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FOCUS

Volume 24 Issue 8

Inside

On the cover: Martin Gardner sitting on the Alice statue in Central Park. See pages 4-9 for our tribute to Gardner on the occasion of his 90th birthday. Photograph courtesy of Jim Gardner.

Math Gateway: An NSDL Pathway to Undergraduate Mathematics

The National Science Foundation has awarded the Mathematical Association of America a Pathways Grant as part of the National STEM (STEM is NSF-speak for Science, Technology, Engineering, and Mathematics) Digital Library (NSDL) Program. This four-year grant will support the creation of a portal, The Math Gateway, for undergraduate mathematics materials within NSDL. This project will bring together collections with significant mathematical content and services of particular importance to the delivery and use of mathematics on the Web. The Association will use a new version of the content management system currently supporting the Mathematical Sciences Digital Library (MathDL) to support the portal to these collections and services.

The Math Gateway project is an outgrowth of the Mathematical Sciences Conference Group on Digital Educational Resources. This group of individuals with an interest in online mathematics has met each year for the past four years at MAA headquarters. Many of the organizations represented at these meetings will participate in the Math Gateway. The initial participating organizations/collections are listed below.

MERLOT
(http://www.merlot.org) MERLOT provides access to an extensive collection of resources and services over many different disciplines. Flora McMartin of MERLOT is supervising the evaluation program for the Gateway Project.

Eisenhower National Clearinghouse
(http://www.enc.org) The Eisenhower National Clearinghouse is an extensive online resource for K-12 science and math teachers. ENC is playing a central role in the NSDL outreach to middle schools.

Math Forum
(http://www.mathforum.org) The Math Forum is one of the oldest online resources in mathematics with a particular emphasis on K-12 mathematics.

iLumina
(http://www.ilumina-dlib.org) The iLumina site, hosted at the University of North Carolina at Wilmington, is one of the oldest collections in the NSDL.

College Board
(http://apcentral.collegeboard.com) At their AP Central site the College Board has a wealth of resources directed toward AP high school teachers. The Math Gateway would link to their resources for calculus and statistics.

CAUSE
(http://causeweb.org) The Consortium for the Advancement of Undergraduate Statistics Education is a project of the American Statistical Association.

Demos with Positive Impact
(http://mathdemos.gcsu.edu) This project is managed by Lila Roberts of Georgia College and State University and Dave Hill of Temple University. The site provides teachers with demos and accompanying information on how these demos might be used.

National Curve Bank
(http://curvebank.calstatela.edu) This site, directed by Shirley Gray at Cal State Los Angeles, has a wide range of online mathematical resources including an audio file of Tom Lehrer singing *New Math*.

Virtual Laboratories in Probability and Statistics
(http://www.math.uah.edu/stat)This site was developed by Kyle Siegrist at the University of Alabama at Huntsville.

Ethnomathematics Digital Library
(http://www.ethnomath.org) The Ethnomathematics Digital Library is a project of Pacific Resources for Education and Learning. The Library has links to relevant websites worldwide.

Duke Connected Curriculum Project (http://www.math.duke.edu/education/ccp)
This site has online materials for lab activities for undergraduate mathematics courses from precalculus through linear algebra, differential equations, and engineering mathematics. Lang Moore and David Smith edit the site.

webODE Project
This project is just getting underway under the direction of Paul Blanchard at Boston University.

Eduworks
(http://www.eduworks.com) The MAA and MathDL are cooperating with Geoff Collier and Robby Robson of Eduworks on their NSDL project to improve interoperability and reusability.

WeBWork
(http://webwork.math.rochester.edu) WeBWork, founded by Arnie Pizer and Mike Gage of Rochester, is one of the most useful online homework systems for mathematics. MathDL will provide some services for WeBWork.

Some of these collections include materials related to many disciplines. In that case, the Math Gateway will only link to the mathematics items.

The new grant will support the publication of a regular *Math in the News* column on the Math Gateway portal. In addition to support of the portal, the new grant will provide resources for the continuing support of MathDL. Perhaps the most important of these will be funds to enable the hiring of a full-time web master to support both MathDL and the Math Gateway. The grant also will support an extensive system of workshops at the section meetings of the MAA to encourage the mathematical public to explore the learning opportunities afforded by The Math Gateway and, more generally, by the NSDL.

Master of Recreational Mathematics — and Much More
An Interview with Martin Gardner

By Don Albers

On October 21, Martin Gardner celebrated his ninetieth birthday. For 25 of his 90 years, Gardner wrote the monthly "Mathematical Games " column for *Scientific American*. His columns have inspired thousands of readers to learn more about the mathematics that he loved to explore and explain. Among his column correspondents were several distinguished mathematicians and scientists, including John Horton Conway, Persi Diaconis, Ron Graham, Douglas Hofstadter, Richard Guy, Don Knuth, Sol Golomb, and Roger Penrose.

Gardner's columns have earned him a place of honor in the mathematical community, which has given him many awards. But he has always declined invitations to accept awards in person, on the grounds that he is not a mathematician. "I'm strictly a journalist," he insists. "I just write about what other people are doing in the field." His modesty is admirable, but we insist that he is far more than a journalist.

In addition to his massive contributions to mathematics, Gardner has written about magic, philosophy, literature, and pseudoscience. Over his first ninety years, he has produced more than 60 books, most still in print; many have been bestsellers. His *Annotated Alice* has sold over a million copies, and the 15 volumes collecting his "Mathematical Games" columns have gone through several printings. All 15 volumes have been digitized and will soon be published by the MAA on a single CD entitled *Martin Gardner's Mathematical Games.*

In his ninetieth year, he has returned to Oklahoma, where he was born. He is in good health and full of energy. We look forward to more from him as he begins his second 90 years. What follows is a small portion of an interview done at Gardner's home in Hendersonville, NC in the fall of 1990 and spring of 1991.

Martin and his younger brother Jim, 1920.

Martin at age 10, 1925.

Martin reading on his front porch at age 15, 1929

Don Albers: As a high school student you were already writing articles for *The Sphinx*, a magazine devoted to magic. Does your interest in magic go back to your father?

Martin Gardner: Magic wasn't a special hobby of his, but he did show me some magic tricks when I was a little boy. I learned my first tricks from him, in particular one with a knife and little pieces of paper on it. I then got acquainted with a few local magicians in Tulsa, Logan Waite and Wabash Hughes, who worked for the Wabash Railroad.

DA: At what age did this occur?

MG: I was a high school student at the time. I've never performed magic; it's just been a hobby. The only time I got paid for doing magic was when I was a student at The University of Chicago; I used to work at the Marshall Field's department store during the Christmas season demonstrating Gilbert magic sets. I learned a lot from the experience. That was the first time I realized that you're really not doing a magic trick well until you've done it in front of an audience about a hundred times. Then it becomes second nature, and you know what to say.

DA: What are the elements of a successful magic trick?

MG: The most important thing is to startle people, and have them wonder how it's done. Close-up magic that you do on a table right in front of people is very different from the stage illusions that David Copperfield does. It's close-up magic that most intrigues me, espe-

cially when it has a mathematical flavor. I did a book on mathematical tricks that has, for example, a chapter on topological tricks. I did two massive books for the magic profession: The *Encyclopedia of Impromptu Magic* and *Martin Gardner Presents*. The first book covers tricks that don't require any special equipment. A lot of them are just jokes and gags of the type 'bet you can't do this.'

DA: Your book *Mathematics, Magic, and Mystery* has been a bestseller for many years.

MG: I waste a lot of time on magic. Dai Vernon was one of the great inventors of magic. He was a great influence on Persi Diaconis. Persi traveled with Dai for a long time. I knew Vernon very well. I knew Persi when he was a student at NYU. You probably heard the story how he got into Harvard.

DA: As I recall, he gave you some credit for writing a letter of recommendation to Fred Mosteller, the Harvard statistician.

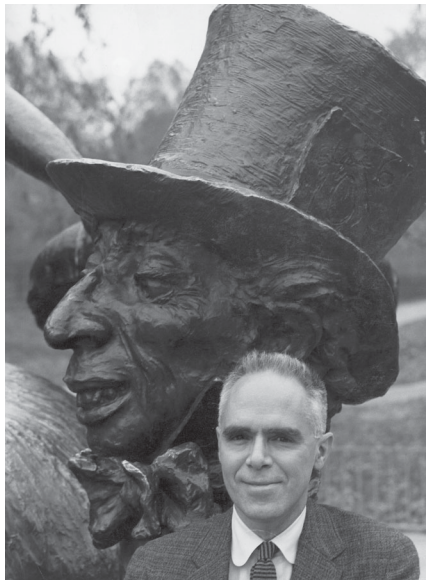
MG: Mosteller is a magic buff. When Persi said he wanted to get into Harvard, I wrote to Fred and said that Persi can do the best bottom deal and second deal of anybody I know, and that got him into Harvard. I talked to Fred on the phone about it and he said, "Is he willing to major in statistics?" And Persi said sure he'd major in statistics if that would get him into Harvard. So he went up to Harvard, and they had a session together, maybe doing card tricks. Mosteller got him into Harvard.

DA: What did your mother do?

MG: She was a kindergarten teacher before marriage, but then became a housewife, caring for three children. Her hobby was painting, and I have a number of her paintings hanging in the house. Both of my parents lived into their nineties. I had a brother and sister, both younger, who are deceased.

I learned to read before I went to school. My mother read *The Wizard of Oz* to me when I was a little boy, and I looked over her shoulder as she read it. I learned how to read that way. It was very embarrassing when I was in first grade, because the teacher would hold up cards that said 'cat' and 'dog' and I was always the first to call out the word. She had to tell me to shut

Gardner as a navy sailor, 1941.



Martin Gardner with the Mad Hatter in Central Park, New York City.

up, to give the other children a chance to learn how to read.

DA: As a kid, do you remember other strong interests in addition to magic?

MG: I was very good at math in high school. In fact, it and physics were the only subjects in which I got good grades. I was bored to death by the other classes. I flunked a class in Latin and had to take it over. I just don't have a good ear for languages.

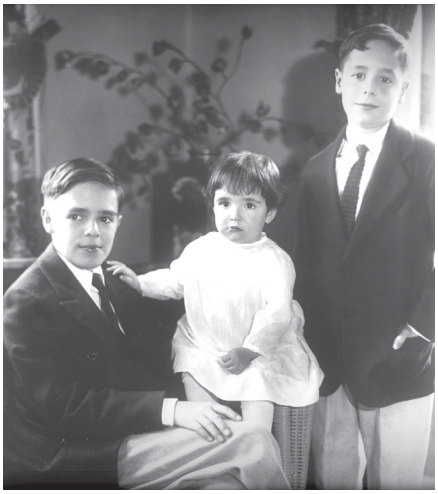
DA: You got your B.A. in 1936, then worked briefly for the *Tulsa Tribune* as a reporter, and then came back to The University of Chicago to the PR office writing news releases (primarily science releases), and took a graduate course from Carnap. What else did you do until the outbreak of World War II?

MG: I had various jobs. I worked as a case worker for the Chicago Relief Administration, I had to visit 140 families regularly in what was called the Black Belt. I also had several odd jobs: waiter, soda jerk, etc. Remember, this was at the height of the Great Depression.

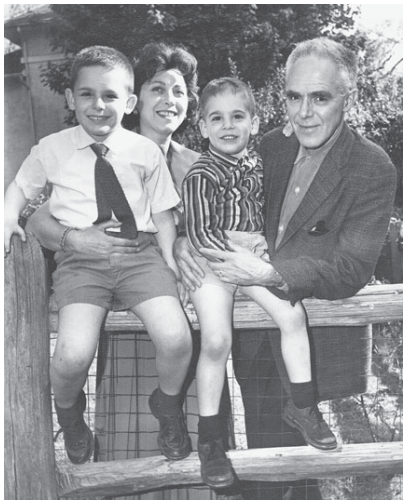
DA: In December of 1941, the U.S. entered World War II and you enlisted in the Navy.

MG: I ended up serving on DE 134, a destroyer escort, in the Atlantic. I was miserably seasick for about three days, and then I was never seasick again. I couldn't wait for the war to end, but later I looked back at it as a rather pleasurable time of my life. You're on a ship, you make friends with your shipmates, you got liberties now and then, and you didn't have to worry about anything.

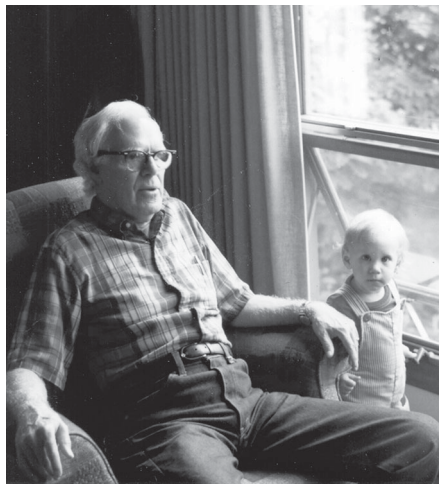
I've had migraine headaches all my life that were fairly severe when I was in high school. When I enlisted in the Navy, I did not list my migraines because I was afraid they wouldn't take me. I feared that I might develop migraine headaches during battle situations. We were part of a so-called "killer group" of six destroyers looking for German submarines. During my four years in the Navy, I never had a migraine headache. I'm convinced that they're associated with periods of anxiety. When you're in the Navy, you don't worry about what you're going to do tomorrow, what tie to put on, etc. You just follow orders. In a way, you have a big sense of freedom. Otherwise, I have no other explanation.



Martin Gardner with his brother Jim and sister Judith.



Gardner with his wife Charlotte, and their two sons Jim, left, and Tom.



Martin and grandson Martin.

DA: At the end of the war, you promptly went back to Chicago.

MG: Yes, I went back, and I could have had my old job back in the public relations office at The University of Chicago because there was an understanding that if you enlisted in the service you could get your old job back. But the one reason I didn't go back to the PR office was that I sold a story, my first sale, to *Esquire*. The title of the story, "The Horse on the Escalator," came from a joke going around at the time about a man who entered Marshall Fields department store on a horse, and the elevator operator told him he couldn't take the horse on the elevator. And he said, "But lady, he gets sick on the escalator!" It was a shaggy dog joke about a horse. The story is about a man who collected horse jokes, and his wife didn't think any of them were funny, but she laughed heartily every time he told one to conceal the fact. So that was my first story. I decided that maybe I could make a living as a freelance writer, and I very quickly sold *Esquire* a second story, and that was the "No-Sided Professor," about topology.

DA: That had to give you a lot of confidence, helping to convince you that you could earn a living as a writer.

MG: That's right, but *Esquire* changed editors after I had sold them several stories. The new editor had a different policy, and he didn't care for the kind of stories I was writing. So I moved to New York City, because for writers that's where all the action is. I had a friend who worked for Parents' Institute, and who was in charge of their periodicals for children. They were starting a new magazine called *Humpty Dumpty*, and were looking for activity features, where you fold the page or stick something through the page, or cut; where you destroy the page. So he hired me to do the activity features for *Humpty Dumpty*, as well as a short story for every issue and a poem of moral advice.

DA: Your work with children's magazines went up to about 1956. By 1957 you were at *Scientific American*. So there was not much of a hiatus between *Humpty Dumpty and Scientific American*.

MG: No, I stopped working for *Humpty Dumpty* to start "Mathematical Games" at *Scientific American*. I couldn't do both. It started with the sale in December 1956, of an article on Hexaflexagons. That was not a column, but that led to the column. When Gerry Piel, the publisher of *Scientific American*, called me and suggested the column. That was when I resigned from Parents.

DA: A lot of people are astonished that anybody could turn out one of those columns on mathematical games and recreations every single month for *Scientific American*.

MG: Perhaps they don't realize I had no other job. I'm not a professional mathematician who has to teach a course in mathematics, and then write. To me, it's hard to imagine how a professional mathematician would have time to even write a book. I had nothing else to do, except research for those columns, and write them up.

