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Editor: Fernando Gouvêa, Colby College; fqgouvea@colby.edu

Managing Editor: Carol Baxter, MAA cbaxter@maa.org

Senior Writer: Harry Waldman, MAA hwaldman@maa.org

Please address advertising inquiries to: Frank Peterson ads@catalystcom.com

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Letters to the editor should be addressed to Fernando Gouvêa, Colby College, Dept. of Mathematics, Waterville, ME 04901, or by email to fqgouvea@colby.edu.

Subscription and membership questions should be directed to the MAA Customer Service Center, 800-331-1622; e-mail: maahq@maa.org; (301) 617-7800 (outside U.S. and Canada); fax: (301) 206-9789. MAA Headquarters: (202) 387-5200.

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FOCUS

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Sir Michael Atiyah and Prof. Isadore Singer Win the 2004 Abel Prize

The Norwegian Academy of Sciences and Letters has awarded the 2004 Abel Prize jointly to Sir Michael Francis Atiyah, of the University of Edinburgh, and Isadore M. Singer, of the Massachusetts Institute of Technology. Atiyah and Singer will receive the prize, wrote the Academy, "for their discovery and proof of the index theorem, bringing together topology, geometry and analysis, and their outstanding role in building new bridges between mathematics and theoretical physics." The Atiyah-Singer Index Theorem is considered one of the great landmarks of twentieth-century mathematics, influencing many of the most important developments in topology, differential geometry, and quantum field theory. An account of the theorem aimed at a general mathematical public can be found on the Abel Prize web site at http://www.abelprisen.no/nedlastning/2004/popular_english_2004.pdf.

Sir Michael Francis Atiyah

Isadore M. Singer

A few decades ago, physicist Freeman Dyson pointed out that "the marriage between mathematics and physics, which was so enormously fruitful in past centuries, has recently ended in divorce." The situation has changed dramatically since then; Dyson's "divorce" turned out to be only a temporary separation. Atiyah and Singer, both jointly and individually, have been instrumental in repairing the rift, and the Norwegian Academy noted this as one of their most important contributions.

Isadore M. Singer was born in 1924 in Detroit and was educated at the University of Michigan and the University of Chicago. He joined the faculty at the Massachusetts Institute of Technology in 1950, and has been there ever since. He has received several prizes for his work, including the Steele Prize for Lifetime Achievement. Accepting that prize, he said, "For me the classroom is an important counterpart to research. I enjoy teaching undergraduates at all levels, and I have a host of graduate students, many of whom have ended up teaching me more than I have taught them." Singer has also written several important textbooks.

Michael Francis Atiyah was born in 1929 in London and was educated at Trinity College, Cambridge. He spent most of his career at Cambridge and Oxford. He occupied the famous Savilian Chair of Geometry at Oxford and later was Master of Trinity College in Cambridge.

While in Cambridge, he helped create the Isaac Newton Institute for Mathematical Sciences and became its first director. Atiyah received the Fields Medal in 1966. He has been *Sir* Michael Atiyah since 1983, and was made a member of the Order of Merit in 1992.

For more information on the Abel Prize and on this year's winners, visit http://www.abelprisen.no/en. See also the April 2004 *Devlin's Angle* on the MAA web site.

An Update on Hales' Proof of Kepler's Conjecture

In 1998, Thomas C. Hales announced that he had proved Kepler's Conjecture about the best possible sphere packing in three-dimensional space. His claim generated controversy, mostly because of the crucial role of computers in the (very long) proof. As Hales says in the most recent version, "nearly every aspect of the proof relies on computer verification." The issue was put into sharp relief by the editors of the *Annals of Mathematics*, who were leery of publishing a paper whose correctness they could not verify.

The problem, for the editors, was to what extent they should trust mathematics done on the computer without checking it. An attempt to check everything by hand ended badly: "[The referees] have not been able to certify the correctness of the proof, and will not be able to certify it in the future, because they have run out of energy to devote to the problem," said *Annals* editor Robert McPherson. The *Annals* then considered publishing the paper with a disclaimer, to the effect that the editors could not certify that every detail was correct.

An article in the April 6 issue of The *New York Times*, entitled "In Math, Computers Don't Lie. Or Do They?," reports that the *Annals* editors have decided to solve the problem in a different way. The paper will be split in two parts. The more theoretical part will be published by the *Annals* and the computer-intensive part will be published in another journal, *Discrete and Computational Geometry*.

Hales himself has opted for a more radical route. He has started the *Flyspeck Project*, an attempt to create a *formal proof* of Kepler's Conjecture. The idea is to create (via computer) a version of the proof of the conjecture that can be automatically verified line-by-line. You can read more about this at http://www.math.pitt.edu/~thales/flyspeck/index.html.

Convergence: A New Online Magazine from the MAA

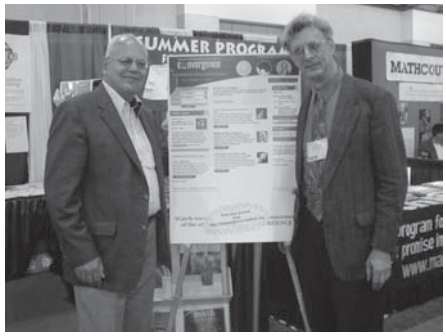
By Victor Katz

The MAA announced the launching of a new online magazine on the history of mathematics and its use in teaching, entitled *Convergence: Where Mathematics, History and Teaching Interact*, with the financial support of the National Science Foundation. The target audience is teachers of grades 9-14 mathematics, be they secondary teachers, two- or four-year college teachers, or college teachers preparing secondary teachers. ("Grade 9–14 mathematics" encompasses algebra, synthetic and analytic geometry, trigonometry, probability and statistics, elementary functions, calculus, linear algebra, and differential equations.) The initial editors of the magazine are Victor J. Katz, from the University of the District of Columbia, and Frank Swetz, from Penn State University, Harrisburg.

