedicated to providing a welcoming intellectual environment for all of its faculty, staff and students; as an EEO/AA employer, Williams especially encourages applications from women and minorities. For more information on the Department of Mathematics and Statistics, visit http://www.williams.edu/Mathematics.

**WILLIAMS COLLEGE**
The Williams College Department of Mathematics and Statistics invites applications for one tenure track position in statistics, beginning fall 2005, 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, 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.

To apply, please send a vita and have three letters of recommendation on teaching and research sent to the Hiring Committee, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. Teaching and research statements are also welcome. Evaluations of applications will begin on or after November 15 and will continue until the position is filled. Williams College is dedicated to providing a welcoming intellectual environment for all of its faculty, staff and students; as an EEO/AA employer, Williams especially encourages applications from women and minorities. For more information on the Department of Mathematics and Statistics, visit http://www.williams.edu/Mathematics.

## MISSOURI

**WILLIAM JEWELL COLLEGE**
Assistant Professor of Mathematics
The Department of Mathematics and Physics at William Jewell College invites applications for a tenure-track position in mathematics at the assistant professor level beginning August 2005. A Ph.D. in Mathematics or Applied Mathematics by August 2005 is required. Area of specialty is open; however, potential for interdisciplinary collaboration with the ability and desire to mentor students in scholarly activity is preferred. Candidates should demonstrate strong commitment to excellence in teaching. Successful applicant will teach a full range of undergraduate courses.

Candidates must submit AMS standard cover sheet, letter of application, CV, statement of teaching philosophy, statement of research goals with a brief plan for mentoring of undergraduates in scholarly activity, and arrange three letters of reference (including a letter concerning teaching) to be sent to

Mathematics Search Committee,
WJC Box 1017
William Jewell College
Liberty, MO 64068.

Review of applicants will begin December 17, 2004 and continue until the position is filled. NO E-MAIL APPLICATIONS ACCEPTED. For more information about the college see http://www.jewell.edu.

William Jewell College, among the oldest colleges west of the Mississippi River, is one of a selected group of 218 liberal arts colleges named by the Carnegie Foundation for the Advancement of Teaching and included among "America's Best Colleges" by *U.S. News and World Report*. William Jewell offers a liberal arts education within a distinctively Christian context.

## NEW HAMPSHIRE

**DARTMOUTH COLLEGE**
John Wesley Young
Research Instructorship
The John Wesley Young Instructorship is a postdoctoral two-year appointment intended for promising Ph.D. graduates with strong interests in both research and teaching and whose research interests overlap a department member's. Current research areas include applied mathematics, combinatorics, geometry, logic, non-commutative geometry, number theory, operator algebras, probability, set theory, and topology. Instructors teach four ten-week courses distributed over three terms, though one of these terms in residence may be free of teaching. The assignments normally include introductory, advanced undergraduate, and graduate courses. Instructors usually teach at least one course in their own specialty. This appointment is for 26 months with a monthly salary of $4,350.00, and is not renewable. Salary includes two-month research stipend for Instructors in residence during two of the three summer months in 2006 and 2007. To be eligible for a 2005-2007 Instructorship, candidate must be able to complete all requirements for the Ph.D. degree before September, 2005. Applications may be obtained at http://www.math.dartmouth.edu/recruiting/. Or, submit a letter of application, curriculum vitae, graduate school transcript, thesis abstract, statement of research plans and interests, and at least three, preferably four, letters of recommendation to Donna Black, Department of Mathematics, Dartmouth College, 6188 Bradley Hall, Hanover, New Hampshire 03755-3551. At least one referee should comment on applicant's teaching ability; at least two referees should write about applicant's research ability. Applications received by January 5, 2005 receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to diversity and strongly encourages applications from women and minorities.

**DARTMOUTH COLLEGE**
The Department of Mathematics anticipates a tenure-track opening with initial appointment in the 2005-2006 academic year. The position is for an applied mathematician at the rank of Assistant Professor. In extraordinary cases, an appointment at a higher rank is possible. Successful candidate should have demonstrated ability to work across disciplines; particularly, it is expected that he or she seek out and strike up collaborations across campus with departments such as biology, physics, computer science; he/she should also aggressively seek funding in his/her area of research. Current applied interests include (but not limited to) imaging, signal processing, computational number theory, statistical physics, stochastic processes, quantum computing and computational biology and are receiving funding from various sources including NSF and NIH. Candidates for the position must be committed to outstanding teaching and interaction with students at all levels of undergraduate and graduate study.