DA: Most people that I've ever talked to about your *Scientific American* columns know that it was your job, but they're still awed by the fact that you turned out something really sparkling every month. It's one thing to write something every month, but that doesn't mean that it's going to be inspirational or great fun to read each time.

MG: I miss doing those columns, they were a lot of fun, and I met many fascinating people while doing them. Once the column got started I began hearing from people like Sol Golomb and John Conway, who were really doing creative work that had a recreational flavor. That kept the column going. It became much more interesting after I began getting feedback from people like Conway, Ron Graham, Don Knuth, and many others.

Probably my most famous column was the one in which I introduced Conway's game of *Life*. Conway had no idea when he showed it to me that it was going to take off the way it did. He came out on a visit, and he asked me if I had a Go board. I did have one, and we played *Life* on the Go board. He had about 50 other things to talk about besides that. I thought that

Life was wonderful — a fascinating computer game. When I did the first column on *Life*, it really took off. There was even an article in *Time* magazine about it.

DA: Can you tell me a little bit more about how you actually approach writing? You previously said something about how you did your monthly columns over a long period of time. You write about many other things as well. Do you have a different style or a different mode when you write about pseudoscience?

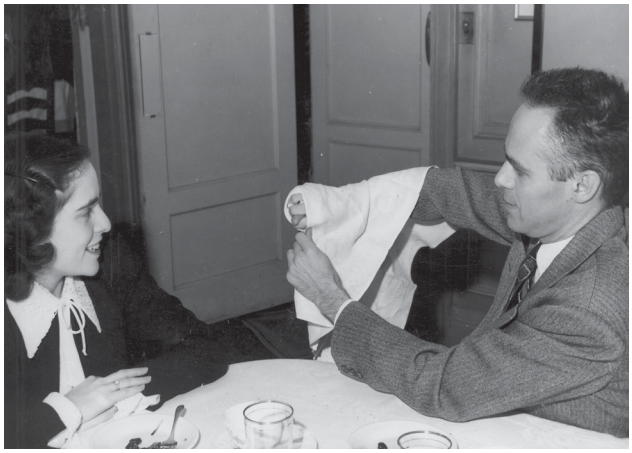
MG: I don't think so. I've never worried about style. I just write as clearly as I can, and I suppose it's improved over the years. I get interested in a topic, and I do as much research as I can on it. I have my library of working tools, so I can do a lot of research right here. I usually rough out the topic first, just list all the things that I have to say, and then I sit down and try to put it together on the typewriter. It's all kind of a sequence that is hard to explain. It comes easy for me, I enjoy writing and I don't suffer from writer's block, where I sit and wonder for an hour how I'm going to phrase the opening sentence.

DA: Which of your more than sixty books is in some sense a favorite?

MG: I think my *Whys of a Philosophical Scrivener* is my favorite because it is a detailed account of everything I believe.

DA: Let's move back to math for a minute. You've lived long enough now to see a lot of really interesting mathematical ideas hit the scene, and there are also some really beautiful ideas that were here long before you were on the scene. First, during your own lifetime, what ideas, what discoveries just kind of knocked your socks off?

MG: Well, I think the most interesting developments are mainly in mathematical physics, and in particular the development of superstring theory. That came as a complete surprise to me. It's a beautiful theory of particles, and it may or may not be true, but it's the hottest thing in town now in particle physics. It opens up the possibility that higher dimensions are not just artifacts but actually real.



Gardner doing some table magic

Martin Gardner regrets that it is impossible for him to:

1. Evaluate:
   - Angle trisections
   - Circle squarings
   - Proofs of Fermat's last theorem
   - Proofs of the four-color theorem
   - Roulette systems
2. Give advice on, or supply references for, high school science or math projects.
3. Inscribe books for strangers.
4. Give lectures, or appear on radio or TV shows.
5. Attend cocktail parties.
6. Make trips to Manhattan except under extreme provocation.
7. Donate books to libraries.
8. Provide answers to old puzzles.
9. Prepare material on speculation for toy companies or advertising agencies.
10. Put the reader in touch with Dr. Matrix.

Martin Gardner's form letter, often sent as a response to requests he received from readers.

DA: You've read a lot of contemporary material, and you've read a lot by those who have been gone a long time. Are there any of those departed people that you'd like to sit down with over dinner, or sit down here in your library and chat with them?

MG: I'd love to chat with Gödel for example. He had some strange cosmological views, and I'd like to talk to him about that, about time travel into the past. I never could quite understand that. And of course he was a dedicated Platonist. He thought all of mathematics was out there, including the transfinite numbers. I'd enjoy talking to him about that. Of course I'd love to talk with Einstein and Neils Bohr. Among puzzle makers, I'd most want to talk with Henry Dudeney and Sam Loyd. I also would enjoy talking to Bertrand Russell. He's one of my heroes.

DA: Here's an equally easy question for you. Once you've departed this life, let's suppose you had an opportunity to come back in a hundred years. What questions would you most want to know the answers to that might have been developed during that time?

MG: I guess I'd be interested to know if various famous unsolved problems had been solved, such as the Goldbach Conjecture. But I don't have any great desire to come back and learn what modern mathematics is up to. You're giving me credit for being more of a mathematician than I really am. I'm strictly a journalist. I just write about what other people are doing in the field.

Thanks to Jim Gardner for supplying the photos that accompany this interview.

Low Down Triple Dealing

By Colm Mulcahy

Dedicated to Martin Gardner on the occasion of his 90th birthday

Consider the following three demonstrations of mathemagic:

1. A deck of cards is handed to a spectator, who is invited to shuffle freely. She is asked to call out her favourite ice-cream flavour; let's suppose she says, "Chocolate." Next, she is asked to cut off about a quarter of the deck and hold it ready for dealing. You take another quarter of the deck and demonstrate a spelling deal, dealing cards into a pile, one for each letter in the word "chocolate," before dropping the rest of your quarter deck on top. Set those cards aside and have the spectator perform this spelling routine three times with the cards in her hands. You correctly name the top card in her pile at the conclusion of her triple dealing.

2. A deck of cards is handed to two spectators, each of whom is invited to shuffle at will and then choose a card (of not too low a value) and place it face up on the table. Let's suppose that 4♣ and 9❤ are selected and displayed. You run through the deck face up, tossing out all of the Aces, 2s and 3s — saying, "Sorry, I should have eliminated the low cards earlier." Then riffle shuffle a few times. Remark, "Since a 9 was selected, let's count out nine cards," dealing into a pile on the table. Shuffle overhand and continue, "We'll need four more," as you peel off that many cards as a single unit, without changing their order. Drop these on top of the other nine. (The rest of the deck is ignored from now on.) Pick up this pile of thirteen cards and demonstrate a deal of the nine top cards into a pile, reversing their order, and then putting the remaining four on top. Have the first spectator do this deal three more times, and hand the cards to the second spectator. Have the second volunteer deal either four or nine cards into a pile, with the remainder placed beside this to form a second pile. Recap: the two numbers (4 and 9) being used were determined by freely selected cards, and as a result a deal of nine cards was performed done (three times) on a packet of thirteen cards, which was then split into two piles. Draw attention to the two cards originally selected. Say, "Wouldn't it be surprising if, after all that triple dealing based on the values of two randomly selected cards from a shuffled deck, there were cards intimately related to the two you selected at the bottoms of the two piles now on the table?" Have the piles on the table turned over: one of the cards exposed is 9♣ and the other is 4❤. "A curious alignment with the selected cards."

3. Have each of three volunteers in turn pick a card at random, and then have the cards returned to anywhere in the deck. Shuffle with abandon. Ask a fourth person to name their favourite magician. Assume they say, "Harry Houdini." Hold the deck in the right hand, and peel cards off the bottom into a pile in the left hand, without altering their order, one for each letter, as you spell out the whole name. Hand the stack of twelve cards to the first volunteer and ask him to spell out HOUDINI while dealing out seven cards, then dropping the other five on top. Now give the cards to the second volunteer and give the same directions, and finally to the third volunteer for one last deal of the same type. Take the cards behind your back and immediately produce three cards, handing one to each volunteer face down. Have the chosen cards named, as they are turned over, to reveal that you have correctly located each one.

The same purely mathematical principle underlies each of these demonstrations, with a little more magic thrown in for good effect as we progress to the second and third tricks. We gradually reveal this principle below, and discuss how each of the tricks is done as we go, before finally explaining why the principle works.

Let's start with the first effect. There are two secrets working behind the scenes for you here: an unadvertised but important relationship between the length of the word being spelled out and the size of the "quarter deck" which the spectator starts with, and the fact that you must somehow know the identity of one card in the spectator's hand from the beginning! It should come as no surprise that the card in question is the bottom card: asking the spectator to hold the cards in her hand in preparation for the spelling is just to give you an added opportunity to peek at this card, if you haven't already done that as she completed her shuffling. You must do whatever it takes to discover that card's identity!

This is the scoop on the ice cream trick:

Claim 1: Start with n cards, the bottom one of which is known. If k cards are dealt out into a pile, thus reversing their order, and the remaining $n - k$ cards are dropped on top as a unit, and this type of deal is repeated twice more, then the known card rises like cream to the top — provided that $n \leq 2k$.

In the case of the nine-letter word CHOCOLATE, the trick works provided that the portion of the deck selected by the volunteer contains at most eighteen cards. If MINT CHOCOLATE CHIP (seventeen letters) is named, you'll ask for between a third and half of the deck. (If RUM is selected, try to force RUM RAISIN!)

The triple deal described is actually 75% of a rather interesting quadruple deal. This is the real scoop:

Claim 2: Start with n cards, and assume that $n \leq 2k \leq 2n$. If k cards are dealt out into a pile, thus reversing their order, and the remaining $n - k$ cards are dropped on top as a unit, and this deal is *repeated three more times*, the entire packet of n cards is restored to its original order.

Now consider the second effect above. Two cards (not Aces, 2s or 3s) are chosen and set aside face up. Let's suppose they

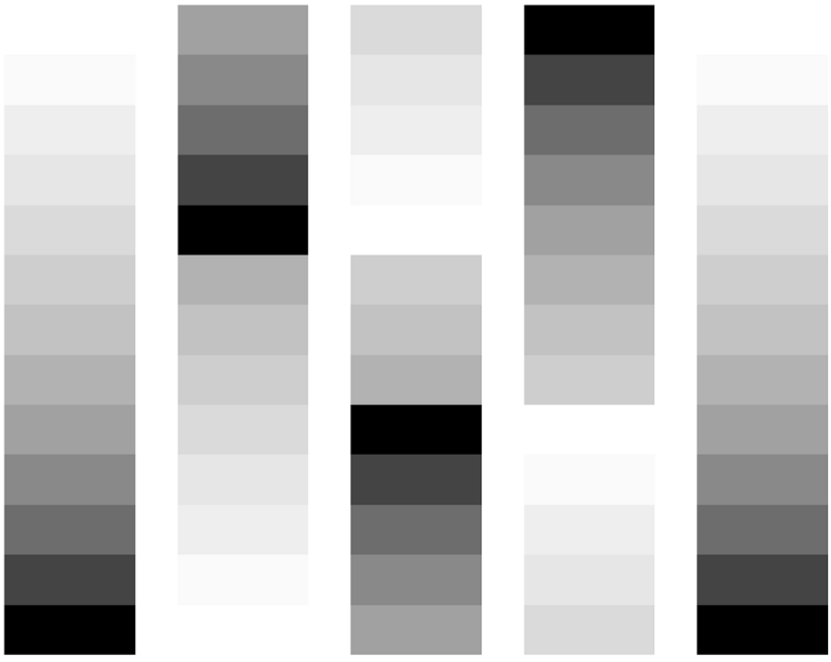
are 4♣ and 9❤. As you run through the deck face up, ostensibly to toss out the low valued cards, what you really focus on doing is cutting the 9♣ and 4❤ to the top and bottom respectively. They will stay there if you are careful how you riffle shuffle. Continue as described earlier: reversing nine cards into a pile and then doing some overhand shuffling whose purpose is to bring the bottom card to the top. Peel four more off the top without reversing them and drop on top of the other nine. You now have thirteen cards with the desired two cards at the top and bottom of that packet. Your subsequent demonstration of dealing nine and dropping four is just the first of a series of four deals: the first spectator does the next three deals, thereby restoring the packet to its initial state. The second spectator deals (either four or nine) cards into a pile and then there are two piles on the table with one of the desired cards at the bottom of each pile. You are all set for the grand finale.

The third effect uses the fact that after three deals of the type described, not only does the bottom card rise to the top, the next to last card becomes the second card from the top, the one above that becomes the third card, and so on:

This is the real triple scoop:

Claim 3: If k cards from n cards are dealt out into a pile, reversing their order, and the remaining $n - k$ are dropped on top as a unit, and this process is repeated twice more, then provided that $n \geq k \geq n/2$, the original k bottom cards become the top k cards, in reverse order.

To perform the third trick, ask each of three volunteers to pick a card at random. Have these cards returned, one at a time, to the deck and *then control them to the bottom* — this means that you appear to allow free choice of where to put the cards, but you actually use elementary magic techniques (e.g., double cuts) to get each card to the bottom. As a result, the third volunteer's card is at the bottom of the deck, the second volunteer's card is one up from the bottom, and the first volunteer's card is two up from the bottom. Peel cards off the bottom of the deck — without altering their order — one for each letter of the name of the magician called out, as you spell out both words in full. Hand the resulting packet of cards to the first volunteer and ask that the longer of the two names (HOUDINI in our example) be spelled out as cards are dealt into a pile, before dropping the remainder on top. Now give the cards to the second volunteer and finally to the third volunteer for two more deals. The three chosen cards are now on the top of the packet of cards, with the order reversed, and you are all set to conclude in triumph.



Proof Without Words

Why are all of the above claims valid for any n and k with $n \leq 2k \leq 2n$? It's certainly easy to see if $n = k$ (reversing all of the cards each time), and almost as easy to see if $n = 2k$ (reversing exactly half of the cards). Actually, it's *easy to see* in all cases: Suppose for the sake of concreteness that $n = 13$ and $k = 8$. Let's agree to represent a pile of thirteen cards in a particular order by a sequence of gray-scale panels in decreasing order of brightness, from white for the top card to black for the bottom card, as depicted in the image.

Then the results of the four deals — each of eight cards into a pile with the other five dropped on top — is given by the successive images in the pictures.

Since the last image shows a fully restored pile, the deal in question has period 4: after four deals we are always back to where we started. After three such deals, the original bottom card (black) has risen to the top — in preparation for its final journey back to the bottom under one more deal. Moreover, it is clear that the eight bottom cards become the eight top cards, suitably reversed, after three deals. There are just three portions of the packet — of sizes 5, 3 and 5 here — to keep track of: and they move around intact, subject at most to some internal reversals. The only relationship between 13 and 8 which is needed to make this sequence of images totally generalizable is the fact that $8 \geq 13/2$.

Finally, we suggest that during all dealing the cards are held low, close to the table, so as to justify fully the title of this article.

Colm Mulcahy (colm@spelman.edu) *has taught at Spelman College since 1988. He is currently the chair of the department of mathematics there. The number of syllables in his first name is strictly between 1 and 2. He is a member of the FOCUS editorial board and will be contributing a regular "Card Colm" to FOCUS Online.*

Science Policy at the MAA

By David Lutzer

Many MAA members might not realize that MAA is involved in national science policy — but it is. Presenting a discipline's perspectives on research funding issues to national policy makers has long been an activity of professional organizations. See, for example, the governmental affairs sections of the web pages of the American Institute of Physics, the American Chemical Society, the Society for Industrial and Applied Mathematics, and the American Mathematical Society. But Washington decisions can also affect *undergraduate* mathematics, which is among MAA's most central interests. Consequently the jobs of the MAA President and the MAA Executive Director include presenting MAA policy perspectives on pending federal decisions with undergraduate ramifications.