Among the types of material that will appear in the magazine are the following:

Expository articles dealing with the history of various topics in mathematics curriculum. They will usually contain interactive components and color graphics, to take advantage of the capabilities of the Web. Frequently, articles will be designed, through use of hyperlinks, to appeal to multiple audiences. In addition, each article will have a discussion group attached, where readers can share suggestions as to how the material can be used in the classroom and point out strong points and possible pitfalls; authors would also have a chance to respond.

Translations of original sources. These will generally be accompanied by commentary from experts showing the context of the works. If possible, interactive components will be used to help with the understanding of these materials. But the goal of the translation is always to show teachers how ideas were developed in various cultures and how knowledge of this development is useful to teaching the same ideas to today's students.



Frank Swetz and Victor Katz

Reviews of current and past books, articles, and teaching aids on the history of mathematics of use to teachers, as well as reviews of websites providing information on the history of mathematics.

Classroom suggestions. These may be self-contained articles showing how to use history in the teaching of a particular topic or they may be materials closely related to a main article, showing in some detail how to use the article in a classroom setting.

Historical problems. These problems will appear in a section entitled "Problems from another time," with new problems appearing frequently. After publication, the problems will be archived in sections based on the main topic of the problem, such as algebra, geometry, trigonometry, or calculus. Answers will appear separately.

What Happened Today in History? Each day, there will be a listing of 2-3 "mathematical events" which happened on that date in history. Many of the items in this section will have links to other websites, so teachers can find out more about the particular person or event.

Quotation of the day. A new and interesting quotation about mathematics from a historical figure will appear in this section each day. The reader will also be able to search our database of quotations to find additional ones.

An up-to-date *guide* to what is happening around the world in the history of mathematics and its use in teaching. The magazine will report on past meetings and give notice of future meetings. Where abstracts are available for a particular meeting, these will be included. We may also include copies of handouts for easy access, as well as links to the author's webpage, if available.

Initially the magazine will be free to all. However, a subscription fee will be necessary after the initial period. We hope to secure institutional as well as personal subscriptions. Information as to cost and access will be provided on the *Convergence* site shortly.

Currently, we have a limited supply of articles in our pipeline. Because our goal is to bring out new material on a regular basis, we need a continual flow of articles and classroom suggestions. We therefore welcome your ideas for articles as well as your completed manuscripts. In particular, we welcome short classroom suggestions that can immediately be implemented by teachers. Materials should be sent both in hardcopy and electronically. Hardcopy should be sent to Victor Katz, *Convergence*, Mathematical Association of America, 1529 18th St. N.W., Washington, DC 20036. We can take articles in Word or TeX, but please include illustrations (in jpg format), applets, etc. as separate files, and give explicit instructions for both internal and external hyperlinks. If there are many illustrations or applets, it is best to send the electronic version on a CD to the same address. Short articles, as well as ideas for articles, can be sent electronically to Victor Katz at vkatz@udc.edu. If you have an idea for an article, but do not know how to produce applets for it, we suggest that you contact an expert on your own campus for help. If necessary, however, we can provide help in the editorial office, provided you give us very explicit instructions as to what you need. The editors look forward to producing this magazine for the mathematics community.

Convergence can be accessed through the MAA home page, http://www.maa.org, or directly at http://convergence.mathdl.org.

SIGMAA QL Is Formed

By Rick Gillman

At its January, 2004, meeting, the Board of Governors approved the formation of SIGMAA QL — the special interest group for Quantitative Literacy.

Quantitative literacy (QL) can be described as the ability to adequately use elementary mathematical tools to interpret and manipulate quantitative data and ideas that arise in an individual's private, civic, and work life. Like reading and writing literacy, quantitative literacy is a habit of mind that is best formed by exposure in many contexts.

While developing a quantitatively literate citizenry is the responsibility of a much larger community, it is the obligation of the collegiate level mathematics community to take leadership in identifying the prerequisite mathematical skills for QL, finding innovative ways of developing and implementing QL curricula, assisting colleagues in other disciplines to infuse appropriate QL experiences into their courses, and stimulating the national dialogue concerning QL.

The purpose of this SIGMAA is to provide a structure within the mathematics community to achieve these goals. It will achieve this by hosting receptions at MAA meetings, organizing talks, panels and paper presentations at MAA meetings, providing e-mail bulletins of timely events and issues via a listserv restricted to members of the SIGMAA, and promoting submissions to publications that further the QL movement. We will also maintain a web page of QL information and distribute a semi-annual newsletter to the SIGMAA membership.

In addition, the leadership of SIGMAA QL will be coordinating its activities with the many other groups, both internal and external to the MAA. Internally, these groups include the CUPM and its various subcommittees and other SIGMAAs which have an interest in this area. Externally, the SIGMAA will be interacting with the NCTM, AMATYC, and the National Numeracy Network.

The initial leadership for SIGMAA QL includes Judy Moran (Trinity College) as Chair, Caren Diefenderfer (Hollins University) as Chair-elect, John Bukowski (Juniata College) as secretary-treasurer, and Matt DeLong (Taylor University) as webmaster. The SIGMAA will hold its first electronic election for new officers in November, 2004, with the new officers assuming their duties in January of 2005.

SIGMAA QL will hold its first business meeting and sponsor an invited speaker at the Joint Mathematics Meetings being held in Atlanta in January 2005. In addition, the SIGMAA will host an informal gathering of interested individuals at MathFest being held in Providence in August, 2004. Further information on this gathering will be published in the program for that meeting.

Finally, members of the MAA are encouraged to be part of a team from their institution attending the PREP workshop on Quantitative Literacy being held this summer from August 17-20, 2004, at the Sleeping Lady Mountain Resort in Leavenworth, Washington.

