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Teaching Time Savers: Some Advice on Giving Advice

Michael E. Orrison Jr.
Harvey Mudd College

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FOCUS

Volume 26 Issue 9

Inside

On the cover: The golden icosahedron on the cover was offered for sale to the MAA. See page 13 for the full story. Photograph provided by Sebastian Thewes.

Birth Announcement: It's a SIGMAA!

We are proud to announce the arrival of a new Special Interest Group of the Mathematical Association of America, on Mathematical and Computational Biology, henceforth to be known as BIO SIGMAA. This SIGMAA was officially born at MathFest in August 2006, after the usual nine month gestation period.

The BIO SIGMAA charter begins:

The focus of BIO SIGMAA is on the pedagogy of mathematical and computational biology at the undergraduate level. This includes the support of curriculum development, faculty development, and undergraduate research in those fields. The purpose of BIO SIGMAA is to support those activities that will enhance the exchange of ideas and access to educational opportunities among undergraduates and undergraduate faculty in the fields of mathematical and computational biology. This necessarily includes interaction with all concerned departmental structures (i.e. mathematics, computer science, biology, and other related departments) and also institutions and organizations that feed into, and from, the undergraduate programs.

The first BIO SIGMAA Business Meeting and Reception will take place on Saturday, January 6, 2007, from 5:45 PM to 7:00 PM, at the Joint Mathematics Meeting in New Orleans.

Dozens of talks and other interesting sessions relating to mathematical and computational biology are scheduled for the Joint Meetings, including an MAA panel, an MAA CUPM subcommitee discussion and an MAA minicourse, as well as AMS & SIAM events. BIO SIGMAA is the official sponsor of a three-part MAA session on *Integrating Mathematics and Biology in Undergraduate Education,* to be held on Friday, January 5, 2007, from 8:00 AM to 10:55 AM, Sunday, January 7, 2007, 4:15 PM to 6:10 PM, and Monday, January 8, 2007, 8:40 AM to 10:35 AM.

Questions regarding membership in BIO SIGMAA or the goals and activities of BIO SIGMAA, should be directed to the BIO SIGMAA Chair, Eric Marland at marlandes@appstate.edu. The BIO SIGMAA web site is at http://www.maa.org/SIGMAA/biosigmaa.

MAA Study Tour to Celebrate Euler's 300th

By Lisa Kolbe

To help commemorate Leonhard Euler's 300th birthday, the MAA Mathematical Study Tour for 2007 will be an Euler tour, visiting his birthplace, Basel, and the two cities in which he spent his working life, St. Petersburg and Berlin. The Study Tour will happen on July 1-14, 2007. There will be five full days in St. Petersburg, with tours of the places where Euler lived and worked and the cemetery where he is buried. We will visit the Academy of Sciences to see their archive of Euler letters and manuscripts and meet with Russian mathematicians at the St. Petersburg Mathematical Society and with teachers who work with talented youth.

In two days in Basel, we will visit the church where Euler's father was pastor and hear about how work is proceeding on the massive collection of Euler's collected works. There will also be visits to sites associated with Johann Bernoulli, Euler's teacher at the University of Basel.

In four full days in Berlin, we will not only visit the Berlin Academy where Euler worked, but also learn about mathematics in the time of Weierstrass at the University of Berlin (now the Humboldt University). In addition, we will meet with mathematicians in Berlin today, to discuss common issues in mathematics education, and be able to enjoy a musical performance at one of Berlin's many musical venues.

The tour leaders will be Victor J. Katz, Professor Emeritus of Mathematics, University of the District of Columbia, and Phyllis Katz, founding Executive Director (retired) of Hands On Science Outreach, Inc. In each city, Phyllis Katz will provide interested participants with ways to use the tour experience in teaching. She will help you formulate plans to use your photographs and other information to assist students in developing projects involving mathematics history. She will also provide suggestions on how visits to museums can supplement formal teaching, and on how Euler's biography,

as well as that of other mathematicians, can help inspire and motivate mathematics learning. In addition, participants with expertise in any area related to the tour are encouraged to contact Victor Katz personally to discuss the possibility of sharing their knowledge with the other tour members.

See http://www.maa.org/ euler_trip/ for full details, itinerary and registration. The number of travelers for this tour is limited to 35.

2007 Haimo Award Winners to Speak at the January Joint Meetings

By Colin Adams

The Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics recognizes excellence at the national level in the teaching of mathematics. The 2007 winners are Michael Starbird from the University of Texas at Austin, Jennifer Quinn of the Association for Women in Mathematics, and W. Gilbert Strang of the Massachusetts Institute of Technology. As happens every year, the winners have been invited to speak on "the secrets of their success" at the Joint Mathematics Meetings, to be held in New Orleans on January 5–8. This special session will be held on Sunday, January 7, from 2:30–4:00 PM.

Jennifer Quinn

Jennifer Quinn has a contagious enthusiasm that draws students to mathematics. The joy she takes in all things mathematical is reflected in her classes, her presentations, her publications, her videos and her on-line materials.

When Jenny was at Occidental College, she created many popular and innovative courses. Working with members of the physics department and funded by an NSF grant, she helped develop a combined year-long course in calculus and mechanics. She also developed a course on "Mathematics as a Liberal Art" which included computer discussions, writing assignments, and other means to draw technophobes into the course. One project that grew out of her History of Mathematics course was a math game show called "The Number Years." It was a huge hit at the winter Joint Mathematics Meetings in 2000.

Jenny has been invited to give talks on mathematics to wide and varied audiences, from middle school students to senior citizens. Her ability to give successful talks over such a wide range is remarkable. She has also made her mark as a writer and editor: in addition to being the co-editor of the MAA's undergraduate magazine, *Math Horizons*, she has written a variety of expository and research articles. Her MAA book, *Proofs that Really Count: the Art of Combinatorial Proof*, co-authored with Arthur Benjamin, has been described (by Persi Diaconis) as a blend of the talents of Martin Gardner and Houdini: "It gives magical 'aha' proofs that are real mathematics but accessible to everyone." Not surprisingly, it won the MAA's Beckenbach Book Prize in 2006.

The excellence of Jenny's teaching has been recognized in other ways as well. In 2001, she received the Southern California MAA Distinguished Teaching Award. In Fall 2005, she was the recipient of the Sterling Prize from Occidental College, awarded to only one professor at the College per year, based on professional achievement, excellence in teaching and service to the college.

Jenny's presentation at the Joint Meetings is entitled "My Practice of Mathematics." She will explore the way in which "teaching, learning, experimentation, inquiry, action, and reflection are hopelessly intertwined" in her practice of mathematics as a college professor, and discuss several significant questions about what and how we teach.

Michael Starbird

Michael Starbird has as his goal to help his students unleash the creativity within them. He doesn't just teach them mathematics. He teaches them how to discover and appreciate mathematics for themselves.

Mike has impacted dramatic numbers of students. In addition to the thousands of students he has taught at the University of Texas over his 32 years there, his teaching videos, which appear in the Great Courses series offered by the Teaching Company, have reached countless others. His expository work and his workshops have touched many more students either directly or through the teachers who have learned from him.

Mike's teaching excellence is documented by about a dozen teaching awards, including the Excellence Award from the Eyes of Texas (twice), the Dad's Association Centennial Teaching Fellowship, the President's Associates Teaching Excellence Award, the Jean Holloway Award for Teaching Excellence, the Chad Oliver Plan II Teaching Award, the Friar Society Centennial Teaching Fellowship, awarded to only one of the 2,700 faculty at UT per year, and the Minnie Stevens Piper Professorship, awarded to ten faculty in any field per year at any college or university in the state of Texas.

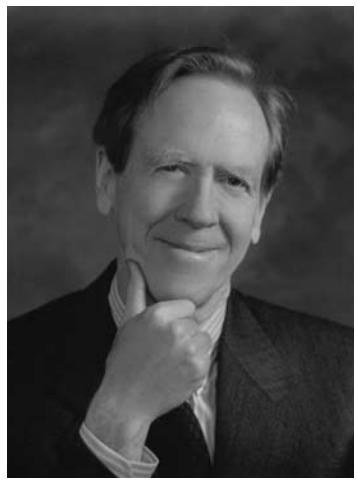
Mike is also in great demand as a speaker and workshop leader. Since he stepped down as Associate Dean at the University of Texas in 2000, he has delivered over 50 invited addresses in a wide spectrum of venues. He has presented workshops for a variety of programs, including the MAA's Project NExT, PREP, and PMET programs, MER, and the NSF Chautaqua program.

In 2001, with Edward Burger, he co-authored a "Math for Non-Majors" textbook, *The Heart of Mathematics: An Invitation to Effective Thinking*. It was awarded the Robert W. Hamilton Book Award in 2002, and it has been adopted at over 200 colleges and universities. The expository mathematics book *Coincidences, Chaos, and All That Math Jazz: Making Light of Weighty Ideas*, also co-authored with Edward Burger, appeared in 2005, and has already received a lot of attention. As Ian Stewart said, it is, "informative, intelligent, and refreshingly irreverent. A roller-coaster ride along the frontiers of today's mathematics."

At the Joint Meetings, Mike will speak on "Teaching the Joy of Thought." In

Michael Starbird

Jennifer Quinn



W. Gilbert Strang

the light of B. F. Skinner's dictum that "Education is what survives when what has been learned has been forgotten," Mike will explore what students will retain from our courses when, twenty years later, they have forgotten the mathematics, and argue that we should guide students to discover the joy of thinking.

W. Gilbert Strang

W. Gilbert Strang has influenced a tremendous number of students, both at his home institution of MIT and around the world. His approach to teaching linear algebra and mathematics for engineers has changed the way we all approach these subjects.

In 1970, Gil began teaching the linear algebra course at MIT. He realized the subject was not simply for mathematics majors and so he included a variety of engineering applications. Students loved his lecturing style and appreciated the material he included. Enrollments steadily grew. In 1976, Gil published *Linear Algebra and its Applications*, his textbook based on that course. This book sparked a revolution in the way linear algebra was taught and has influenced a multitude of books that have come out since then. Rather than utilizing a theorem-proof format, the book was written in a conversational tone and included many practical applications. In 1993, he published a successor, *Introduction to Linear Algebra*.

In the 1980s, Gil began to think about how mathematics was taught to engineers. Recognizing the impact of computers, he believed that students would be better served by a deep understanding of the mathematical methods underlying numerical methods. In 1986, he published *Introduction to Applied Mathematics*, a textbook for a course on that material. MIT's Graduate Student Council recognized his work on that course with a teaching award in 2003.

In 2001, MIT began implementing a program of "Open Courseware" which made course materials and lectures available online for any students who wish to view them. From among the over 500 courses now available , Gil's linear algebra course ranks first among math courses and 16th among all courses available. Calculus is the second most popular math course followed by Gil's "Mathematical Methods for Engineers" and "Wavelets and Filter Banks" in the third and fourth slot.

In 1977, Gil received the MAA's Chauvenet Prize for an article that appeared in the *Bulletin of the American Mathematical Society*. In 2006, he was the recipient of the MAA Northeastern Section Teaching Award. In addition, Gil is a prolific researcher and has supervised 20 PhD dissertations and five Master's students.

Gil Strang will unfortunately be unable to attend the Joint Meetings in New Orleans. He has agreed to give his Haimo talk in the 2008 Joint Meetings in San Diego. His title will be "Linear Algebra: A Happy Chance to Teach Mathematics."

The Haimo Distinguished Teaching Award is awarded to up to three recipients each year, who are typically from amongst the past winners of the sectional teaching awards. If you know someone who you think is deserving, please nominate them for their section teaching award.

Colin Adams is Professor of Mathematics at Williams College, in Williamstown, MA. He is currently the chair of the Haimo Awards Committee.

Have You Moved?

The MAA makes it easy to change your address. Please inform the MAA Service Center about your change of address by using the electronic combined membership list at MAA Online http://www.maa.org) or call (800) 331-1622, fax (301) 206-9789, email: maaservice@maa.org, or mail to the MAA, PO Box 90973, Washington, DC 20090.