Where do MAA's science policy positions come from? According to the MAA bylaws, only the MAA President and Executive Director may speak for MAA on science policy issues. The Board of Governors can be influential in shaping MAA science policy, and the MAA also has a Science Policy Committee (SPC) whose charge is to assist the Association "in anticipating, responding to, and initiating changes in the educational, the financial, and the policy environments that may impact the work of the MAA and its members." (To see some of what SPC has traditionally done, go to the MAA home page at http://www.maa.org and then choose "Science and Professional Policy" within the "Special Groups" pull-down menu.)

The MAA President and Executive Director are both *ex officio* members of SPC and can seek committee advice whenever the need arises. For example, some years ago the SPC formulated talking points that the MAA President and Executive Director could use in case they were asked for comment on what seemed to be a controversial educational proposal from the White House. Perhaps the most important SPC action in recent years was to recommend that MAA engage the services of a professional government relations firm. The Board of Governors agreed, and the firm of Lewis-Burke Associates (LBA) was chosen.

Among LBA's first activities on behalf of MAA was to organize a two-day Washington meeting of the Science Policy Committee on March 22 and 23 of this year. The purpose of the meeting was to get SPC members to meet with congressional and executive branch officials, to present MAA's positions on several science funding issues in person. On Monday, March 22, the SPC met senior staff members of the National Science Foundation (NSF) and the Office of Management and Budget (OMB), the goal was to prepare committee members for meetings with congressional staffers, scheduled on Tuesday.

Monday's meetings included extended discussions with David Radzanowski who is in charge of Science and Space Programs in the White House OMB; with Rosemary Haggett, Director of the NSF Division of Undergraduate Education; and with Bill Rundell, Director of the NSF Division of Mathematical Sciences. Both Joel Widder (of Lewis-Burke) and David Radzanowski (of OMB) made it clear that budget times will be very bleak in the near future. The NSF visitors briefed SPC on the programs in their directorates that contribute to undergraduate mathematical education. Both NSF visitors agreed with Radzanowski's prediction of lean budgets for the next few years and recently an important congressional appropriations subcommittee has proposed a 2% budget cut for NSF in the 2005 fiscal year, confirming Radzanowski's gloomy predictions.

In addition, the SPC spent a considerable amount of time trying to understand the intricacies of an administration proposal to move NSF's Mathematics and Sciences Partnerships (MSP) program from NSF to the Department of Education, where it would be consolidated with a second MSP program already in the Education Department. As explained below, the MAA opposes this proposed shift.

At the end of the day on Monday, SPC worked with Lewis-Burke Associates staff to formulate a page of talking points. Themes were taken from scheduled congressional testimony of MAA President Ron Graham (see pages 21–22 in the May/June 2004 issue of FOCUS) and reflected the day's conversations with NSF and OMB officials. A copy of the talking points page was left with each staff member visited on Tuesday and is available on the SPC website, mentioned above. The talking points focused on mathematics as a cornerstone of the nation's technical workforce preparation program, currently a hot issue in Washington. They urged Congress to reverse previous years' declines in the budget of the NSF Division of Undergraduate Education, one of two NSF divisions that support undergraduate mathematics, and called for increased support for the VIGRE and REU programs in the NSF Division of Mathematical Sciences because of their importance to undergraduate mathematics. The talking points also argued that the NSF Math and Sciences Partnership Program should *not* be shifted to the Department of Education, because, to quote President Graham's congressional testimony,

The MAA believes that if transferred to the Department [of Education], MSP funds will likely be distributed via block grants, which could spread the money too thinly to do any real good and which will, in all likelihood, result in much of the funding being redirected at the state level to programs outside the scope of MSP's original intent.

On Tuesday, after some SPC members visited the offices of their own senators and representatives, SPC met as a group with Jeff Smith who is the senior adviser to Senate Minority Leader Daschle on science policy; with Kara Haas and Jim

Wilson from the staff of the House Science Committee; with Tracy Locklin of the Senate Health and Labor committee; and with Jennifer Miller of the House VA, HUD and Independent Agencies Appropriations Subcommittee. (In spite of its name, the Senate Health and Labor Committee is the authorizing committee for both the NSF and for the Department of Education, and the House VA, HUD and Independent Agencies Committee is the appropriations committee in charge of NSF.) With small variations, the message to each was (a) that, using relatively small expenditures, NSF has been very effective in focusing nationwide efforts of college and university mathematicians on several important undergraduate issues and in fostering educational improvement in the U.S., and (b) that relatively small additional allocations in the 2005 budget (now in the planning stage) would yield a lot of "bang for the buck" in terms of enhancing the nation's scientific and technical workforce preparation effort. We had been warned that "Washington runs on anecdotes" and so we did our best to wrap our messages in stories from our personal experiences with undergraduates and undergraduate teaching.

Everyone with whom the SPC met was courteous and many were enthusiastic about the issues that we presented. While some SPC members had never visited the offices of a congressman or senator before, by the end of the day, all of us felt that presenting MAA's perspectives "on the Hill" was something we could confidently and comfortably do.

While members of SPC and the Lewis-Burke staff were pleased with the efforts launched in March 2004, all agreed that this cannot be a one-time effort. The multi-year task will be to build linkages with congressional staffers and federal agency program officials who will come to understand MAA's science policy positions, and to call upon MAA representatives for advice on issues related to undergraduate mathematical education. If you want to help in this effort, please contact MAA Secretary Martha Siegel (msiegel@towson.edu) to volunteer for appointment to the SPC.

David Lutzer is Professor of Mathematics at the College of William and Mary. He chairs the MAA Science Policy Committee, is a member of MAA's Committee on the Profession, and is a member of the Joint Policy Board for Mathematics (JPBM). He also headed the CBMS2000 national survey of the undergraduate mathematical sciences. His website is at http://www.math.wm.edu/~lutzer.

New MathDL

By Lang Moore

The MAA's *Mathematical Sciences Digital Library* (MathDL) has a new home, a new look, new material, and many forthcoming new features. In August, the MAA began publishing the three components of MathDL, *The Journal of Online Mathematics and its Applications* (JOMA), *Digital Classroom Resources* (DCR), and *Convergence,* using a new content management system. The site is now housed at MAA Headquarters and maintained by the MAA. The web address has not changed: MathDL may still be accessed at http://www.mathdl.org.

Work on MathDL began in the Fall of 2000 under a National Science Foundation grant in the National STEM(STEM stands for Science, Technology, Engineering, and Mathematics) Digital Library (NSDL) Program (see http://www.nsdl.org). MathDL was one of the first of over 171 projects supported by the NSDL program. MathDL debuted in January 2001 with the first issue of JOMA. It was hosted by the Math Forum until August of 2004.

All articles and other materials submitted to JOMA are peer-reviewed. Since the first year, JOMA has been published continuously as accepted materials are ready to be posted. Each volume after Volume 1 represents a calendar year without subdivision into issues.

JOMA takes full advantage of the Web as a publication medium. Its materials contain dynamic, full-color graphics; internal and external hyperlinks to related resources; applets in Java, Flash, Shockwave, or other languages; MathML, SVG, and other XML markups; audio and video clips; and other Web-based features. David Smith, founding editor of JOMA, will retire from the editorship at the end of this calendar year. A search is currently underway for his replacement.

The *Digital Classroom Resources* (DCR) library is an exemplary collection of free online learning materials. All materials have been classroom tested and peer reviewed. DCR provides instructors with a set of tools ready for implementation in an existing curriculum as well as an ongoing forum for discussion of the issues surrounding the materials and their uses. Within this community, the library also provides a snapshot of trends and thoughts on issues relevant to the use of technology in mathematics teaching and learning. Learning materials in DCR include (but are not limited to): interactive web pages; web pages enhanced with animation or streaming video; downloadable programs that run independently of the web or web browser; and modules developed for commercial computer algebra systems. Doug Ensley, the founding editor of DCR, continues as the current editor.

Convergence, the newest component of MathDL, first appeared last April. This online magazine focuses on the use of the history of mathematics in teaching mathematics. The magazine, also funded by an NSF grant, features articles, reviews, "Today's Quotation," a "problem from another time," and "on this day." Editors Victor Katz and Frank Swetz have created an online magazine that is both enjoyable and instructive.

The next component of MathDL to come online will be OSSLETS — Open Source Sharable Mathlets. OSSLETS will feature short interactive online materials that are scientifically and pedagogically sound and that can be easily reused or repurposed. In addition, many of these materials can produce output that is easily cut-and-pasted into a spreadsheet or a computer algebra system. The prototype OSSLETS, called *Lite Applets*, was designed by a group headed by Frank Wattenberg and funded by a supplement to the MathDL grant. These first applets were reported on in the article *Lite Applets* by Frank Wattenberg, Bart Stewart, and Suzanne Alejandre which appeared in Volume 2 of JOMA.

The OSSLET site will feature mathlets that satisfy the following criteria: the mathlet and its source code are available for reuse; two examples of use of the mathlet are given; a discussion of how to work with the mathlet is included. All mathlets published in OSSLETS, will be reviewed and approved by an editorial board directed by OSSLETS Editor, Frank Wattenberg.

Early in 2005, two additional components, *MAA Reviews* and *Online Classroom Capsules,* will appear. *MAA Reviews* will be the online successor to the Telegraphic Reviews that, until recently, appeared in *The American Mathematical Monthly*. Fernando Gouvêa will edit this section of MathDL. The reviews will be similar to the ones that currently appear in the *Briefly Noted* section of *Read This!,* the MAA's online book review column. In addition to brief reviews, the site will feature longer reviews of selected books, a complete searchable database of books received, and a regularly updated Basic Library List.

Classroom Capsules will bring together the best of 111 years of the short classroom materials from the MAA print publications. It will be easily searched by topic, author, and student level. Wayne Roberts, the editor of *Classroom Capsules,* is currently assembling an editorial board.

The Committee on Programs in Mathematics is developing a successor to their current *Illustrative Resources* site at http://www.maa.org/cupm/illres_refs.html. The new component of MathDL will replace the current site and will continue to be named *Illustrative Resources*. David Bressoud and Susanna Epp will be co-editors. CUPM is currently seeking funding to support this site development.

In addition, MathDL has been developing software to support online meetings and workshops. Andrew Schretter of Duke has done the development work. A preliminary version of the software was used by Lang Moore, David Smith, and Frank Wattenberg to support their 2003 online PREP workshop, Authoring Online Interactive Materials in Mathematics. Information on how to use this software for committee meetings, workshops, and similar activities will be available soon.

MAA Around the World and in the Classroom

By Joel Haack

My academic training was as a ring theorist. Following a stint in administration, I have inherited the history of mathematics courses at my institution. Consequently, the professional development that I have experienced and enjoyed through the first two MAA mathematics study tours has been significant.

Joel and Linda Haack aboard the London Eye. Photo courtesy of Carol Dotseth.

Linda Haack studying the Thompson Harmonic Analyser at the London Science Museum. Photograph courtesy of Joel Haack.

With respect to my teaching, I have been able to use information learned on the Greece and England trips in my classroom in many ways that make the subject more present for the students. For just a few examples, I have been able to share photographs of Miletus and Samos, making Thales and Pythagoras come alive for the students. At the office of the European Cultural Center of Delphi, we had the opportunity to hear and play a reconstruction of an ancient hydraulic organ, discussed in one of Heron of Alexandria's works; the CD and accompanying booklet have let me share some of this experience with my class as well. I can describe the reflecting telescope that Isaac Newton presented to the Royal Society, having had the chance to see a replica at the Royal Society in London. Our visit to Bletchley Park will allow me to share the story of Alan Turing's life with an immediacy that would otherwise not be possible.

Finally, I am now responsible for a course entitled Science, Mathematics, and Technology in the Americas. Next year's MAA study tour to Mexico to study the Mayan civilization will be a significant learning opportunity for me. But, perhaps surprisingly, last year's trip to England adds to this class as well, as we include a discussion of "What is science?" that is made tangible by information and photographs about the development of science from the Royal Society and the British Museum.

This year, I will make a number of presentations that have been enriched by the MAA tours. Together with a colleague from acoustics, I will make several presentations describing the use of the Henrici harmonic analyzer, a hundred-year-old tool used to find Fourier coefficients. While I first learned of this device at the MAA's pre-conference workshop on Mathematical Technologies, I had the chance to view an early model in the Science Museum of London, where I could also see Lord Kelvin's much more massive harmonic analyzer. Another presentation, to the secondary mathematics teachers of Iowa, will be based on what I learned about Thomas Harriot in a lecture Jackie Stedall delivered to our group in London.

Space limitations here keep me from extolling additional professional opportunities on the tours: discussing mathematics education with Greek and English colleagues, viewing an impressive mathematics exhibit in Athens and an exhibit of JMW Turner's lectures on perspective in London, and developing professional friendships. The first two MAA tours have been intellectually satisfying and reinvigorating; I look forward to the next one!

Joel Haack is Professor of Mathematics at University of Northern Iowa in Cedar Falls, Iowa.

This is a new series that will feature occasional articles by MAA Mathematical Study Tour participants on how they have incorporated the information and educational experience abroad into their classroom teaching, syllabi preparation, and course discussions.

Found Math

Florida Student: "What are the angles on a three-four-five-triangle?"

Governor Jeb Bush: "The angles would be ... If I was going to guess ... Three-four-five. Three-four-five. I don't know, 125, 90 and whatever remains on 180?"

Florida Student: "It's 30-60-90."

Reported on WFTV, July 6, 2004 Online at http://www.wftv.com/education/3498203/detail.html.

The Changing Face of Calculus: First- and Second-Semester Calculus as College Courses

By David M. Bressoud

There was a time when it made sense to teach single variable calculus as a year-long course. Most of the students who enrolled for the first semester intended to complete a full year. Nearly all the students who began the second semester came from the first-semester course at that institution. No more. The number of students who take their first calculus course in high school is much higher than the number who take calculus for the first time in college[a]. At many colleges and universities, the majority of students in Calculus II passed the first-semester course somewhere else, a trend that is accelerating. Large and increasing numbers of the students who take Calculus I do so with no intention of continuing on to the second semester of the course.

In the CUPM Curriculum Guide 2004 [6], the first and foundational recommendation for all departments is to "understand the student population and evaluate courses and programs." The CUPM Guide encourages departments to "determine the extent to which goals of courses and programs are aligned with the needs of students" and "continually strengthen courses and programs to better align with student needs." I will argue that the traditional year-long single variable calculus course is badly out of alignment with student needs at most institutions.

The Need for a New Calculus II

At colleges and universities on semester systems, the traditional Calculus I is differential calculus with the barest introduction to integration in the last few weeks. Calculus II picks up where Calculus I left off, reintroducing and then developing integral calculus for roughly half a semester. It then moves on to sequences and series and may touch on some topics of several variable calculus such as partial derivatives. Aside from the fact that the material on sequences and series never seems to hang together with the earlier work on differential and integral calculus, it is not a bad course. The problem is that few students take it as intended.

In the fall of 2000, 107,000 students took mainstream Calculus II in a 2- or 4-year college or university in the United States [4]. Spring enrollments were certainly higher. Enrollments in Calculus II have been flat[b], so we can estimate that roughly a quarter million students take mainstream Calculus II in college each year. In the spring of 2004, over 150,000 high school students earned a score of 3 or better on one of the Advanced Placement Calculus Exams[c]. Many more high school students obtained International Baccalaureate or community college credit for calculus.

In many colleges and universities, it is already the case that most of the students who take Calculus II come with credit for Calculus I taken in high school. These students are not well served by the traditional approach to calculus in college. They have seen an entire course of differential and integral calculus and have already studied many of the topics that will be covered in the first half of Calculus II. It makes no sense to pretend that they are barely familiar with integration.