Congress Asks for Teacher Education Study

Tucked into a major appropriations bill this March was a request by Congress that the Institute for Education Sciences assess teacher education programs nationwide. According to the March 3 issue of *Education Week,* "Congress intends for existing data to be synthesized on the consistency of required coursework, how reading and math are taught, and the degree to which programs are aligned with scientific evidence on the subjects." The study will likely be conducted by the National Research Council.

The Institute for Education Sciences is a branch of the Department of Education created in 2002. Its purpose is "to advance the field of education research, making it more rigorous in support of evidence-based education." Grover J. (Russ) Whitehurst is the current Director of the Institute. For more information about IES, see http://www.ed.gov/about/offices/list/ies/index.html.

It will probably be several years until the study is complete. Meanwhile, reactions are mixed. Some education experts are confident that the study will confirm the effectiveness of teacher education programs. Others fear that the study will be used against Schools of Education, and doubt that the concept of "scientific evidence" is applicable to the assessment of teacher education.

Figure This!

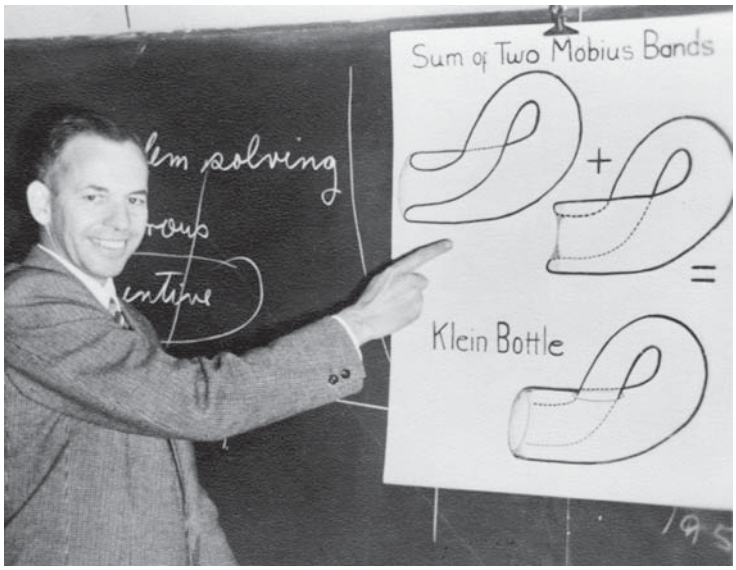
If you started counting your heartbeats at midnight on January 1, 2000, when would you count the millionth beat? How about the billionth beat? This is one of the "math challenges for families" to be found at the *Figure This!* web site at http://figurethis.org. The rationale for the site, which was created by the National Council of Teachers of Mathematics, is explained in the family corner: "Family members — as children's first teachers — are crucial to student success. And the more adults become engaged in their children's education, the greater the chances that children will succeed." The site provides mathematical challenges both in a format appropriate for the web and in printable format.

The Archives of American Mathematics at the Center for American History

By Kristy Sorensen

The Archives of American Mathematics (AAM), a unit of The University of Texas at Austin's Center for American History, has been an important resource for mathematicians, historians, and sociologists for nearly thirty years. Thanks to the generous financial support recently provided by the Legacy of R. L. Moore Project, through the Mathematical Association of America this valuable collection will be made more accessible for teaching and research.

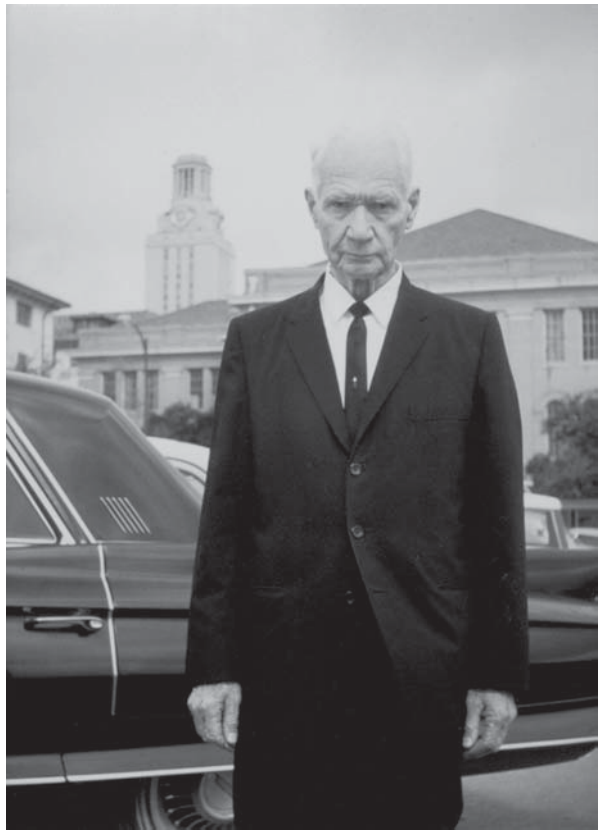
In February, 2003, the Center for American History utilized grant funds to hire Kristy Sorensen, a full-time archivist, and Traci Drummond, a part-time assistant, to manage the growing collection.



R.H. Bing, ca. 1960s, from the R.L. Bing Papers, Archives of American Mathematics, Center for American History, The University of Texas at Austin.

Together they have taken major steps to enhance the value of AAM collections to researchers, including the placement of over 50 collection inventories on the Internet, where they can be accessed by researchers worldwide. In February, 2004, the AAM was awarded an additional two years of funding from the Legacy of R.L. Moore Project. In March, Amelia Abreu replaced

George Bruce Halsted, date unknown. From the R.L. Moore Papers, Archives of American Mathematics, Center for American History, The University of Texas at Austin.



R.L. Moore, January, 1969. Photo taken by Homer G. Ellis, from the R.L. Bing Papers, Archives of American Mathematics, Center for American History, The University of Texas at Austin.

