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On the cover: Virginia and Paul Halmos, Los Gatos, California, 2002. Photograph courtesy of Leonard Klosinski.

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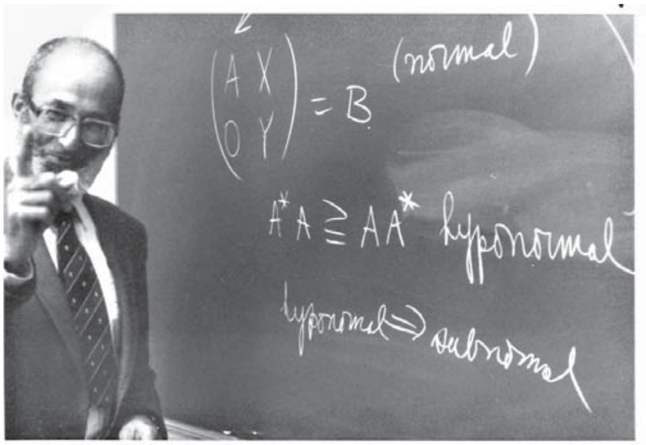
Major Donation Announced for New MAA Conference Center

By G. L. Alexanderson

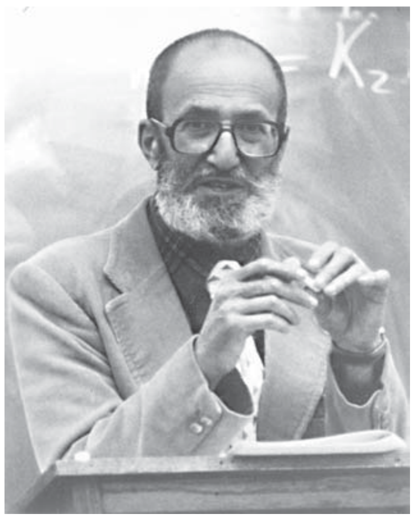
The MAA recently received a gift of $3 million from Paul and Virginia Halmos to establish a Mathematical Sciences Conference Center in Washington, DC. The Association plans to restore to its former charm the exterior of its historic carriage house, one of the three buildings in the MAA complex in the Dupont Circle district, and to renovate completely the interior to accommodate conferences of up to 60 people, with ample additional space for mathematicians to meet in smaller groups or to work individually. Up to now mathematical meetings at the MAA are confined to two small conference rooms in the Vaughn Building or, if too large, they are held in facilities in Washington hotels.



"I am proud to be a teacher—Teaching is an ephemeral subject. It is like playing the violin. The piece is over, and it's gone. The student is taught, and the teaching is gone."

The gift will fund the renovation and construction of the space, along with furnishing and equipping the interior to provide a completely modern meeting facility. Beyond capital expenditures, the gift will provide funds that will support the programs in the Center, which the donors envision as an ongoing series of mathematically intensive workshops, symposia and seminars. Programs will reflect the range of ideas and topics for which the MAA has been long known through its many fine publications as well as programs at sectional and national meetings.

Paul Halmos has a long association with the MAA and a lifetime commitment to mathematical exposition. He was editor of the *American Mathematical Monthly* from 1982 to 1986, and in 2000 he was awarded the MAA's Gung-Hu Award for Distinguished Service to Mathematics. The Association was founded in 1915 to provide a home for the *Monthly* and, through its many other publications, starting with the Carus Monographs in 1925, it has been an active proponent of good mathematical exposition ever since. It is not surprising then that Professor Halmos and his wife, Virginia, should choose to enhance even further the ability of the MAA to carry on this tradition of producing fine exposition by creating this meeting facility. In his "Automathography," *I Want To Be a Mathematician* (Springer, 1985), page 390, Halmos explained the difference between a survey [of research results] and an expository paper—something for the reader who is not an expert but is curious about the subject, pointing out that the latter kind of paper is hard to write. But Paul Halmos has repeatedly written memorable and elegant expository papers, with a style that is easily recognizable as his own. In the same work, page 403, he wrote "I was, in I think decreasing order of quality, a writer, an editor, a teacher, and a research mathematician."


One student's remarked of Halmos' lectures: "…He often asked us to be 'mindreaders,' and tell us what he was thinking."

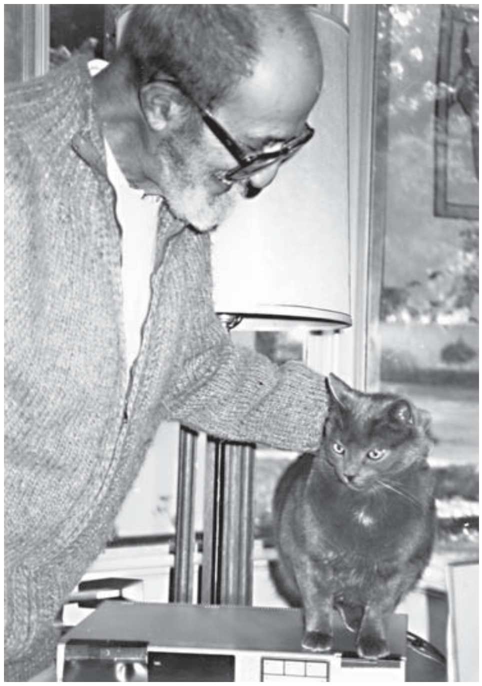
He has left his mark on written mathematics in two commonly observed ways: he introduced "iff" as an abbreviation for "if and only if" and denoted the end of a proof with what is sometimes known as a tombstone and now often called a "halmos."

Virginia Halmos, an alumna of Vassar College, pursued graduate work in philosophy at Brown. She and Paul married in 1945 and since then she has been a supporter and partner to Paul throughout his wide-ranging career. Larry Wallen, a longtime friend and mathematician at the University of Hawaii, in his contribution to the volume *Paul Halmos: Celebrating 50 Years of Mathematics* (Springer, 1991), wrote of her: "Late that summer [1955] I met Virginia (Ginger) Halmos, a striking woman I recall thinking. Any picture of Paul that omits Ginger is grossly incomplete. In the first place, she's crucial to keeping the entropy of the Halmos household improbably small and in keeping Paul and the cats hale and hearty. This, of course, doesn't define Ginger. She's a woman of remarkable intelligence with a fine wit that not everybody is privy to. She's the ecological Halmos who fishes floundering lizards from the pool and worries about wetlands." As interested as she is in being a good citizen of her community with her volunteer work, in quietly supporting animal welfare programs, and in following her strong interest in literature (even in Latin), she has nevertheless lived most of her life around mathematicians and has an extensive knowledge of mathematical culture. With happy memories of visits to Oberwolfach, Ginger has been an enthusiastic force behind the establishment of the MAA Conference Center since conversations on possibilities began. Paul Halmos' own fond reminiscences of Oberwolfach appear in his' "Automathography," pp. 384-87.

Professor Wallen mentioned cats. To know Paul and Ginger Halmos well one has to know that they are both avid animal lovers. They have in recent years had cats but they love dogs equally well. Don Albers, in one of his interviews with Paul, noted that during the interview Paul had, sitting on his lap, Pizzicato (a suitable name for a cat owned by someone interested in words and music). When asked whether anything about cats especially appealed to him, Paul replied: "Do animals have souls? People debate the subject, and I stand firmly on the affirmative. But what is it that appeals? Well, they look nice, they're interesting, they're loving, they're lovable, and somehow one is in touch with another soul. They enlarge one's life a little bit."

For his expository writing Paul Halmos has received from the MAA the Chauvenet Prize (1948), two Lester R. Ford Awards (1971, 1972), and the George Pólya Award (1983), and, from the American Mathematical Society, the Leroy P. Steele Prize for Mathematical Exposition (1983).

Highly respected as a teacher, and an advocate for a modified Moore method, he won both the sectional award and the MAA's national Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics in 1993 and 1994, respectively. In support of these teaching awards, one former student wrote, "He stresses above all the need for clear oral and written communication of ideas as a prerequisite to good mathematics. Several times, [as I was] struggling over an explanation, he would cut me off and demand that I say *exactly* what I meant… [He asks] questions to draw out the answers. This technique thoroughly involves students in class, giving them a personal stake in



Paul Halmos with Pizzicato.

the process of discovery. Of all the things I saw in Dr. Halmos' class I never saw someone yawn and look at the clock." Another wrote: "That quarter the only class I looked forward to was Paul Halmos'. Our classroom discussions were always animated, interesting, and even sometimes humorous… He often asked us to be 'mindreaders,' and tell him what he was thinking. If we didn't know the answer to a question that he expected we should have known, he would swing his arm in a motion that we came to understand as our decapitation. Some of the funnier moments in class came when we realized that we could sometimes avoid this motion by giving a silly answer, causing Dr. Halmos to laugh." One former student wrote him to tell him how much he had enjoyed his classes, and closed with "you are an inspiration and you should demand that Santa Clara University throw parades in your honor every month or so!"

Paul Halmos received his B.S., M.S., and Ph.D. at the University of Illinois, writing his dissertation under the direction of J. L. Doob. After a period at the Institute for Advanced Study (IAS), Princeton, where he was assistant to John von Neumann (1940-42), he returned briefly to Illinois. Since then he has held faculty positions at the following universities: Illinois, Syracuse, Chicago, Michigan (Ann Arbor), Hawaii, California (Santa Barbara), Indiana, and Santa Clara, where he became professor emeritus in 1995. He and his wife now live in Los Gatos, California.

Along the way Professor Halmos has held visiting appointments at Harvard, Tulane, Montevideo, Miami (Florida), California (Berkeley), Washington (Seattle), Edinburgh, Chiao Tung (Taiwan), and Western Australia, as well as several visits to the IAS. He has written over 100 research papers and many reviews in his principal research fields of operator theory, algebraic logic, and ergodic theory, with additional work in topological groups, probability, statistics, and Boolean algebras. Two volumes of his work appear as *Selecta*, published by Springer-Verlag.