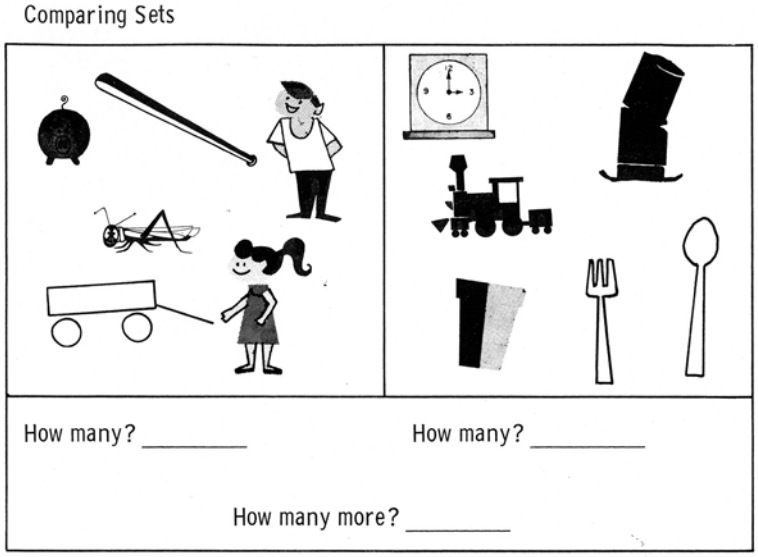
Archives of American Mathematics Spotlight: The School Mathematics Study Group Records

By Kristy Sorensen

One of the most comprehensive and distinctive collections at the Archives of American Mathematics is the School Mathematics Study Group Records. In order to make this collection more accessible to our researchers, the archivist has recently completed a project to transfer the ninety-five linear feet of files and publications from hanging file folders in filing cabinets into archival boxes. During the process of re-housing these materials, staff also enhanced the inventory by adding more detail to the existing folder list.

Under the direction of Edward G. Begle (1914-1978), the School Mathematics Study Group (SMSG) created and implemented a primary and secondary school curriculum between 1958 and 1977 that was widely known as the "new math." The SMSG Records at the Archives of American Mathematics document the history of the writing, implementation, and evaluation of the SMSG curriculum. The records consist largely of the director's files, and include correspondence, meeting agendas and minutes, grant proposals, financial records, newsletters, drafts of publications, tests, and training films. The collection also includes a comprehensive collection of SMSG textbooks and other publications as well as the records and publications of the National Longitudinal Study of Mathematical Abilities (NLSMA). The inventory to the School Mathematics Study Group Records is available online at:http://www.lib.utexas.edu/taro/utcah/00284/cah-00284.html.

The SMSG Records are closely related to the New Mathematical Library Records, another collection at the Archives of American Mathematics. The New Mathematical Library was originally a publishing arm of the SMSG project, before it was taken over by the Mathematical Association of America and became a separate concern. The inventory to the New Mathematical Library Records is available online at: http://www.lib.utexas.edu/taro/utcah/00387/cah-00387.html.



A worksheet from Mathematics for the Elementary School: Book 1, Student's Text, Unit 52 by the School Mathematics Study Group, 1965. From the School Mathematics Study Group Records, Archives of American Mathematics, Center for American History, The University of Texas at Austin.

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. The Archives web page is at http://www.cah.utexas.edu/collectioncomponents/math.html.

Kristy Sorensen served as the Archivist at the Archives of American Mathematics at the Center for American History until November, when she accepted a new position as archivist and records manager for the Austin Presbyterian Theological Seminary in Austin, Texas. The Archives are in the process of hiring a new archivist for the collections. Until then, all inquiries can be directed to cahref@uts.cc.utexas.edu.

THE CENTER for American History
THE UNIVERSITY of TEXAS at AUSTIN

UNIVERSITY OF VIRGINIA
DEPARTMENT OF MATHEMATICS

CHARLOTTESVILLE, VA.

November 22, 1961

Professor E. G. Begle
Department of Mathematics
Yale University
New Haven 11, Connecticut

Dear Ed:

Under separate cover I am sending you a copy of the speech I am planning to give at Bogota next month. Apologies for not having got it off sooner.

A more important reason for writing you is something that came up at the time of the meeting of the travel grants meeting in Washington last Saturday. Joe Weyl told me that Zacharias is being pressed by physicists colleagues to undertake the writing of high school mathematics texts. Their claim is that the SMSG material is such pure mathematics that it would be fatal to physics if widely taught. He seemed to be sounding me out as to whether I thought ONR should support such an activity on the part of the physicists. I believe I made my position quite clear in only a few words and with hardly any profanity. He then went on to talk about his own horror at the SMSG geometry courses. In case you haven't noticed it, Ed, the SMSG geometry course has no geometry in it at all (in fact what mathematicians are calling mathematics today is queer exercises completely unrelated to anything that people have called mathematics for 2000 years). In the geometry course there are no geometric constructions. Everything is being done algebraically by means of numbers. I mentioned to him that I was slightly astonished to find this out, since I had counselled some geometry teachers in exactly that geometry course and thought I had a pretty good idea of what was in it. Since then it has occurred to me that he may have seen the new geometry course of which I have been told, and which I understand is much more analytic than the Moise version. In any case I am now convinced that Joe Weyl is as far from me on one side as Bourbaki is on the other, and I am in an excellent position to intercept all rotten eggs thrown by either one at the other.

I am firmly convinced that turning over the writing of our mathematics courses to physicists or engineers would be just as deadly as turning it over to the ultra-purists who regard any application as degradation. Nevertheless, we have to live with these physicist boys. Maybe the compromise will be putting in more exercises of the kind that they would like. I remarked with sympathy and relief that this is your problem, not mine, but might'nt it be a good idea to establish some kind of contact with their objections, maybe by inviting them in on some conferences, so as to find out what it is that they want? I honestly believe that they express a earnest conviction but that everything that they really want can be reached by much less drastic methods than they are thinking about. They are sincere gentlemen and deserve respectful hearing. Besides that they could be horrible nuisances.

PS I spent yesterday evening re-reading SMSG books. I am now firmer than before that Weyl & the physicists don't know what they're talking about. Stick this need gentle & sympathetic instruction. Jim

Yours,

Jim

E. J. McShane

Letter from E.J. McShane to Edward Begle, 22 November 1961. The "New Math" movement drew widespread praise as well as extensive criticism. In this 1961 letter, E.J. McShane, a professor of mathematics at the University of Virginia and a former president of both the AMS and MAA, writes to Edward Begle about criticisms of the SMSG program from physicists, as told to McShane by Joe Weyl (son of Hermann Weyl). The letter highlights the ongoing conflict in the classroom between pure and applied mathematics. From the School Mathematics Study Group Records, Archives of American Mathematics, Center for American History, The University of Texas at Austin.

MAA Names Arthur Benjamin — Mathematical Wizard, Writer, and Editor — A Pólya Lecturer

By Harry Waldman

George Pólya, renowned teacher and writer, embodied the high quality of exposition that the MAA seeks to encourage. To further this goal, the MAA created a George Pólya Lectureship in 1991. This year's Pólya Lecturer—the 16th such named—is Arthur Benjamin.

Each Section of the MAA is entitled to a Pólya Lecture for a Section meeting approximately once every five years.

Arthur Benjamin, 45, earned his B.S. in Applied Mathematics from Carnegie Mellon and his Ph.D. in Mathematical Sciences from Johns Hopkins. Since 1989, he has taught at Harvey Mudd College, where he is Professor of Mathematics and past Chair. In 2000, he received the MAA's Haimo Award for Distinguished Teaching.

Benjamin's research interests include game theory and combinatorics, with a special fondness for Fibonacci numbers. Many of these ideas appear in his book (co-authored with Jennifer Quinn), *Proofs That Really Count: The Art of Combinatorial Proof*, which the MAA published. In 2006, Benjamin's book received the MAA's Beckenbach Book Prize.

Research topic:
Statistical Mechanics

Education Theme:
Knowledge for Teaching Mathematics

A three-week summer program for
graduate students
undergraduate students
mathematics researchers
undergraduate faculty
secondary school teachers
math education researchers

IAS/Park City Mathematics Institute (PCMI)
July 1 – 21, 2007
Park City, Utah

Organizers: Scott Sheffield, Courant Institute; Thomas Spencer, Institute for Advanced Study.
Graduate Summer School Lecturers: David Brydges, University of British Columbia; Alice Guionnet, Ecole Normale Supérieure de Lyon; Richard Kenyon, University of British Columbia; Gregory Lawler, University of Chicago; Yuval Peres, Microsoft Research and University of California Berkeley; Wendelin Werner, Université Paris-Sud.
Clay Senior Scholars in Residence: Andrei Okounkov, Princeton University; Srinivasa Varadhan, Courant Institute.

Other Organizers: Secondary School Teachers Program: Gail Burrill, Michigan State University; Carol Hattan, Vancouver, WA; James King, University of Washington. Undergraduate Summer School: Aaron Bertram, University of Utah. Undergraduate Faculty Program: William Barker, Bowdoin College.

Applications: www.ias.edu/parkcity
Deadline: February 15, 2007
IAS/Park City Mathematics Institute
Institute for Advanced Study, Princeton, NJ 08540
Financial Support Available

Knowles Science Teaching Foundation Offers Fellowships for Future Teachers

In the United States, approximately half of all secondary teachers leave the teaching profession within five years. Research on issues of recruitment, retention and induction of secondary science and mathematics teachers indicates that among key challenges facing beginning teachers are a sense of professional isolation and a lack of support and mentoring. The Knowles Science Teaching Foundation (KSFT) has created a Teaching Fellowship program to meet these needs by encouraging future school science and mathematics teachers as they earn a teaching credential and through the early years of their career.

KSTF Teaching Fellows are young men and women who have received a bachelor's or advanced degree in science, engineering or mathematics and are committed to teaching high school science and/or mathematics in U.S. schools. The fellowship supports them professionally and financially for up to five years as they go through a teacher preparation program and then begin their teaching careers. Applications for the next round of fellowships are due January 16, 2007. For more information, visit http://www.kstf.org/teaching_fellowships/.

The Fourth Blackwell-Tapia Conference

By Joe Gallian

More than 150 people attended the fourth in a series of biannual conferences honoring David Blackwell and Richard Tapia held at the University of Minnesota's Institute for Mathematics on November 3–4, 2006. The conference featured sixteen invited talks, two panels and thirty-four posters.

The goal of the conference was to continue the work of Blackwell and Tapia of inspiring under-represented groups to pursue careers in the mathematical sciences. To this end, it showcased research done by African-Americans, Native Americans and Latinos/Latinas and provided opportunities for networking. The highlight of the meeting was the closing address on dynamical queueing systems by William Massey of Princeton University, who was awarded the 2006 Blackwell-Tapia prize at the meeting for his outstanding research achievements and for his work towards increasing diversity in the mathematical sciences.

The closing banquet address was given by Tony Chan of the National Science Foundation. See http://www.maa.org/news/052406blackwell.html for the news release about the 2006 Blackwell-Tapia Prize.

Discussions during break.

Seated from left to right: Shirley Malcom, Bill Vélez, Farrah Chandler, David Manderscheid.

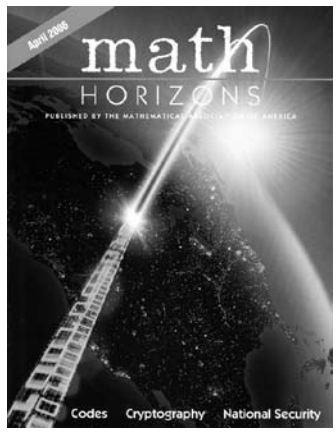
Richard Tapia

Standing from left to right: Gerardo Chowell, Chehrzad Shakiban, Abba Gumel, Karen Rios-Soto, David Murillo, Carlos Castillo-Chavez.

Math Horizons: Time for a New Editor

By Steve Kennedy

The MAA is searching for a new Editor for *Math Horizons*, the MAA student magazine. The ideal candidate will have a wide-ranging interest in mathematics, as well as its culture, history, institutions and people. She or he will also need to be an excellent expositor, a painstaking editor, and a careful manager. An application consists of a curriculum vitae, a letter of interest outlining a vision for *Math Horizons*, and the names and contact information of three references willing and able to answer questions from the Search Committee about the applicant's writing, editing, and organizational skills. Joint applications from prospective editorial teams are welcome. Review of applications will begin on March 15, 2007 with appointment as Editor-elect to commence on March 15, 2007. The five-year editorial term runs January 1, 2009 through December 31, 2013. Some support, largely in the form of release time, is available. Send inquiries and applications to Steve Kennedy, Department of Mathematics, Carleton College, Northfield, MN 55057 (skennedy@carleton.edu).



Geometry
If not, why not? If so, what?

By P.N. Ruane

It's common knowledge that geometry is the Cinderella of contemporary mathematics curricula; but restoring it to its rightful place is no easy matter. For a start, there is no clear consensus concerning the best approach to geometry at school and early undergraduate levels. And school geometry falls between two stools, because it constitutes neither a coherent coverage of Euclid nor a meaningful introduction to transformation geometry. Consequently, those wishing to incorporate the subject into their university programmes have to take into account the very poor levels of geometric knowledge of the students.