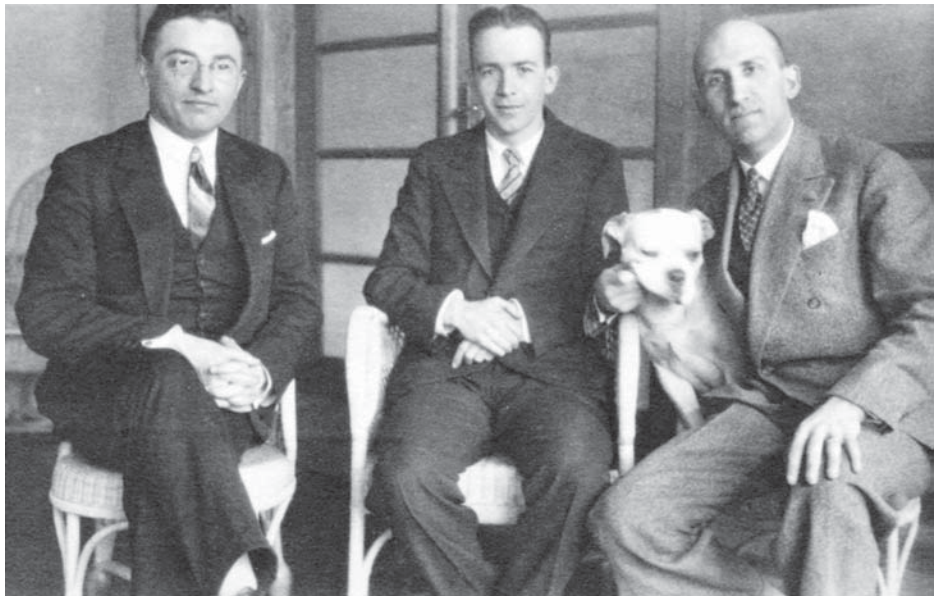
Traci Drummond as the archival assistant. She and Kristy Sorensen look foward to continued work with the mathematics collections in the coming years.

Colleagues of R. L. Moore, a prominent mathematician and long-time professor at The University of Texas (1920-1969), established the Archives of American Mathematics in 1975 with the donation of his papers. This core collection attracted other donors, and led to the addition of the papers of many of Moore's students and colleagues, including R. L. Wilder, R. H. Bing, and G. B. Halsted. In 1978 the AAM became the official repository for the records of the Mathematical Association of America, expanding the collection to include the administrative records of this important professional organization. Adding to the breadth of collections in the AAM are the records of the School Mathematics Study Group, creator of the influential "New Math" primary and secondary curriculum of the 1960s. Other prominent collections include the papers of Max Dehn, Emil Grosswald, and William T. Reid. Major strengths of the archives are in topology, mathematics education, analysis, number theory, logic, and the mathematical foundations of physics. The AAM currently consists of 70 collections measuring more than one-thousand linear feet.

The Center for American History is a special collections library, archive, and museum that facilitates research and sponsors programs on the history of the United States. The Center supports research and education by acquiring, preserving, and making available research collections and by sponsoring exhibitions, conferences, symposia, oral history projects, publications, and grant-funded initiatives.

Persons interested in conducting research or donating materials or who have general questions about the Archives of American Mathematics should contact the Archivist Kristy Sorensen, k.sorensen@mail.utexas.edu, (512) 495-4539. For more information on the Archives, visit the archives' web page at http://www.cah.utexas.edu/collectioncomponents/math.html.

Joint AMS/MAA Mathematics Meeting, Cleveland, Ohio, December, 1930. From left to right: Wilfrid Wilson, J.W. Alexander, W.L. Ayres, G.T. Whyburn, R.L. Wilder, P.M. Swingle, C.N. Reynolds, W.W. Flexner, R.L. Moore, T.C. Benton, K. Menger, S. Lefschetz. From the R.L. Moore Papers, Archives of American Mathematics, Center for American History, The University of Texas at Austin.



C. Zarankiewicz, W.L. Ayres, and B. Knaster (with unidentified dog), undated. From the R.L. Moore Papers, Archives of American Mathematics, Center for American History, The University of Texas at Austin.

The Teacher as Artist: A Letter to My Colleagues

By Peter Taylor

In a time of diminishing resources, must we give up the attempt to offer a high quality mathematics education to our students? Peter Taylor, recently chosen to head the Department of Mathematics and Statistics at Queen's University in Kingston, Ontario, addresses this question in a letter to his colleagues.

Department of Mathematics
and Statistics
Queen's University
February, 2004

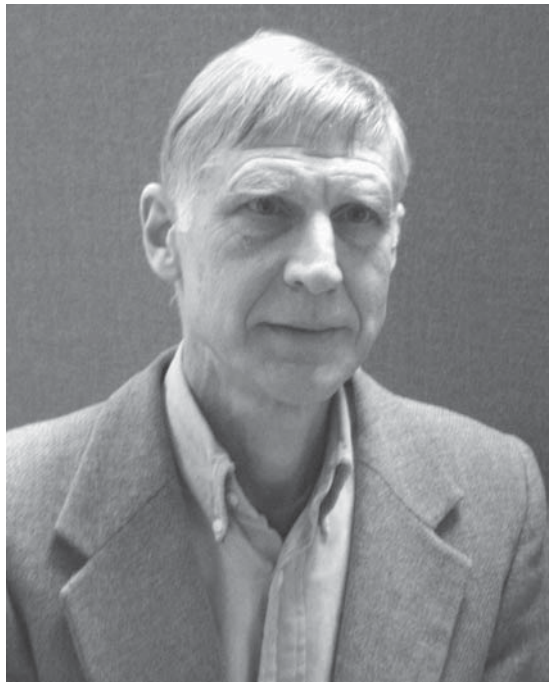
Dear Colleagues:

Thanks to all those who have congratulated me and wished me well. We have at Queen's a versatile and dedicated Department and I look forward to guiding it through the next few years of its growth. I say "growth" in the faint hope that this means more than spiritual and intellectual growth, though the Dean seems unable to say more than that *some but not all* of our upcoming retirements will be replaced. These are challenging times.