On the other hand, those who have taken the AB syllabus have had the equivalent of a one-semester course, not a full college year. There are significant gaps in their knowledge. Most of these students will not have studied integration by parts, L'Hospital's Rule, or parametrized motion. Many of them would benefit from more and deeper work on limits, implicit differentiation, differential equations, and the theorems of calculus. They need a Calculus II course, but not the one we traditionally offer.

The need for revising Calculus II becomes even more imperative when we remember that the students who come to this course directly from a high school AP course are among our most mathematically promising. The last thing we should do is to put them into a course that does not build directly on their training and lead them into further mathematics. Calculus II should be a course that they find challenging and exciting, one that helps them see the potential of modern mathematics and makes them want to pursue it. Those colleges and universities that find that many or most of their Calculus II students come with credit for calculus taken in high school should assess how well their curriculum meets the needs of these students and entices them into continuing their study of mathematics.

The Need for a New Calculus I

The movement of first-semester calculus into the high school curriculum also has profound implications for how we teach Calculus I in college. Students who begin calculus in college are very different from those of a generation ago. They are far more likely to have weakness in their mathematical preparation. They are also far less likely to aspire to taking a second semester of calculus. The traditional Calculus I course was never designed to stand alone. Now it must.

There are many initiatives under way to supplement Calculus I instruction with "just in time" refreshment or teaching of pre-calculus topics. These are important, but I want to focus on a different side of the problem with Calculus I that is relevant to the needs of the students at my institution, Macalester College. The largest single group of students taking our Calculus I consists of prospective majors in the biological sciences. They are particularly ill-served by the traditional course.

As part of the preparation for the CUPM Curriculum Guide 2004, the subcommittee on Curriculum Renewal Across the First Two Years (CRAFTY) sponsored the Curriculum Foundations Project, a series of eleven workshops for faculty from partner disciplines such as economics, engineering, and physics. These faculty came together to explain and elaborate upon what they want their students to

learn from their mathematics courses[d]. The workshop for biologists, held at Macalester College in November, 2000, was personally enlightening.

Biology programs face constraints. They usually require two semesters of mathematics. Some institutions require more or less, but because there is so much technical information that has to be taught within four years, few feel they can afford to require more than two semesters of mathematics, and most feel that one semester of mathematics is not sufficient. Many medical schools, a driving force in the biology curriculum, require one semester of calculus. It is not uncommon for biology departments to have a mathematics requirement of Calculus I & II. When the biologists gathered at Macalester, they were unanimous and strong in the opinion that Calculus I & II made no sense as the two mathematics courses their majors should take. In their own words: "The current mathematics curriculum for biology majors does not provide biology students with appropriate quantitative skills. The field of biology is becoming much more quantitative which will necessitate a change in the mathematics curriculum for biology majors" (p. 16). Biologists need mathematics, but not what we have been teaching.

There are aspects of calculus that biologists do need, though they need far less than we teach. The topics identified at the workshop were "integration for the purpose of calculating areas and average value, rates of change, optimization, and gradients for the purpose of understanding contour maps." The most important mathematical tools for biologists lie in data analysis and statistics. Here the list of needed topics is far richer, "descriptive statistics, conditional probability, regression analysis, multivariate statistics, probability distributions, simulations, significance and error analysis" (p. 16).

The kind of statistical analysis that these students need to be able to do is deep. If they are to understand the statistical tools that they will be using, then they need some familiarity with the concepts of gradients, linear transformations, and eigenvectors. Can they learn all this within the context of Calculus I?

Macalester is among a handful of colleges that believes the answer is "yes." We have developed a substitute for Calculus I that does not attempt to duplicate the coverage of the traditional course. Its emphasis is on geometric and conceptual understanding, and its syllabus includes:

Functions and units: linear functions, power relations, polynomials, trigonometric functions, exponential functions, logarithms.
Dynamical systems: simple systems of discrete difference equations and differential equations.
The derivative: graphically, numerically, algebraically; Taylor polynomials to second degree.
The integral: as anti-derivative and as area.
Functions of two variables: contours, gradients, optimization via hill climbing.
The linear algebra of Ax = b: vectors, projection, least-squares, subspace, span. Emphasis is on 3-dimensional space.

This is a course that stands on its own merits. Not only our biologists, but also our chemists and economists have praised it for meeting the needs of their students. We have been running it experimentally, a program made possible by funding from the Hughes Foundation. That money is ending. We are too small an institution to be able to afford to run two distinct Calculus I courses. In view of the fact that Calculus II now draws so few students from Calculus I, we have decided that it is the traditional Calculus I that will disappear. For us, Calculus I and Calculus II will become very distinct courses.

These courses will still be connected. Part of the intention of the revised syllabus is to show students the importance and usefulness of mathematics and to encourage them to continue their pursuit of it. But our two courses in single variable calculus will no longer be two halves of a single course. Each is being redesigned around the actual needs of the students who take it, moving them forward in their understanding of and ability to use mathematics, preparing them for and enticing them into the further study of mathematics. This should be the goal of every mathematics course, whether taught in high school or college.

There are fundamental shifts now occurring in the needs of the students who take our mathematics courses. Macalester's solution is built around the needs of this college and its students. What is needed at your college or university will depend on your situation and your students. What you cannot expect is for the curricular solutions that worked a generation ago are still best for today.

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Notes

a) As estimated in the first article of this series [2], there are probably between 500,000 and 600,000 high school students taking calculus each year. Also as shown in that article, the numbers

taking first-semester calculus in colleges have been flat or slightly declining for the past twenty years. Total mainstream and non-mainstream Calculus I enrollments in all 2- and 4-year institutions in the fall of 2000 was 384,000 [4]. If we estimate that spring enrollments in Calculus I are two-thirds of fall enrollments, then between 600,000 and 700,000 students take some form of Calculus I in college each year. Roughly half of these, perhaps more, will have taken calculus in high school.

b) 111,000 in fall, 1990, 106,000 in fall, 1995 [4].

c) Not all colleges or universities give credit for a 3 on the AP Calculus exam, but a study [5] of students at 21 universities including Boston College, Carnegie Mellon, William and Mary, Michigan State University, Pennsylvania State University, Stanford, University of Virginia, and Yale showed that those who scored a 3 on the AP Calculus AB exam and started at the university with Calculus II did better in that course than did students who had completed Calculus I at that university.

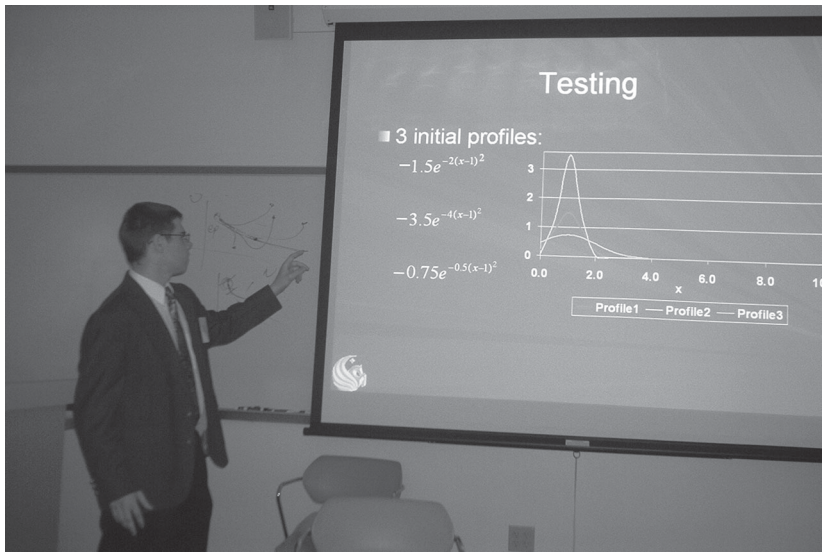
d) The reports of these workshops, written by faculty in the partner disciplines, are available from the MAA as Curriculum Foundations [3]. Page references that follow refer to this edition.

David Bressoud is DeWitt Wallace Professor of Mathematics at Macalester College in St. Paul, Minnesota. He serves both as Chair of the MAA's Committee on the Undergraduate Program in Mathematics (CUPM) and as Chair of The College Board's AP Calculus Development Committee. He has been involved with AP Calculus since 1990–91 when he had the privilege of teaching an AB course at the State College Area High School and of learning how to teach calculus from some great teachers, especially Annalee Henderson.

First Annual Embry-Riddle Undergraduate Mathematics Conference

By Greg Spradlin

The first annual Embry-Riddle Undergraduate Mathematics Conference, funded by MAA NSF Grant DMS-0241090, was held on March 27, 2004 at Embry-Riddle Aeronautical University. ERAU is a fairly small (with about 4500 students at the Daytona Beach campus) university focusing on aviation and aerospace. ERAU has no mathematics major, but does have a large and active student MAA chapter, many of whose members participated in the conference. The one-day program included student presentations and a keynote address. Approximately 70 people attended, from several Florida universities.



Jan Prokaj explaining "Multirate Numerical Techniques for Linear and Nonlinear Diffusion Problems In One Spatial Dimension."

A total number of 14 student presenters delivered 10 talks. When registering for the conference, the students were given the option of a 20-minute talk or a 50-minute talk. Two students chose the 50-minute option. Jay Lang of Embry-Riddle gave an enthusiastic talk about the Golden Ratio, its mathematical properties, and its occurrence in art and nature. Uriah Tobey, also of Embry-Riddle, explained how he programmed a TI-89 calculator to compute rocket trajectories from Earth to Mars, given initial and terminal positions of the trajectory. Many in the audience were awestruck by the complexity of the problem and the speed of the calculator in solving it.

Other highlights of the conference included an introduction by Amanda Fountain (University of Western Florida) to hyperbolic geometry, Christopher Subitch's (University of Central Florida) simulation of propagating optical waves, and an Embry-Riddle team's use of STELLA and Maple to design a landing system for interplanetary travel. 8 of the 10 student talks could be classified as "applied" mathematics, and the other 2 as "pure," reflecting the aerospace interests of the Embry-Riddle students. The agenda for the conference is still online at http://faculty.erau.edu/spradlig/erumc/agenda.htm .

The keynote address, by Erich Friedman of Stetson University in Deland, Florida, was about unsolved problems in plane geometry. Professor Friedman presented twenty-five easily stated but unsolved problems. His talk was accessible to anyone with a high school background in geometry, and drew many questions from the audience.

Approximately 33 students attended the conference. It was difficult to count them, because these included many Embry-Riddle students who happened to be in the same building, saw the signs for the conference, and dropped in to listen to some talks. Although the students were not polled about their affiliation, the number of unfamiliar faces suggested that at least half of them were from institutions other than Embry-Riddle.

The response of the attendees to the conference evaluation was overwhelmingly positive. All respondents completing a survey thought that the conference was well organized, and indicated that they would attend another conference. Some respondents would have liked to have more breaks between talks for introductions and socializing. Some respondents would have liked a greater variety of talks from which to choose. Some complained (justifiably) about an audiovisual snafu that delayed the last talk by 20 minutes. We will act on these suggestions at future conferences.

The MAA and NSF have given Embry-Riddle another grant to hold a similar conference in spring 2005. This year, the Conference Program Director will organize a committee of ERAU mathematics department members to generate ideas on how to improve on our promising start. Our primary challenge is to attract more students to give talks, especially from other universities. In 2004 only three students from outside Embry-Riddle gave presentations. We will try to enlarge this number by speaking to area faculty at MAA state and regional meetings, and more persistently reminding area MAA liaisons and student chapter leaders about the 2005 conference.

Greg Spradlin is an Assistant Professor of Mathematics at Embry-Riddle Aeronautical University.

MathFest 2004

The 2004 MathFest was held in Providence, RI on August 12 to 14. With over 1200 participants, it was one of the most successful MathFests ever. Peter Sarnak was the Hedrick Lecturer, giving three fascinating lectures on *Ramanujan Graphs* and their connections with automorphic forms and Ramanujan's Conjecture. Alan Schoenfeld was the Leitzel Lecturer. Schoenfeld's lecture, entitled *Mathematics and the Schools*, was a report on his attempt, as part of a group at the University of California at Berkeley, to do some work with the local schools. Other exciting speakers included Tony DeRose of Pixar Animation on "How Computer Graphics is Changing Hollywood" and Steve Sigur on "The Mystery of the Missing Tangents." There were many special sessions, panels, and contributed paper sessions, and of course also many social activities. Even *USA Today* seemed to be in on the action, carrying a front-page story on how "Algebra's for Everyone Now — Expectations are Rising" on August 21. The following pages give a glimpse of some of what went on.

Overheard at MathFest

I needed some exercise, so I rode the escalators up and down several times.

— Anonymous

Algebra is a 4000-year-old mathematical system that uses letters or other symbols to stand for relationships between numbers.

— *USA Today*

The *USA Today* forgot to mention that analysis is also useful.

— Peter Sarnak

The real macho guys do hard analysis; the clever guys do soft analysis. "Soft" means that you've understood it.

— Peter Sarnak

How to Get a Job at Pixar

Want to enter the high-flying world of computer animation? One way to get yourself a job at Pixar Animation is to figure out how to solve integral equations like:

$$L(x,y) = B(x,y) + \int_{z\in Z} L(x,z)R(x,y,z)V(x,z)\,dz$$

Or at least learn to approximate a solution *quickly.*

Tony DeRose described how animators handle lighting today by asking his audience to imagine a photographer setting up his lighting equipment in the dark. Once everything was set up, the photographer would wait for two hours. At that point, the lights would go on and he could assess the result. If he wasn't satisfied, the lights would go out again, the equipment would be rearranged, and another two hour wait would follow.

Figuring out the effect of lighting a scene in an animated film involves solving the integral equation above. This is done numerically on (essentially) a supercomputer, and it takes several hours. So if you can do it quickly, you'll have it made.

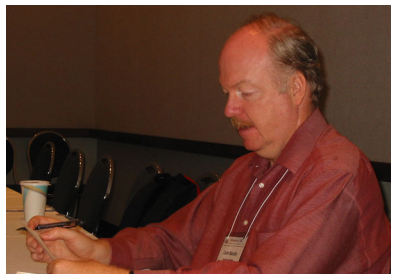
A full audience in a darkened room: Tony DeRose explains "How Computer Graphics is Changing Hollywood."

Photographs courtesy of Fernando Gouvêa.

MathFest in Photos

Ron Graham at the MAA Business Meeting.

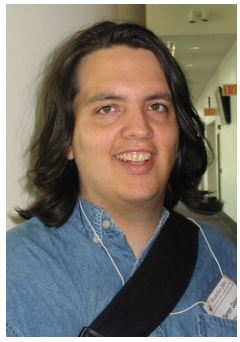
Joe Gallian, Richard Guy, and Aparna Higgins.



Colm Mulcahy at the FOCUS Editorial Board Meeting.

Baby pictures! Ina Lindemann and Tom Grasso.

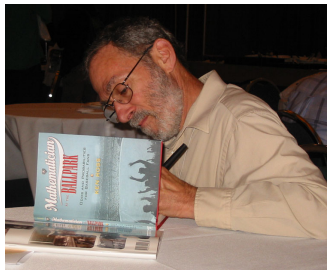
Aparna Higgins



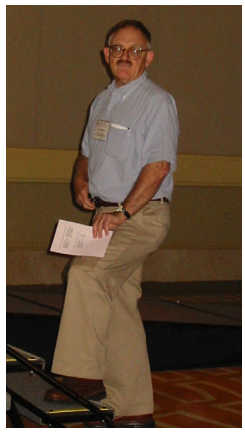
Darren Glass

An impossible object, an exhibit at the "Glass and Geometry" booth.

The Board of Governor's Meeting

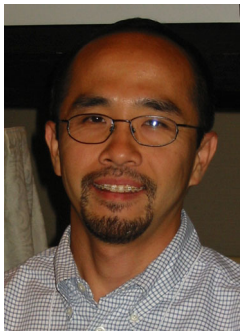


Ken Ross signs a copy of his latest book.