Honors have included a Guggenheim Fellowship, membership in the Royal Society of Edinburgh and the Hungarian Academy of Sciences, and honorary doctorates from St. Andrews, DePauw, Waterloo, and Kalamazoo.

Widely known as an editor, in addition to his years of editing the *Monthly*, Paul Halmos has held similar positions with *Mathematical Reviews*, the *Proceedings of the American Mathematical Society*, the *Journal für die Reine und Angewandte Mathematik* (Crelle's Journal), *Mathematical Spectrum*, the *Indiana Journal of Mathematics*, as well as the *Ergebniße der Mathematik*, the *Undergraduate Texts* series, the *Graduate Texts* series and the *Problem Books* series for Springer-Verlag.

More than one generation of mathematicians has benefited from his famous and groundbreaking text, *Finite-Dimensional Vector Spaces* (1942, 1958, 1974). Others are devoted to his *Measure Theory* (1950, 1974), *Naive Set Theory* (1960, 1974), and the *Hilbert Space Problem Book* (1967, 1974, 1982). Four of his sixteen books are currently available from the MAA: *I Want To Be a Mathematician/ An Automathography* (1985, 1988), *Problems for Mathematicians Young and Old*

(1991), the *Linear Algebra Problem Book* (1995), and *Logic as Algebra* (with Steven Givant) (1998). Another popular book of his is *I Have a Photographic Memory* (1987). He has also written on how to write mathematics and how to give a mathematical talk in "How to write mathematics," *L'Enseignement Mathématique* **16** (1970), 123-52; "How to talk mathematics," *Notices Amer. Math. Soc.* **21** (1974), 155-58; and "What to publish," *Amer. Math. Monthly* **82** (1975), 14-47, in addition to parts of his "Automathography."

Paul Halmos has always made a case for the equal importance of proof and conceptual understanding in mathematics, so he emphasizes ideas in addition to proofs. This he shares with other great teachers. His concern for expository writing was summed up nicely in his response to receiving the Steele Prize:
"Not long ago I ran across a reference to a publication titled *A method of taking votes on more than two issues*. Do you know, or could you guess, who the author is? What about an article titled *On automorphisms of compact groups*? Who wrote *that* one? The answer to the first question is C. L. Dodgson, better known as Lewis Carroll, and the answer to the second question is Paul Halmos.

"Lewis Carroll and I have in common that we both called ourselves mathematicians, that we both strove to do research, and that we both took very seriously our attempts to enlarge the known body of mathematical truths. To earn his living Lewis Carroll was a teacher, and, just for fun, because he loved to tell stories, he wrote *Alice's Adventures in Wonderland*. To earn my living, I've been a teacher for almost fifty years, and, just for fun, because I love to organize and clarify, I wrote *Finite-Dimensional Vector Spaces.* And what's the outcome? I doubt if as many as a dozen readers of these words have ever looked at either *A method of taking votes…* or *On automorphisms…* but Lewis Carroll is immortal for the Alice stories, and I got the Steele Prize for exposition…"

"I enjoy studying, learning, coming to understand, and then explaining, but it doesn't follow that communicating what I know is always easy; it can be devilishly hard. To explain something you must

Virginia Halmos at Brown circa 1947.

know not only what to put in, but also what to leave out; you must know when to tell the whole truth and when to get the right idea across by telling a little white fib. The difficulty in exposition is not the style, the choice of words—it is the structure, the organization. The words are important, yes, but the arrangement of the material, the indication of the connections of its parts with each other and with other parts of mathematics, the proper emphasis that shows what's easy and what deserves to be treated with caution—these things are much more important."

When I was thinking about how to write this announcement for *FOCUS*, I asked Virginia Halmos how she would like to be described. She told me she is a "housewife." While it is true that she has made her career inside the home, she has distinguished herself by reading widely and participating in many community activities. She is truly a partner of Paul's in her appreciation of the written word. I never fail to be amazed at the range of things she knows about and her erudition. Our most recent e-mail exchange on literary matters (the week before I started writing this) concerned a piece of verse by Walter Savage Landor. That led to a question of a proper translation of the Latin inscription on Hadrian's tomb. And so it goes. How many people today can rattle off the nine ranks of angels in medieval angelology? We have all heard about seraphim, cherubim, archangels, and angels, but how many of us can come up with the rest of them, the thrones, dominions, virtues, powers, and principalities? Virginia Halmos can and does, in order of rank.

Paul and Virginia Halmos have devoted their lives to the exposition and understanding of difficult ideas. Paul's many publications will live on for years to come. Now this remarkable couple are making it possible for the MAA to continue in the dissemination of mathematical ideas beyond the existing journals, books, regional and national meetings, minicourses, and special sessions, with an ongoing series of programs at the MAA Conference Center in Washington. Use of the facility will not be limited to the MAA. Other mathematical organizations will be invited to hold programs at the Center. Two such organizations have offices in the MAA buildings—the American Mathematical Society Washington Office and the headquarters of the Conference Board of the Mathematical Sciences. The MAA is setting up an Advisory Board to advise the officers and MAA Board of Governors on programs for the new facilities. The Board welcomes suggestions from MAA members for activities to be held at the new Center. This is a great opportunity for the MAA to expand significantly the programs it offers to members and the larger community it serves. ■

Gerald Alexanderson is Michael and Elizabeth Valeriote Professor of Mathematics at Santa Clara University.

So You Think You Want to be in Pictures...

By Dan Rockmore

It all started with the movie "Good Will Hunting": In his breakout role, Matt Damon plays a wrong-side-of-the-tracks kid, Will Hunting. While working as a janitor at MIT, he happens upon a mathematics problem left on a blackboard. Unbeknownst to Will this is an incredibly difficult problem, but in a flash of insight (in spite of seemingly having no background in mathematics) he solves the problem. He is thus propelled into what is portrayed as the high-powered and cutthroat world of academic mathematics, and slowly comes to grips with the new opportunities afforded by the revelation of his genius. His best buddy (Ben Affleck) spurs him on, and of course there is also a beautiful right-side-of-the-tracks Harvard girlfriend (Minnie Driver) to help him along, as well as a kindly (albeit damaged) therapist (Robin Williams) who learns a thing or two about life from helping Will work through his anger management problems.

Wendy Conquest interviews Michael Freedman for *The Math Life.*

Friends kept asking me what I thought of this "math movie." I felt the same as many people did; I liked it. It is a good Hollywood love story—but definitely not a movie about math! But most people did see it this way: genius mathematicians, often arrogant and surely born to the subject, puzzling over arcane diagrams on blackboards, and if not, sent to crack codes for some nameless government agency. Yup, this is what, to many, it means to be a mathematician.

Certainly, there are mathematicians that fit this bill, but there are others too —many others. I began to think about making a film that showed what research mathematics was, in all of its diversity, both in terms of the people who do it, and the intellects that are attracted to it. I also wanted to give some insight into what it means to "do" mathematics. In short, I wanted to show that mathematics is more than just numbers and mathematicians are more than just the extreme personalities that periodically make it to the big, or little, screen.

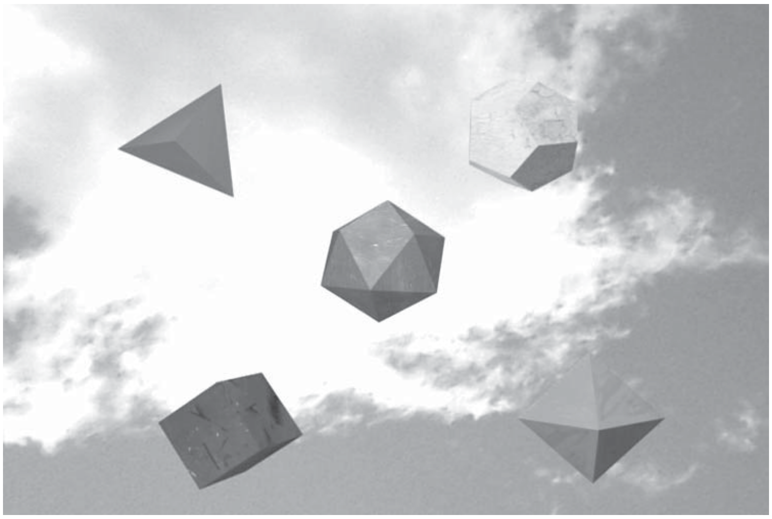
It took a few years of knocking on doors at various agencies and foundations, but eventually I found a sponsor at the National Science Foundation: Joe Jenkins, a Program Officer in the Analysis Program, thought that it sounded like a good idea. So, backed by a budget on the scale of "The Blair Witch Project", filmmakers Wendy Conquest and Bob Drake and I set out to show that mathematics is not so scary. Two years later, the result is""The Math Life", a documentary film on the people, problems, and process of mathematical research. It's now available for distribution through Films in the Humanities and Sciences, and will soon be appearing on a public television station near you.

The making of "The Math Life" was one of the most interesting and enjoyable projects I've ever undertaken. We crafted a list of questions and began interviewing a spectrum of mathematicians (hmm, maybe that's the collective noun…). We asked people how they came to mathematics, what their earliest mathematical memories are, what sorts of mathematics they work on, what it is like to work on mathematics, how is mathematics like art, and even asking what they find beautiful about mathematics. For many, this last question proved to be the most difficult to answer.