Indeed, we are called upon now to do much more with many fewer resources than were available when I was a student here. Our response to each new cut over the years has been to squeeze harder and fit more in and I am now convinced that this response can no longer serve us or our students. It's time to do old things in a new way. I'm not sure just what a new system might look like, but my understanding of how significant advances were made in our evolutionary trajectory as a species is that it was at times of tight constraint that significant "saltations" were made.

I was glad that so many of you attended the colloquium last week — my thoughts on some possible changes in our large first-year service courses. It wasn't really meant as a directive, though some of you might have wondered about that. Well maybe it was — certainly I am serious about this type of change: less breadth and more depth, a few critical examples, the best we can find, powerful, beautiful, engaging, exploratory, artistic, as many of those fine words as possible, done thoroughly and well, hopefully enough of these to capture the essentials of the subject, be that calculus or linear algebra. Such examples are not easy to find; but once you have them you have pure gold. In the conversations I had afterwards, many of you picked up on my phrase that we should dare to be "less comprehensive and systematic." You pointed out that while most of these students will never encounter us again, some of them do stay to take MATH 211 or MATH 232 and there are many things they will need to know. It's true that some will go on to other math courses and in fact I hope that the changes I have in mind will encourage even more to stay with us longer and learn some more mathematics. In part, my purpose in writing this is to address this "prerequisite" worry that many of you seem to have.

On the other hand, perhaps I protest too much. Perhaps it's not such a worry. After all, these students are majors in another discipline and this is an applied course, and I am an applied mathematician and apparently a good teacher so on the whole you trust me with these students, and my schemes will probably turn out fine. And of course I did make it clear at the very beginning that I was not talking about our honours courses — those, we have a duty to teach "properly," a duty not only to our students, but to the subject itself. No, the colloquium was very much about our service courses.



Peter Taylor

But now I owe you a confession. The changes I have in mind apply, in my view, equally to the honours courses. In these courses, I think we can do much less, have more fun and engagement, and come away with a much higher retention rate. In saying this I am aware that our honours courses are generally very well taught and our graduating students on the whole look back on them with positive memories. But less than half of the students (in fact much less) who enroll in those courses wind up with any kind of math concentration. I want more of them to stay. I believe that more mathematics would serve them well, and that they in turn would serve our subject well in whatever they chose to do in life.

I have already touched on this subject with one or two of you, and in fact, over the years, with other mathematicians at professional meetings. It is a difficult debate, partly because so much of it is waged abstractly away from concrete examples and explicit curriculum models. But the bottom line — what my conver-

sations always seem to come down to — is your worry that my "schemes" will fail to properly prepare our students for upper level mathematics courses. Thinking about this, I wonder exactly what it is that you are worried about. Is it the students themselves and their future? Is it the reputation of the university? Or is it your own future courses, the readiness with which the students will be able to grapple with the many neat things you want to teach them?

Well, let's think for a moment about these students. They come in different flavours. First there's A and B who are natural problem solvers and might well wind up in research careers in mathematics or science. These students will thrive with your curriculum as well as with mine — all they need is good problems and someone to talk to about them. So can we agree that they are not the problem? Then there are C, D, E, F, G, H, I and J. Some of them will go on to law or business, some to government; some are in our teacher program. And then of course there is (or will be) X, Y and Z who started out in the service courses but because they were so interesting and lively (!) decided to switch to a math major and find themselves now in third year. You seem to suggest that these students, from C to Z, would have great difficulty filling in the gaps on their own, that if we do not teach them a "proper" systematic course they will not manage to carry the subject effectively forward.

Well, in my experience, they do not now carry the subject effectively forward. Many of them take my MATH 382 and I can attest that they are not very good at using simple (basic!) ideas of calculus and linear algebra to solve new problems. [Actually I don't mean to suggest that they *should* be able to do that in third year; the point I'm making is that they don't come away (from the teaching and learning) with what you might think, that while an alternate approach might be no better than the traditional one, it might equally well be no worse. In fact I have reasons for thinking that a lighter, livelier approach might actually work better and gain us more students. As an example I cite my way of treating eigenvalues which (I feel) is much more fun than the standard approach but which I am sure gives them a much clearer idea of what an eigenvalue really is.]

For most of our math majors (from C on), it is enough that they learn a little math, enough math to see the power and beauty, and learn it well and positively enough that they can feel it belonging to them, feel it part of their domain. After that, we simply have to trust the subject itself to impel them forward as appropriate, and trust them to respond.

I know that many of you have important stories that you want to tell your senior students, stories that they would not be able to appreciate or even understand without a "proper" grounding in the first and second year, and so you are understandably worried by my suggestion that we might lighten (that word in all its meanings!) our introductory courses. I find that the metaphor of "teacher as artist" is helpful here.

Briefly, the idea is that the curriculum be regarded as a set of integral works of art. Because such works have a wholeness in themselves, it is not so crucial whether the student has mastered this technical skill or that, rather what counts is the nature and level of sophistication of the technical skills he has mastered, and it is this that should increase from year to year. As each new work is brought forward, crucial technical skills can be, and indeed ought to be, reinvented in the new context, and the experience that is needed for this to succeed is of a general rather than a specific nature.

The artist and the poet do not to tell the entire tale as they know it. Rather they display it on the canvas, or on the page, in a way that is true both to the story and to the constraints imposed by the medium. The response of the artist is therefore highly conditioned, bowing to form, and to technique, *but it is the more powerful for that*; this is the wonderful paradox of artistic expression. Good stories become art when they are told in simple ways which capture their richness. It is a challenge to find such ways, but it is the fundamental challenge of the teacher as artist.