To create an atmosphere supportive of research, Dartmouth offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence and flexible scheduling of teaching responsibilities. The teaching responsibility in mathematics is three courses spread over three of four ten-week terms.

To apply for the position, applications may be obtained at the math department website: http://www.math.dartmouth.edu/recruiting/. Or, send a letter of application, curriculum vitae, and a brief statement of research results and interests, and arrange for four letters of reference, at least one of which specifically addresses teaching, to be sent to Donna Black, Recruiting Secretary, Department of Mathematics, Dartmouth College, 6188 Bradley Hall, Hanover, New Hampshire 03755-3551. Applications received by December 15, 2004 will receive first consideration.

Dartmouth College is committed to diversity and strongly encourages applications from women and minorities. Inquiries about the progress of the selection process may be directed to Dan Rockmore, Recruiting Chair.

**DARTMOUTH COLLEGE**
The Department of Mathematics anticipates a tenure-track opening with initial appointment in the 2005-2006 academic year. In extraordinary cases, an appointment at a higher rank is possible. Preference given to candidates working in either set theory/logic or areas of algebra with connections to existing research interests in the department including computational algebra, algebraic and arithmetic geometry, representation theory, coding theory and algebraic combinatorics. Candidates for the position must also be committed to outstanding teaching and interaction with students at all levels of undergraduate and graduate study.

To create an atmosphere supportive of research, Dartmouth offers new faculty members grants for research-related expenses, a quarter of sab-

batical leave for each three academic years in residence and flexible scheduling of teaching responsibilities. The teaching responsibility in mathematics is three courses spread over three of four ten-week terms.

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## NEW JERSEY

**RAMAPO COLLEGE OF NEW JERSEY**
Assistant Professor of Mathematics
Tenure-Track, Fall 2005
Ramapo College of New Jersey is located in the beautiful foothills of the Ramapo Valley Mountains approximately 25 miles northwest of New York City. Ramapo College is a comprehensive institution of higher education dedicated to the promotion of teaching and learning within strong liberal arts based curriculum, thus earning the designation "New Jersey's Public Liberal Arts College." Its curricular emphasis includes the liberal arts and sciences, social sciences, fine and performing arts, and the professional programs within a residential and sustainable living and learning environment. Organized into thematic learning communities, Ramapo College provides academic excellence through its interdisciplinary curriculum, international education, intercultural understanding and experiential learning opportunities.

JOB DESCRIPTION: Responsibilities encompass a wide range of undergraduate mathematics courses, and the teaching and development of General Education mathematics courses.

REQUIREMENTS: Ph.D. in Mathematics by September 1, 2005, is required. College teaching experience preferred.

Faculty members are expected to maintain active participation in research, scholarship, college governance, service, academic advisement and professional development activities.

All applications must be completed online at: http://www.ramapo.edu/hrjobs. Attach resume, cover letter, statement of teaching philosophy, research interests and a list of three references to your completed application. Since its beginning, Ramapo College has had an intercultural/international mission. Please tell us how your background, interest and experience can contribute to this mission, as well as to the specific position for which you are applying.

Review of applications will begin immediately and continue until the position is filled. Position offers excellent state benefits. To request accommodations, call (201) 684-7734. Dr. Lawrence D'Antonio, Search Committee Chair. Ramapo College of New Jersey, 505 Ramapo Valley Road, Mahwah, NJ 07430

"New Jersey's Public Liberal Arts College"

Ramapo College is a member of the Council of Public Liberal Arts Colleges (COPLAC), a national alliance of leading liberal arts colleges in the public sector. EEO/AFFIRMATIVE ACTION.

## NEW YORK

**SIENA COLLEGE**
Assistant Professor
Mathematics Department
The Mathematics Department invites applications for at least one tenure-track assistant professor position starting Fall 2005. A PhD in Mathematics or Statistics is required. A strong commitment to undergraduate teaching and excellent communications skills are also required. Preference will be given to candidates with an established research program.

The department has 7 full-time faculty and more than 50 majors. The department offers B.A. and B.S. degrees, supports secondary education certification for its majors, offers courses to satisfy the College's quantitative reasoning core requirements and offers courses to support the requirements of other majors in the School of Science.

Our facilities include a dedicated high tech classroom, a laboratory with 16 Macintosh computers running *Mathematica*, a departmental server, and other software. We have a library-lounge for student and faculty use.