Jennifer Chayes of Microsoft Research being interviewed for *The Math Life.*

After several interviews a narrative line began to emerge. We decided that what we wanted to tell were stories of the possible lives of a mathematician, from tentative childhood beginnings to working researcher, and to show that this is a road which is often anything but straight and narrow. There are naive, wonder-inspired beginnings, as well as frustration-laden false starts. Stanford's Persi Diaconis tells of being led to mathematics from mysteries of magic and card shuffling. Princeton's Ingrid Daubecheis remembers discovering the wonder of π after measuring the diameters and circumferences of all the platters in the house. Dartmouth's Dorothy Wallace, (recipient of the 2000 New Hampshire Professor of the Year award), recalls that as a schoolchild, her lack of facility with fractions led some teachers to label her as slow. The road to a career in math can be, and often is, a meandering one. Along the way we discuss some of the things that attract people to mathematics.

As Wallace's story shows, mathematics is done by all kinds of people with all sorts of different skills and aptitudes—not just the quiet kid in the back who got all the multiplication problems right. Those with a talent for picturing things find their way to subjects like geometry and topology. A love of numbers leads others to become number theorists. A fascination with randomness is the first step on a road to probability and statistics. A desire to understand the workings of the world can be the hook to becoming an applied mathematician.



The five regular polyhedra make an appearance in *The Math Life.*

Indeed, Wallace's story is but one of several cautionary tales for educators embedded in'"The Math Life." Cornell's Steven Strogatz recalls almost, "being derailed," by a classroom experience. Microsoft's Michael Freedman (winner of the Fields Medal) reminds us that an aptitude for mathematics is reflected less in, "getting A's on all the tests," than in having a "quirky" mind, able to produce a different reason to explain why something is true. Many of the mathematicians we interviewed told horror stories of being browbeaten for not getting the right answer in the "right" way.

These are beginnings that as often as not almost led to ends. In essence it is the same process writ large, that many (if not all) of us relive during the long slow process which is mathematical research. As Arlie Petters says, this process is, in its own way, "a human experience", one which, as Peter Sarnak says, is probably not for the person who "needs a daily high." More often than not you are "stuck," hoping, living for that brief and hard-earned moment of triumph when you "get it," only to quickly return to being stuck once again. It is, for many of us, as much an artistic process as a technical one. References to the visual arts are scattered throughout "The Math Life."

Off this narrative skeleton we hang some of the fruits of mathematical labor: primes and the Riemann Hypothesis, geometry and topology in the guise of shape and symmetry, the paradoxes of probability, and of course a brief look at some math in the real world, in this case a brief interlude on synchronization of large systems, illuminated by the commonality in flashing fireflies, cricket choruses, beating hearts, and clapping audiences. Each of these examples is illustrated with computer graphics animations.

"The Math Life" is but fifty-two minutes long, and in that short space of time we hope we have shown the general public that the inside of the head of a mathematician is not such a scary place —a good sense of humor is just as important as the ability to focus the intellect. Mathematicians are more than just the cartoon mix of genius and arrogance that we usually see on the big screen. We also think we have given the public a sense of what mathematics is. Those fifty-two minutes were distilled from almost thirty hours of interviews, and I came to see the truth in the adage that "ninety-nine percent of what you shoot is left on the editing room floor." Among these was one of my favorite little stories, one told by Jean Taylor. Like many a mathematician, Taylor found her way to mathematics after sampling the sciences. In her case she was a graduate student in chemistry before being bitten by the math bug. While musing on what drew her away from chemistry she noted that in mathematics you experience a daily immediacy with the subject that is often lost in the lab sciences. She recalled one particular lab experience in which in order to study collagen she had to spend countless hours going through shipments of frozen rat tails and stripping the collagen off the tails for later processing. "Pretty far from grand ideas" she says, "but in mathematics… you don't have this distance between what you're doing and what the big idea is. It may be the details that you're working on, but they're still mathematics… It's not frozen rat tails." I couldn't have said it any better myself! ■

Dan Rockmore is Professor of Mathematics and Computer Science at Dartmouth College, Hanover, New Hampshire, where he is also Vice-Chair of Mathematics. His research interests focus on the mathematics of signal and image processing.

Dan Rockmore can be contacted at rockmore@cs.dartmouth.edu *or by visiting his webpage at* http://www.cs.dartmouth.edu/~rockmore. *A review of The Math Life can be found on MAA Online at* http://www.maa.org/reviews/mathlife.html.

The Kentucky Section Goes High-Tech: The tale of an e-newsletter

By Alex McAllister

At our 2000 Annual Meeting, I was elected the Newsletter Editor for the Kentucky Section of the MAA (KYMAA). At the same time, the section also voted to eliminate the traditional paper newsletter in favor of an electronic newsletter. Talk about a fundamental change in job descriptions!

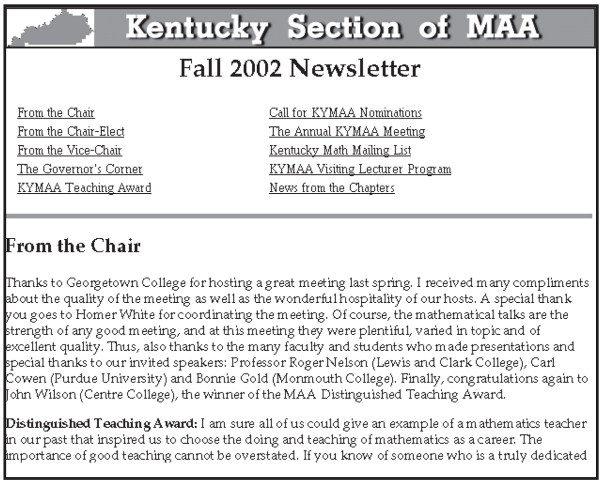
We now have a couple years of e-newsletters under our belt. Bill Fenton, our Chair-Elect, has suggested that other sections might be interested in learning of our experiences before the spring business meetings. So, here's a bit of our story.

For several years before this vote, KYMAA had a voluntary electronic newsletter program. The vice-chair had established a basic website for our section and the newsletter editor had been submitting web-versions, produced with *Microsoft Word*, of the newsletters. Unfortunately, participation was rather minimal and this particular blending of paper and electronic media was somewhat awkward. The vote in Y2K continued the web-based version of our newsletter, only e-participation became mandatory!

At our website, http://www.maa.org/kentucky/, both members and non-members can readily access the newsletter as well as other information about our section and about mathematics in general. Furthermore, the newsletters are, in some sense, "permanently" available through electronic archiving. Ultimately, our deliberations of "to e or not to e?" have resulted in re-focusing our website as the primary media for communicating with each other and the wider world.

After the annual meeting, I talked with the previous webmaster and newsletter editor and we recognized that this transition would be most easily accomplished by a blending of their respective responsibilities. And so, at least for now, the KYMAA newsletter editor is also the KYMAA webmaster.

Of course, serving as a webmaster requires some level of technical skills and resources beyond word processing. Several years ago, I took an html course and developed sufficient skills with web editors to start creating course web pages. In addition, earlier in 2000, I revamped my math department's website and so I had some ideas for retooling the KYMAA web site. I would recommend *Web Style Guide: Basic Design Principles for Creating Websites,* by Patrick Lynch and Sarah Horton (ISBN: 0300076744) to anyone creating and maintaining websites.


Kentucky Section of MAA

Fall 2002 Newsletter

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From the Chair

Thanks to Georgetown College for hosting a great meeting last spring. I received many compliments about the quality of the meeting as well as the wonderful hospitality of our hosts. A special thank you goes to Homer White for coordinating the meeting. Of course, the mathematical talks are the strength of any good meeting, and at this meeting they were plentiful, varied in topic and of excellent quality. Thus, also thanks to the many faculty and students who made presentations and special thanks to our invited speakers: Professor Roger Nelson (Lewis and Clark College), Carl Cowen (Purdue University) and Bonnie Gold (Monmouth College). Finally, congratulations again to John Wilson (Centre College), the winner of the MAA Distinguished Teaching Award.

Distinguished Teaching Award: I am sure all of us could give an example of a mathematics teacher in our past that inspired us to choose the doing and teaching of mathematics as a career. The importance of good teaching cannot be overstated. If you know of someone who is a truly dedicated

Screen Capture from a recent KYMAA online newsletter.

As for technical resources, my home institution is currently serving as the repository for the KYMAA website. When my tenure as newsletter editor is over, I expect the files for the website will be transferred to the institution of the next editor. Interestingly enough, I learned that the MAA has reserved a URL for each section. Shortly after our annual meeting, I contacted the national office and the MAA reset our reserved URL, http://www.maa.org/kentucky/, to "point" to the local URL, http://web.centre.edu/~mat/kymaa, where the web pages are stored at Centre College. Hopefully, this "permanent" URL and consistent use of relative URLs within the KYMAA web pages will support the needed element of portability.

During the summer of 2000, I spent some time reworking the website; keeping what was strong from the existing site and mixing in some new elements. I also began the process of creating the email distribution list of KYMAA members that is used to notify members when newsletters are posted. The national MAA office had a list that I could start from. In the end, I wound up visiting all of the math department websites in our section to gather email addresses. While doing this, I realized that our e-newsletter could also provide an important opportunity to "freely spread the good news" of KYMAA activities to the mathematicians at the universities, colleges, and community colleges in our section. And so, our e-newsletter not only facilitates communication among KYMAA members, but has also become an outreach to nonmembers of the MAA who will hopefully develop an interest in our section's activities. In fact, we have noticed a greater number and diversity in participants' home institutions at our last two annual meetings.

After gathering articles from officers and campus liaisons, I created the e-newsletter webpage and set up a link on the section website. After all this prep work, the first KYMAA e-newsletter was produced and distributed in September 2000. Members of the section were notified both by email and by physical postcard; as mentioned above, some nonmembers of the MAA were included in our email distribution list.

This process appears to be successful and we continue to follow this approach in developing and distributing our e-newsletter three times per year. We recognized that some members might not have ready access to email or the web; therefore, I also send a paper copy of the newsletter to the few members who have requested traditional mailings.