In closing, these remarks of mine focus on what I believe are fundamental problems of the area of study known as mathematics education. For 30 years I have attended professional meetings and read journal articles in this field and followed the big debates and you know what? — except for an oscillation from right to left and back again, little seems to change. One problem is that the system is completely interconnected — a powerful current of experience and ideas runs from elementary school through high school and university, to teacher's college and right back to the beginning again. Perhaps the only hope is a decisive intervention at some critical point in the system and my target these days is that crucial first year in which we play host to a significant fraction of the students at this university.

You've noticed a strong thread of idealism running through this letter. That's how we're going to start. We'll temper it as we go.

All the best,
Peter

Peter Taylor is Professor of Mathematics, Biology and Education at Queen's University. In July, 2004 he will assume duties as Head of the Department of Mathematics and Statistics at Queen's University. He is determined that this will not cut into his squash.

What I Learned by Teaching Proof and Logic

By Peter Ruane

Most of my years in mathematics education have been spent in primary teacher training in the UK. Naturally, this has involved much time in primary schools, working with teachers and doing maths with children between the ages of 5 and 11 years. By the phrase 'doing maths' I mean that I always get the children actively exploring a problem or provide them with heuristic exercises that generate discussion and the exchange of ideas. It involves observation of pattern, forming hypotheses, explaining and justifying (however informally).

On the question of 'logic' and 'proof', I rarely embark upon explicit teaching of such themes but they often arise as side issues, and very valuably so. Looking back, many instances spring to mind, but I recall some particular teaching episodes that illustrate children's capacity for logical thought and proof. What I have learned from this has consequently affected the way I have taught mathematics to trainee teachers.

Below, I recount some past teaching episodes as a means of illustrating this philosophy. Some of the conversations with children have been reconstructed from memory, but the gist of the dialogue is authentic.

Odds and Evens

This was a lesson with a class of children aged between 8 and 9 years, the aim being to extend their understanding of basic addition. The activity was centered upon exercises that involved adding pairs of even numbers, *or* adding pairs of odd numbers, *or* adding a mixed pair (one odd, the other even). Initially, I didn't explain what was going on, but I got the children doing the additions and, after a while, asking them what they'd observed.

Nearly all the children had noticed the simple patterns: E + E = E, O + O = E, E + O = O and O + E = O and this was followed by quite a bit of discussion around questions such as 'How can we tell if a number is even?' etc and then to the matter of generalising results about the addition of three or more odd numbers etc.

Most of the attempts to justify the claim that O+O =E were based upon statements of the sort '*It always works*'. Probing more deeply, I challenged the children to provide a counter-example, which, of course, they could not. What did emerge were two particularly striking contributions, one from Brendan another from Clare.

Brendan's explanation was based upon a last digit argument. He pointed out that since the sum of any pair from 1, 3, 5, 7, 9 would be even, then the sum of any two large odd numbers would also be even. For example, since 7 + 5 is even, then 127 + 105 is even, and so on. On the other hand, Clare's explanation was intuitively based upon that used in a formal proof. She held up both fists, each with just one finger sticking out. She said '*If this is odd, there's one left over, and if that's odd, there's one left over. The left overs make two, so everything's even*'.

Formally, if x, y are odd then x = 2m+1 (Clare's left fist) and y = 2n+1 (Clare's right fist), where m and n are non-negative integers. So x + y = (2m+1) + (2n+1) = 2m+2n+2 and *'everything's even*'.

Halving a Square

For this activity, the children were about ten years of age and I provided each of them with a sheet with lots of squares drawn on it. After an opening discussion, I asked them to find different ways of dividing a square into two equal pieces by use of a single line. I actually meant 'congruent' pieces, but some of the children took this to mean 'equal by area' but not necessarily congruent (so what?).

Many drew in the obvious dividing lines (vertical, horizontal and diagonal lines of symmetry) and then ran out of ideas. Calling the class together for discussion, one of the boys (Glen), who had been working quietly in a corner of the classroom, told us that there were 'lots' of ways of doing this. I was amazed by Glen's justification, which was based upon rotational symmetry as follows:

- Find the centre, C, of the square by pencilling the diagonals then erase the pencil lines.
- Join C, to another point, P, on one of the sides by drawing any line (straight, curve or squiggly).
- Using tracing paper, rotate the segment PC through 180° (about C) to meet the opposite side at a point Q.
- Line PCQ divides the square into two congruent parts.
- Check this by cutting out the two pieces and superimposing.

Of course, Glen didn't word his response like this, but he explained this method in his own vernacular, showing us his diagrams. Equipped with scissors, tracing paper, coloured pencils etc, the rest of the class then embarked upon Glen's approach and started to manufacture their own sets of examples.

Classifying by Symmetry

Symmetry is one of those topics that have long been included in school syllabuses in the UK, but most teachers don't know why that is, so they end up treating the topic by providing recreational colouring and cutting activities with no ostensible geometrical content. What I intended was to use symmetry to extend children's awareness of properties of shape by getting them to investigate questions such as:

- How many lines of symmetry can a triangle have?
- Find, if you can, quadrilaterals having 0, 1, 2, 3 or 4 lines of symmetry.

- Which of these can have a right-angle? How many right angles at most?
- Which of your quadrilaterals have rotational symmetry?
- Which quadrilaterals only have lines of symmetry that are diagonals? etc.

The work was practical (templates, scissors, sticky paper, glue etc) and, for some of these questions, the children recorded the results by cutting out and sticking their shapes into appropriate boxes of a two-attribute Carroll diagram.

When it came to summarising the results, and reaching agreed conclusions, we were really employing proof by exhaustion (deriving all possible cases). It was agreed, for example, that a triangle could have 0 lines of symmetry, 1 line of symmetry or three lines of symmetry (because the children had found such examples). However, as to providing a reason for not being able to find a triangle with exactly *two* lines of symmetry most children rather lost interest — except two of the girls (both 11 yrs old).