Then there are impediments of a 'political' sort, such as that mentioned by Bressoud [1], who says that 'No one wants to relinquish several variable calculus, differential equations, linear algebra, or the department's bridge course to make way for geometry.' In the UK, mathematical education is more widely political since, at school level, important aspects of curriculum development are partly determined by government agencies.

There is some irony, however, in the fact that, by re-interpreting existing syllabi, it is possible to provide a coherent treatment of geometry from early primary school to first year university level, and that treatment could be very much Kleinian. So, by way of illustration, I delineate such a development, beginning with a range of 2d topics that are compatible with the material specified in the section on 'Shape and Space', which is part of the UK national framework for primary mathematics.

Primary

From the age of 5 years and upwards, the emphasis is physical movement and description of position. Use of spatial prepositions (inside, next to, between, etc) and directional language (left, right etc) is encouraged, whilst work with geometric figures is by movement (dissection, pattern formation and creating compound shapes using triangles, squares etc). Then there are activities such as 'shape postbox', in which squares are put in square holes, triangles in triangular holes, rhombus in the rhombic slot and so on. In how many ways will the square fit its slot? Which triangles fit their outlines in one way only? Later on, this activity can be followed by paper-folding exercises that lead to definition of 2d shape by symmetry properties:

- A square has sides and four lines of symmetry.
- A quadrilateral with two diagonal lines of symmetry is a rhombus.
- Rectangles are quadrilateral whose two lines of symmetry bisect its sides.
- Circles have infinitely many lines of symmetry, etc.
- Rectangles and rhombi are 'symmetrically dual'.

Work on tessellation raises various questions, such as which 2d figures tessellate? Which of the movements slide, turn, flip are required in order to tessellate with a particular shape? And the fact that all triangles and all quadrilaterals will tessellate indicates that their angle sums are 180^0 and 360^0 respectively.

Tessellation with, say, a rectangular stencil, and perhaps the shape of an animal cut from its interior, can be an artistic activity but, for primary pupils, it will reveal important connections between the three basic isometries:

- Two successive slides (translations) are equivalent to another single slide (translation)
- Two successive flips (reflections) in parallel sides of the stencil are equivalent to a translation. If the flips are made in perpendicular sides, the effect is a rotation of 180^0
- A combination of rotations may be equivalent to a translation or another rotation.

Thus far, primary school geometry will have provided an informal, investigational introduction to transformation geometry with the important notion of invariance making its first appearance. Alongside this, work on area, length, angle will have taken place – not to mention the general development of spatial awareness and knowledge of 3d shape etc.

Moving on from isometries, there are many practical ways of introducing enlargement, shear and other transformations. For instance, children draw a simple shape on $1cm^2$ paper and then transfer it to a variety of other grids (e.g., $4cm^2$ paper, a 1cm x 2 cm rectangular grid or even any topologically equivalent grid). The degree to which the results are analysed obviously depends on the abilities of the children but, in the later primary years, pupils can investigate changes in perimeter, area, angle etc, and students can explore many interesting ideas of numerical and algebraic interest. Questions of invariance again emerge, and much of the above work can be coordinatised.

Secondary

There may be continuation of previous practical/investigative work, but it will lead to more formal analysis and algebraic representation of transformations (coordinates, matrices and vectors). Building upon a practical introduction to similarity, early concepts on trigonometry will emerge. Relationships between the isometries can be formalised and they can be applied to a variety of situations. For example, by applying suitable translations to the curve $y = x^2$, methods for solving general quadratics can be explored (motivating the method of completing the square).

Speaking of transformation geometry, far too many texts and school maths syllabi

take it only as far as introducing the transformations themselves, possibly going as far as matrix representation and some vector geometry. Consequently, students often see this as a rather pointless activity because they are rarely shown how transformations can be used to derive many of the theorems seen in Euclid. I give a few instances of what can be done:

- Rotational proofs for angle properties of triangles and quadrilaterals.
- Relating the Kleinian definition for congruence of triangles with that of Euclid (SSS, SAS etc).
- Reflectional proof of Pons Asinorum.
- Proof of the Pythagorean theorem using translations and rotations.
- Rotational proof of the fact that equal chords subtend equal angles at the circumference.
- Angle properties of cyclic quadrilaterals.

Later work (for high school or sixth form) could, for instance, include proof of the theorems Ceva and Menelaus within the context of affine invariance, or homothetic derivations of the nine-point circle etc.

This is not to say that all the theorems of Euclid concerning plane geometry should be directly derived via transformations, only a judicious selection in fact, because there is still scope for inclusion of synthetic and algebraic methods, as can be illustrated by a the following sequence:

- Pythagorean theorem suggested by motivational, practical activities.
- Proved by transformational methods.
- Explore variations of the Pythagorean theorem (is it true for rectangles placed on each of the sides of a right-angled triangle? What about semi-circles? Etc).
- Devise a coordinate proof of a 3d version of the Pythagorean theorem.
- Investigate the Pythagorean theorem as special case of cosine rule.
- Pythagorean triples.

But there is also opportunity for work with ruler and compass constructions, which can be done at any level, from late primary school onwards. Beginning with creation of circle patterns, it can proceed to more structured activities like constructing triangles with given side-lengths, bisecting angles, drawing perpendiculars and so on. Subsequent work at high school and first-year university, could be based upon the chapter on 'Geometrical Constructions' from Courant and Robbins [2]. This contains a fascinating range of topics, such as: construction of fields, square root extraction, constructible numbers, Apollonius' problem, polygon construction and the unsolvability of the three classic Greek problems etc.

Early university years

Seeking further evidence in support of Bressoud's comments, I conducted a brief informal survey to detect the extent to which geometry is actually included in undergraduate mathematics. Specifically, I went online and examined undergraduate mathematics courses in nine universities (randomly chosen). Three of these were in the USA, three in the UK and three in Australia. Not one of the nine offered a meaningful foundation course on geometry, although a few included some geometry amongst a whole range optional subjects. However, when geometry did begin to appear, it was in the form of 3rd or 4th year specialist courses in subjects like differential geometry, introductions to algebraic topology or algebraic geometry etc. For example, I have just received for review what seems to be an excellent book on Desarguesian projective geometry. This is intended for use with 3rd or 4th year maths majors who are expected to be familiar with a significant range of algebraic ideas, such as finite fields, group theory and linear algebra. But the only reference to prior geometric knowledge is a vague requirement for some previous work on coordinate geometry. What, I ask, can be achieved in such courses when they are effectively the first time students will have studied anything that is specifically geometric?

I suggest that all undergraduate mathematics courses include a strong foundation course on geometry, which should build well-founded approaches to school geometry. Naturally, this would be Kleinian geometry, based upon the book like that by Brannen, Esplen and Gray [3]. To my mind, this is the best introductory book ever written on introductory university geometry, with that by John Silvester [4] being on almost equal terms (it is less accessible in terms of self-tuition). From such sources, many marvellous results emerge by means of a fascinating range of powerful algebraic methods. In the first of the above books, readers are introduced to the notions of Euclidean congruence, affine congruence, projective congruence and certain versions of non-Euclidean geometry (hyperbolic, spherical and inversive). Not only are students introduced to a wide range of algebraic methods, but they will encounter a most pleasing combination of process and product.

Having laid such good foundations, we may be inclined to return to the theme of ruler and compass constructions, and what better means than by the book *Ruler and the Round* by Kazarinoff [5]. It begins by explaining the ground rules for ruler and compass constructions leading to some historical discussion the problems of angle trisection, cube duplication and squaring the circle etc. The book then places the notion of constructible geometric objects in the context of analytic geometry, thereby providing algebraic classification of constructible numbers. The concept of fields of real numbers then emerges as a source of roots of algebraic equations. The second part treats non-constructible regular polygons and introduces the algebra associated with them. This begins with consideration of irreducibility and factorisation, unique factorisation of quadratic integers, finite dimensional vector spaces, algebraic fields and non-constructible regular polygons.

Such approaches to geometry would motivate the introduction of a wide range of algebraic ideas, which could be synthesised by subsequent (or simultaneous) courses on algebra. Moreover, they form a springboard for subsequent ventures into many other aspects of mathemat-

ics (differential geometry, geometry of curves, algebraic geometry etc).

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Director of Publications for Journals and Communications

Mathematical Association of America
Washington, DC

The Mathematical Association of America seeks a highly qualified person for the position of Director of Publications for Journals and Communications. The primary responsibilities of the position are to oversee journals and other periodicals and content and resources on the MAA website. In addition, the Director will perform other duties related to communications of the MAA to our members, the public, and other specific constituencies. Requirements for the candidate include editorial experience, writing articles for journals, periodicals, and the web, and experience with creating web content. An advanced degree in mathematics or a related field in the sciences, engineering, or computer sciences is desirable but not required. The candidate should have a strong interest in writing and publication, and express a vision for MAA publications in print and online.

The Director will oversee publication of the Association's three journals, three magazines (two online), the Association's newsmagazine, a variety of columns and articles, the MAA's Mathematical Sciences Digital Library (MathDL) and the new Math Gateway site. In addition, the Director will oversee mathematical and professional resources on the MAA website and will work with members and staff to develop content for new resources to serve our members and the public. The Director will be responsible for communications of the MAA such as reports, news articles, and public awareness pieces.

The Director will oversee a staff of three located in the headquarters office and numerous editors and editorial boards. Duties include administration of the department and grant management. The Director will report to the Executive Director and will be a key member of the MAA's staff leadership team. S/he will work closely with other members of the staff, national and sectional officers, committees and editors, and others in strategic planning and program development.

The mission of the MAA is to advance the mathematical sciences. The MAA, with nearly 30,000 members, is the largest association in the world with a focus on mathematics accessible at the undergraduate level. Membership includes college and university faculty and students, high school teachers, individuals from business, industry, and government, and others who enjoy mathematics. The Director will be responsible for ensuring that publications encompass the interests of all major constituencies of the MAA, embrace all areas of mathematics, and are easily available to all of our members and the larger community who are interested in mathematics, especially for expository mathematics and materials for faculty and students.

Applications will be accepted and reviewed as received, with a preference to those received by January 1, 2007. The position is located at the national headquarters of the MAA in Washington, DC.

Candidates should send a resume and letter of interest to:

Ms. Calluna Euving, Chief of Staff
Mathematical Association of America
1529 18th Street, NW
Washington, DC 20036

Applications may be submitted electronically to ceuving@maa.org. References will be requested after review of applications. Applications from individuals from underrepresented groups are encouraged. Additional information about the MAA and its programs and services may be found on MAA's website: www.maa.org. AA/EOE.

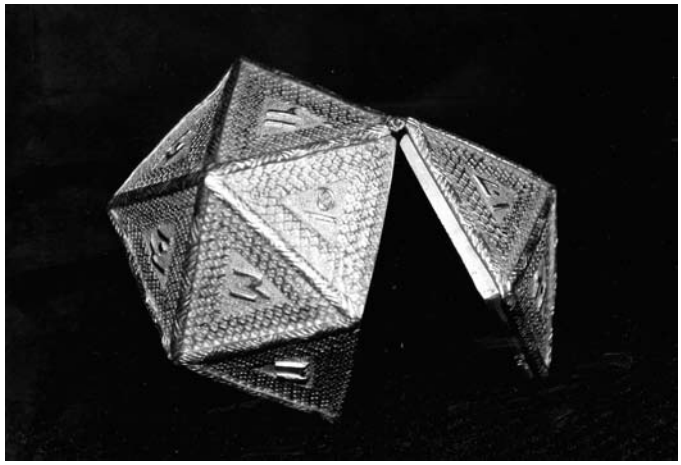
MAA Is Offered Opportunity to Buy a Unique Golden Logo

By Harry Waldman

A rare 40 ounce gold box, in the shape of the MAA's logo — the icosahedron — was offered for sale to the MAA… at 200,000 pounds. The offer came this past summer from Sebastian Thewes, a fine arts consultant with Strathgarry House, in Killiecrankie, Pitlochry, Scotland.

This 17th or 18th century piece of Islamic art had been part of the treasury of Tipu Sultan, who died at the hands of the British in India at the Battle of Seringapatam, in May 1799. The victors then claimed possession of this and other valuables of the vanquished army of Tipu.

Each of the sides of the golden box is inscribed with Arabic numerals in the form in use in Mughal India. The numbers are 11, 20, 21, 31, 41, 51, 61, 71, 81, 91, 101, 201, 301, 401, 501, 601, 701, 801, 901, and 202. Research, however, has failed to offer clues as to the meaning of these inscriptions. (Perhaps some of MAA member can offer a conjecture.)