The only person who knew all that was going on: Jim Tattersall, Associate Secretary of the MAA.

Ron Bradley, fearless leader of HOM-SIGMAA.

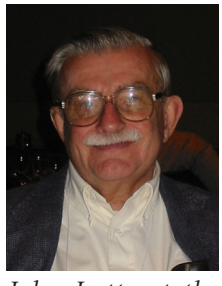


Francis Su, one of the first winners of the Henry Alder Award.

Ed Burger, winner of the Chauvenet Prize.

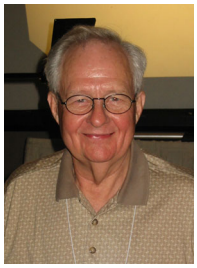
Stan Seltzer celebrates 25 years as a member of the MAA.

Dan Kalman speaking at the Opening Banquet.



John Lutts at the Silver and Gold Banquet.

Books!



John Harvey, 50 years with the MAA.

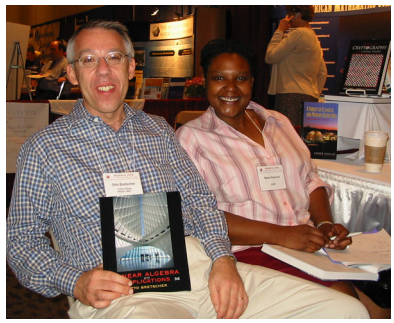
Placing the email center inside the exhibits area made it particularly pleasant to check on news from home.

More baby pictures! Jennifer Quinn, Doris Schattschneider, and Martha Siegel.

More books!

Glass and Geometry

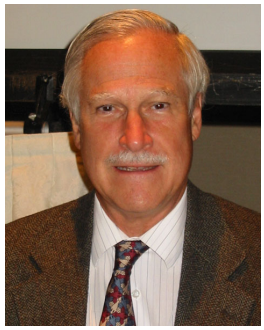
Steve Kennedy looks closely at a dodecahedron in the "Glass and Geometry" booth.



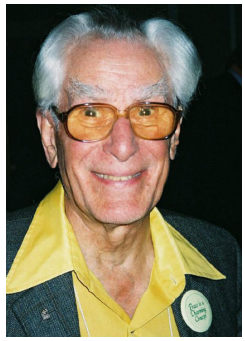
Otto and Marlisa Bretscher promote Otto's Linear Algebra textbook.

Emma Breedlove Smith celebrates 25 years as a member of MAA.

Greg Frederickson, winner of the George Pólya Award.



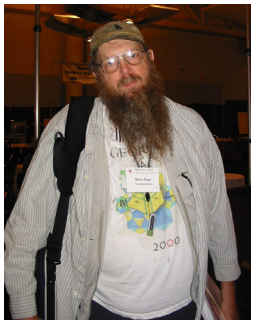
Douglas Duncan, winner of the Trevor Evans Award.



Richard K. Guy

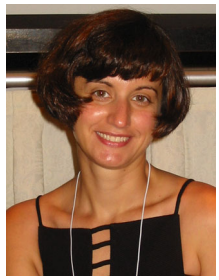
Jim Smith, 50-year member.

Beverly Ruedi and Carol Baxter tending to the MAA booth.



Steve Sigur of the Paideia School, who gave one of the invited addresses.

"Dali is the one on the right."– A slide from Tom Banchoff's talk at the Silver and Gold Banquet. Tom is the one on the left.



Zvezdelina Stankova, one of the first Henry Alder Award winners.

The August 2004 Board of Governors Meeting: A Graduate Student's Perspective

By Michael Lauzon

A mathematician's duties fall into three general categories: research, teaching, and service. Most of us enjoy one or both of the first two, and put up with the latter because it is necessary to do some administrative work to organize conferences, find new faculty or graduate students to keep our mathematics departments thriving, and, in this case, to keep the MAA running smoothly. The Board of Governors, while a decision making organization, also serves as a vehicle for different parts of the MAA to communicate to each other what they are doing to further mathematics and mathematics education. Governors fall into three broad categories, sectional governors, who represent geographic regions, governors who represent specific interests, such as minorities, high school teachers, or certain MAA publications, and MAA officers.

When I arrived at the Board of Governors (BOG) meeting, I had a chance to talk with some of the governors before the meeting began. Some I knew from either my undergraduate or graduate institution; others I met for the first time. Everyone was friendly, but they all seemed to indicate we were in for a long day. The general opinion was that the agenda for this meeting had many reports and a few contentious issues that might lead to lively debates.

For the first two hours or so, the meeting consisted of dry but necessary reports. For example, we heard several reports related to the finances of the MAA, which can be summarized as follows: The MAA has enough money to carry out its programs, but of course more money would be nice. After these reports, the president issued a comment that the BOG is responsible for all activities that take place in the MAA, and we really should try to pay attention. At this point the governor sitting on my left turned to me and said, "So what are you going to write?" Fortunately for this article, from here on the reports became more interesting.

The report about upcoming book publications was the most enjoyable of the meeting. There were about a dozen new publications this year, and we were given a summary of each book and copies of the new publications were passed around for our perusal. We were also told about last year's bestsellers. Two books that caught my attention were *Euler: Master of Us All* by Bill Dunham and *Musings of the Masters,* edited by Raymond Ayoub. *Euler: Master of Us All* is about Euler's life and prolific works in mathematics and has been on the MAA top ten bestseller list for five years. *Musings of the Masters* is a new book which presents informal writings of many mathematical greats (Poincaré, von Neumann, Hardy, and many more).

Creating a conflict of interest policy was the most contentious issue of the meeting. While there was near universal agreement that some conflict of interest policy was necessary (for people on awards committees, for example), it was not clear what form the policy should take. For example, the governors decided that a list of examples of conflict of interest as part of the MAA's official written policy might turn into a laundry list of situations to avoid instead of serving as examples to suggest a general idea of what conflict of interest means. It was decided that identifying when a conflict of interest arises should be left to the common sense of individuals, but that the MAA secretary should be contacted about unclear cases. There was also some debate about what should be done in cases of suspected conflict of interest, and whether immediately recusing oneself should be part of official policy. It was decided that many discussions, such as those conducted over e-mail, move slowly enough for a conflict of interest to be resolved without someone necessarily having to recuse themselves, but that a committee's secretary should be informed immediately about any possible conflict of interest. Finally it was decided that the MAA secretary should take these suggestions into account and write a policy that reflects them to be voted on at the next board of governors meeting.

Another issue that involved some discussion was the formation of a steering committee for the next strategic planning process. What was proposed was that a few section governors form a plan to put together a statement of long-term objectives for the MAA. The committee is not supposed to suggest any particular long-term goals, but decide how such goals will be decided upon. After some discussion, the governors agreed that the committee should be kept small (and for this reason would be unable to reflect too many diverse opinions) and should be made up of sectional Governors.

One interesting thing about attending the BOG meeting was that I heard about many MAA activities that as a graduate student I would otherwise not know about. Some issues pertained to people with much more money than I, such as a policy requiring a minimum amount of money to establish an endowed prize. Others were reports about programs for people with a different background from me, such as the Report from the Office of Minority Participation. Still others were programs targeted toward younger people, such as a report about what goes on at the Math Olympiad Summer Program, and a report about mathematical contests in general. While there was little excitement or glamour in the BOG, I did come away with a better idea of how much hard work is involved to keep the various parts of an organization as large as the MAA working well together.

Michael Lauzon is a graduate student at Brown University.

NSF Beat

By Sharon Cutler-Ross

The Mentoring through Critical Transition Points (MCTP) initiative of the National Science Foundation made its first awards this year. The program has support from the Division of Mathematical Sciences, the Division of Undergraduate Education, and the MPS Office of Multidisciplinary Activities. The transition points of interest are those from high school to college, undergraduate school to graduate school, and from graduate school to a professional career in mathematics.

The Statistics Undergraduate Mentoring (SUM) Project at St. Olaf College (Julie Legler, PI) is intended to increase the number of undergraduates from four-year colleges who concentrate on statistics in graduate school and to increase the number of statistics PhDs who choose to teach at four-year colleges. A Center for Interdisciplinary Research will be established where undergraduate students, post-doctoral assistants, and faculty mentors can work collaboratively with faculty and students in other departments on statistical aspects of professional and undergraduate research. Other opportunities for undergraduate students will include working in small teams with undergraduate summer researchers from other disciplines and helping faculty mentors develop statistics modules for non-mathematics courses. Post docs will help run the Center, teach undergraduate statistics courses, aid the summer research teams, and continue their own research programs.

The MCTP project at the University of Alabama at Birmingham (Lex Oversteegen, PI) addresses all three transition points. Talented high school students will be able to go directly into an accelerated program leading to a BS and an MS in four to five years. The transition to graduate school will be smoothed by an increased focus on independent research in the undergraduate courses. Finally, the mathematics doctoral program will be supplemented with more emphasis on the breadth of mathematics, exposure to another science, and development of interpersonal and communication skills for career success.

The transitions from undergraduate to graduate school and from graduate school to the early years of an academic career are the transition points addressed by the project at the University of Nebraska (Judy Walker, PI). The central piece of the program is Nebraska Intensive Mathematics: a Mentoring, Education, and Research Experience which will bring together students about to enter graduate school, students who have just finished the first year of graduate school, graduate students close to finishing the PhD, and faculty a few years out of graduate school who teach at predominately undergraduate colleges. The key piece of the various components of the project is the focus on the relationship between PhD- and non-PhD-granting institutions.

The Institute for Advanced Study will sponsor a Program for Women in Mathematics (Phillip Griffiths, PI) with MCTP funding. This annual ten-day mentoring program serves a mix of undergraduate and graduate students, and post-doctoral researchers. Senior women mathematicians organize and present the program on a specific topic each year. The project goals are to enhance the mathematical education of talented women mathematicians and retain these women in the field by establishing an extensive support network of other women mathematicians.

Freshmen Can Offer Mathematical Solutions to Real-World Issues

By Joseph Kirtland and Pau-San Hoh

Many first-semester freshmen view their education as a process of mastering a collection of unrelated skills from a variety of academic disciplines. The authors have found this to be particularly true of students who must take mathematics and writing courses as part of their general requirements. Rather than seeing the practical value of solid mathematical and writing skills, these students are more apt to express relief at having "gotten through" these course requirements because they perceive that they have gotten them "out of the way" of their college careers. To address this and other concerns, the authors have taught for the last six years a mathematics-composition course cluster (partially supported by NSF–DUE 9752632) to incoming undecided freshmen where the same students are enrolled in both an introductory-level mathematics and a freshman composition class.

The cluster creates a unified learning environment where students develop basic skills and examine practical applications of mathematics. As students write formal papers on the mathematics, they are compelled to demonstrate and assess their own understanding of the subject. By having them write at length, the instructors can then identify those who have a comprehensive understanding of the content, those who fall somewhat short of that, and those who have simply relied on rote memorization. By the end of the semester, all cluster students demonstrate understanding of the mathematics and its value in the real world by writing a research paper. In this final paper, the students document their investigation of a topic using the skills and knowledge presented in the mathematics class. Whether drawing from a personal experience or addressing a national or global problem, the project provides an avenue for students to explore the broader impact of mathematics and to see how mathematics can be used to address significant issues. The instructors give one-on-one guidance through all stages of research and writing, from defining the problem to formatting and revising the paper. To complete the project successfully, students must investigate the history of their topic, be aware of current trends, and develop a solution or describe the next step that should be taken. By doing this, they start to make larger connections among different disciplines.

Over the years, the students have tackled a variety of topics, including modern dance, environmental science, cryptography, criminal justice, and transportation engineering. Some of the more interesting projects were those in which student proposals anticipated or predicted solutions suggested or implemented later. During the fall of 1998, for example, one student decided to wade into the world of health care with its dizzying array of care providers and benefit management bureaucracies, coupled with the constant movement of patients through the system. In particular, he wanted to make it easier for patient information to be maintained and insurance claims processed as a person grows and changes physicians and insurance companies. The student's solution was to develop a universal health care identification number system and accompanying check digit scheme.

The medical identification number he designed would be assigned to a person at birth and used by all health care providers, insurance companies, and employers throughout that person's life. This involved creating a hashing process that encoded the most relevant information that a doctor and an insurance company would need to know about a patient. The identifier was a 25-character alphanumeric string. After all letters were converted into digits, the check digit scheme would apply the permutation $s = (0)(1,2,4,8,7,5)(3,6)(9)$ to every other digit, add up all the resulting digits, and then append the check digit so that the sum, with the check digit included, was equal to 0 (mod 10). For example, the abbreviated number 186452 (here 2 is the check digit) would be a valid number as $s(1)+8+s(6)+4+s(5)+2 = 2+8+3+4+1+2 = 20$, which is congruent to 0 (mod 10). The abbreviated number 673494 (here 4 is the check digit) would be an invalid number as $s(6)+7+s(3)+4+s(9)+4 = 3+7+6+4+9+4 = 33$, which is not congruent to 0 (mod 10). Unknown to us until a year or so later was that the federal Health Care Financing Administration, an agency in the Department of Health and Human Services, had proposed creating a national standard identifier in May of 1998.

Another student's proposal in the fall of 2003 similarly paralleled a real-world interest. To deal with the problem of underage drinking and fake IDs, a student developed an enhanced identification number system for all drivers in the U.S. The number would be associated with a person's driver license and would be unique to that person. In addition, the number included a check digit scheme so that all establishments that sell alcohol could scan the card and verify its authenticity. This freshman's proposal was echoed in a September 2003 report by the American Association of Motor Vehicle Administrators (AAMVA). While the studen concentrated on a way to make the identification number of a license a more secure and unique identifier of the license holder, the AAMVA report discusses the progress that has been made with regards to all aspects of driver's license security (issuing, forgeries, unique identifiers, etc.).

In addition to predicting or paralleling current efforts, a number of students have also tackled known problems. New York State, on August 16, 2000, and the state of Washington, on April 19, 2001, passed laws stating that social security numbers could not be openly used by public or private colleges to identify students. A number of our cluster students have proposed new methods for creating a student identification number system. These methods involved elaborate hashing functions that encode student information in a sophisticated and secure way so that no two students get assigned the same number (which is why schools

use social security numbers). In addition, many of the systems developed also included a check digit.

Although writing is often seen as the discipline that serves mathematics in such linkages, the reverse effect is equally strong in this particular cluster. The cluster students have said often that writing about mathematics has forced them to confront the demands of academic writing, such as concision, precision, coherence, and logical order.

With careful guidance, even first-semester freshmen produced results where mathematics was used in a meaningful and practical way. The key was to have the students pick their own problems and then to guide them so that they used the most appropriate data sources. While we never pushed a student in one direction or another, we did impart on them the importance of strong writing and good mathematical skills. We also trained the students in basic research methodology and encouraged them to not be afraid to tackle large issues. Most importantly, the projects gave the students the sense that they can do meaningful work on issues that have an impact on the world in which they live. Even at the initial stage of their projects when they were exploring topics to investigate, we could see the students' excitement in considering the options where they thought mathematical applications were possible: GPS, molecular research, endangered species tracking, ciphers based on natural language systems, etc. All of the students mentioned in this article were very proud of their work and felt a real sense of accomplishment when they found out that their approaches paralleled or predicted work done by others in the field. This fact alone was the best reinforcement of the importance of having solid mathematics and writing skills.