At the beginning of this process, I wondered if breaking the established paradigm of a paper newsletter would be successful. However, the Spring 2000 vote in support of an e-newsletter was a strong expression of active members seeking and embracing a change. Follow-up surveys of KYMAA members indicate an overwhelmingly positive response to continuing the e-newsletter.

In addition to the added convenience and efficiency of e-communication, the section has realized other benefits, including significant financial savings, from this conversion to an e-newsletter. Our annual newsletter costs dropped from approximately $1000 a couple years ago to approximately $200 each of the last two years. For the environmentally conscious, we have also significantly reduced the amount of paper and other physical resources used in creating the newsletter.

Of course, there's still some grunt work. Each summer, the overall website needs to be evaluated and updated and the email distribution list needs to be updated. In fact, maintaining the email distribution list has really been the most difficult aspect of this new system. Many of our campus liaisons have played a key role in this process, but there's still a bit of web-surfing required each summer.

Reflecting back on the last two years of e-newsletters, I must say that I have enjoyed developing KYMAA's website and e-newsletter and acknowledge that many members of our section have provided important suggestions and support for this venture. Both the section membership and the newsletter editor appear to be pleased with this approach (I'm even running for a second term as newsletter editor this spring!). I've noticed that a number of other sections have also started using an e-newsletter. I hope our story may be of some assistance for others considering and implementing this communication option. ■

Alex McAllister (alexmcal@centre.edu) is Assistant Professor of Mathematics at Centre College and Newsletter Editor for the Kentucky Section of the MAA.

Biology and Mathematics

By Victor J. Katz

"The next big thing in mathematics? Biology." So wrote John Ewing, executive director of the AMS in the September 20, 2002 issue of the *Chronicle of Higher Education*. In fact, Mathematics Awareness Month in April of 2002 was devoted to Mathematics and the Genome. The MAM web site at http://www.mathforum.org/mam/02/ contains much information about the mathematics used in the genome project and in biology generally. The mathematics involved is relatively sophisticated, and some of it is entirely new.

It is becoming increasingly clear that biology will be providing significant challenges for the mathematical community over the next few decades. Not only must new mathematics be developed to enable biologists to continue to make rapid progress, but also mathematicians must be prepared to educate a new generation of biological and biomedical researchers in our colleges and universities.

The mathematics necessary for biology today is not the mathematics that was typically required of biology majors in the past: a year of calculus and perhaps a semester of descriptive statistics. These courses are only a bare minimum today. Although biology as currently practiced needs the basic concepts of calculus, it requires far more sophisticated tools as well. We illustrate this with problems taken from biological and biomedical research.

It has long been evident that biologists need familiarity with differential equations and linear algebra. For example, in population biology, we want to study the growth of one or several animal populations. The simple exponential model, of course, only works for a limited time, when there are unlimited resources for the population. Once resources become limited, other models prove more important. These include the logistic model, given by the differential equation

$$\frac{1}{y}\frac{dy}{dt} = r\left(1 - \frac{y}{K}\right),$$

which models the situation where there is a maximum environmental carrying capacity, as well as the more complicated model given by the equation

$$\frac{1}{y}\frac{dy}{dt} = r\left(\frac{y}{\theta} - 1\right)\left(1 - \frac{y}{K}\right),$$

which models the situation where a population tends to extinction if its size is too low. The first equation, of course, has a closed form solution, while the second, in general, does not. Nevertheless, with appropriate technology, the second equation can be solved graphically and its salient characteristics analyzed.(See the illustration on page 11.) Analogously, the Lotka-Volterra system of equations modeling the populations of predator and prey, which again do not in general have a closed form solution, can also be analyzed graphically for various values of the parameters.

Another useful biological population model is one that looks at the age distribution of a population. Given that the number of individuals $P(n, t)$ at a given age n at time t is a major factor in determining $P(n+k, t+k)$, it turns out that successful analysis of the population involves the use of certain matrices expressing this fact. The population density over time then involves finding powers of this matrix, a process made simpler by looking at eigenvalues. So biology students who want to make a mark in this field need to understand the basic concepts of linear algebra.

Both differential equations and linear algebra are used in many other areas of biology. A study of the activity of lead in the body requires looking at a system of differential equations, since one needs to consider the lead level in the blood, the soft tissue, and the bones. Since these systems have constant coefficients, they are generally solved by matrix methods. Systems of equations are also used to follow the dispersion of drugs throughout the body.

In molecular genetics the central process is the passing on of information from DNA to RNA; the RNA information is then converted into information enabling the cell to make enzymes, which in turn catalyze a specific set of chemical reactions that determine the biological nature of the cell. To study these reactions requires the construction and solution of differential equations expressing the rates at which various reactants are combining and producing new products. Some of the typical equations have closed form solutions, generally involving exponential functions, while others do not. In any case, it is important for the prospective biologist to understand the modeling process, that is, how these equations are formed and what their solutions mean, both mathematically and biologically. This process can be aided, of course, by appropriate software. Frequently, however, one needs to study carefully the dependence of the solutions on the various parameters involved and this in turn requires a firm understanding of the nature of differential equations.

But differential equations are not sufficient mathematics for the study of DNA. It turns out that an understanding of the enzymes that perform the reactions necessary for the winding, unwinding, recombination, and transposition of DNA requires an understanding of the topology of knots. After all, DNA is in the form of a double helix. The knowledge of what kinds of twisting and untwisting is possible as the DNA performs its tasks in the life cycle of the cell often comes from recent work in knot theory. To infer the process used by an enzyme, one needs to understand when a strand of DNA must be broken and when it can just be untwisted.

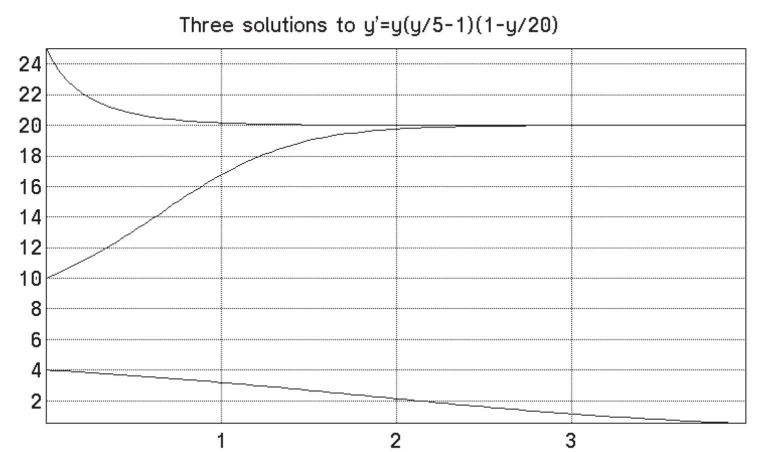
In addition to the ideas of linear algebra, differential equations, and topology, it is becoming increasingly clear that a prospective biologist must understand data analysis. With many experiments producing millions of data points, it is necessary to use computers for data mining, that is, the automated search for patterns. For example, there is an enormous amount of data about the diagnosis and treatment of cancer patients. In a given situation, we have symptoms, test results, the physical parameters of the individual, and the outcome of one or more medical interventions. Ideally, one then uses data mining to determine patterns, including, for example, a decision tree. Such a tree enables physicians to improve their choices of treatment for current patients. How does a machine make sense of enormous amounts of data? The machine must be "taught," so algorithms must be developed for machine learning. This is a very active area of study in computer science.

Trees are important in another active area of biology, phylogenetics, the determination of how an organism has developed from its evolutionary ancestors. The goal here is to develop what is called a phylogenetic tree, the leaves of which represent extant species. Each internal node of the tree represents a postulated speciation event in which a species divides into two populations that follow separate evolutionary paths and become distinct species. These trees are today constructed by computer programs based on the comparison of related DNA sequences or protein sequences in the different species. Ideally, similar species should be close together in the tree. The construction of such a tree is then an optimization problem. That is, one needs to assign numerical values ("lengths") to each edge of the tree, where these values represent an evolutionary distance between adjacent species. One then wants to minimize the sum of the lengths of all the edges. Clearly, a deep knowledge of graph theory is required as well as a knowledge of the construction of algorithms enabling computers to perform the optimization in a reasonable time. Not only is this phylogenetic reconstruction used in determining ancestry among species, but it also applies to the recent work in reconstructing human evolution by looking at the mitochondrial genome. Since human mitchondria are inherited only from the mother, researchers were able to determine the existence of our common ancestor (called Eve) in Africa about 200,000 years ago. This study has also enabled biologists to begin to map the migration of human groups throughout history.

The problems discussed in the last two paragraphs require the use of computers. Before the advent of high-speed computing, biology research tended to be reductionist in nature. That is, one tried to decompose a biological system into as small subsystems as possible, and then study each independently. After all, it is easier to form and test hypotheses on "small" systems. But with the use of computers, it is much easier to attempt discovery-based rather than hypothesis-driven research. That is, by applying computers to the data of the human genome project, for example, it is much easier to discover patterns and see the importance of interdependencies, links, and communications among various subsystems. The new subject of bioinformatics, the application of computer science to biology, which grew up with the genome project, has made the systemic view of an organism much more amenable to study.

One of the new technologies to which bioinformatics is applied is that of microarrays. A microarray is a chip containing a huge amount of data in an orderly arrangement. Each unit of data is a piece of DNA, with a physical size of about 200 microns. The microarray then provides a medium for matching DNA samples based on rules involving the pairings of the bases making up the DNA. For example, the DNA "signature" of a tumor consists of some 15,000 numbers. Mathematically, one can think of this signature as a point in a 15,000-dimensional space. The idea is then to compare tumors by seeing if they are "close" to one another in this space. Algorithms are necessary to achieve this determination of whether the different tumors are "clustered." The hope is that "close" tumors respond similarly to treatment, so the use of microarrays will help oncologists make correct diagnoses and choose the best available treatment. Eventually, once the appropriate algorithms are developed, your doctor will have your personal DNA sequence on the computer and will use microarrays to diagnose your disease and figure out the treatment to which you will respond.