In May 2005, the gold icosahedron had been offered for sale by Sotheby's, in London, as part of its "Exotica — East meets West 1500-1900" auction. An observer noted that the box "exudes an aura of royaly and mysticism." Nonetheless, it failed to attract any buyers at the time. One reason for this, according to Thewes, is that the box was "somewhat beyond the contemplation of the ordinary collector."

Unfortunately, while the MAA finds the work of art appealing, its purchase price is out of reach — even if it were not subject to the 20% buyer's premium applied to objects bought at auction!

Summer Mathematics Program for Women at Carleton College

By Deanna Haunsperger

The mathematics department of Carleton College is pleased to announce that NSF has renewed the funding for our month-long summer mathematics program for eighteen mathematically-talented first- and second-year undergraduate women. By introducing them to new and exciting areas of mathematics that they would not see in a standard undergraduate curriculum, and by honing their skills in writing, speaking and doing mathematics, the program leaders endeavor to excite these women on to advanced degrees in the mathematical sciences, and, more importantly, to increase each woman's confidence in her own abilities and connect them all into a supportive network to carry them through their undergraduate and graduate education.

At the heart of the program are two demanding, intense courses under the supervision of female faculty who are active in research and renowned for their teaching. In past summers we have had the following instructors: Judy Kennedy (Topological Dynamical Systems), Laura Chihara (Algebraic Coding Theory), Margie Hale (Fuzzy Logic), Rhonda Hatcher (Game Theory), Katherine Crowley (Morse Theory) and others. This summer's courses will be offered by Erica Flapan of Pomona College (Knots and Chemistry) and Karen Brucks of the University of Wisconsin-Milwaukee (Low Dimensional Dynamical Systems).

Besides the coursework, participants take part in a variety of mathematical events: panel discussions on graduate schools and careers, colloquia on a variety of topics, recreational problem-solving, and visits from at least one REU organizer and the organizer of the Budapest Semester. The mathematical part of the program is balanced with weekend events including canoeing, hiking, picnics, and tubing. Past participants (through program evaluations and the list server set up for their correspondence) report increased facility with mathematics, bolstered self-confidence, and new or renewed excitement toward mathematics.

If you have first- or second-year women students whom you think would benefit from a demanding, invigorating month-long exposure to mathematics next summer (June 17 July 15), please refer them to our web page at http://www.math.carleton.edu/smp or have them contact Deanna Haunsperger at Department of Mathematics, Carleton College, Northfield, MN 55057 (dhaunspe@carleton.edu). The deadline for applications is February 23, 2007.

Perception and Research: Mathematics, Gender, and the SAT

By Cathy Kessel

Camilla Benbow is the vice-chair of the National Mathematics Advisory Panel and has been recently appointed to the National Science Board, which oversees the National Science Foundation. Since 1980, the work of Benbow and her colleagues has received attention in the media ("Do males have a math gene?," *Newsweek*, 1980; "Academy of P.C. Sciences," *New York Times*, 2006) and in popular books (*Brain Sex: The Real Difference Between Men and Women*, 1991; *Boys and Girls Learn Differently!*, 2001), and recently on various web sites. This research is often perceived to support the view that humans have two extremely different patterns of cognition and behavior, and that these are explained by male and female brain differences.

At the same time, criticisms and findings that conflict with the work of Benbow and her colleagues have received little notice, in the media and even in academic writing. In this article, I describe some of those criticisms and findings, and their relevance for current studies.

In 1980, Camilla Benbow and Julian Stanley published an article in *Science* entitled "Sex Differences in Mathematical Ability: Fact or Artifact?" They reported large gender differences in "mathematical reasoning ability." Their evidence was scores on the mathematics SAT taken by seventh and eighth graders as part of a talent search for a program at Johns Hopkins University. In a sample of about 10,000, collected between 1972 and 1979, the distribution of boys' scores differed greatly from the distribution of girls' scores. For example, 1,817 boys and 675 girls scored above 500. In their conclusion, Benbow and Stanley explicitly favored (their word) "the hypothesis that sex differences in achievement in and attitude towards mathematics result from superior male mathematical ability… [which] is probably an expression of a combination of both endogenous and exogenous variables," thus including the possibility of social and environmental factors. Benbow and Stanley had not found differences in formal education for students in a 1976 talent search, but did not discuss other social and environmental factors that might affect seventh and eighth graders.

At the time, their article was criticized for the way in which the sample was collected, its measure of "mathematical reasoning ability" (the SAT), and the way in which the results were interpreted. Susan Chipman, then at the National Institute of Education, wrote, "The most serious problem with the report by Benbow and Stanley is the underlying presumption that the concept of mathematical ability as defined by the SAT is theoretically defensible." The mathematicians Alice Schafer and Mary Gray also questioned the use of the SAT as a measure of mathematical ability, and moreover, noted that environmental and cultural factors could not be lightly set aside.

In 1983, Benbow and Stanley published another article in *Science* entitled "Sex Differences in Mathematical Reasoning Ability: More Facts" They reported that in talent searches in 1980, 1981, and

SAT-M Scores of Seventh- and Eighth-Grade Students in Talent Searches

Year	N			N scoring 700 or above		M/F Ratio Scores ≥ 700
	Total	**M**	**F**	M	F	
			Hopkins			
1972–1979[a]	9,927	5,674	4,253	–	–	–
1980-1982[b]	39,820	19,883	19,937	113	9	12.6
1984-1991[b]	243,428	122,185	121,063	622	106	5.7
1997[c]	–	–	–	–	–	4
2005[d]	–	–	–	–	–	3
			Nationwide			
1980-1982[a]	~24,000*e*	–	–	147	11	13
1983[f]				121	12	10
1980-1983[g]	–	–	–	268	23	12
			Duke			
1981-1983[h]	39,754	19,157	20,597	32	3	10.7
1984-1986	73,278	35,424	37,854	54	6	9.0
1987-1989	92,268	44,642	47,626	94	6	15.7
1990-1992	103,097	50,231	52,866	91	33	2.8
1981-1992	308,397	149,454	158,943	271	48	5.6

1982, about 13 boys to every 1 girl scored above 700. The numbers were very small (see table). In 1986, Camilla Benbow and Robert Benbow wrote that, based on talent search results, "it is quite clear that there are very large sex differences in mathematical reasoning ability" and that extensive studies conducted over a 14-year period had failed to show an "exclusively environmental explanation."

Between 1988 and 2000, the 13-to-1 ratio was reported in journal articles by Benbow and her colleagues (*Behavioral and Brain Science*, 1988; *Current Directions in Psychological Science*, 1992; *Psychological Scientist*, 2000). In 2000, Lubinski, Benbow, and Morelock gave the 13 to 1 ratio in the *International Handbook of Giftedness and Talent* and said, "Comparable ratios have been replicated across the U.S. in a number of talent searches (Benbow & Stanley, 1996), as well as in other cultures [no reference given]."

However, in 1997, Stanley reported that the ratio had fallen to 4 to 1. Earlier studies, published in 1994, of talent searches at Johns Hopkins and Duke University had also reported different, smaller ratios obtained from larger samples (see table). In 2005, Hopkins researchers reported this ratio as 3 to 1.

Beyond Bias and Barriers, a new report from the National Academies, notes the change from 13-to-1 to 3-to-1 and says, "This difference can obviously not be explained by biological factors and suggests that social and cultural changes in the education of men and women have influenced test scores." This echoes Schafer and Gray's earlier criticism that environmental and cultural factors could not be set aside. Whatever the reason for the change in ratios, it seems unscientific to reiterate the 13-to-1 ratio, without explanation, when other studies consistently report conflicting findings.

A second major criticism from 1980 was that the SAT may not be a good measure of mathematical ability. Recent work provides some empirical evidence that it is not. The economist Catherine Weinberger writes, "It was previously widely believed that entry into bachelor's degree level careers in engineering, mathematics, computer science, or physical sciences (EMS) was limited to individuals who had ability (as measured by high school mathematics test scores) in the top few centiles…. This belief was so well accepted that no empirical analysis testing this assumption has yet been published." Weinberger analyzed longitudinal data from 1972 and 1980 high school seniors. In this sample, less than one-third of college-educated white men working in EMS occupations had high school SAT-M scores above 650 and more than one-third had SAT-M scores below 550.

Use of the SAT as a measure of mathematical ability has also been questioned recently on theoretical grounds. *Gender Differences in Mathematics*, a recent compendium of psychological research on mathematics and gender, concludes that mathematical reasoning is only vaguely defined in most testing organizations that produce measures of this construct. It notes that "Specifications for the contents of such tests are often based more on historical precedent than on theoretical work defining which cognitive processes are crucial components of mathematical and spatial reasoning and which are not."

Since the 1980s, Benbow and her colleagues have repeatedly reported on longitudinal studies of talent search participants identified in the 1970s and early 1980s. Conclusions based on this sample about "mathematically facile men and women," "intellectually precocious youths," or "correlates of high mathematical reasoning ability" are subject to the limitations of the sample. Moreover, such conclusions need to be considered in light of related studies, as is customary in empirical work.

Cathy Kessel works as a mathematics education consultant in Berkeley, California. She is president-elect of the Association for Women in Mathematics. Portions of this article appeared in the Newsletter of the Association for Women in Mathematics. This article has benefited from discussions with members of the AWM but represents only the views of the author.

The Association for Women in Mathematics has expressed concern about Camilla Benbow's presence on the National Mathematics Advisory Panel — see http://www.thepetitionsite.com/takeaction/474037752?ltl=1162163842.

Sources for the Data on Page 14

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[d] L. E. Brody and C. J. Mills, "Talent Search Research: What Have We Learned?," *High Ability Studies*, Vol. 16, No. 1 (2005), 97–111.

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[g] C. Benbow "Sex Differences in Mathematics," *Behavioral and Brain Sciences*, Vol. 11 (1988), p. 172.

[h] All Duke statistics from D. Goldstein and V. Stocking, "TIP Studies of Gender Differences in Talented Adolescents," in *Competence and Responsibility: The Third European Conference of the European Council for High Ability*, ed. K. A. Heller and E. A. Hany (Seattle: Hogrefe & Huber, 1994).

Teaching Time Savers
Some Advice on Giving Advice

By Michael E. Orrison

There are always a lot of questions that need to be answered at the beginning of a course. When are office hours? What are the grading policies? How many exams will there be? Will late homework be accepted? We have all seen the answers to these sorts of questions form the bulk of a standard course syllabus, and most of us feel an obligation (and rightly so) to provide such information.

A few years ago, it occurred to me that there was a particularly helpful question that my students could have been asking me all along. That question might go something like, "As the instructor, what advice do you have for someone who wants to be successful in this course?" It is no secret that I want all of my students to succeed in my courses, so why wouldn't I want to share such advice?

So, in preparing for a course I was about to teach, I decided to create a list of suggestions for how to be successful in the course. The whole process started well enough with advice that I thought was pretty straightforward: start your homework early, make sure to read the book, and don't hesitate to ask questions in class.

It didn't take long, though, for the process to become bogged down. Aside from a handful of generic bits of advice (like starting homework early), I began to wonder if the advice I might give would be too specific. Did it simply reflect who I was when I was a student? Would the majority of my students find it helpful? Moreover, I was the instructor, not some trusted roommate who had recently taken the course. Would my students really believe me? Would I have believed the instructor when I was a student?

I then realized that the entire list would be much more effective, and much easier to construct, if the advice were coming from former students of the course instead of me. After all, as far as my students were concerned, the comments of former students would come with built in weight and legitimacy. Moreover, if I were able to gather advice from former students, then I would almost certainly be able to pass on great tips that I would have never thought of myself.

So I gave the class my generic list at the beginning of the course, but on the last day of class I asked them, "What advice do you have for future students of this course?" The results were amazing. The bits of advice were genuinely sincere and reflective, and although each of my original suggestions appeared somewhere in the collection, there were indeed some great additional suggestions or phrasings that I would not have (and could not have) come up with on my own.