Joseph Kirtland and Pau-San Hoh teach Mathematics and English, respectively, at Marist College in Poughkeepsie, NY. *They would like to express their gratitude to the students who participated in the cluster and especially to Rich Carlson, David Chamberlain, Melissa Long, and Elizabeth Camire.*

ICMI Study 16

The International Commission on Mathematical Instruction (ICMI) has commissioned a study on *Challenging Mathematics in and beyond the Classroom*, whose main event will be a Study Conference from June 27 to July 3, 2006 at Trondheim, Norway with invited participants. The scope of this study will be wide. It will look at, for instance, the impact of mathematical challenges both inside and outside of the classroom, the role of mathematical challenges in supporting the curriculum for students of all levels of ability, vehicles for propagating mathematical challenges and assessment of their effectiveness. We would like to emphasize that we are interested in students and activities of all type, and want to go far beyond contests for talented students.

A discussion document has been prepared by an international committee chaired by Ed Barbeau of the University of Toronto (barbeau@math.utoronto.ca) and Peter Taylor of the University of Canberra in Australia who is the executive-director of the Australian Mathematical Trust (pjt@olympiad.org). This document defines terms, describes issues, provides sample situations, and poses questions for discussion. Finally, it indicates how to become involved in the Study Conference. Would-be participants will be asked to submit a brief curriculum vita and a 6-10 page document addressing matters relevant to the study no later than August 31, 2005. The committee plans to send out invitations by January 31, 2006. The Conference will be followed by a publication. A copy of the discussion document can be obtained by going to the website http://www.amt.canberra.edu, clicking on "LINKS" and then on "ICMI Study 16."

HOMSIGMAA Contest

The **History Of Mathematics Special Interest Group** of the MAA is pleased to announce its second annual **Student Writing Contest in the History of Mathematics.**

The deadline for submissions is March 30, 2005. Information and submission guidelines can be found on the HOM SIGMAA website at http://www.maa.org/homsigmaa or by contacting Amy Shell-Gellasch at amy.shellgellasch@us.army.mil

Research Experiences for Minority Undergraduates: SUMMA's National REU Program

By Robert E. Megginson

Though some progress has been made in recent years on the problem of the scarcity of African Americans, Hispanic Americans, and Native Americans (for brevity, these three groups will hereinafter be referred to collectively as *minorities,* with full recognition that there are many other minority groups in the U.S.) in the research mathematics community, much remains to be done. According to recent census figures, these three groups together now constitute about 27% of the U.S. population (see [1]), but according to [2] they still account for only about 6% of the mathematics Ph.D.s given to U.S. citizens and permanent residents each year.

Student Researchers Ary Clemons, Francesca Duncan, Mariam Konatè, and Jeremy Smith studied protein folding and DNA sequencing using graph-theoretic techniques with Debra Knisley at East Tennessee State University.

The under-representation of minorities in the ranks of Ph.D. mathematicians, and more generally in all of academe, is a well-known problem. Much of the damage has already occurred by the time the undergraduate years are reached. For example, minorities receive high school diplomas at rates substantially lower than the national average, and those minorities who do graduate from high school then enroll in college at rates lower than their white counterparts with high school degrees (see http://nces.ed.gov/programs/digest/d02/tables/dt012.asp). Some might take this as evidence that "it's not our problem here in college," and that the matter needs to be addressed somewhere earlier in the educational pipeline. In fact, it makes it imperative that we, as college mathematicians, encourage the minority students who do make it into our mathematics undergraduate programs to persist through to advanced degrees to provide the next generation of mentors and role models for students from similar backgrounds.

There is much evidence that mathematics REUs (research experiences for undergraduates) can excite minority students about the prospect of a research career in mathematics and persuade them to continue their education into mathematics graduate school. A good example is provided by the Summer Institute in Mathematics for Undergraduates (SIMU) conducted at the University of Puerto Rico–Humacao from 1998 to 2002 (see http://cuhwww.upr.clu.edu/~simu/). In each of its five summers this program engaged about two dozen Hispanic American and Native American students, all U.S. citizens or permanent residents, in intensive six-week research projects designed and conducted by leading mathematicians. Follow-up included continuing in contact with research mentors during the school year and presentations of research at the annual conferences of the Society for Advancement of Chicanos and Native Americans in Science as well as in the MAA's undergraduate poster session at the January Joint Mathematics Meetings.

Students were not accepted into the SIMU program just on the basis of their promise for graduate school in the traditional sense, but with much attention paid to their untapped potential and willingness to work as described by faculty recommenders. As of January 2003, twenty of the 47 students who participated in SIMU in its first two summers had been accepted into Ph.D. programs in the mathematical sciences, and seventeen others had been accepted into other graduate programs. With the total annual output of U.S. Hispanic American and Native American mathematics Ph.D.s averaging only about fifteen in recent years, this single program has the potential of having a significant impact on that production.

One factor that almost certainly contributed to SIMU's success is that participants interacted with a critical mass of students from backgrounds like their own, and saw first hand that there were other Chicano, Latino, and Native American students who shared their interest in mathematics and could succeed in the field. Without a direct focus on recruiting minority participants, it is difficult for an REU to achieve such a critical mass. Mathematics REU sites between 1980 and 2000 that did not explicitly focus on recruiting minorities averaged fewer than 4% minority participants, which clearly does not contribute to the solution of the under-representation problem in the Ph.D. ranks.

With all of this in mind, the MAA's Project for Strengthening Under-represented Minority Mathematics Achievement (SUMMA) established a National Research Experience for Undergraduates Program (NREUP) in 2003 to provide primary or supplemental funding for summer REUs of substantial length enrolling enough minority students to have a presence in the program. It was decided to require that the students be local to the program, in part to stretch program funds by eliminating travel costs but also to encourage program sites to develop

the talent at their own institutions rather than recruit from talent already developed elsewhere.

With funding in hand from the National Security Agency for a pilot project, SUMMA conducted an e-mail solicitation of its members for "MAA Summer Research Program" sites for summer 2003. The two primary sites selected from the seventeen applications received are programs at California State University at Chico and Texas Southern University. Funding was also provided to Goshen College in Indiana for adding a student to an existing REU. All three programs received continuation funding from NREUP for summer 2004 after the pilot proved successful.

The Pebbling Team: Marlene Merchain, Modesty Briggs, Juan Zuniga, and Victor Moreno did research on graph pebbling at the NREUP program at California Lutheran University.

Quite a bit of thought is needed to be put into the initial selection process, since many more worthy proposals were received than could be funded, but the excellence of the proposal pool showed from the beginning that a larger program would be feasible with no loss in quality. A major criterion for selection was that the research in which the students would be engaged had to be intellectually substantial and require hard work on their part, with an excellent chance of developing further directions of investigation, presentations that would interest research mathematicians, and, possibly, publications.

For example, in the program on knot polynomials conducted by Thomas Mattman at California State University at Chico, students investigated such matters as the trip matrix of a knot and a generalization from which the Jones polynomial of the knot can be computed and the algebraic nature of some of the properties of the Jones polynomial can be deduced. There are several important open questions arising in this investigation that lend themselves to student exploration and for which the students can produce interesting partial results. David Housman's program at Goshen College focuses on cooperative game theory and fair division, where, for example, known allocation methods fail for partially defined cooperative games due to the difficulty or infeasibility of determining the coalitional worth functions, but where there are several possible approaches open to student investigation. In the program on geometric graph theory and game theory directed by Nathaniel Dean and Tong Wu at Texas Southern University, students work on problems such as finding tight bounds for the size of the smallest square integer lattice that will realize a sphere-of-influence graph, a certain type of graph important in pattern recognition and computer vision.

Though it is too early to know with certainty how many of the students in NREUP's 2003 pilot project will end up in graduate school, initial attitudinal surveys of the students are quite encouraging. For example, the four African American students in the Texas Southern University program, who were tentative about attending graduate school when the program began, reported at the end that they had become determined to do so.

With this and much other evidence of success in hand, the MAA and SUMMA sought funding for expanding and continuing the project, and received an NSF/DMS grant for doing so along with continued NSA funding. With this funding, it was possible to expand the number of sites for summer 2004 to six, with East Tennessee State University, Virginia State University, and California Lutheran University added to the original sites. Each of the six sites had at least four minority undergraduates participating, and initial indications are that the students in them have done exciting work that should whet their appetites for a career as a mathematician and point them toward graduate school in the mathematical sciences.

Funding for NREUP will again be available for summer 2005, for which applications will be accepted through January 31. Up to six grants of up to $25,000 each will be given. Grants are intended to provide some compensation for a faculty researcher as well as stipends, room, and board for at least four undergraduates from minority groups underrepresented in the mathematical sciences. Funding received through this program can be for new projects, but can also be used to supplement existing projects provided the student funds are used for undergraduates from underrepresented minority groups. See http://www.maa.org/nreup for further details and application instructions.

References

[1] U.S. census figures; http://www.census.gov/Press-Release/www/2003/cb03-100.html.

[2] American Mathematical Society, *Annual Survey of the Mathematical Sciences, First Report, for 2000 through 2003*; http://www.ams.org/employment/surveyreports.html.

Robert E. Megginson is Professor and Associate Dean at the University of Michigan at Ann Arbor. *The project described in this article is being supported by the National Science Foundation under Grant No. 0353841, with other significant funding received from the National Security Agency.*

SAUM Offers On-line Guide for Assessment of Student Learning

Several factors continue to press for stronger assessment of student learning. In his recent article "The Four A's: Accountability, Accreditation, Assessment, and Articulation," Lynn Steen pointed out that "as higher education has become more important, more prevalent, and more costly, those who pay the bills — administrators, trustees, legislators, parents — are beginning to ask for evidence of value." This summer, as Congress considers reauthorization of the Higher Education Act, connections between accountability (and in particular outcome assessment) and accreditation are some of the most contentious issues, raising concerns among many in higher education of federal imposition of burdensome and costly oversight. Unless the academic community begins to take seriously the need to use assessment as a tool for both documenting and improving our work, it is almost certain that such requirements will be imposed from the outside, either from federal or state governments, traditional accreditation bodies, or (more likely) from a combination of all three.

With support from the National Science Foundation, the MAA Supporting Assessment in Undergraduate Mathematics (SAUM) project aims to assist faculty develop effective methods of assessing courses, blocks of courses, or entire programs within the mathematics department, not only to answer the external calls for accountability, but even more importantly, to assist faculty as they make critical decisions about course and curricular revision.

Over the past three years, a series of workshops have brought together teams of faculty from mathematical sciences departments with more experienced colleagues from a variety of institutions to construct plans for assessment. Follow-up sessions have allowed the teams to receive assistance at the implementation stage as well. A volume of case studies, *Assessment Studies in Undergraduate Mathematics* (MAA Notes #49), published in 1999, was distributed to all mathematics departments and the full text is available on the SAUM web site, http://www.maa.org/saum. A second volume is expected sometime next year. SAUM has also provided leaders for more informal "assessment forums" at section meetings for seventeen of the 29 MAA sections.

Through both the forums and workshops, we have found that there is a growing interest in the mathematics community for information and support for development of assessment plans. In order to reach a broader audience, a self-paced on-line guide, "Designing and Implementing a Program for Assessing Learning in the Major," has now been posted on the SAUM website. Together with a range of other materials, including the full text of the case studies volume, SAUM offers faculty an in-depth look at the assessment process. Whether you are just beginning to think about assessment, or trying to refine existing mechanisms, you can find the resources to help you understand and improve student learning in your courses.

SAUM Self Paced On Line Guide to Designing and Implementing a Program for Assessing Learning in the Major

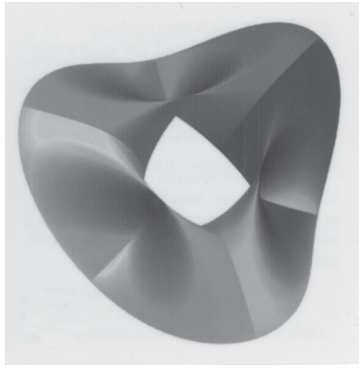
Available through the SAUM website, http://www.maa.org/saum, this Guide provides easy access to materials designed to assist faculty develop or enhance assessment programs in their departments. The first section provides an overview of assessment, including an introduction to terminology, and points to recent recommendations from the MAA's Committee on the Undergraduate Program in Mathematics on both curriculum and assessment.

In the second section, broader readings are presented that expand on assessment by looking at it from an international perspective and in a larger arena of program evaluation and accountability, where your assessment results may be used.

Finally, a collection of representative case studies are presented, together with pointers to ongoing projects that may provide points of contact for faculty interested in discussing their own efforts with others who are pursuing similar goals. A bibliography rounds out the Guide, offering those so inclined to continue exploring the current research and practice on assessment and accountability.

Tattoo Design Contest

Calling all aspiring artists! The MAA is looking for math-related designs for its new temporary tattoo, to be made available to students, student chapters, and members. The first such tattoo, which was very popular at the Phoenix Joint Mathematics Meetings, is shown right. To enter, email a four-color design, two inches square at 300 DPI, to the MAA at member@maa.org by Friday, December 10th. Designs selected for printing will be notified by email and receive 100 free tattoos. Winners will be announced in *Math Horizons*.The triaxial tritorus design was created by Paul Bourke of Swinburne University.

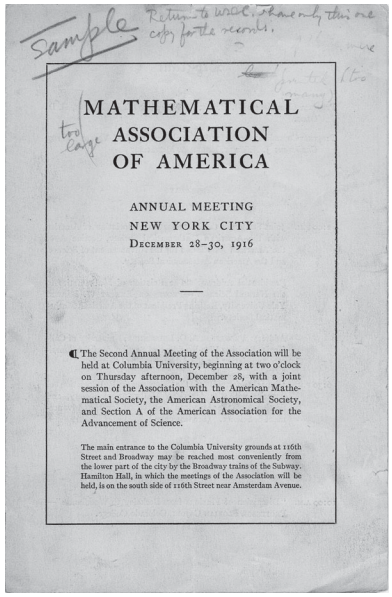


Archives of American Mathematics Spotlight: The Mathematical Association of America Records

By Kristy Sorensen

The Mathematical Association of America and the Archives of American Mathematics (AAM) at the Center for American History have had a close relationship for many years. Building on the presence of the papers of R. L. Moore and some of his colleagues and students, the AAM was established when the Mathematical Association of America chose The University of Texas at Austin as its official archival repository in 1978. Since then, numerous deposits of papers, photographs, and other records have come into the archives. The MAA records held at the AAM now total more than 300 linear feet.

We now have a strong foundation of records in which mathematical historians, mathematicians, and members and officers of MAA can find valuable and unique information about the history and work of this professional organization. I am working to develop a more focused appraisal strategy that can bring in the most historically relevant materials from all areas of the MAA. Too often important records are inadvertently destroyed or relegated to unopened basement files. Alternatively, bulky day-to-day files can take up valuable space in offices or archives shelves. My goal is to create an appraisal strategy that will be flexible enough to allow for a variety of historical records, without opening the floodgates to unexamined materials.


Sample Return to WDC; take only this one copy for the records.

too large

MATHEMATICAL ASSOCIATION OF AMERICA

ANNUAL MEETING
NEW YORK CITY
DECEMBER 28–30, 1916

¶ The Second Annual Meeting of the Association will be held at Columbia University, beginning at two o'clock on Thursday afternoon, December 28, with a joint session of the Association with the American Mathematical Society, the American Astronomical Society, and Section A of the American Association for the Advancement of Science.

The main entrance to the Columbia University grounds at 116th Street and Broadway may be reached most conveniently from the lower part of the city by the Broadway trains of the Subway. Hamilton Hall, in which the meetings of the Association will be held, is on the south side of 116th Street near Amsterdam Avenue.

Annotated program from the Second Annual Meeting of the Mathematical Association of America, December 28–30, 1916. From the Mathematical Association of America Records, Archive of American Mathematics, Center for American History, The University of Texas at Austin.

In order to create an effective appraisal strategy, I'll need to hear from those of you who are creating potentially archival records. If you are an officer, a committee chair, a section leader, an editor, or involved with any one of the many important records-creating positions in the MAA, I'd be happy to discuss your records with you. To get an idea of what types of papers we currently hold, you may be interested to learn that the searching aid for the MAA Records was recently mounted on the Texas Archival Resources Online (TARO) website. It can be viewed at http://www.lib.utexas.edu/taro/utcah/00328/cah-00328.html.