A final example of the use of mathematics in biology involves fractals. Some of the most visually striking examples of fractal forms are found in physiology. The respiratory, circulatory, and nervous systems are remarkable instances of fractals, branches subdividing and subdividing and subdividing again. Al-



though we do not know why these systems develop this way, careful analysis reveals fractal scaling. Among the hypotheses are that the fractal structure makes the lungs more fault-tolerant during growth and enables the circulatory system to achieve a homogeneous oxygen supply throughout the body. It is also known that healthy heartbeats are chaotic rather than regular. If one plots heart rates over several time scales, one again sees the fractal patterns of self-similar scaling.

Since there is so much advanced mathematics that may be required in biological or biomedical research, the question becomes how mathematics departments should react. There seem to be two distinct aspects of the problem. First, we should come to some agreement on the minimum mathematical requirements for a biology major, particularly for students who intend to go into research. Second, we need to figure out how to teach future biologists the advanced mathematics described above, without requiring them to be mathematics majors themselves.

The first problem appears well on its way to a solution. The MAA Committee on the Undergraduate Program's Subcommittee for Curriculum Reform Across the First Two Years (CRAFTY) held one of its Curriculum Foundations Conferences on the Mathematical Curriculum for Health and Life Sciences Students in May, 2000 and shortly thereafter issued a report (see the November 2002 issue of FOCUS or visit http://www.maa.org/features/currfound.html and the links found on that page).

Two issues are addressed in that report, a core curriculum for all life sciences students and the need for flexibility in the curriculum of life science disciplines. Agreement was reached that the core should include the basic notions of calculus, probability, approximation, logic and mathematical thinking, and deductive reasoning, as well as some work with statistics and computers. Such a course should put special emphasis on the use of models, both as a way of organizing information about and providing intuition into systems that are too complex to understand otherwise. But any study of modeling should also discuss the limitations of the subject. The computer should be used wherever relevant as a way of solving problems and analyzing models.

Interestingly, the Committee on Undergraduate Biology Education to Prepare Research Scientists for the 21st Century, organized by the National Research Council, issued a report entitled *BIO2010: Transforming Undergraduate Education for Future Research Biologists* (see http://www.nap.edu/books/0309085357.html) that suggested that a more demanding core of mathematics should be added to the undergraduate biology curriculum:

It is essential that biology undergraduates become quantitatively literate, studying the mathematical concepts of change, modeling, equilibria and stability, structure of a system, interactions among components, data and measurement, visualization, and algorithms. Every student should acquire the ability to analyze issues in these contexts in some depth, using analytical methods (e.g., pencil and paper) and appropriate computational tools. An appropriate course of study would include aspects of probability, statistics, discrete models, linear algebra, calculus and differential equations, modeling and programming.

Many universities have attempted to develop yearlong courses meeting at least a substantial portion of these requirements, and textbooks have also appeared. One of the earliest such courses was at the University of Tennessee, Knoxville. The first semester of the course deals with statistics, probability, exponentials and logarithms, matrix algebra, and sequences and difference equations. The second semester continues the material on difference equations, provides a survey of differential and integral calculus, including the trigonometric functions, and concludes with some work on differential equations. And as recommended, the course always deals with the idea of modeling biological phenomena. Students are expected to generate hypotheses and then attempt to verify them using the mathematical tools being developed.

Solving the second problem is more difficult, since so many different mathematical ideas are now or may in the future be necessary for prospective biological researchers. One university that has attacked this problem is the University of Pennsylvania.

Starting in 1994, Penn designed a Ph.D. program in computational biology and bioinformatics. The program was open to students with a solid education in molecular, cellular, organismal, and evolutionary biology as well as a strong foundation in mathematics, statistics, chemistry, and computer science. However, Penn soon found that relatively few of their prospective students, most of whom had a B.S. in biology, appeared to have a rigorous enough mathematical background for the program. Thus, Penn decided to put together undergraduate concentrations in computational biology. Such programs now exist within the biology department, the computer science department, and the mathematics department. In addition, Penn put together a three-semester Master of Biotechnology program with a track in bioinformatics and computational biology specifically designed for the needs of the biotech industry.

The Biological Mathematics concentration in the mathematics department includes year-long courses in advanced calculus and abstract algebra (including linear algebra), as well as courses in computational methods and statistics, among others. It also requires a substantial number of biology and chemistry courses. The Computational and Mathematical Biology concentrations in the biology department include some of those same courses as electives, but of course require more biology courses. Those programs also require a graduate-level course in computational biology as well as an interdisciplinary research project.

Interestingly, the upper-level mathematics courses required in all of these programs are the same courses taken by mathematics majors in general, so it is up to the instructors (and the students) to connect these courses to biology problems. Other universities may decide to have special sections of upper-level courses specifically designed for biologists.

Most colleges and universities will not be able to match the resources of the University of Pennsylvania, but mathematics departments nevertheless need to pay attention to the needs of prospective biological researchers. To help in this regard, the MAA, the American Association for the Advancement of Science, and the American Society for Microbiology are organizing a special invited conference entitled *Meeting the Challenges in Emerging Areas Across the Life, Mathematical, and Computer Sciences*. This conference, funded by the National Science Foundation, will be held February 27– March 1, 2003 in Bethesda, Maryland. It will bring together approximately seventy-five participants from the life sciences, mathematics, statistics, and computer science, as well as representatives from disciplinary societies such as the American Statistical Association and the Association for Computing Machinery and the federal agencies. The participants will be divided into seven working groups, each of which will discuss curriculum, faculty development, and teaching and student learning in a specific area of biological mathematics. The working groups are on bioinformatics, structural biology, computational cell biology, developmental biology, physiology, biocomplexity, and phylogenetics.

Meeting the Challenges will have four plenary addresses, by Michael Summers (University of Maryland, Baltimore County and Howard Hughes Medical Institute), James Cassatt (National Institute of General Medical Sciences in the National Institutes of Health), Judith Ramaley (National Science Foundation), and Lou Gross (Institute for Environmental Modeling, University of Tennessee, Knoxville). The plenary speakers will help the participants confront their major mission, to think through the issues of how best to educate future biology and biomedical researchers and then to produce a comprehensive report which will be widely disseminated to the nation's stakeholders. Among the expected outcomes of the conference will be comprehensive listings of student resources, including recruitment and mentoring programs, faculty retraining possibilities, and curriculum resources. Suggestions will also be made on overcoming administrative hurdles to the necessary interdisciplinary cooperation. (The conference website can be found at http://pub.nigms.nih.gov/challenges.)

The MAA has already been heavily involved in this process of thinking about education in mathematical biology. But once the results of this conference are disseminated, our membership must take the lead in implementing the recommendations on their own campuses. Just as it was impossible in the past for mathematics departments to ignore the needs of engineering students, it will be impossible in the future to ignore the needs of biology students. And although we cannot predict exactly what their needs will be a decade or two from now, we can predict with confidence that biology and medicine will need more and more mathematics to continue the research aimed at fully understanding the processes of life. ■

Victor Katz is Professor of Mathematics at the University of the District of Columbia. He is the author of an introductory textbook and many other books and papers on the history of mathematics. He is currently visiting mathematician at the MAA.

Have a RUMBUS! Courtesy of the Boston University Student Chapter of the MAA

Boston University will have its first RUMBUS on Saturday, March 22, 2003. A RUMBUS sounds, of course, like the name of a beautiful geometric figure, but it is actually the Research by Undergraduates in Mathematics Boston University Symposium, which will feature Student Talks, a PosterFest, Panel Discussions and a KeyNote Speaker of world repute. This year's speaker is Professor Frank Morgan of Williams College (settler of the Double-Bubble Conjecture, and many things besides).

The Symposium is meant for undergraduates of the greater Boston Area and New England to come together for a day of activities, information on the profession, and relentless math fun. The symposium web page at http://math.bu.edu/people/RUMBUS03 includes a program, instructions for participation and local information. ■

Statistical Evidence that Web-Based Homework Helps

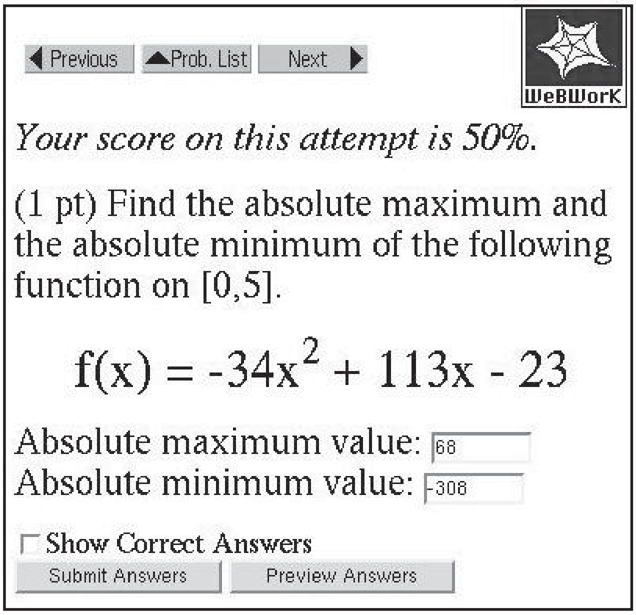
By L. Hirsch and C. Weibel

Since 1996, dozens of mathematics departments have introduced an internet-based homework system into their calculus curricula. One popular choice is WeBWorK, which was developed with NSF support at the University of Rochester. At Rutgers University, we were able to examine the effect of WeBWorK on student performance on the common final exam in our general calculus class. (This course excludes engineering, physics, chemistry and mathematics majors.) Because WeBWorK was implemented in only two-thirds of all sections, we could treat the course as a controlled experiment, using the non-WeBWorK sections as the control group. (We later verified that there were no significant section effects.)