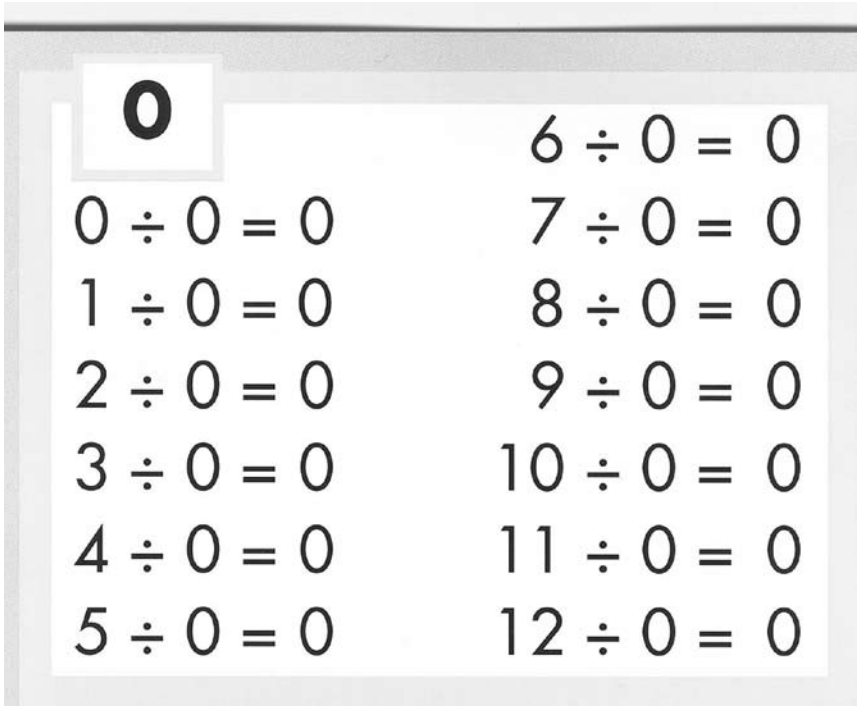
Nowadays, I ask all of my classes to provide advice for future students, and I make sure to share what I feel are the most important tips with those future students. I am confident that it is working because of the large number of my students that are, for example, actually starting their homework early, reading the book, and asking questions in class. Of course, not only do these activities help my students be successful in my course, but they also end up saving me time as well!

Time spent: 15-30 minutes to read, filter, and type up selected student advice.

Time saved: 30-60 minutes to create and type up your own advice, and an estimated 2-10 hours per course associated with the consequences of students not following that advice.

See the next page for a sample of the results of this process when applied to "Math 55", a Discrete Mathematics course at Harvey Mudd College.

Found Math



Portion of a poster of "division facts" on sale at a teaching supply store in Indiana. (Thanks to Carl Cowen)

Advice from Former Students for Math 55

Math 55, Harvey Mudd College
Prof. Michael Orrison

- Read everything!
- Read the book! It is essential.
- He's not kidding — read the book, and don't skim. It's an awesome book.
- Do the reading right after class and look at the homework problems. A lot of time the problems need to sit for a couple of days before you see the solution.
- You can't do homework for this class last minute.
- Start homework early! Don't wait until the night before. Some problems require a lot of thinking.
- Look at the homework assignments a couple of days in advance and let the problems sink in. Discrete is easier if you've been thinking about the problems before you actually attempt them.
- Do the special problems early in the semester.
- Always have people you can talk to about discrete.
- I've found that working through all of the problems on your own is essential for really understanding the material. However, once you finish the problems, or if you can't, go talk to your classmates. You will find far more errors working with them than on your own, and learning how to talk and communicate math ideas clearly helps you learn the ideas and is a great side benefit from this course.
- Don't hesitate to ask Prof. O. for help on your assignments if you need it. He won't chase you away.
- Take advantage of rewrites.
- LaTeX is very nice, but it may not be for you. Don't feel pressured into using it.
- Learn the definitions.
- Going to every single class will make your life much easier.
- This course has a lot of material that comes up again later in the semester, so it's important to get the concepts early on.
- Understand the big picture and how everything is related.

Teaching Time Savers are articles designed to share easy-to-implement activities for streamlining the day-to-day tasks of faculty members everywhere. If you would like to share your favorite time savers with the readers of FOCUS, then send a separate email description of each activity to Michael Orrison at orrison@hmc.edu. Make sure to include a comment on "time spent" and "time saved" for each activity, and to include pictures and/or figures if at all possible.

Terence Tao to Receive 2006 SASTRA Ramanujan Prize

On top of the Fields Medal and a McArthur Fellowship (see our November issue), Terence Tao will also recieve the 2006 SASTRA Ramanujan Prize. This annual prize, valued at $10,000, was launched in 2005 to recognize outstanding contributions to areas of mathematics influenced by Srinivasa Ramanujan. The age limit for the prize has been set at 32 because Ramanujan achieved so much in his brief life of 32 years. The prize will be awarded at the International Conference on Number Theory and Combinatorics, to be held on December 19-22, at SASTRA University in Kumbakonam, India, Ramanujan's hometown.

What I Learned at the MAA Digital Library Workshop

By Gizem Karaali

I have to admit that I am a regular (virtual) surfer, and sometimes this habit of mine takes me places. This is the story of one of those places, and involves colorful personalities, great catered food, and a tremendously ambitious project in the making.

Toward the end of July 2006, an item appeared briefly on the MAA website. This was the call for participants for the MAA Digital Library Workshop. Curious surfers like me clicked on it to find the description of this workshop, which was to be held over the course of a weekend in October 2006 in Washington, DC. The announcement included a cryptic sentence of the form "The primary aims of the workshop are to provide an overview of the two MAA digital libraries and of the National Science Digital Library, and to prepare participants to offer a short workshop on these digital libraries at MAA Section meetings."

I had spent (possibly more than) enough time on the MAA website before, so I did have an idea of what the Mathematical Sciences Digital Library (MathDL) was. But for those who have more important things to do instead of mindlessly surfing the Internet, I should perhaps summarize: MathDL is an online resource published by the MAA and accessible via MAA Online, the official website of the Mathematical Association of America. It currently has five components, which are:

The Journal of Online Mathematics and its Applications (JOMA): An online scholarly journal focusing on online learning materials, (JOMA is rigorously peer-reviewed and mainly publishes articles which make significant use of online tools and the World Wide Web in general as the publication medium)

Digital Classroom Resources (DCR): A free library of online resources for use in the classroom, (All items on DCR have been peer reviewed and classroom tested)

Convergence: An online magazine focusing on the history of mathematics and its uses in the classroom, (There is also a cool "On this day…" feature from which I learned that I am writing these notes precisely 163 years after Sir William Rowan Hamilton discovered the quaternions!)

MAA Reviews: The online continuation of the Telegraphic Reviews that used to be in the *American Mathematical Monthly*. The site has information on more than 2200 books and new books are constantly being added to the database; why not check out the MAA Reviews before you decide which textbook to use for your next algebra course or what book to recommend for your curious niece?

Classroom Capsules: An online database collecting together the wealth of short classroom resources available in the various MAA print publications. More than 10,000 such pieces have appeared in the MAA journals, and the process of selecting materials, classifying them appropriately, and making them available online is still ongoing.

A sixth component is in the works, containing all the MAA prize-winning articles. It should appear very soon.

So I knew more or less what the MathDL is. (As it turned out I knew less, rather than more; that is to come later in the story.) But I had no idea what this National Science Digital Library was. So I looked it up online; I confess, I went ahead and googled it. I was feeling lucky and I was not wrong, I got myself on the NSDL site, which was, according to itself, "the Nation's online library for education and research in Science, Technology, Engineering, and Mathematics." That sounded fascinating and certainly appetizing, but I had other things to do and so I left it at that. I just shot an application for the workshop to see what would come out of it.

When I received an invitation to the workshop I was very happy. I expected that I would learn a lot about the digital libraries. I was also hoping that I would meet interesting people, and I was looking forward to the chance to participate in the first workshop ever to use the MAA Carriage House Conference Center. This small building next to the MAA Headquarters in Washington, DC had been under construction for the last year, with the aid of a sizeable donation from Paul and Virginia Halmos. (During the week of our workshop, Halmos passed away, leaving a sad mathematical community behind him.)

Then came October, and it was time for the workshop. Teaching on the West Coast cost me the Friday dinner and the official introductions, but the Saturday morning, during breakfast, I had the chance to meet some of the participants and Lang Moore, one of the organizers. I was certainly glad, after hours of flying and staying in my hotel room, to finally get some fresh fruit and water and caffeine. Then we started.

The program was quite intense, and the organizers had planned for many short sessions. We first began with MathDL. I felt at ease because I, of course, knew everything! However, as expected, I still had so much to learn! For instance I had no idea that MathDL had been in preparation ever since 2000, and that in the beginning it was a joint venture with Math Forum. I also did not know how the tech boom (or more significantly, the following bust) influenced the development of MathDL. There were some quite interesting and juicy stories told and many only left to our imagination… All ended well of course, with the MathDL moving under the umbrella of the MAA in 2003.

Next we started discussing the Math Gateway, and after a handsome lunch, we continued in the afternoon. Simply put, Math Gateway is the mathematics portal of the National Science Digital Library; it aims to "bring together collections with significant mathematical content and services of particular importance to the delivery and use of mathematics on the Web." MathDL is one of these collections, but Math Gateway has several other partners. Among these are Eric Weiss-

tein's MathWorld, the well-established online homework system WeBWorK, National Curve Bank, College Board AP Central, and one of the oldest math resources online, the Math Forum, now housed at Drexel University. The focus of the Math Gateway is on undergraduate level mathematics education.

The last item on the agenda for the day was the National Science Digital Library (NSDL). In some sense, throughout the day we were looking consecutively at larger and larger scale projects; the NSDL is the largest of them all. MathDL is one big catalogue of resources, the Math Gateway is a catalogue of catalogues, each of which is like MathDL, and the NSDL is a catalogue of catalogues of catalogues.

NSDL is a project of the National Science Foundation. It initially began as a platform intended to publicize NSF-funded research projects and their results, which in itself is a solid, respectable goal. Sometimes, though, scientists and policy-makers get carried away in their dreams. In this case, too, somehow people started dreaming on and things got out of hand (in a good way!). NSDL was eventually transformed into this incredibly idealistic project of creating the ultimate online science library for the nation and the world.

Still in its development stage, the NSDL already offers its audience (K-12 teachers, librarians, university faculty, and others who are looking to find scientific and mathematical content from reliable online resources) material from over 1.5 million individual records. The end goal of NSDL seems to be becoming the virtual equivalent of the Library of Congress. The collections of the latter hold more than 130 million items, and so NSDL has a long way to go, but those of us who love Google (or plug in your favorite search engine here), but still hate it when a search yields hundreds of thousands of results which we then need to wade through to get what we really want, will be fine with waiting a while.

At various points during the workshop, we were told to pair up and try our hands at searching for resources to teach some topic of our choice. My partner was Gerard Kiernan of Manhattanville College, NY. We chose the Fundamental Theorem of Calculus and began our search. Since both Kiernan and I have strong opinions about how one should teach, some of the items we found on the databases we used received more criticism from us than enthusiastic support and interest. Nevertheless both of us could see how these tools we were learning to use would come in handy in our career.

On Sunday morning, we discussed the nature of our introductory workshops at our own local MAA section meetings. We were once again reminded about our part of the deal. Now, it was our turn and we would be asked to go back to our local mathematics communities and spread the word! So coming soon to a sectional meeting near you is your very own MAA Digital Library workshop! Keep your eyes open and be on the lookout for that friendly person who will tell you all about these digital libraries and then some more. (You will even get hands-on experience playing with the tools during the workshop!) But of course if you are like those of us who prefer instant gratification, you can always go ahead and check out these web resources on your own. Note that the MAA Reviews and the Classroom Capsules components of MathDL require you to enter in your MAA member number (this is the number you will find in the upper left corner of the mailing address on your FOCUS magazine) and password. Non-members can purchase access by buying a $25/year subscription. The other tools are all freely available, though Convergence requires (free) registration.

Me? I enjoyed the whole package. I learned a lot about what I can find on the web and where to look for it. I also learned that catered food can be delicious, and that there are some very friendly East Coasters who nonetheless love to tease us West Coasters. I met many wonderful people, two of whom are my colleagues from the Southern California region. The fact that we represent different parts of the educational spectrum made our conversations more stimulating. There were people who came from all over the country (approximately 20 of the 29 sections were represented in the workshop), and we even had international participation. On top of everything, walking from the hotel to the workshop and back, I had the chance to witness autumn with all her glory. Those of us on the West Coast do not often (if ever) get to see the beauty of the change of seasons. I felt lucky to have this scenery along with the wonderful workshop. I flew home with a cold, but also with the contagious enthusiasm of the idealism underlying this huge project.

Gizem Karaali is Assistant Professor of Mathematics at Pomona College.