As is the case with any growing collection, the finding aid for the MAA Records is a work in progress. We expect it to grow, change, and become more refined as new groups of papers are brought into the archives, cataloged, and opened for research. The Mathematical Association of America Records is one of the core collections at the AAM, and we look forward to helping it grow and evolve to best help our researchers in the future.

The Archives of American Mathematics is located at the Research and Collections division of the Center for American History on the University of Texas at Austin campus. Persons interested in conducting research or donating materials or who have general questions about the Archives of American Mathematics should contact Kristy Sorensen, Archivist, k.sorensen@mail.utexas.edu, (512) 495-4539. Our web site is located at http://www.cah.utexas.edu/collectioncomponents/math.html.

In Memoriam

William Firey, Emeritus Professor at Oregon State University, died on August 15, 2004. Described by friends as a "mathematician of the old school," Firey had been part of the Putnam Questions Committee and a member of the editorial board for the MAA's Spectrum series. He was a member of MAA since 1968.

John E. Freund, longtime member of the MAA and prolific author of textbooks on probability and statistics, died on August 14, 2004 at the age of 83. A passionate educator, he was a member of the MAA since 1949.

Joseph L. Doob, a pioneer in the study of the mathematical foundations of probability theory, died on June 7, 2004 at the age of 94. Doob taught at the University of Illinois at Urbana-Champaign from 1935 until his retirement in 1978.He had been a member of the MAA since 1963.

Brief death notices of interest to MAA members are posted online at http://www.maa.org/news/inmemoriam.html *and included in FOCUS. Send notices to Carol Baxter at* cbaxter@maa.org.

Undergraduate Poster Session at the 2005 Joint Meetings

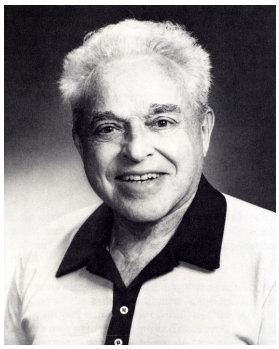
The 2005 Undergraduate Student Poster Session will take place on Friday January 7 in Atlanta, Georgia, at the Joint Annual Meeting of the AMS, MAA, and AWM. Professor Mario Martelli of Claremont McKenna College is the organizer. The MAA Committee on Undergraduate Students Activities and Chapters (CUSAC) sponsors the Session.

Please apply early, since the space is limited! Posters are expected to present a new result, or a different proof of a known theorem, or an innovative solution of a Putnam problem, etc. Purely expository posters cannot be accepted. To apply, students need to supply (1) the project title, (2) an abstract, no longer than a half page, (3) names and affiliations of all authors, (4) name, email, and telephone number of the student who will be the contact person for the logistics of the presentation, (5) name(s) and affiliation(s) of the advisor(s), and (6) sources of financial support. Send all the information to Professor Mario Martelli, Mathematics Department, Claremont McKenna College, Claremont, CA 91711 or by email (PDF format, TeX, or Microsoft Word) to Mario Martelli at mmartelli@claremontmckenna.edu.

Each poster will be evaluated by at least three judges. Prizes will be awarded to the best posters with money provided by the AMS, MAA, AWM, CUR, PME, and by the Moore Foundation. The person in charge of coordinating the accomodations of students participating in the Poster Session is Prof. Diana Thomas of Montclair State University. Please get in touch with her at thomasdia@mail.montclair.edu if you are interested in this service.

In Memoriam

Howard W. Eves, 1911–2004
By Cindy Eves-Thomas and Clayton W. Dodge



Howard W. Eves, well known author and longtime professor at the University of Maine, died June 6, 2004, after a long illness. He was 93.

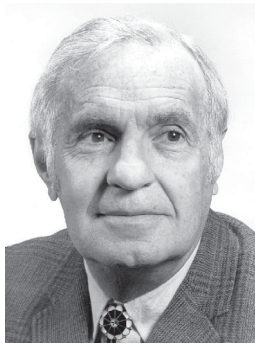
Eves received his Ph.D. in mathematics from Oregon State University. He enjoyed a long and distinguished career as a teacher, geometer, writer, editor, and historian of mathematics. He served as associate editor for several journals. His many awards included a Distinguished Teaching Award from the State of Maine, honorary doctorates from the University of Maine and McDaniel College, and the George Pólya Award for mathematical writing. Eves spent most of his career at the University of Maine at Orono and at Machias, and more recently at Central Florida University. For 25 years he edited the *Elementary Problems* section of the *American Mathematical Monthly*. He was a member of the MAA since 1942.

Eves was the author of numerous mathematics articles and books, including *Introduction to the History of Mathematics*, one of the most widely used texts in the subject. His six volume *Mathematical Circles* series, collecting humorous and interesting anecdotes about mathematicians, was recently reprinted by the MAA, who also published his two volumes of *Great Moments in the History of Mathematics* and in 2001 his *Mathematical Reminiscences*. In 1997 Dover reprinted his *Foundations and Fundamental Concepts of Mathematics*. His two volume *Survey of Geometry* was first published by Allyn & Bacon in 1963 and has been reprinted in several abridged versions.

While at the Institute for Advanced Studies in Princeton, he became a friend of Albert Einstein, who once pointed to an aster growing in a crack in the sidewalk and remarked, "Bloom where you are planted." His MMM (My Mathematical Museum) contained a nickel that Einstein had owned and a pencil Oswald Veblen had probably dropped, among hundreds of other interesting curiosities.

Eves was a strong spokesman for the MAA and a founder of its Northeast Section, which made him the first recipient, in 1980, of its Howard Eves Award for service to the Section and the Association. More importantly, he was a great humanitarian. Quietly and without fanfare or expectation of reward, he helped many people in need, going far beyond the call of duty. His honorary degree from the University of Maine was therefore a Doctorate of Humane Letters. His comment on that degree was equally modest: "They must have seen me patting a dog."

Murray Klamkin, 1921–2004
By Steven R. Dunbar



Murray Klamkin, prolific mathematical problem poser and solver, professor of mathematics, and member of the MAA since 1948, passed away on August 6, 2004 at the age of 83. Murray Klamkin received a B. Ch. E. from the Cooper School of Engineering in 1942, then spent 4 years in the U.S. Army. After receiving an M.S. in Physics at the Polytechnic Institute of Brooklyn in 1947, he spent 1947–48 studying mathematics at Carnegie-Mellon. From there, he returned as an instructor to the Polytechnic Institute, then held positions successively at AVCO Research, SUNY-Buffalo, the University of Minnesota, Ford Motor Company, the University of Waterloo, and the University of Alberta, where he was Chair of the Department of Mathematics from 1976 to 1981. Murray Klamkin is best known for editing the Problems columns of many journals: *SIAM Review*, the *Pi Mu Epsilon Journal, School Science and Mathematics Journal, Crux Mathematicorum,* the *American Mathematical Monthly, Mathematics Magazine*, and most recently, *Math Horizons*. Klamkin is one of the three greatest contributors to the *SIAM Review* Problems and Solutions Section. Murray also served the MAA as a visiting lecturer, a committee member, and on the Board of Governors,

Not surprisingly, he was also on the Putnam Competition Committee, and was instrumental in starting the USA Mathematical Olympiad. The standards he set as the Chair of the USAMO Committee from 1972–1985 and the Coach of the USA Team at the International Mathematical Olympiads from 1975–1984 were significant to the continued success of the program. Under his leadership, the USA team delightfully surprised the mathematics community by doing well despite having to compete against countries that had been participating in the IMO since its beginning in 1959. In Steve Olson's recent book *Count Down*, Klamkin is quoted as saying "A lot of people were dead set against it, they thought a US team would be crushed ..." In the 2001 IMO in Washington DC, he returned as an Honorary Member of the Problem Selections Committee and a guest lecturer at the summer training program for the USA team.

Mathematicians and students of mathematics will long appreciate his creation of brilliant problems and lucid solutions and the standards that he set. "The best problems," he said, "are elegant in statement, elegant in result, and elegant in solution. Such problems are not easy to come by." Murray found them consistently and shared them generously throughout his long and fruitful career.

James E. White 1946–2004
By Dan Kalman

James E. White, founder and director of the *Mathwright Library* at http://www.mathwright.com, as well as principal creative force behind the *Mathwright* software family, died suddenly and unexpectedly July 18, 2004. He was 58 years old, and is survived by his wife, Sally, four children, and two grandchildren. White received his Ph.D. at Yale University under William Massey in 1972 in Algebraic Topology. He held permanent and visiting faculty positions at many institutions, including the University of California at San Diego, Carleton College, Bates College, Kenyon College, Spelman College, California State University Monterey Bay, and Stetson University. His non-academic experience included work at Jet Propulsion Laboratory. Most of his work on the *Mathwright* project was done during his tenure at the Institute for Academic Technology at the University of North Carolina Chapel Hill.

White will best be remembered in the mathematics education community for his vision, creativity, and leadership in the applications of technology. He recognized early that computers offer a unique and powerful tool to inspire, captivate, and entrance students, and for 30 years devoted himself to innovative uses of computer technology. His philosophy was that students will learn best when they ask and answer their own questions, and he understood that computer software can create powerful environments in which students are empowered to do so. His dream and vision was to develop a tool with which teachers and students could easily create these environments. The hundreds of activities housed in the *Mathwright Library*, created by scores of teachers and students from around the world, bear witness to his successful realization of this vision.

White had a long and active involvement with the Mathematical Association of America. He was co-director of the MAA's *Interactive Mathematical Text Project*, which introduced dozens of mathematicians to the development and use of interactive instructional computer activities. He was also Principal Investigator for another MAA project, the *Web Educators Library Collection of Mathematical Explorations* (WELCOME). This project combined three areas of MAA concern: educational technology, professional development, and increasing access to mathematics for under-represented groups. The project, which was incorporated into the MAA's SUMMA Program, worked to bring interactive computer activities to students of minority serving institutions by offering professional development opportunities and mentoring to the faculty of these institutions. His final project for the MAA, completed shortly before his death, involved incorporating materials from the WELCOME project in the MAA's MathDL digital library.

James White had a life-long fascination with the world of ideas. He was first a mathematician, with several books and scholarly papers to his credit. He was widely read in mathematics, philosophy, and physics, studied differential geometry and its applications to relativity, and had a particular interest in foundational issues in quantum mechanics. At the time of his death, he was deeply immersed in research in these areas, and had recently completed a paper presenting an innovative new link between the geometric ideas of ancient Greece and the modern subject of special relativity. At the same time, he was fascinated by the issues of cognition and learning, and read widely in this area.

White was also a prolific author of interactive computer activities for students, and for their teachers. The *Mathwright Library* includes nearly a hundred of his contributions, displaying an amazing wealth of creative and inspiring lessons. There is a lunar lander that accurately models the physics of rockets, an activity that puts students in the driver's seat of a space shuttle to achieve orbit, a beautifully rendered three dimensional version of tic-tac-toe, and a physically and geometrically accurate simulation of pocket billiards. Most impressive of all, perhaps, is his multimedia survey of gravitation, in which the user navigates a Myst-like virtual world, while retracing the mathematical and physical evolution of our understanding of gravity. And this is just a small sample. He recently completed a calculus textbook, integrating both traditional text lectures and interactive explorations.

Those who knew him well recognized both a powerful intellect and a gentle and generous spirit. There was poetry at the heart of his life and work, and he saw poetry and beauty in mathematics. Who else would choose Monet's Water Lillies as the setting for an interactive exploration of buoyancy and boat construction?

Through his software and internet library, James White inspired and influenced mathematics students and educators from all over the world. He offered generous encouragement to all who met him, and carried on correspondence with a host of collaborators, followers, and students. His memory will continue to inspire all who knew him. His energy, enthusiasm, creativity, and originality will be sadly missed. An invited paper session in his honor will take place at the January Joint Mathematics Meetings in Atlanta. The title of the session is *Worlds of Interactive Mathematics: The Legacy of James E. White*. See http://www.ams.org/amsmtgs/2091_maainvited.html for more information on this session.

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 (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.

Wisconsin's NPRIME Project

By Linda Thompson and Margaret Wilsman

The Networking Project for Improvement in Mathematics Education (NPRIME) is currently in its sixth year in Wisconsin. This highly successful statewide project has used the Internet and conferences to establish connections between faculty involved in mathematics education at the state's colleges and universities and PK-12 mathematics teachers. The Project has been funded by grants from the Eisenhower Professional Development Program, the Wisconsin Education Communications Board, PBS Mathline, and the Wisconsin ESEA Improving Teacher Quality Program. A summary of five of NPRIME's most successful programs follows.

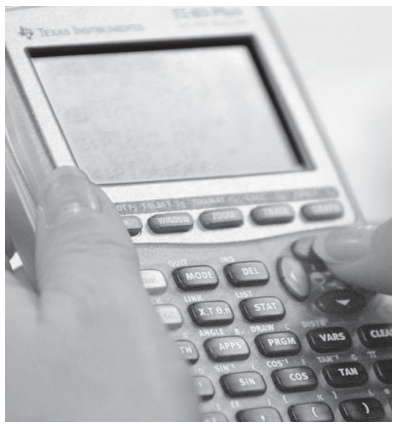
Through *Student NPRIME*, preservice teachers from 10 Wisconsin colleges and universities have had the opportunity through an open forum to ask questions online of master mathematics teachers concerning the teaching and learning of mathematics. They are also encouraged to express their own views on questions and concerns raised by other students. Over 250 students have participated to date.

The *NPRIME Online Learning Community* has brought some 50 mathematics educators from state colleges and universities online for discussions on such topics as Wisconsin's new performance-based licensing, the NCTM 2000 *Principles and Standards for School Mathematics*, mathematics education research, NSF Reform Curricula, and implications of the TIMSS study.

Two *Book Talks* have been organized online over the past couple of years. During the summer of 2002 participants discussed Liping Ma's *Knowing and Teaching Elementary Mathematics*. During the fall of 2003 an online discussion of the National Research Council's *Adding It Up: Helping Children Learn Mathematics* was facilitated by Linda Uselmann of Edgewood College.

Marcia Weller Weinhold of Purdue University presented the findings from her dissertation.

Linda Uselmann of Edgewood College.



Participants explored the use of calculators in teaching mathematics.

In each year of the project two or three *Face-to-Face Meetings* have been held at different college and university sites. These conferences have featured presentations and discussion of current issues in the field. Materials such as selected Mathline videos, information concerning NSF reform curricula, and the Wisconsin Department of Instruction's *Curriculum Planning in Mathematics Guide* have been distributed to those who attend or request these materials online.

In the past two years NPRIME has made small grants available for colleges or universities for *Connection Projects*. Eight schools have received these grants for projects that involve some or all of: college faculty observations in PK-12 classrooms; PK-12 students' work used as case studies in college courses; PK-12 teachers participation in college classrooms; preservice students connected online with PK-12 mathematics teachers; college faculty connected online with PK-12 mathematics teachers; staff in high need school districts learning more about NPRIME and giving input into future directions of NPRIME.

An exciting new initiative for the group in the coming year will be NPRIME's participation in the Institutions of Higher Education (IHE) Network of the *Milwaukee Mathematics Partnership*, a National Science Foundation sponsored award of $20 million over 5 years targeting the improvement of student learning in mathematics. While the award is housed at University of Wisconsin–Milwaukee, the Milwaukee Public Schools, and Milwaukee Area Technical College, the IHE Network has been established to share knowledge among those institutions of higher education in Southeast Wisconsin most likely to educate future teachers of the Milwaukee Public Schools. This connection with NPRIME will enable this effort to engage faculty from throughout the state. The work will be centered on research efforts targeting teacher learning through multiple measures and will be based on national research and professional recommendations highlighted in *The Mathematical Education of Teachers* (CBMS, 2001) and *Adding It Up* (NRC, 2001a).