Siena, a liberal arts college, has a Franciscan and Catholic tradition, and an undergraduate enrollment of 3000 students. The average class size is less than 20 students; the maximum class size is 35. Siena is located just north of Albany in upstate New York. There are many cultural, professional, and recreational opportunities in the area.

To apply, send a resume, three letters of recommendation, and a statement of teaching and research interests to: Dr. Emelie Kenney, Siena College, 515 Loudon Road, Loudonville, New York 12211-1462. Email: kenney@siena.edu

**Siena College is an Equal Opportunity Employer and Encourages Applications.** ***From all Qualified Candidates.***

**SUNY FREDONIA**
SUNY Fredonia, Applied Mathematics: Tenure track position at the rank of Assistant Professor. A Ph.D. (or ABD) in Mathematics is required. For more information, visit our website at www.fredonia.edu/department/math. Review of applications will begin December 10 and continue until the position is filled. Send vita, statement of philosophy of teaching and research plan, unofficial transcript of graduate work, and three letters of recommendation to Joseph Straight, Chair, Applied Mathematics Search Committee, Department of Mathematical Sciences, SUNY Fredonia, Fredonia, NY 14063. SUNY Fredonia is an Equal Opportunity/Affirmative Action employer. We actively seek and encourage applications from minorities, women, and people with disabilities.

**SUNY POTSDAM**
SUNY Potsdam invites applications for one anticipated full-time tenure track position in the Mathematics Department, effective September 1, 2005, at the rank of Assistant Professor. Responsibilities of the position include teaching twelve hours per semester of undergraduate through first year graduate courses in mathematics. Ph.D. in any area of mathematics with a strong interest in and preparation for teaching undergraduate major mathematics courses required. Candidates from all areas are encouraged to apply. Applications, which must include a letter of interest, a teaching statement, a curriculum vitae, three letters of recommendation (at least one of which addresses teaching experience and abilities), and a transcript (a copy is acceptable) should be sent to Dr. Joel Foisy, Department of Mathematics, SUNY Potsdam, Potsdam, NY 13676 (foisyjs@potsdam.edu). To ensure full consideration, complete applications must be received by January 18, 2005. For information about the College and the Department, you may go to http://www.potsdam.edu. SUNY Potsdam is an equal opportunity employer committed to excellence through diversity.

## PENNSYLVANIA

**PHILADELPHIA UNIVERSITY**
Assistant Professor of Mathematics
Philadelphia University invites applications for a tenure-track position as assistant professor of Mathematics to start in Fall 2005. Mathematics is housed in the School of Science and Health. All mathematics courses support the general education, science, and engineering curricula. There is no major in mathematics at the University. Applicants must have a Ph.D. in mathematics or mathematics education. Excellent teaching, especially to non-science-majors, is crucial. Being conversant with trends in pedagogy is strongly encouraged. You are expected

to have a research program and participation by undergraduate students in your research is a plus.

Philadelphia University, founded in 1884, is a private university with 3,100 part- and full-time students from 38 states and 42 countries. The University offers more than 40 undergraduate and graduate degree programs leading to the bachelor of science, bachelor of architecture, master's degrees and a doctoral degree in Textile Engineering and Science. Academic programs encompass architecture, design, business, engineering, textiles, fashion, science and health.

Submit letter of application, curriculum vitae, statement of teaching philosophy, research interests, and names, addresses, E-mail addresses, and telephone numbers of three professional references to:
Prof. Matt Baker
Interim Dean, School of Science and Health
Philadelphia University
Philadelphia, PA 19144
Applications will be reviewed starting October 2004 until the position fills.
Philadelphia University is an Equal Opportunity Institution. http://www.PhilaU.edu

## TENNESSEE

**UNIVERSITY OF TENNESSEE**
The Department of Mathematics seeks to fill one tenure-track assistant professorship with an Outreach Mathematician (OM). Candidates must have either a doctorate in mathematics or a doctoral degree in another discipline plus a master's degree in Mathematics. Also required is a clear commitment to outreach activities. Some postdoctoral experience is preferred. Employment begins August 1, 2005.

In addition to exhibiting excellence in teaching and maintaining an active program of scholarly activities, the successful candidate will concentrate on making connections with high schools and/or community colleges. The expectations about research activities include engagement in scholarly publications related to outreach efforts; writing successful grant proposals to fund teacher enhancement workshops and/or related events which improve the teaching and learning of mathematics; being involved in mathematics education reform across the state or the Appalachian region; providing leadership to the department for the pre-service and in-service training of K-12 mathematics teachers and for ongoing outreach efforts; and serving on committees for mathematics education student in the master's and doctoral programs.