Tom Marley Wins Distinguished Teaching Award from Nebraska-S.E. South Dakota Section

Tom Marley
University of Nebraska-Lincoln

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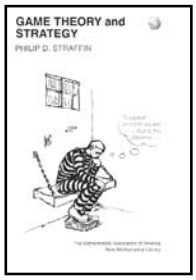

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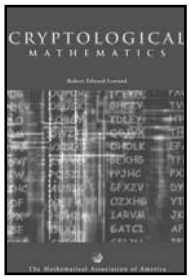
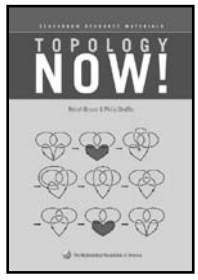
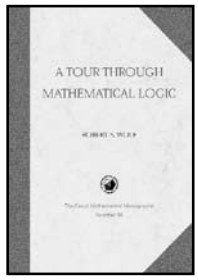


Cryptanalysis/ Combinatorics

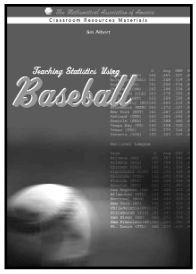
Transition to Advanced Mathematics



Topology



Logic



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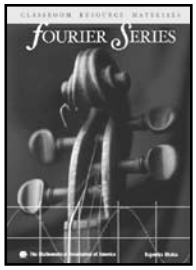

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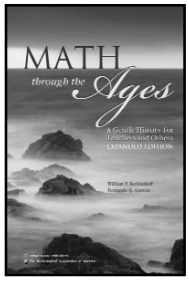

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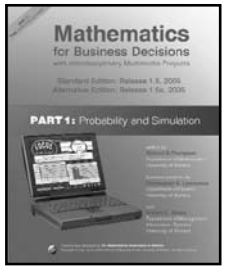

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Legendary Mathematician and Former MAA President G. Baley Price Dies at 101

By Harry Waldman

Former MAA President G. Baley Price, who died on November 7, was a legendary mathematician. A gentle, soft-spoken man, Price was known for his keen mind and his recognition in the 1950s that technology would be a major influence in how we learn and how we teach. He and his late wife, Cora, were devoted professors and mentors.

"Wherever he looked," said University of Kansas Chancellor Robert Hemenway, "G. Baley Price saw potential." Long after his retirement from the University of Kansas, Price remained deeply connected to mathematics and to his university. He was always generous in support of his former university.

Price began his mathematical career at KU in 1937, five years after earning his PhD from Harvard University. In 1943 he served with the U.S. Army's 8th Air Force Operational Research Section in England. His duties included improving the accuracy of bomber pilots and anti-artillery interception over Britain. Price was instrumental in the development of the "New Math" nationally and in the purchase of the first computer at KU in 1956, an IBM 650, which was the granddaddy of today's desktop models. Price was named the first E. B. Stouffer Distinguished Professor of Mathematics at KU in 1974, and retired in 1975.

G. Baley Price served as president of the MAA in 1957–1958. In 1970, Price received the MAA's Award for Distinguished Service to Mathematics, which recognized him for his part in establishing *Mathematical Reviews*, the NSF Summer Institutes for Mathematics Teachers Program, and the School Mathematics Study Group.

An article by Steve Carlson on the occasion of the celebration of Price's 100th birthday appeared in the May/June 2005 issue FOCUS. It included photographs and more details about his life and achievements.

Price was involved in many national and international activities, earned many grants and awards, and showed a

pattern of conceiving, organizing, and finding funding for and implementing new ideas, programs and opportunities at the local and national level. During "retirement," Price completed two mathematical monographs. He also turned his interest to documenting the history of mathematics, publishing a history of the KU Department of Mathematics in addition to articles on the contribution of mathematics to the World War II effort and related topics.

In Memoriam

Leon A. Henkin (1921–2006) died on November 1 at his home in Oakland, CA. Born in Brooklyn, NY, Henkin did his doctoral work in Princeton under the direction of Alonzo Church, receiving his PhD in 1947. He worked in logic, but during World War II he did quite a lot of applied work for the war effort, including a stint at Los Alamos. He went to the University of Southern California in 1949, then moved to the University of California at Berkeley in 1953, staying there until his retirement. In addition to his mathematical work and his teaching, Henkin made a mark with his work towards increasing the number of women and minorities in mathematics. He started this work in the 1960s, and he was still at it until recently.

In 1990, Henkin received the first Yueh-Gin Gung and Dr. Charles Y. Hu Distinguished Service to Mathematics Award from the MAA. The citation, which appeared in the January 1990 issue of the *American Mathematical Monthly*, focused on Henkin's contribution to mathematics education and to increasing opportunities for women and minorities in mathematics. Henkin appeared unexpectedly on the cover of the December 2005 issue of FOCUS, when Kristy Sorensen of the Archives for American Mathematics asked for help in identifying the mathematician appearing in a series of photographs. Kristy's report on the responses she received appeared in the March 2006 issue. Henkin was a member of MAA for 49 years.

Zalman Rubinstein (1933–2006) of the University of Haifa passed away unexpectedly on Septemeber 7, 2006. Born in Warsaw on June 14, 1933, he completed his PhD under Mishael Zedek at the University of Maryland in 1962. He taught at Clark University for several years before moving to the University of Haifa in 1972. Rubinstein's area of research was complex analysis, with a special interest in the zeros of real and complex polynomials; he wrote over 30 papers on this subject. Rubinstein was President of the Israel Mathematical Union in 1974–76. He had been a member of the MAA since 1963.

AAAS Meeting in San Francisco Will Feature Interdisciplinary Mathematics Program

By Edward Aboufadel

The 2007 Annual Meeting of the American Association for the Advancement of Science will be February 15–19, in San Francisco, CA. This year's program features many outstanding expository talks by prominent mathematicians. The theme of the meeting is "Science and Technology for Sustainable Well-Being,"and many of the symposia sponsored by Section A (Mathematics) are interdisciplinary sessions that fit this theme. See the list on this page for topics and organizers.

Other symposia that will be of interest to the mathematical community include: *Decision-Making Under Uncertainty: The Challenge of Sustainable Well-Being; Climate Change: Treatment of Uncertainty in Assessment and Decision-Making; Numbers and Nerves: Affect and Meaning in Risk Information; Mathematics and America's Future: A Call to Action; Examining TIMSS Teaching and Learning Through Videos and Assessments; New Approaches to the Development of the U.S. Computing Work Force;* and *Internet Searching in 2017.*

The above symposia are only a few of the 200 or so AAAS program offerings in the physical, life, social, and biological sciences. For further details about the 2007 AAAS program, see the October 20, 2006 issue of *Science*, or visit http://www.aaas.meeting.org and look under "Program and Events."

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.) The AAAS Program Committee is genuinely interested in offering symposia on pure and applied mathematical topics of current interest, and in previous years there have been symposia on subjects such as the changing nature of mathematical proof, models for how insects fly, and mathematical oncology.

The 2008 meeting will be February 14-18, 2008, in Boston. The Steering Committee for Section A seeks organizers and speakers who can present substantial new material in an accessible manner to a large scientific audience. All are invited to attend the Section A Committee business meeting in San Francisco on Friday, February 16, 2007, at 7:45 PM, where we will brainstorm ideas for symposia. In addition, I invite you to send me, and encourage your colleagues to send me, proposals for future AAAS annual meetings.

Edward Aboufadel is the Secretary of Section A of the AAAS. He can be reached at aboufade@gvsu.edu.

Symposia Sponsored by Section A at the 2007 AAAS Meeting

The Science and Modeling of Hurricanes
Organized by Clint Dawson

New Vistas in the Mathematics of Ecology and Evolution
Organized by Simon Levin

Prime Numbers: New Developments on Ancient Problems
Organized by Dan Goldston

New Mathematical Methods in the Visual Arts
Organized by Dan Rockmore

Are We a Democracy? Vote Counting in the United States
Organized by Stephanie Singer

How Should Elementary Mathematics Be Taught?
Organized by Cathy Kessel

Controversies in Forest Fire Suppression and Management
Organized by John Braun

Blockbuster Science: Math & Science Behind Movies & Entertainment
Organized by Tony Chan

A Mathematician's View of the AAAS Annual Meeting

By David L. Finn

In February 2006, I had the opportunity to attend the Annual AAAS meeting in St. Louis. AAAS is the American Association for the Advancement of Science; it describes itself as "an international nonprofit organization dedicated to advancing science around the world by serving as an educator, leader, spokesperson and professional association." This includes the mathematical sciences, though membership in AAAS by mathematicians is low (less than 1,000) compared to the memberships of AMS (about 31,000), MAA (about 27,000), and SIAM (about 10,000).

The 2006 annual meeting included some interesting mathematics. Each annual meeting has a theme; in 2006, it was "Grand Challenges and Great Opportunities." The mathematical part of the meeting included several symposia spread over two days: "Paradise Lost: The Changing Nature of Mathematical Proof," "Million Dollar Mathematics: Challenge Problems in the 21st Century," "How Insects Fly," "Astrodynamics, Space Missions and Chaos," "Tsunamis: Their Hydrodynamics and Impact on People,"*NUMB3RS* and the Challenge of Changing Public Perception of Mathematics," and "Arches: Gateways from Science to Culture."

The mathematical symposia were well attended. To give a flavor of the symposia and the level of interest in mathematics at the meeting, let me describe the symposium on "Paradise Lost" and the questions asked by the audience. The symposium started with a description by Keith Devlin on what is usually meant by a proof, then moved towards the modern research programs and how they differ from the classical view of proof. Michael Aschbacher described the classification of finite simple groups, currently estimated at more than 10,000 pages in 500 journals by over 100 authors. It may well be that there are some gaps in the proof. One serious gap has been filled (see http://www.ams.org/notices/200407/fea-aschbacher.pdf), but are there others? Further interest was generated by Steven Krantz's description of the status of the Poincaré Conjecture as unclear. Tom Hales described the status of the Flyspeck Project, which deals with how to check the correctness of computer proofs and reflects the unsatisfactory status of his proof of Kepler's Conjecture. He was asked about how computers are used in theoretical mathematics as opposed to scientific investigations. Many of the questions were from scientists curious about current mathematical practice. They were especially interested in how mathematical progress seems to be more similar to scientific progress and in some areas of mathematics is becoming more like a research program in science. As a mathematician who is aware of some of the particulars in these proofs, it was great to hear the experts explaining them to non-mathematicians. I feel I learned more of the big picture than I ever would at a mathematics conference.

The symposium on *NUMB3RS* drew a large audience, partly due to the scheduling (late afternoon) and partly due to the presence of producers and writers Nicholas Fallaci and Cheryl Heuton, mathematics advisors Gary Lorden, Tony Chan and others, and actor David Krumholtz. After describing the show and explaining how it tries to display mathematics in a positive light, the symposium focused on the connections between the show and high school education. Questions from the audience covered the spectrum, from questions to David Krumholtz about his mathematical background and how he tries to portray mathematics to questions about *NUMB3RS* and high school mathematics education. There were also questions about the mathematics involved in the show and about how the mathematical themes are chosen. I enjoyed hearing David Krumholtz remark that he used to hate mathematics but that he now likes it, because it makes sense when it is explained passionately and with enthusiasm in a way that highlights practical and commonplace applications. He made particular reference to an early episode which connected Fibonacci numbers to flowers and nature. This illustration helped him to understand higher mathematics.

All in all, the meeting was very interesting. Joining AAAS was a worthwhile adventure. As a member, besides a cheaper registration fee at the meeting, you get the weekly magazine/journal *Science*. *Science* contains research articles and news on science, science policy, and science education. At the moment, one will not find much explicit mathematics in *Science*, but many applications of mathematics and some items on mathematics education do appear in *Science*. For instance, several news items on President Bush's National Mathematics Advisory Panel appeared this year.

At the meeting, I talked to Ed Aboufadel, the new secretary of Section A (mathematics) of AAAS. Ed has been a member of AAAS for almost twenty years. His reason for joining AAAS is that he has "broader interests in science other than just mathematics." His involvement in AAAS has given him ideas for classes (in particular, a statistical literacy class for non-majors) and at least one research paper. His 1996 article in the *Monthly*, "A mathematician catches a baseball," was motivated by an article by two psychologists that appeared in *Science*.

Ed and I talked about how mathematics is under-represented in AAAS. The program in St. Louis seemed dominated by the life sciences, which just reflects that AAAS itself is dominated by the life sciences. Ed said that Section A "needs more mathematical involvement and more ambassadors for math." He argued that "if mathematics does not have a loud voice, it does not a have a voice" in AAAS and science in general.

From my experiences at the meeting and as a fairly new a member, I would encourage more mathematicians to join AAAS, especially if they are interested in applications of mathematics to science and in science and science policy in general.

David L. Finn is Associate Professor Mathematics at the Rose-Hulman Institute of Technology. He is also the editor of the newsletter of the Indiana Section of the MAA, where this article first appeared.

Writing as an Effective Teaching and Assessment Tool

By Anna Davis

As teachers of mathematics we continually face two questions. How do we best foster learning? How do we assess the learning that has taken place? The following two (mostly real) stories may cast some light on these questions.

Story 1: Bob, a student in my calculus class, says that he had not really understood the geometric meaning of the derivative until he had to explain it to a friend.