The study used data from the Fall 2001 semester of the general calculus class at Rutgers. Out of over 1300 students in the class, we had complete data (SAT scores, placement scores as well as final exams, etc.) for 1175 students. Of these, 368 were in the control group and 807 students in the study group. Both groups submitted written homework assignments, but in the study group about 11 written problems per week were replaced by WeBWorK problems. The WeBWorK questions were similar for each student, but were individualized by varying the numerical parameters from student to student.

Overall, the students in the web-based sections showed a small but statistically significant improvement (of 4%) on the final exam. This improvement was also present after adjusting for placement scores, which are a measure of prior skill level. As reported by us in the January 2001 issue of the FOCUS, placement scores are the most significant predictor of success. The small difference between group means is not surprising, because the WeBWorK group contained a sub-population of students who did not attempt many web assignments. This sub-population diluted the gains in final exam performance attributable to WeBWorK, as the analysis detailed below shows.

In fact, we found that the effectiveness of WeBWorK depended dramatically upon how many of the problems were attempted. The correlation between attempts and percentage of problems solved was a remarkable .944, suggesting that once students began a problem they persisted until they had solved it. An analysis of variance showed that only 9% of the variability in WeBWorK scores could be attributed to prior skill level, even among entering students, so the number of problems attempted may be an indicator of effort rather than ability.



Sample WeBWorK problem. The score is 50% because one answer is wrong.

Among first-year students in WeBWorK sections, most of whom attempted every problem, there was a two-letter grade difference on the final (from D to B) between students who did not attempt many WeBWorK problems and those who attempted most problems. This was also true after adjusting for the effect of prior knowledge, measured either by our placement test or by their Math SAT (also a significant predictor).

Surprisingly, the data suggests a quadratic relationship between the percentage of WeBWorK problems attempted and the final exam score, with the best-fitting curve being concave up. In other words, students who do less than 50% of the WeBWorK get less "marginal" benefit on the final (i.e., less improvement from doing one more problem) than students who do over 80% of the WeBWorK.

A second sub-population consisted of upper-class students who were taking calculus for the first time. Unlike the first-year students who placed right into calculus, these students typically took precalculus first. In WeBWorK sections, most of these students attempted between 40% and 80% of the assigned WeBWorK problems. Here there was a three letter-grade difference (from F to B) between those who did most of the assigned WeBWorK problems and those who did only a few.

Upper-class students who were repeating Calculus did not seem to derive any benefit from attempting WeBWorK problems. We are still in the process of studying this group in an effort to understand the reason for the absence of any correlation between the amount of WeBWorK activity and final exam scores in this group. ■

Lew Hirsch and Chuck Weibel teach at Rutgers University.

Short Takes

By Fernando Q. Gouvêa

Tenth Annual Hudson River Undergraduate Mathematics Conference

HRUMC X, the tenth annual Hudson River Undergraduate Mathematics Conference will be held at Union College, Schenectady, NY on April 12, 2003. The conference, which is funded by the Andrew W. Mellon Foundation with additional support from Union College, includes presentations on mathematics by both faculty and students, and both are encouraged to participate. Conference sessions are designed so that some presentations are accessible to undergraduates in their first years of study, and others are accessible to third- or fourth-year undergraduate mathematics majors. This year's conference will focus on interdisciplinary talks, though talks in any mathematical area are welcome. You can find out more about HRUMC by visiting the conference web site at http://www.skidmore.edu/academics/mcs/hrumc.htm. Those wishing to make a presentation at the conference should submit an abstract via the web site by February 27th, 2003.

Demands for Teacher Quality Spur New Initiatives

According to an article in *Education Week* (December 4, 2002), the new federal rules requiring under-qualified teachers to upgrade their credentials by 2006 is spurring new initiatives outside of the more traditional teacher education programs. Since traditional schools don't have an easy way to offer specific programs to school districts, various for-profit institutions, colleges that already have in-service teacher-training programs, and textbook publishers are rushing to provide solutions. School districts have welcomed such partnerships because they need to get into compliance quickly, but some educators worry that the programs do not offer the same level of preparation as traditional teacher preparation courses. See http://www.edweek.org/ew/ewstory.cfm?slug=14train.h22 for more information.

GAO Calls for Monitoring of Teacher-Education Projects

In 1998, Congress created a program that offered grants intended to improve the quality of teaching in American schools. The Department of Education set up the Teacher Quality Enhancement Grant Office to administer the program. On December 11, 2002, the General Accounting Office released a report that concludes that the Department of Education is not adequately overseeing the use of these funds. In particular, the GAO argues that DoE needs to set up "an effective system for communicating with grantees." The report also argues that the terms associated with the accountability provisions in the grants are so vague that it is impossible to determine success, and therefore recommends that DoE provide clearer definitions and more precise measures of success or failure. See http://www.gao.gov/cgi-bin/getrpt?GAO-03-6 for the full report.

New Faculty: Consider Project NExT

Project NExT (New Experiences in Teaching) is an MAA professional development program for new and recent Ph.D.s in the mathematical sciences (including pure and applied mathematics, statistics, operations research, and mathematics education). It addresses all aspects of an academic career: improving the teaching and learning of mathematics, engaging in research and scholarship, and participating in professional activities. It also provides the participants with a network of peers and mentors as they assume these responsibilities.

Each year, about sixty faculty members from colleges and universities throughout the country are selected to participate in a workshop preceding the MAA summer meeting, activities during the summer MAA meetings and the Joint Mathematics Meetings in January, and an electronic discussion network. Faculty for whom the 2003-2004 academic year will be the first or second year of full-time employment with significant teaching responsibilities at the college/university level are invited to apply to become Project NexT Fellows. The application deadline is April 11, 2003. For more information, see the Project NExT Website, http://archives.math.utk.edu/projnext/.

Project NExT receives major funding from The ExxonMobil Foundation, with additional funding from The Dolciani-Halloran Foundation, The American Mathematical Society, The Educational Advancement Foundation, The American Statistical Association, The Association of Mathematics Teacher Educators, and the Greater MAA Fund.

Mathematics Project Wins Siemens-Westinghouse Competition

Early in December, the Siemens Foundation announced the national winners of the Siemens Westinghouse Competition in Mathematics, Science, and Technology. High school students from across the nation submitted reports on their research to the Siemens Westinghouse judges, then selected students made oral presentations on their work. At the end of the process, the top prize in the individual category went to Steven J. Byrnes, a senior at Roxbury Latin School in West Roxbury, MA, for a mathematics project entitled "Poset-Game Periodicity", in which he proved a significant new theorem on poset games. The award includes a $100,000 scholarship that Byrnes plans to use to study mathematics at Harvard. See http://www.siemens-foundation.org for more information. ■

Sources

HRUMC: press release, Janine Wittwer, William Zwicker. New teacher ed initiatives: Education Week, December 4, 2002. GAO report: Chronicle of Higher Education Daily News, December 13, 2002, highlights section of GAO report, Project NExT: Joe Gallian. Siemens-Westinghouse competition: AMS, Siemens Foundation.

Call for Papers
Contributed Paper Sessions at MathFest 2003

The Mathematical Association of America will hold its annual MathFest, Thursday, July 31 through Saturday, August 2, 2003 in Boulder, Colorado. The complete meetings program will appear in the April 2003 issue of FOCUS.

This announcement is designed to alert participants about the contributed paper sessions and their deadlines. Please note that the days scheduled for these sessions remain tentative.

The organizers listed below, indicated with an (*), solicit contributed papers pertinent to their sessions. Sessions generally limit presentations to ten or fifteen minutes. Each session room contains an overhead projector and screen. Persons needing additional equipment should contact the organizer of their session as soon as possible, but prior to Tuesday, June 5, 2003.

Submission Procedures for Contributed Paper Proposals

Send the name(s) and address(es) of the author(s), and a one-page summary of your paper directly to the organizer indicated with an (*). In order to enable the organizer(s) to evaluate the appropriateness of your paper, include as much detailed information as possible within the one-page limitation.

Proposals should not be sent to more than one organizer. If your paper cannot be accommodated in the session it was submitted, it will be automatically considered for the general contributed paper session. E-mail submissions are preferred. The e-mail address is: fpford@providence.edu.

Your summary must reach the designated organizer by Tuesday, May 6, 2003. Early submissions are encouraged. The organizer will acknowledge receipt of all summaries. If your paper is accepted, the organizer will provide you with an e-mail template and directions on how to submit an abstract for your presentation.

Contributed Paper Sessions

MAA CPS A1 The Art/Science of Using Mathematics in Applications
Thursday and Friday afternoons

Mathematics is a valuable tool in a diverse array of disciplines. Many application problems appeal to the systematic reduction, logic, and structure that mathematical techniques can offer. On the other hand, using mathematics may also produce a beautiful insight into an application problem. This session seeks to find application problems that illustrate the beauty and the power of mathematics. Preference will be given to presentations that easily lend themselves to be used as classroom modules in an undergraduate mathematics class.

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MAA CP B1 Innovations in the Teaching of Calculus
Thursday and Friday afternoons

The last several years have seen many presentations at various meetings on innovative methods to teach calculus. This session is seeking talks about truly new ideas on how to teach all three semesters of calculus. These approaches can include but are not limited to the use of the computer or World Wide Web, student projects, student group work and innovative presentations of applications.

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MAA CP C1 Creative Use Of Technology in Teaching Mathematics
Thursday and Friday afternoons

This session will focus on innovative uses of technology to support and enhance the learning of mathematics in all college courses. In particular, we are interested in the use of technology to support conceptual understanding and appreciation of the application of mathematical principles to solving real world problems. This session is sponsored by the MAA Committee on Computers in Mathematics Education (CCIME).