Interested applicants should arrange to have a vita, three reference letters, a statement of accomplishments, qualifications, plans for outreach activities, and evidence of quality teaching sent to Professor Robert J. Daverman, OM Search, Mathematics Department, University of Tennessee, Knoxville, TN 37996-1300. Electronic applications are not acceptable. Use of the recent AMS application form is encouraged. Review of applications will begin December 1 and will continue until the position is filled.

The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services.

## TEXAS

**EXECUTIVE DIRECTOR**
**THE LEGACY OF R. L. MOORE PROJECT**
Austin, Texas
The Legacy of R. L. Moore Project, a nonprofit organization located in Austin, TX, supporting mathematical education through inquiry-based learning, seeks a full-time Executive Director. Applicants should have a strong mathematics background (preferably a current or former faculty member in Mathematics or Science), including recent administrative or leadership experience in academic societies or professional associations. Some experience in "entrepreneurial" (i.e. sole proprietorship or small business) type management accomplishment is desirable – such as managing a research "team".

**Duties:** Strong "hands-on" managerial leadership and personal involvement carrying out non-routine activities is essential. The Executive Director will coordinate workflow and assign "priority" while working actively with a small staff and a large, diverse group of consultants/volunteers/constituency members and outsiders. The candidate should have exceptional communication, organizational and executive skills as well as an ability to articulate a mission-focused vision to diverse constituencies. It is essential that the Executive Director be able to manage actively and conclude multiple non-routine projects on a timely basis.

**Requirements:** Advanced degree in mathematics or science desirable, with over 10 years educational/administrative experience. The prospective Executive Director must demonstrate accomplishment in combining leadership with administrative controls and support, while sustaining entrepreneurial initiatives. Applicants must be adaptable and flexible to rapidly changing priorities; a self-starter and self-responsible individual with a successful history working with both small groups and liaison/"active" membership with larger organizations/associations.

Excellent benefits (health, life, and long-term disability insurance, retirement, etc.) and stimulating cross-disciplinary working environment with generous compensation including an early merit bonus for exceptional performance.

*The Legacy of R. L. Moore Project is an equal opportunity employer. U. S. Citizenship required.*

**Email cover letter and resume to:** personnel@edu-adv-foundation.org

**ST. MARY'S UNIVERSITY OF SAN ANTONIO**
The Department of Mathematics at St. Mary's University of San Antonio invites applications for two tenure-track faculty positions at the assistant professor level beginning fall 2005. Ph. D. in mathematics, mathematics education, statistics, or applied mathematics, quality teaching of various undergraduate courses, and evidence of scholarly activities required. All areas considered. Review of applications will begin immediately and continue while positions are open. Send application letter, resume, statements of teaching and research interests, and three letters of reference to: Dr. Mary Wagner-Krankel, Department of Mathematics, St. Mary's University, San Antonio, TX 78228-8560. St. Mary's University is an equal opportunity/affirmative action employer

## WISCONSIN

**WISCONSIN LUTHERAN COLLEGE**
Mathematical Sciences Department
Inquiries and nominations are invited for a tenure-track position at the assistant/associate professor level to begin fall 2005. Teaching responsibilities include mathematics courses from calculus through upper-level in a four-year undergraduate curriculum. Teaching load is 10-12 credits consisting of two or three preparations per semester.

A Ph.D. in mathematics, applied mathematics, or statistics is required. Candidates must have excellent communication skills and must demonstrate the potential for outstanding teaching. A commitment to active scholarship, which may include student participation, is expected. Qualifications and interest in teaching upper-level courses in applied mathematics or statistics are desirable.

Please send a cover letter discussing background, interests, and teaching philosophy in the context of a confessional Lutheran liberal arts college; curriculum vitae; and three letters of recommendation including one pastoral reference discussing personal qualities to

Chair, Mathematical Sciences
Wisconsin Lutheran College
8800 West Bluemound Road
Milwaukee, WI 53226.

The position will remain open until filled. For more information visit www.wlc.ed hr/employment_wlc.html.

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Contact the MAA Advertising Department at 703-706-0386, fax: (703) 836-2031, Ads may be sent via email to rhall@mgilists.com.

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**Mathematical Association of America**
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