Story 2: John, a student in my college algebra class, gets an A on a quiz dealing with sketching solutions to systems of inequalities. When John comes in to pick up his quiz, he excitedly tells me how all of a sudden he started getting right answers after someone showed him how each graph can be interpreted as "a big fish coming over the x-axis to swallow the little fish…" Apparently, someone had shown him some trick that seems to work, but offers absolutely no insight into the meaning of solutions, systems or inequalities. John is thrilled with his grade, but I am left to ponder how I single-handedly gave someone an A for interpreting graphs as fish.

The first story has to do with effective learning, the second, with effective assessment, but the two share a trait. It was the use of *language*, not mathematical symbols, that aided learning in the first case and helped identify problems in the second case. The episode described in Story 2 is a rare experience, but some less staggering versions of it are quite common. Just let an average student spend a few minutes in your office talking to you about your subject and you will quickly observe a high level of discomfort with vocabulary and ideas. Sooner or later a phrase will slip out that will offer you an insight into the nature of the student's misconceptions. This is what I call "mathematical self-incrimination." Students try to fall back on symbols because they are not comfortable *speaking* mathematics.

In light of these observations, I started assigning essay questions in my upper division mathematics courses. One assignment turned out to be particularly meaningful to me and to the class as a whole. The topic in question was establishing a one-to-one correspondence between a given set and the set of natural numbers to demonstrate that the given set is countable. Based on regular homework assignments I felt that we were making good progress. Then came the paper…

For their essay, I asked my students to find a listener with no mathematical background and explain to that person how we can measure the size of an infinite set by comparing it to the set of numbers 1, 2, 3, … Students were instructed to avoid technical jargon and symbols. Students were asked to submit their explanations and their listener's reactions in writing.

Some amazing misconceptions surfaced. For example, a student who had successfully written up a proof of the fact that a countable union of countable sets is countable claimed in her paper that if there were countably many people there would be uncountably many phones, because one person might have more than one phone, which would violate the one-to-one correspondence requirement. Another student, who readily told me that sets Z and N have the same cardinality, claimed in his paper that if there were countably many juice bottles in an infinite line, adding an extra bottle at the front of the line would increase the size of the set by one.

Overall, three out of eight papers contained major blunders, four papers were acceptable and one paper was outstanding. These results indicated to me that I had completely failed to reach over one third of my class. What was even more frightening was that every one of the three students who failed to grasp the concept was earning an A or a B in the course.

The three students were shocked and discouraged by the magnitude of their errors, and I was shocked by my inability to get the concept across to a very bright group of people. We had to start over. I had to find new ways of explaining the concept, while they had to put their previous misconceptions aside and work with me on overcoming their difficulties. After some one-on-one discussions and new drafts, all three of them submitted new — error-free — papers which, I hope, were indicative of their new and better understanding.

The one outstanding essay was written by Sam Belk who is studying to be a high school mathematics teacher. He chose to explain countable infinity to his mother. Asking her to imagine an infinity of souls in heaven, he asked what would happen when one more person died: would heaven become bigger? Her first answer was yes, but his essay explained how he had conveyed to her the notion of one-to-one correspondence as a way of measuring size, and led her to conclude that the new heaven was in fact no larger than the first.

This assignment combined learning-through-speaking with assessment-through-writing. Those students who made no conceptual errors came to understand the topic better by having to explain it to someone else. Those students who had major misconceptions saw them exposed through their writing. Having the students speak and write about mathematics revealed problems that might have otherwise stayed hidden.

Anna Davis received her Ph.D. from the University of Kentucky in 2002 and is now assistant professor of mathematics at Ohio Dominican University. Her research area is geometric topology. She now incorporates "concept essays" into all of her courses, starting with Calculus I. She would like to thank Sam Belk for his outstanding essay and for agreeing to allow her to use it in this.

Letter to the Editor

In the Nov 2006 (vol 26, issue 8) of Focus, on page 14, appears an illustration of the theorem "The 3 medians of any triangle are concurrent", but the diagram does not show medians, which are lines from the vertices to the midpoints of the opposite sides.

On page 16, in "Removal from Office", Martha Siegel describes a proposal to comply with the Sarbanes-Oxley Act, a law to protect Whistle Blowers. However, the proposal removes all protection from whistle blowers. I am curious why the MAA needs to remove all protection from whistle blowers.

Mike Brenner
MITRE Corporation

The picture on page 14 came from the papers of Alfred Schild, so we cannot be sure why it is drawn as it is. There is more than one triangle in the picture, however, and in the case of the lighter triangle the lines do seem to be medians. Perhaps one of our readers can take a guess at what Schild was up to.

As to the proposed bylaws change, note that a Whistle Blower Protection Policy was passed by the Board of Governors a year ago; it can be found at http://www.maa.org/Aboutmaa/whistleblowerpolicy.html. *However, it is possible that as a result of the complaints of a whistle blower someone will be found guilty of some kind of wrongdoing. The proposed change addresses that situation, providing a means by which someone who has been found guilty can be removed from office.*

Found Math

"With the new school year looming, I was increasingly worried I would never reach my goal. My daughter had already started on fractions and decimals, which were still as incomprehensible to me as Poincaré's conjecture. I discussed my distress with Shah, but she said doing the same problem multiple times was essential to mastering the material. I accept that this unshakable attachment to drills and repetition may be why the Japanese are better at math than Americans. But it may also be why the Japanese invented ritual seppuku."

Emily Yoffe attempts to use the *Kumon* method to learn enough mathematics to help her daughter in school. From *Salon*'s "Human Guinea Pig" column, online at http://www.slate.com/id/2152480.

Employment Opportunities

ARIZONA

The University of Arizona
The Mathematics Department at the University of Arizona invites applications for tenure-track positions at the Assistant, Associate or Full Professor levels, to begin Fall of 2007. By the time of appointment, candidates are expected to have a PhD and an excellent research record or potential, as well as a strong commitment to teaching.

There will also be Post-doc positions and/or Visiting positions available.

Please refer to the "Employment" portion of our website at http://math.arizona.edu for additional information, application procedures and deadlines.

ARKANSAS

University of Arkansas at Little Rock
Chair
The University of Arkansas at Little Rock invites applications for the position of Chair in the Department of Mathematics and Statistics. Successful candidates should have a Ph.D. in mathematics or a related field with experience commensurate with the rank of a tenured professor. The Chair position is a 12-month appointment. Rank and salary will be commensurate with qualifications.

Requirements include; outstanding research credentials and teaching experience, a record of university and professional service, effective leadership, communication and administrative skills. Applicants must be strongly committed to lead the faculty in shaping, improving, and developing the department's initiatives in teaching, grant-funded research, interdisciplinary research and service. The Department consists of twenty-three full time faculty members. The faculty currently has interactions with other university departments and research centers, with regional governmental organizations, with private research and development organizations, and with local schools. In addition to B.A. and B.S. degrees, the Department offers an M.S. degree in Applied Mathematics and participates in the Applied Science Ph.D. program. For more information about the university and our department visit, http://www.ualr.edu/mathdept/about_us.html.

Letters of application for job #175 should include a curriculum vita and names with contact information for at least three references. Review of applications will begin November 15, 2006 and will continue until a successful candidate is selected. Send applications to: Dr. Hassan Elsalloukh, Chairperson, Search Committee, Department of Mathematics and Statistics, University Arkansas at Little Rock, 2801 South University Avenue, Little Rock, Arkansas 72204, E-mail: hxelsalloukh@ualr.edu.

The University of Arkansas at Little Rock is an affirmative action, equal opportunity employer and actively seeks the candidacy of minorities and women. Under Arkansas law, all applications are subject to disclosure.

CALIFORNIA

California State University, Fresno
The Department of Mathematics at the California State University, Fresno, invites applications for four tenure-track assistant professor positions beginning August of 2007. All areas of mathematical expertise will be considered for two of the positions. One position however is reserved for mathematical analysis and another for Mathematics Education. A Ph.D. (or ABD) in mathematics is a requirement. Exceptional faculty at a higher rank may be considered. For more information consult the web site http://www.csufresno.edu/aps/vacancy/sm.html For full consideration, all application materials must be received by 1/15/2007.

DISTRICT OF COLUMBIA

American University
Tenure-track Assistant Professor in Mathematics, American University, beginning Fall 2007. PhD required. American University is an AA/EEO employer, committed to a diverse faculty, staff, and student body. Minority and women candidates are encouraged to apply. For position information and application instructions, see math.american.edu/positions, or contact the Department of Mathematics and Statistics at (202) 885-3120.

GEORGIA

Georgia College & State University
The Department of Mathematics at Georgia College & State University invites applications for a tenure-track position in mathematics and a tenure track position in mathematics education, at the rank of Assistant Professor. A terminal degree is required for each position. Excellence in teaching, scholarly activity, and service are requirements for promotion and tenure. Employment will begin August 1, 2007. GCSU is Georgia's Public Liberal Arts University, with a strong commitment to student-centered education in a residential setting. For more information about these positions and application instructions, see http://www.gcsu.edu/facultyjobs. Review of applications will begin November 27, 2006. GCSU is an Equal Opportunity/Affirmative Action institution.

North Georgia College
& State University
Applications are invited for one or more tenure-track mathematics education positions in the Department of Mathematics and Computer Science beginning August 2007. A doctorate in mathematics or mathematics education at the time of appointment is required. Demonstrated excellence in teaching is essential. Preference will be given to candidates with experience in teaching elementary, middle grades, or high school mathematics, and mathematics courses for K-8 pre-service teachers. Duties include teaching 12-13 hours per semester to include mathematics and mathematics education courses for the elementary, middle grades, and secondary mathematics education programs and engaging in service and scholarly activities. Salary is commensurate with qualifications. Further information appears at http://www.ngcsu.edu/adminsrv/hr/facultypositions.htm.

Review of applications begins January 31, 2007, and continues until the position(s) is filled. All applicants should send a letter of application, CV, unofficial transcripts of all undergraduate and graduate credit, a statement of teaching philosophy, and three letters of recommendation that include telephone numbers and e-mail addresses of references to:

Department of Human Resources
ATTN: Mathematics Education Position
North Georgia College & State University
Dahlonega, GA 30597

MARYLAND

United States Naval Academy
Mathematics Department
The USNA Mathematics Department anticipates at least one tenure-track position (subject to approval and funding) at the Assistant Professor level to start in August 2007. See web site http://www.usna.edu/MathDept/website/Hire.htm for full information. Tel: 410-293-6701; Fax: 410-293-6707; Email: amg@usna.edu. The United States Naval Academy is an Affirmative Action/Equal Employment Opportunity Employer and provides reasonable accommodations to applicants with disabilities.

MICHIGAN

Northern Michigan University
Mathematics
POSITION TYPE: Tenure Earning, Assistant Professor (2 positions) DEPARTMENT: Mathematics and Computer Science DESCRIPTION/REQUIREMENTS: Visit HigherEdJobs.Com, or call (906) 227-2020 ANNUAL SALARY: Competitive APPLICATION DEADLINE: Screening will begin January 3, 2007, and continue until the positions are filled. NMU is an AA/EOE

NEW HAMPSHIRE

Dartmouth College
John Wesley Young
Research Instructorship
The John Wesley Young Instructorship is a

postdoctoral, two- to three-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 $4650.00, and a possible 12 month renewal. Salary includes two-month research stipend for Instructors in residence during two of the three summer months. To be eligible for a 2007-2009 Instructorship, candidate must be able to complete all requirements for the Ph.D. degree before September, 2007. 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 Annette Luce, Department of Mathematics, Dartmouth College, 6188 Kemeny 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, 2007 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 2007-2008 academic year. In extraordinary cases, an appointment at a higher rank is possible. Preference given to candidates working in discrete or combinatorial mathematics with connections to existing research interests in the department including discrete probability, graph theory, algebraic combinatorics, combinatorial number theory and discrete geometry. 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 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.

Applications may be obtained at 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 Annette Luce, Recruiting Secretary, Department of Mathematics, Dartmouth College, 6188 Kemeny Hall, Hanover, New Hampshire 03755-3551. Applications received by December 15, 2006 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 Dana Williams, Recruiting Chair.