Employment Opportunities

ALABAMA

UNIVERSITY OF ALABAMA IN HUNTSVILLE
Department of Mathematical Sciences
The Department of Mathematical Sciences at the University of Alabama in Huntsville invites applications for a tenure track position at the rank of assistant professor, beginning spring semester 2005 or fall semester 2005. In exceptional cases, more advanced appointments may be considered. A Ph.D. degree in mathematics or applied mathematics is required. Applicants must have a strong commitment to teaching and show evidence of excellent teaching ability. Applicants should also show evidence of outstanding research potential in an area that matches the interests of the department. Preference will be given to applicants whose research areas are probability/stochastic processes or numerical analysis.

Applicants should send a curriculum vita with the AMS standard cover sheet, transcripts, and three letters of recommendation (with at least one letter addressing teaching) to

Chairman
Department of Mathematical Sciences
University of Alabama in Huntsville
Huntsville, AL 35899.

For more information about the department, visit our web site at:

http://www.math.uah.edu.

To ensure full consideration, all materials should be received by November 1, 2004. Late applications will be reviewed until the position is closed. Women and minorities are encouraged to apply. The University of Alabama in Huntsville is an Affirmative Action, Equal Opportunity Institution.

ARIZONA

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

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

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

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

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

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

The University of Arizona is an EEO/AA Employer-M/W/D/V

CALIFORNIA

CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA
The Mathematics Department invites applications for two tenure track positions, one in Mathematics Education and one in Statistics, both at the Assistant or Associate Professor, beginning September 2005. To be considered in the initial review, complete applications are due by 12/8/04 for Mathematics Education and 1/20/05 for Statistics. The search continues until closed. For information about qualifications or the application procedure, visit www.csupomona.edu/~math/position, or contact the Faculty Search Committee, Mathematics Department, Cal Poly Pomona, 3801 W. Temple Ave., Pomona, CA 91768-4007; 909-869-4008; Fax: 909-869-4904; math@csupomona.edu. AA/EEO.

GEORGIA

COLUMBUS STATE UNIVERSITY
The Mathematics Department at Columbus State University invites applications for a tenure track position beginning August 2005. Responsibilities include teaching four courses per semester, academic advising, service for the department and for the university, and scholarship. Required: excellent communication skills and a Ph.D. in math/statistics by the time of appointment. Preferred: teaching experience, potential for continued research, and ability to contribute to our newly designed applied math program with tracks in actuarial science and statistics. Information about the position and the university can be found on the web at http:/math.colstate.edu. Review of applications begins November 329, 2004. As an AA/EEO employer, CSU is committed to diversity and equality in education and employment.

GEORGIA COLLEGE & STATE UNIVERSITY
The Mathematics/Computer Science Department of Georgia College & State University invites applications for a tenure track Assistant/Associate Professor position in mathematics education. Employment would begin August 2005. For details see www.gcsu.edu/facultyjobs. Application review begins December 8, 2004 and continues until position is filled. GC&SU is an Equal Opportunity/Affirmative Action Employer.

INDIANA

UNIVERSITY OF NOTRE DAME
Department of Mathematics, University of Notre Dame, Notre Dame, IN
46556 Special Professional
Faculty Positions
The Department of Mathematics of the University of Notre Dame invites applications for two Special Professional Faculty positions. Candidates should have a doctorate in Mathematics or Mathematics Education, a passion for undergraduate teaching, and a record of excellence in the classroom. The starting date for these positions is August 22, 2005. Candidates at any rank will be considered. The teaching load can vary between two and three courses a semester, depending on class size and other duties. These are not tenure track positions, but they provide all usual faculty benefits, and have the possibility of being renewed indefinitely. The salary is competitive. Applications, including a curriculum vitae, a letter of application, and a completed AMS standard cover sheet, should be sent to: William G. Dwyer, Chair, at the above address. Applicants should arrange for at least three letters of recommendation to be sent to the chair. These letters should document the applicant's ability as a creative and effective teacher of undergraduate mathematics. Notre Dame is an equal opportunity employer. Women and minorities are urged to apply. The evaluation of candidates will begin December 1, 2004. Information about the department is available at http://www.math.nd.edu/.

MARYLAND

GOUCHER COLLEGE
Assistant Professor
Department of Mathematics
and Computer Science
A tenure track position is available at the assistant professor level for Fall 2005, pending final approval in October 2004. Ph.D. required in mathematics, with a specialization in the fields of applied mathematics or probability preferred. Additional requirements: a commitment to excellence in teaching; the ability to teach a wide variety of courses and conduct a research program; a commitment to fostering research by undergraduates. The position also includes opportunities to develop courses for the college's first year program and courses with interdisciplinary and international emphases. Preference will be given to qualified candidates who are interested in participating in such programs. The ability to teach introductory level computer science courses is a plus. Deadline for applications: January 7, 2005. Informal interviews will be conducted at the AMS/MAA meetings in January. Submit vitae, transcripts of graduate work, three letters of recommendation (two of which must address teaching experience or potential), and a personal statement describing your interest in teaching at a small liberal arts college and also briefly describing your research to: Human Resources, Goucher College, 1021 Dulaney Valley Road, Baltimore, MD 21204. Goucher College is an Equal Opportunity Employer.

U.S. NAVAL ACADEMY
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 2005. See web site http://www.usna.edu/MathDept/website/Hire.htm for full information. Tel: 410-293-6701; Fax: 410-293-4883; 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.

MASSACHUSETTS

WILLIAMS COLLEGE
The Williams College Department of Mathematics and Statistics invites applications for one tenure track position in mathematics, beginning fall 2005, at the rank of assistant professor (in an exceptional case, a more advanced appointment may be considered). We are seeking a highly qualified candidate who has demonstrated excellence in teaching and research, and who will have a Ph.D. by the time of appointment.

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

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

WILLIAMS COLLEGE
The Williams College Department of Mathematics and Statistics invites applications for one tenure track position in statistics, beginning fall 2005, at the rank of assistant professor (in an exceptional case, a more advanced appointment may be considered). We are seeking a highly qualified candidate who has demonstrated excellence in teaching and research, and who will have a Ph.D. by the time of appointment.

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

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

NEW HAMPSHIRE

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

DARTMOUTH COLLEGE
The Department of Mathematics anticipates a tenure-track opening with initial appointment in the 2005-2006 academic year. The position is for an applied mathematician at the rank of Assistant Professor. In extraordinary cases, an appointment at a higher rank is possible. Successful candidate should have demonstrated ability to work across disciplines; particularly, it is expected that he or she seek out and strike up collaborations

across campus with departments such as biology, physics, computer science; he/she should also aggressively seek funding in his/her area of research. Current applied interests include (but not limited to) imaging, signal processing, computational number theory, statistical physics, stochastic processes, quantum computing and computational biology and are receiving funding from various sources including NSF and NIH. Candidates for the position must be committed to outstanding teaching and interaction with students at all levels of undergraduate and graduate study.

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

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

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

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

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

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

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

NEW YORK

BUFFALO STATE COLLEGE
Mathematics
Assistant/Associate Professor
Buffalo State will receive applications for a tenure-track assistant/associate professor, Mathematics Department, to begin spring or fall 2005 semester. Salary is competitive.

Responsibilities: Effectively teach variety of undergraduate and graduate courses in mathematics and applied mathematics; grow professionally through scholarly activities; participate in department and college committee work; advise students. Provide leadership in developing new concentration in applied mathematics. Teaching load 9 hours/semester. Successful graduate must have genuine interest in teaching undergraduates.

Required Qualifications: Ph.D. in applied mathematics or mathematics with concentration in applied field; potential for scholarly activity; effective teaching; strong communication skills; knowledge of computer algebra systems and/or graphing calculators.

Preferred Qualifications: Operations research, modeling, computational mathematics, applied statistics, actualrial science, biomedical mathematics, or other applications to natural sciences.

Review of applications will begin November 15, 2004 and continue until the position is filled. Send letter of application, vita, transcripts, and 3 letters of recommendation (at least one addressing teaching potential or ability) to: Dr. Robin Sue Sanders, Chair, Mathematics Dept., Buffalo State College, Bishop 317, 1300 Elmwood Ave., Buffalo, NY 14222-1095. For more information about the college, visit www.buffalostate.edu.

Buffalo State is the largest four-year comprehensive college in the State University of New York (SUNY) system. The campus is located in the museum district of Buffalo, the second largest city in New York State. The area offers a variety of cultural and recreational activities.

Buffalo State is an affirmative action/equal opportunity employer.

NAZARETH COLLEGE
Tenure-track position in mathematics, beginning Fall 2005. Ph.D. in mathematical sciences, demonstrated teaching excellence, commitment to innovative teaching in a collaborative environment, and use of technology in teaching required. Responsibilities include: 4 courses per semester (majors and non-majors), scholarship and service. Preference will be given to qualified candidates with an interest in teaching applied mathematics, in particular, statistics, mathematics education, and/or directing student research.

Nazareth College, a thriving, independent, co-educational, liberal arts college with 2000 undergraduates and 1200 graduate students, is minutes from downtown Rochester, noted for its internationally recognized industries and museums, and for its cultural diversity. Nazareth College seeks individuals with an understanding of the benefits and importance of ethnic and racial diversity on campus and demonstrated commitment to the promotion of such diversity.
Send letter of application, philosophy of teaching, *curriculum vitae*, transcripts, and three letters of reference at least two of which address teaching history/potential to: Professor Susan Riegle, Search Committee, Nazareth College, 4245 East Avenue, Rochester, NY 14618. E-mail: smriegle@naz.edu.

See: http://www.naz.edu/dept/hr/postings/faculty.html EOE/AA.

OHIO

BALDWIN-WALLACE COLLEGE
Mathematics and Computer Science Department, Tenure-track Assistant Professor, beginning August 2005. Teaching introductory mathematics courses for education majors.

Qualifications include a Ph.D. in Mathematics Education with master's level work in mathematics and K-12 teaching experience. Candidates with a Ph.D. in Mathematics or those who have entered a Ph.D. program in Mathematics Education will be considered. B-W is an equal opportunity employer, committed to a diverse faculty, staff and student body. For position information and application instructions, see www.bw.edu/resources/hr/jobs.

THE OHIO STATE UNIVERSITY AT NEWARK
Assistant Professor of Mathematics
(Two Positions)
The Ohio State University at Newark seeks to fill two positions in mathematics at the level of assistant professor. Applicants should possess a Ph.D in Mathmatics, excellent teaching documentation and an active research program. Duties include an annual teaching load of six courses on a quarterly system and service to the department and campus. Preference will be given to those applicants with a research area compatible with current OSUN math faculty. These areas include Algebraic Topology, Commutative Ring Theory, Differential Geometry and Analysis.

OSUN is located 35 miles east of downtown Columbus on a lovely campus in the scenic rolling hills of central Ohio. It enjoys close ties with the Columbus campus and area. OSUN faculty members have their primary teaching responsibilities in Newark but are regular faculty members of their respective departments in Columbus. Instruction takes place in small classes which facilitates careful attention to student needs.

To apply please send a cover letter, detailed CV and three letters of reference to The Ohio State University Newark, 1179 University Drive, Newark, OH 43055. The Ohio State University is a regional campus of The Ohio State University. To build a diverse workforce Ohio State University encourages applications from individuals with disabilities, minorities, veterans, and women. "EEO/AA employer".

PENNSYLVANIA

CLARION UNIVERSITY
Tenure track Assistant Professor of Mathematics beginning August 2005. We seek an outstanding teacher, who is an active scholar and an excellent colleague. Doctorate in mathematics or a related field preferred: ABD considered. For complete details see our web page: http://math.clarion.edu. Send to Mathematics Search Committee, Department of Mathematics, Clarion University, Clarion, PA 16214 or e-mail to mathsearch@clarion.edu. Applications completed by December 10, 2004 will receive full consideration. Clarion University is an EOE Empolyer.

INDIANA UNIVERSITY OF PENNSYLVANIA
Mathematics Faculty Positions
Indiana University of Pennsylvania's Mathematics Department invites applications for tenure track faculty positions in Mathematics, Statistics, and Research in undergraduate mathematics education to begin in fall of 2005. A Ph. D. in the appropriate field is required. Review of applications begins December 1, 2004 and continues until positions are filled or closed. All applicants must be work eligible. For job descriptions, requirements, and application procedures, log on to http://www.math.iup.edu/jobs, e-mail Gary.Stoudt@iup.edu or call 724-357-2608. Indiana University of Pennsylvania, a member of the State System of Higher Education, is an equal opportunity employer M/F/H/V.

MESSIAH COLLEGE
Mathematics - Tenure-Track
Faculty Position
Applications are invited for a full time, term tenure-track position in the Mathematical Sciences Department to begin August 2005. The position requires a doctorate in Mathematics and a commitment to teaching a full range of undergraduate courses in a Christian College environment.

For more information on Messiah College and the Department visit: www.messiah.edu/acdept/depthome/mathsci/home.htm

Send letters of interest, a statement of teaching philosophy, and a résumé to:

J. Barry DeRoos, Chair
Messiah College
Department of Mathematical Sciences
PO Box 3041
One College Avenue
Grantham, PA 17027
EOE

SHIPPENSBURG UNIVERSITY
Mathematics Department
The Mathematics Department seeks candidates having a primary interest in mathematics teacher preparation. Responsibilities: Teaching undergraduate mathematics education or mathematics courses, advising students, supervising student teachers, conducting research, and contributing to the academic climate of the department through writing grants, reviewing the curriculum, serving on committees, and interacting with regional mathematics teachers. Qualifications and requirements: Doctorate in Mathematics or Mathematics Education (ABD upon hire may be considered). A terminal degree from an accredited institution is required for tenure. The position requires excellence in teaching, as well as experience or potential in research and academic service. A demonstration of teaching effectiveness will be required as part of the interview. Candidates will be judged on potential for teaching, research and university service. Preference will be given to candidates with two years of K 12 teaching experience or the equivalent in knowledge and experience. All candidates must furnish proof of eligibility to work in the U.S. upon appointment. Shippensburg University is an Equal Opportunity Employer. Review of applications begins November 15, 2004, and will continue until the position is filled. Applicants must send a letter of application, current curriculum vitae, official undergraduate and graduate transcripts, three letters of recommendation, and copies of course outlines: Search Committee, Department of Mathematics, 1871 Old Main Drive, Shippensburg University, Shippensburg, PA 17257. At least one recommendation letter must address the candidate's teaching ability, and the letter of application should address how the candidate will contribute to this department. Incomplete applications and applications sent by e mail will not be considered. For additional information see http://www.ship.edu/~math. Contact: Pamela A. McLaughlin, E Mail: mathcs@ship.edu, Phone: 717-477-1431, Fax: 717-477 4009

TEXAS

TEXAS LUTHERAN UNIVERSITY
Department of Mathematics invites applications for a tenure-track assistant professorship beginning August 2005. Requirements include Ph.D. in mathematics by appointment date, ability to teach a wide range of introductory and advanced undergraduate courses, and a commitment to mentor students in an undergraduate research program. Submit letter of application, cv, statement of teaching philosophy, and five references (names, addresses including email, telephone) to: Dean John T. Sieben - College of Natural Science and Mathematics, Texas Lutheran University, 1000 W. Court St., Seguin, TX 78155; fax (830) 372-6095, phone (830) 372-6007, e-mail jsieben@tlu.edu. mailto:jsieben@tlu.edu. Review of applications begin November 8 and continue until the position is filled. Texas Lutheran University is an equal opportunity employer and encourages women and minorities to apply. Full position description is available at www.tlu.edu http://www.tlu.edu.

FOCUS Deadlines

	January	February	March
Editorial Copy	November 15	December 15	January 15
Display Ads	November 24	December 21	January 20
Employment Ads	November 24	December 15	January 15