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Marcelle Bessman
Jacksonville University

MAA CP D1 Getting Students to Explore Concepts Through Writing in Mathematics
Thursday afternoon

This session invites papers about assignments and projects that require students to write about mathematical concepts, to express concepts in their own words, to interpret symbolic mathematics in their own words, and to write about mathematics, in general. These assignments can include conceptual papers such as having the students explain a concept in their own words as an answer to a question, in the form of a letter to a friend, a poem, or even a short story. Project reports that require students to explain fully all concepts used to someone who knows little or nothing about the mathematics used in solving the project problem, assignments that require students to express theorems in plain English so that one of their friends could understand, or even simple assignments that require students to explain the meaning and the use of the variables and notations that they use.

Each presenter is encouraged to discuss how the use of the assignment/project helped students to improve their understanding of course concepts and how the use of writing in the course helped students to understand and to learn mathematics. Of particular interest is the effect of such projects/assignments throughout the semester on the students' understanding of course concepts and notations, the ability of students to communicate mathematics using words and symbols, and the attitude of students toward mathematics.

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MAA CP E1 Advances in Recreational Mathematics
Thursday afternoon

There have been many recent advances in recreational mathematics, some of which have involved the use of computers. This session is designed to give you an opportunity to explain your recent work in the field. While the organizer encourages submissions that involve computers, that is not essential for consideration. For the purposes of this session, the definition of recreational mathematics will be a broad one. The primary guideline used to determine suitability of subject will be the understandability of the mathematics. For example, if the mathematics in the paper is commonly found in graduate programs, then it would generally be considered unacceptable. Supplemental computer programs can be written in any language, however they must be clean and WELL documented. Any source code used to create the paper must also be submitted for verification. Papers where existing programs such as Mathematica® were used will also be considered.

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MAA CP F1 E-Learning of Mathematics Courses
Thursday afternoon

This session invites papers that describe e-learning mathematics courses. Papers that deal with methods of design, implementation, delivery assessment and maintenance of complete e-learning environments, as well as experiences implementing such courses are welcomed.

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Ananda Gunawerdena
Carnegie-Mellon University

MAA CP G1 Assessment of Student Learning in Undergraduate Mathematics
Friday afternoon

Papers are invited that describe an institution's program of assessment of student learning in a curricular block of undergraduate mathematics courses. The session is sponsored by the NSF-supported MAA Project "Supporting Assessment in Undergraduate Mathematics" (SAUM). The curricular blocks that have been identified as focus areas by SAUM are (1) mathematics major; (2) mathematics for teachers; (3) general education (or quantitative literacy) courses; (4) placement/developmental programs; (5) mathematics for and in mathematics-intensive majors; and (6) innovations (e.g. reform courses). Programs of assessment in these six focus areas are especially invited, but programs of assessment in other curricular blocks may be contributed. Contributions should present a clear description of the assessment design and results of a currently active and continuing assessment program. The following outline is suggested: Background and goals: What did we hope to accomplish? Description: What did we do?

- Developing the assessment program
- Details of the assessment program
- Revisions based on initial experience (if applicable)
- Insights: What did we learn?
- Findings and success factors
- Use of the findings
- Next steps and recommendations

SAUM is gathering case studies of assessment programs for consideration for publishing on the website below or in a volume similar to MAA Notes #49, *Assessment Practices in Undergraduate Mathematics*. Presenters of papers contributed to this session will be invited to submit a case study for consideration for publication. More details can be found at http://www.maa.org/SAUM/index.html.

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MAA CP H1 The Special Interest Group of the MAA on Research in Undergraduate Mathematics Education (Research-to-Practice)
Friday afternoon

The SIGMAA on RUME invites contributions that address research issues concerning the teaching and learning of undergraduate mathematics. This session will be devoted to expositions of research results and uses of research (RUME) in teaching. Priority will be given to proposals that include summaries of research results together with implications for the classroom, or specific examples describing how research results have informed instruction in actual college classrooms. Proposals must clearly describe the research and the classroom aspects of the presentation, as well as the relationship between them.

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MAA CP I1 Technology Innovations in Mathematics Education for Elementary and Secondary Teachers
Friday and Saturday afternoons

Recently, there has been a great deal of interest in designing mathematics courses and programs for pre-service teachers, for professional development of in-service teachers and for Master of Arts in Teaching (MAT) programs which emphasize pedagogy but have a mathematics component. The CBMS document "The Mathematical Education of Teachers" and the NCTM standards call for the integration of technology in the teaching of mathematics. Many states now require facility with various aspects of computer use for teacher certification and mathematics courses are a natural place for much of this learning. However, to many of us it is not obvious what kinds of topics and problems, let alone software and even hardware, lend themselves to the teacher education setting.

This session invites papers that incorporate technology in the design and implementation of innovative courses for preservice or in-service teachers at any of the pre K-12 levels. Presentations should describe math education courses that have been totally re-designed or that infuse technology into a traditional curriculum. Experiences might include: use of laptops; online or interactive TV courses; web-based research, communication or lessons; discovery learning or investigations in a computer lab using popular computer algebra systems; evidence of how these courses impact either the teachers' or their students' learning of mathematical concepts.

Also of interest is discussion of materials for MAT programs which attract technologically-sophisticated teachers with great variation in mathematical skills. Papers that deal with assessment of such programs or implications for accreditation or standards at the state or national level are also welcomed. It is our hope that the session will provide a forum for those who have had success in this area to educate and inspire those of us who are casting about for ideas.

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MAA CP J1 Innovative Approaches in Quantitative Literacy
Saturday afternoon

Discussions about quantitative or mathematical literacy have become more and more common over the past few years. This session will allow faculty who have developed successful approaches to share their work with others. Submissions should include a description of the course contents, the methods used, and the audience to whom the material is directed. Indication should also be given as to why the approach has worked. Presentations involving interdisciplinary and team-taught approaches are encouraged, as are those for non-traditional students or those with weak mathematical backgrounds.

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MAA CP K1 General Contributed Paper Session
Thursday, Friday, and Saturday afternoons

This session is designed for papers that do not fit into one of the other sessions. Papers may be presented on any mathematically related topic. Papers that fit into one of the other sessions should be sent to that organizer, not to this session.

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Call for Student Papers

Students who wish to present a paper at MathFest 2003 in Boulder, Colorado must be nominated by a faculty advisor familiar with the work to be presented. To propose a paper for presentation, the student must complete a form and obtain the signature of a faculty sponsor.

Nomination forms for the MAA Student Paper Sessions are located on MAA Online at www.maa.org under STUDENTS, or can be obtained from Dr. Thomas Kelley (tkelley@hfcc.net) at Henry Ford Community College (313) 845-6492.

Students who make presentations at the MathFest, and who are also members of MAA Student Chapters, are eligible for partial travel reimbursement. The deadline for receipt of applications is June 27, 2003.

PME student speakers must be nominated by their chapter advisors. Application forms for PME student speakers can be found on the PME web site www.pme-math.org or can be obtained from PME Secretary-Treasurer, Dr. Leo Schneider (leo@jcu.edu). Students who make presentations at the Annual Meeting of PME are eligible for partial travel reimbursement. The deadline for receipt of abstracts is June 27, 2003. ■

Free Copies of MAA Notes Volume on Calculus Reform Available

In the mid-1980s, the mathematics community initiated a movement to change the standard undergraduate course in calculus. This change focused on the need for raising students' conceptual understanding, while implementing new methods to reduce tedious calculations. Efforts were encouraged through funding initiatives by the National Science Foundation (NSF) and others. The movement helped to develop a vision for calculus that is challenging and stimulating, with the primary goal being to improve the quality of calculus courses and the level of learning by students in these courses at all types of institutions. However, there are a limited number of studies that document the impact of such efforts in calculus.

Funding from NSF is supporting the distribution to every college mathematics department of *Changing Calculus: A report on evaluation efforts and national impact from 1988 to 1998*, written by Susan Ganter (Clemson University) and published by MAA in 2001. This publication discusses the results from a study conducted as a part of a larger effort by NSF to evaluate the impact of reform in SMET education at the undergraduate level.

The report includes information from more than 300 studies and writings about calculus reform during this ten-year period. Information for the report was collected to investigate what was learned about the effect of calculus reform on (1) student achievement and attitudes, (2) faculty and the mathematics community, and (3) the general educational environment.

Check with your mathematics department chair to see your institution's free copy. Questions may be directed to the author at sganter@clemson.edu. ■

MAA American Mathematics Competitions Program Seeks MOSP-IMO Leader

The MAA seeks a mathematician to be Academic Director of the Mathematical Olympiad Summer Program June 10 - July 7, 2003 in Lincoln, NE and Leader of the US delegation to the International Mathematical Olympiad in Tokyo, Japan July 7-19, 2003. Must be excellent mathematical problem solver, have excellent teaching skills and be able to work with exceptionally talented high schools students, and be able to represent the USA and the MAA. Please send letter of application and resume by March 1, 2003, to Professor Steve Dunbar, MAA American Mathematics Competitions, 1740 Vine Street, Lincoln, NE. Please send your inquiries about the position to Professor Dunbar at 1-402-472-6206 or sdunbar@math.unl.edu.

MAA Awards Announced at the Baltimore Joint Meetings

By Fernando Q. Gouvêa

As happens every year, the winners of several important MAA awards were announced at the Joint Mathematics Meetings in Baltimore. A list with citations and responses can be found on MAA Online at http://www.maa.org/news/awards_jan03.html.