OHIO

Miami University Middletown Campus
Assistant Professor in Mathematics
Miami University Middletown invites applications for a tenure-track assistant professor position in mathematics beginning Fall 2007. Requires a doctorate by date of appointment in a mathematical science or mathematics education; strong credentials or demonstrated potential for high quality teaching. The ability and willingness to teach mathematics service courses for education and/or computer science majors is desired. Miami University Middletown is primarily a teaching campus with courses at the first and second year levels; however, there will be opportunities to teach in the area of specialty. Service and scholarly activity required at appropriate levels. Salary is competitive, excellent benefits package (visit www.muohio.edu/benefits for more details). Our university values campus diversity; we particularly encourage members of historically underrepresented groups to apply. Send letter of application, AMS cover sheet, curriculum vitae, description of current research, statement of teaching philosophy, and three letters of recommendation (at least one should address teaching) to: Mathematics Search Committee, Miami University Middletown, 4200 East University Boulevard, Middletown, Ohio 45042. Electronic submissions may be sent to MUMMathSearch@muohio.edu. Screening begins December 11, 2006 and continue until position is filled. Miami University is an affirmative action, equal opportunity employer.
For information regarding campus crime and safety, visit www.muohio.edu/righttoknow.

University of Dayton
Applications are invited for a tenure track position in the Department of Mathematics at the assistant professor level starting in August 2007. The position focuses on **mathematics education.**

Candidates must have a Ph.D. in mathematics education with a master's degree in mathematics or a Ph.D. in mathematics. Candidates must have a commitment to teaching, advisement, curriculum development, and research supervision at both the undergraduate and graduate levels. The successful candidate will be expected to develop an ongoing professional/research agenda, support outreach programs in cooperation with departmental colleagues and the School of Education, and support a new master's program in mathematics education. Further responsibilities include teaching responsibilities in an undergraduate liberal arts and sciences program.

To receive full consideration, all materials must be received by January 12, 2007. A complete application consists of a resume, three letters of recommendation, a statement of research and professional plans, a statement of teaching philosophy, and a graduate transcript. Both teaching abilities and research abilities should be addressed in the letters of recommendation. Please include an e-mail address in your correspondence.

Send applications to: Dr. Robert Gorton, Chair of the Mathematics Education Search Committee, Department of Mathematics, University of Dayton, Dayton, OH 45469-2316. Contact the search committee at Robert.Gorton@notes.udayton.edu. For further information, see http://www.udayton.edu/~mathdept.

The University of Dayton is a private comprehensive Catholic university founded by the Society of Mary in 1850. It has more than 6000 undergraduate and 3000 graduate students. The Department of Mathematics offers baccalaureate degrees in mathematics and applied mathematical economics, and master's degrees in applied mathematics, financial mathematics, and mathematics education. The University of Dayton is an Equal Opportunity/Affirmative Action employer. Women, minorities, individuals with disabilities, and veterans are encouraged to apply. The University of Dayton is firmly committed to the principle of diversity.

OKLAHOMA

The University of Oklahoma
Department of Mathematics
Applications are invited for one or more full-time, tenure-track position(s) in mathematics beginning 16 August 2007. The position(s) is initially budgeted at the assistant professor level, but an appointment at the associate professor level may be possible for an exceptional candidate with qualifications and experience appropriate to that rank. Normal duties consist of teaching two courses per semester, conducting research, and rendering service to the Department, University, and profession at a level appropriate to the faculty member's experience. The position(s) requires an earned doctorate and research interests that are compatible with those of the existing faculty; preference will be given to applicants with potential or demonstrated excellence in research and prior successful undergraduate teaching experience. Salary and benefits are competitive. For full consideration, applicants should send a completed AMS cover

sheet, curriculum vitae, a description of current and planned research, and have three letters of recommendation (at least one of which must address the applicant's teaching experience and proficiency) sent to:

Search Committee
Department of Mathematics
The University of Oklahoma
601 Elm, PHSC 423
Norman, OK 73019-0315

Phone: 405-325-6711
FAX: 405-325-7484
E-mail: search@math.ou.edu

Screening of applications will begin on December 15, 2006 and will continue until the position(s) is filled.

The University of Oklahoma is an Equal Opportunity/Affirmative Action Employer. Women and Minorities are Encouraged to Apply.

PENNSYLVANIA

Albright College
Mathematics
The Department of Mathematics invites applications for a tenure-track position beginning fall 2007. The applicant should have a doctorate (by August 2007) in mathematics and evidence of a strong commitment to teaching at a small liberal arts institution where students expect close contact with their professors. Duties include teaching three course per semester normally, scholarship (undergraduate research highly valued), and service to the department and College. Subject line: Mathematics Search. Full consideration will be given to all completed applications received by December 1 and continue until position is filled. Send letter of application, CV, evidence of teaching effectiveness, sample syllabi, scholarship sample and plan, statement of teaching philosophy, graduate transcripts and arrange for 3 letters of recommendation to the Office of Human Resources, Albright College, P.O. Box 15234, Reading, PA, 19612-5234 or to ealvarez@alb.edu (PDF preferred) with the subject line Mathematics Search. Additional information is available at www.albright.edu. Albright is an Affirmative Action/ Equal Opportunity Employer committed to diversity within its community. Women and minorities are encouraged to apply.

Juniata College
Assistant Professor of Mathematics
Juniata College, a highly ranked, national liberal arts college of 1,400 students located in the scenic Allegheny mountains of central Pennsylvania, invites applications for a position as a tenure-track assistant professor in Mathematics to begin August 2007. Candidates must have a Ph.D. in mathematics or a related field, a strong commitment to undergraduate teaching using technology in the classroom, and evidence of continuing professional development. We are looking for an excellent teacher flexible enough to offer courses ranging from quantitative literacy to undergraduate research. Preference will be given to candidates able to teach courses in abstract algebra, geometry, and philosophy of mathematics. Additional information on the college, the department, and its facilities is available at http://www.juniata.edu.

Please send a letter of application, vita, evidence of teaching abilities, graduate transcripts, and three letters of reference to: Gail Leiby Ulrich, Director of Human Resources, Juniata College, 1700 Moore Street, Box MT, Huntingdon, PA 16652. No electronic submissions will be accepted. Review of applications will begin December 15, 2006. Preliminary interviews will take place at the Joint Mathematics Meetings in January. Informal inquiries can be directed to John Bukowski, Chair, Department of Mathematics, bukowski@juniata.edu. It is the policy of the College to conduct background checks.

Juniata College will take positive steps to enhance the ethnic and gender diversity on its campus. The College commits itself to this policy not only because of legal obligations, but because it believes that such practices are basic to human dignity.

AA/EOE

Millersville University
Full-time, tenure-track assistant professorship to begin August 2007, in a department of 20 faculty and approximately 250 majors in mathematics and mathematics education. **Required:** Ph.D. (or completion by date of appointment) in mathematics with expertise in geometry or topology. Must exhibit evidence of strong commitment to excellence in teaching and continued scholarly activity; must be prepared to teach a broad spectrum of undergraduate mathematics courses and to teach undergraduate geometry as it relates to the preparation of secondary school teachers. Must complete a successful interview and teaching demonstration. Duties include an annual 24-hour teaching load, scholarly activity, student advisement, curriculum development and committee work. Millersville University is a selective, comprehensive, state university of 8000 students located in historic Lancaster County, PA within convenient traveling distance to Baltimore, Philadelphia, New York, and the Atlantic Ocean beaches. Additional information on the university and the department can be found at www.millersville.edu. Send application letter that addresses the position requirements, vita, copies of undergraduate and graduate transcripts and three letters of reference (at least two of which attest to recent teaching effectiveness) to Dr. J. Robert Buchanan, Staff Search Committee/**FOC1206,** Department of Mathematics, Millersville University, P.O. Box 1002, Millersville, PA 17551-0302. Full consideration will be given to applications received by **1/19/2007**. An EO/AA Institution. E-mail applications will not be accepted.

Millersville University
Full-time, tenure-track assistant professorship to begin August 2007. Area of expertise in MATHEMATICS EDUCATION. The department, consisting of 20 faculty members and approximately 220 undergraduate majors, offers B.A. and B.S. degrees in mathematics and B.S.Ed. and M.Ed. degrees in mathematics education. Duties include an annual 24-hour teaching load, including mathematics courses for pre-service elementary and secondary teachers and a variety of undergraduate mathematics service courses, scholarly activity, student advisement, curriculum development in mathematics education at both the undergraduate and graduate levels and committee work. This position may include supervision of secondary student teachers. Doctorate (or completion by time of reappointment to the second year) in mathematics education or in mathematics with a specialization in mathematics education is required, including broad training in mathematics with at least 24 hours of graduate level courses in pure or applied mathematics. Must exhibit evidence of strong commitment to excellence in teaching and continued scholarly activity, and have familiarity with current directions in mathematics education, including technology. Must complete a successful interview and teaching demonstration. Evidence of teaching effectiveness is a primary consideration. Preference will be given to candidates with experience teaching both 7-12 and college-level mathematics. Salary/benefits are competitive. Send application letter, vita, copies of undergraduate and graduate transcripts and three letters of reference (**at least two of which attest to recent teaching effectiveness**) to Dr. Janet A. White, Search Committee/ FOC1206, Department of Mathematics, Millersville University of Pennsylvania, P.O. Box 1002, Millersville, PA 17551-0302. Completed application must be received by **January 10, 2007** to assure full consideration. An EO/AA Institution. E-mail applications will not be accepted.

TEXAS

The University of Texas at Tyler
The University of Texas at Tyler invites applications for the position of Chair of the Department of Mathematics to begin fall 2007. The university seeks a candidate who will energetically lead the department in continuing to build excellent undergraduate and graduate programs and who will mentor faculty in teaching, research, and service.

The successful candidate will have a Ph.D. in mathematics; an outstanding record of teaching and research commensurate with a tenured faculty appointment; effective leadership, administrative, and interpersonal skills; and the ability to lead the faculty in obtaining external funding.

Located 90 miles east of Dallas in the beautiful piney woods of East Texas, The University of Texas at Tyler has an enrollment of about 6000 students. The Department of Mathematics offers degrees at the undergraduate and master's levels. For more information, visit http://www.uttyler.edu.

Please submit a letter of application, curriculum vitae, a brief description of research plans, statement of teaching philosophy, and names of at least four references to

Dr. Dick Mitchell
Department of Mathematics
The University of Texas at Tyler
3900 University, Blvd.
Tyler, Texas 75799.

Departmental Website: http://math.uttyler.edu

Review of applications will begin December 1 and continue until the position is filled. UT Tyler is an Equal Opportunity & Affirmative Action employer.

WISCONSIN

Milwaukee School of Engineering
Mathematics Faculty Position
The Milwaukee School of Engineering invites applications for one and possibly two full-time mathematics faculty positions starting in the fall of 2007. The person selected should be able to teach any of the standard courses in an undergraduate mathematics curriculum and possibly a course in graduate level engineering mathematics. MSOE offers degrees in engineering, engineering technology, technical communication, business, construction management and nursing. Candidates should possess an appropriate doctoral degree and related experience. Salary and rank will be commensurate with experience.

MSOE is located in the heart of downtown Milwaukee and has been recognized in several national publications for its "applications-oriented" approach. Faculty are judged primarily on excellence in teaching. MSOE graduates are in high demand as evidenced by our strong job placement rate.

The review of candidates will begin immediately and continue until the position is filled. To apply, please submit a detailed resume, evidence of teaching excellence and three professional references to: Dr. Karl David, Chair, Mathematics Department, Milwaukee School of Engineering, 1025 N. Broadway, Milwaukee, WI 53202-3109. The information can also be faxed to (414) 277-7462. Please visit us at www.msoe.edu.

MSOE is an Equal Opportunity Employer.

BSC
BRIDGEWATER STATE COLLEGE

BRIDGEWATER STATE COLLEGE
Department of Mathematics and Computer Science
Assistant or Associate Professor

Responsibilities: Responsibilities include teaching mathematics courses with special emphasis on courses required of teachers, advising, participating in departmental curriculum development, as well as engaging in ongoing scholarship and professional activity.

Minimum Qualifications: The candidate should possess (by September 1, 2007) a Ph.D. in Mathematics, a Doctor of Arts in Mathematics, or an Ed.D. in Mathematics education, or be presently enrolled in a doctoral program. Knowledge of NCTM Standards is required.

Applicants should be strongly committed to excellence in teaching and advising, and to working in a multicultural environment that fosters diversity. They should also have an ability to use technology effectively in teaching and learning, the ability to work collaboratively, evidence of scholarly activity, and a commitment to public higher education. Applicants with demonstrated teaching excellence and an interest in supervising and training mathematics teachers will be given special consideration.

Salary: Commensurate with qualifications and experience.

Appointment/Start Date: Fall 2007

Application Process: Please apply online at: http://www.bridgew.edu/HR/Joblist/

Bridgewater State College is an affirmative action/equal opportunity employer that actively seeks to increase the diversity of its workforce.

http://www.bridgew.edu

The Mathematical Association of America
1529 Eighteenth St., NW
Washington, DC 20036

Periodicals Postage paid at Washington, DC and additional mailing offices