Later, the girls came up with the argument that, for a triangle with two lines of symmetry, all three sides must be equal and so it is equilateral and therefore has a third line of symmetry. In other words, from an activity based upon exhausting all possible cases, there emerged a nice piece of deductive reasoning that was accepted as a convincing proof by most of the class (and, of course, myself).

Sorting and Classifying

Working with children as young as five years old, there is much scope for activities based upon sorting and classifying everyday objects into sets. This facilitates language development and particularly the refinement of vocabulary connected with length, weight etc. By extending such activities to work with 2d and 3d geometric objects, shape names are introduced and various intuitive geometric properties of shape begin to evolve.

Obviously, such work commences by sorting objects according to one attribute only (e.g., using Logiblocs, sort according to thick/thin or square/non-square etc) and leads to sorting by two or more attributes. However, by using Venn or Carroll diagrams to record the results of sorting, opportunity arises for the use of logical connectives and the formation of compound statements from simple statements as a means of describing the regions of the diagrams (truth sets).

A typical lesson on this was based upon sorting a group of children according to what sort of pets they may own. So, we put a large closed rope loop on the classroom floor, with the fifteen five-year olds excitedly gathered round. 'WHO has a DOG?' I ask in an exaggeratedly dramatic way. Eight eager responses are given, so into the hoop those eight children go.

Qn: Why isn't Alice in the hoop?'

Ans: 'Because she hasn't got a dog!' shouts Ruth (she isn't in the hoop either)

Qn: 'What pets do you have Ruth?

Ans: 'A cat and a tortoise' She replied.

Qn: 'Who else owns a cat?'

There are about five positive replies to this, including two from children in the 'dog hoop'. We put down another hoop for the cat owners, non-overlapping with the dog set.

Problem! Children with cats go into the cat hoop, but some of those are also in the dog hoop. How do we get those children into both sets? After some discussion, it is decided to make the hoops overlap to produce a four-region Venn diagram (including the outside).

Each of the four regions contains at least one child and we discuss why any particular child is, or is not, in a particular region. We have two logical connectives 'and', 'or' and two simple statements and compound statements are elicited from the diminutive participants. Replies to my questions were typically like this:

'Charlie's in that bit 'cos he's got a dog, but no cat'

$$(\sim c \wedge d)$$

'Ruth's got a cat and not a dog'

$$(c \wedge \sim d)$$

'Hannah's got nothing: she's outside'

$$(\sim c \wedge \sim d)$$

This goes on for a while and we return to this type of activity in various guises, always developing children's ability to describe and logically classify mathematical or everyday objects. Really, this is a prelude to symbolic logic, but, of course, that stage is never reached and teachers confine the results to describing subsets of truth sets by use of everyday language.

I have often applied the same idea to symmetry activities for the classification of triangles, quadrilaterals etc. For example, with two attributes 'has rotational symmetry' and 'has mirror symmetry', older children will be asked to insert at least one type of quadrilateral into each of the four regions of a Venn (or Carroll) diagram and give their reasons for placing a particular shape in a particular region. Descriptions will involve compound statements of the sort $\sim m \wedge r$ (parallelogram), $m \wedge \sim r$ (trapezium), $m \wedge r$ (rhombus or rectangle) etc. With some children, it's possible to establish equivalences like $\sim m \vee \sim r \Leftrightarrow \sim (m \wedge r)$, but only in the form of ordinary English and in a specific practical context.

Summary

In the past five years or more, primary mathematics in the UK has been based upon the principle that teaching has to be interactive. This means that children's ideas (right or wrong) must be incorporated into lessons and teachers should encourage children to explain, question and demonstrate. In this way, the capacity for 'logical' thought will gradually develop.

Moreover, the notion of 'proof' has widened from that used in formal mathematics and we now acknowledge different levels of proof, beginning with children's reasonable explanations as to why they believe something to be true or false.

In the examples that I have provided, I am suggesting that many children are quite capable of achieving quite sophisticated proofs and that, even for young children, deductive proof, proof by exhaustion, and proof by counterexample are not beyond the bounds of possibility. Teaching activities such as those above have also taught me that Boolean algebra has its pedagogical roots in sorting activities with very young children.

What did I learn by teaching proof and logic to undergraduate maths majors? That's a different story!

Peter Ruane has taught mathematics in schools to children across the age-range (5 yrs to 18 yrs) and he has been involved in the mathematical education of teachers in England for over thirty years.

Mathematics Magazine Editor Search

The Mathematical Association of America seeks to identify candidates to succeed Frank Farris as Editor of *Mathematics Magazine* when his term expires in December, 2005. The Search Committee plans to make a recommendation during the summer of 2004 so that the new editor can be approved by the Board of Governors and begin handling all new manuscript submissions in January, 2005. The new editor would be Editor Elect during 2005 and would serve as Editor for the five years 2006-2010.

Questions about the nature of the position and its workload can be addressed to Frank Farris (FFarris@scu.edu); questions about MAA support for the editor's work can be addressed to the MAA's Director of Publications, Don Albers (dalbers@maa.org).

Each applicant should submit a resume, names of references, and a statement of interest containing his or her ideas about the journal. These can be emailed with attachments as Word or plain-text TeX documents to the chair of the Search Committee, Deanna Haunsperger (dhaunspe@carleton.edu), or mailed to:

Deanna Haunsperger
Department of Mathematics
and Computer Science
Carleton College
One North College
Northfield, MN 55057

Nominations are also welcome if you know someone who would be an outstanding editor. Applications and nominations will be accepted until the position is filled, although preference will be given to applications received by early May.

There is no basis for your independence

Sign next to a bridge in Beijing, China August, 2002. Photograph by Colm Mulcahy.