Gung Hu Award for Distinguished Service to Mathematics

The *Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics* is the most prestigious award made by the Association. This year's award went to **Clarence F. Stephens**, who until his retirement in 1987 was Chairman of the Department of Mathematics at the State University of New York at Potsdam. Stephens had a major role in achieving the "Potsdam Miracle." His approach to the undergraduate mathematics major at SUNY Potsdam in the 1980s led to a new model for creating a welcoming atmosphere for undergraduate mathematics majors at many other institutions. This achievement was the main reason for Stephens' award, though of course he had already had a long and distinguished career in mathematics education before coming to SUNY Potsdam. A profile of Stephens will appear in the March issue of the *American Mathematical Monthly.*

Certificates of Meritorious Service

The MAA presents *Certificates of Meritorious Service* to members who have served the association in notable ways, both at the national and at the section level. At each January meeting, about six such certificates are awarded. This year's certificates went to:

Larry J. Morley,
Illinois Section (ISMMA)

Karin Chess
Kentucky Section

Alvin R. Tinsley
Missouri Section

Lester H. Lange
Northern California Section

Luise-Charlotte Kappe
Seaway Section

Fredric Tufte
Wisconsin Section

Full citations and responses are available online.

Haimo Awards

As announced in our November issue, the *Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics* went to:

Judith Victor Grabiner
Pitzer College

Ranjan Roy
Beloit College

Paul Zeitz
University of San Francisco

All three winners gave talks at the Baltimore meeting. For more information, see the November issue of FOCUS or go to http://www.maa.org/news/haimo_award_winners.html.

Chauvenet Prize

The Chauvenet Prize is given for an outstanding expository article on a mathematical topic by a member of the Association. The prize is named for William Chauvenet, a professor of mathematics at the United States Naval Academy. This year's Chauvenet Prize went to **Thomas C. Hales** for his article **"Cannonballs and Honeycombs,"** which appeared in *Notices of AMS,* April 2000, vol. 47, no. 4, 440-449.

Hales' article is about two famous problems. The first is the Kepler Conjecture, which asserts that the natural cannonball arrangement gives the maximum density packing of the Euclidean 3-dimensional space with congruent solid balls. The second is the Honeycomb Conjecture, which says that any partition of the plane into regions of equal area has perimeter at least that of the regular hexagonal honeycomb tiling. Hales recently proved both conjectures, and the article gives both the history of the problems and an expository account of their solution. Hales' article is available online at http://www.ams.org/notices/200004/fea-hales.pdf.

Morgan Prize

The *Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student* recognizes and encourages outstanding mathematical research by undergraduate students. This year's prize went to **Joshua Greene** for his work in combinatorics. His paper "A new short proof of Kneser's conjecture" is to appear in the"*American Mathematical Monthly*. It is related to the work in his undergraduate senior thesis "Kneser's conjecture and its generalizations". A description of Greene's work and his response to the award can be found online.

Further coverage of the Joint Mathematics Meetings will appear in the March issue of FOCUS. ■

Mathematics Awareness Week 2003

The theme for this year's mathematics Awareness Week has just been announced. It will be Mathematics and Art. FOCUS will have more detailed information in a future issue; for now, visit http://www.d.umn.edu/~jgallian/art.html for essays, links, references, possible speakers, and the MAM2003 poster.

ANNOUNCING
MAA'S PMET PROGRAM

Preparing Mathematicians to Educate Teachers

A growing set of national reports calls for better preparation of the nation's mathematics teachers by mathematics faculty. To help meet this need, the MAA has proposed a multifaceted program, Preparing Mathematicians to Educate Teachers (PMET).

The PMET program will have three major components:

(1) Faculty Training: summer workshops of varying durations and mini-courses at professional meetings;

(2) Information and Resources: articles in professional journals, panels at meetings, multi-media websites and hard-copy material dissemination to support faculty instruction for teachers;

(3) Mini-grants and Regional Networks: to nurture and support grassroots innovation in teacher education on individual campuses. PMET efforts will be focused particularly in California, New York, North Carolina, Nebraska, and Ohio.

An extensive article on the PMET program and how MAA members can participate will appear in the March issue of FOCUS.

PMET WORKSHOPS SUMMER 2003

For faculty preparing elementary teachers:

June 15-21, 2003, Arcata, CA, organized by Patrick Callahan

August 3-15, 2003, Boone, NC, organized by David Royster and Holly Hirst

June 1-7, 2003, Lincoln, NE, organized by Jim Lewis and Ruth Heaton.

For faculty preparing secondary teachers:

June 8-20, 2003, Potsdam, NY, organized by Ed Dubinsky (with second session to be held in Summer, 2004)

Check MAA Online for full information, including workshop descriptions, and applications: www.maa.org/pmet.

The PMET workshops for 2003 are contingent upon expected notice of awards from NSF/DUE and Texas Instruments.

Employment Opportunities

MASSACHUSETTS

WILLIAMS COLLEGE
The Williams College Department of Mathematics and Statistics invites applications for two positions in mathematics and one position in statistics, beginning fall 2003, all at the rank of assistant professor (in exceptional cases, more advanced appointments may be considered). We are seeking highly qualified candidates who have 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 25 and will continue until the positions are filled. Williams College is dedicated to providing awelcoming intellectual environment for all of its faculty, staff and students; as an EEO/AA employer, Williams especially encouragesapplications from women and underrepresented minorities. For moreinformation on the Department of Mathematics and Statistics, visit http://www.williams.edu/Mathematics.

NEW YORK

Marymount College of Fordham University
Marymount College of Fordham University anticipates an opening for a two-year visiting Assistant Professor of Mathematics position beginning fall 2003. Duties will include teaching a variety of elementary and advanced courses in mathematics. Requirements include a Ph.D. in mathematics, evidence of outstanding teaching and a commitment to scholarship in mathematics. Send resume, transcripts and three letters of recommendation to: Lita Porter, Secretary, Department of Mathematics and Computer Information Sciences, Marymount College, Tarrytown, New York, 10591

PENNSYLVANIA

University of Pittsburgh at Bradford
Mathematics: Tenure-track Assistant Professor position to begin September 2003. Ph.D. or Ed.D. in math earned or near completion. A strong commitment to undergraduate education on a small rural campus and potential for scholarly work are essential. Applicants with math education background or a willingness to develop this expertise will be given favorable consideration. Teaching assignments will include algebra, pre-calculus, and fundamentals of mathematics. Send letter, vita, official transcripts, and 3 letters of reference to: Dr. Yong-Zhuo Chen, Math Search Committee, University of Pittsburgh at Bradford, 300 Campus Drive, Bradford, PA 16701-2898. The selection process will begin March 10, 2003, and continue until the position is filled. Women and minorities are encouraged to apply. Visit our website at www.upb.pitt.edu. AA/EOE

MOSE Math Ad
PDF
Rules do not print.

MAA Section Meeting Schedule 2003

ALLEGHENY MOUNTAIN

April 4-5, 2003-Penn State University DuBois, PA

EASTERN PA & DELAWARE

April 12, 2003-Wilkes University Wilkes-Barre, PA

FLORIDA

February 21-22, 2003-Jacksonville University, Jacksonville, Florida

ILLINOIS

March 28-29, 2003-Illinois College Jacksonville, IL

INDIANA

March 28-29, 2003-Butler University Indianapolis, IN

INTERMOUNTAIN

March 19-20, 2003, Weber State University, Ogden, UT

IOWA

April 4-5, 2003-University of Northern Iowa, Cedar Falls, IA

KANSAS
April 4-5, 2003-Hays, KS

KENTUCKY

April 4-5, 2003-Bellarmine University Louisville, KY

LOUISIANA-MISSISSIPPI

February 21-22, 2003-Mississippi College, Clinton, MS

MD-DC-VA

April 11-12, 2003-Norfolk State University, Norfolk, VA

METRO. NEW YORK

May 3, 2003-La Guardia Community College (CUNY)

MICHIGAN

May 2-3, 2003-Saginaw Valley State University, University Center, MI

MISSOURI

April 4-5, 2003-Washington University St. Louis, MO

NEBRASKA-SOUTHEAST SOUTH DAKOTA

March, 2003-University of South Dakota at Vermillion, Vermillion, SD

NEW JERSEY

April 5, 2003-Kean University, Union, NJ

November 8, 2003-Raritan Valley Community College, North Branch, NJ

NORTH CENTRAL

April 25-26, 2003- Malcalester College St. Paul, MN

Fall 2003-University of Sioux Falls Sioux Falls, SD

NORTHEASTERN

June 13-14, 2003-Massachusetts College of the Liberal Arts, North Adams, MA

NORTHERN CALIFORNIA, NEVADA, HAWAII

February 22, 2003-College of Marin Kentfield Campus, Kentfield, CA

OHIO

April 4-5, 2003-Ohio State University Columbus, OH

October 17-18, 2003- Ohio Northern University, Ada, OH

OKLAHOMA-ARKANSAS

March 28-29, 2003-The University of Tulsa, Tulsa, OK

PACIFIC NORTHWEST

June 20-21, 2003-Whitman College

ROCKY MOUNTAIN

April 2003-United States Air Force Academy, Colorado Springs, CO

SOUTHEASTERN

March 21-22, 2003-Joint Meeting with Atlantic Section of SIAM, Clemson, SC

SOUTHERN CALIFORNIA

March 8, 2003-Harvey Mudd College Claremont, CA

SOUTHWESTERN

April 5-6, 2003-New Mexico Institute of Mining and Technology, Socorro, NM

SEAWAY

April 4-5, 2003 Alfred University Alfred, NY.

November 7-8, 2003-Rochester Institute of Technology, Rochester, NY

TEXAS

April 3-5, 2003-Sam Houston State University, Huntsville, TX

WISCONSIN

April 25-26, 2003-University of Wisconsin-Marathon County Wausau, WI

September 26-28, 2003 (Meeting for Project NExT Wisconsin) Bundy Hall Conference Center, Menomonie, WI