2004 Summer Short Course—Teaching and Doing Knot Theory

The Ohio Section will sponsor a summer short course on Teaching and Doing Knot Theory, which will be held June 2–4 at Ohio Northern University in Ada, Ohio. Colin Adams of Williams College will be the instructor.

Knot theory is a great topic for exciting students about mathematics. It is visual and hands on. Students can begin working on problems the first day with their shoelaces. Knot theory is also an incredibly active field. There is a tremendous amount of work going on currently, and one can easily state open problems. It also has important applications to chemistry, biochemistry, and physics.

This workshop is aimed at anyone who is interested in knowing more about knot theory. There is no assumption of previous background in the field.

Participants completing the workshop will learn how they can:

- Teach an undergraduate course in knot theory
- Do research in knot theory
- Direct student research in knot theory

Participants will have the opportunity to conjecture wildly, throw around ideas, and work on original research.

There will be morning and afternoon sessions on Wednesday and Thursday and a morning session on Friday.

Colin Adams is the Francis Christopher Oakley Third Century Professor of Mathematics at Williams College. He received his Ph.D. from the University of Wisconsin-Madison in 1983. He is particularly interested in the mathematical theory of knots, their applications and their connections with hyperbolic geometry. He is the author of *The Knot Book*. an elementary introduction to the mathematical theory of knots and co-author with Joel Hass and Abigail Thompson of *How to Ace Calculus: The Streetwise Guide*, and *How to Ace the Rest of Calculus: the Streetwise Guide*, humorous supplements to calculus. Having authored a variety of research articles on knot theory and hyperbolic 3-manifolds, he is also known for giving mathematical lectures in the guise of Mel Slugbate, a sleazy real estate agent. A recipient of the Deborah and Franklin Tepper Haimo Distinguished Teaching Award from the Mathematical Association of America (MAA) in 1998, he was a Pólya Lecturer for the MAA for 1998-2000 and was a Sigma Xi Distinguished Lecturer for 2000-2002. He is also the author of mathematical humor column called "Mathematically Bent" which appears in the *Mathematical Intelligencer.*

Registration will begin in April and continue until all seats are filled. The registration fee is $150.00.

For more information contact Don Hunt at d-hunt@onu.edu or call (419) 772-2351.

You may also visit: http://www.onu.edu/a+s/math/NewFiles/maa/shortcourse.htm.

MAA Member Frank Leighton Elected to the National Academy of Engineering

Frank Thompson Leighton, professor of applied mathematics at the Massachusetts Institute of Technology and an MAA member, has been elected to the National Academy of Engineering "for contributions to the design of networks and circuits and for technology for Web content delivery."

The National Academy of Engineering (NAE) elected 76 new members and 11 foreign associates this year, which brings the total U.S. membership to 2,174 and the number of foreign associates to 172. Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made "important contributions to engineering theory and practice, including significant contributions to the literature of engineering theory and practice," and those who have demonstrated accomplishment in "the pioneering of new fields of engineering, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education."

2003 Annual Survery of the Mathematical Sciences

The first report of the *2003 Annual Survey of the Mathematical Sciences* has just been released and is available online at http://www.maa.org/news/2003survey.html. It focuses on new doctoral recipients and the faculty salary survey. The second report will be published in August, 2004.

Remembering Bill Chinn

By Jean Bee Chan

Long time MAA member and supporter William (Bill) G. Chinn passed away quietly on March 23, 2004, in San Francisco. Bill was an active member of the MAA. He served on national and sectional MAA committees, was the Northern California Section Chair, and in 1981–82 served as Second Vice President of the MAA. He was a generous donor to both the MAA and the American Mathematical Society.

An alumnus of Lowell High School and University of California at Berkeley, Bill served in Europe and Africa during World War II, first as a pharmaceutical technician and then as a meteorologist. After his discharge he resumed graduate study in mathematics. He was a Professor of Mathematics at the City College of San Francisco for many years.

Bill also taught in junior high and senior high schools in San Francisco, where students enjoyed his humorous and witty approach to classroom teaching. He maintained a mathematics "laboratory" for gifted students, and served as assistant to the Curriculum Coordinator of the San Francisco Unified School District. He authored and co-authored numerous books, including *First Concepts in Topology*, with Norman Steenrod, and *3.1416 And All That*, with Philip Davis.

I first met Bill when he was Newsletter Editor for the Northern California Section of the MAA. Later he and I served together on the MAA Development Committee. Bill loved to take pictures of people at meetings. Afterward, he would circulate pictures with colleagues and students properly identified. On the occasions we met for dinner, the bill was always magically paid. It turned out Bill always paid for dinner while the rest of us were enjoying ourselves.

MAA members Leonard Klosinski, Jerry Alexanderson, David Sklar, and I were at the memorial service for Bill Chinn in Oakland, California, at the Chapel of the Chimes on March 30, 2004. Bill was *always* cheerful, *always* generous. He was a great friend and a selfless contributor to the mathematical community. He was a good role model for all of us, and he will live forever in our hearts.

Call for 2005 PREP Proposals

The Mathematical Association of America PRofessional Enhancement Program (PREP) seeks proposals for 2005 PREP workshops. PREP is a comprehensive, professional career enhancement project of the MAA funded by NSF DUE grant # 0341481.

Programs for all aspects of career enhancement are encouraged. PREP workshops that present modern mathematical ideas or current interest in research and interdisciplinary applications are especially welcome. Programs that present new developments in teaching and learning, innovative approaches to leadership and career enhancement, or focus on innovative curricula and pedagogical strategies are also welcome. All programs must appeal to a general audience of mathematical professionals.

In addition to PREP-funded workshops, we invite directors of other funded projects who plan to offer a workshop to apply for inclusion under the PREP umbrella. Through this process, a workshop will gain access to the wide audience, logistical support and evaluation services developed for the PREP program. Programs considered for inclusion in this way must meet the same guidelines as core PREP workshops.

More information regarding submission of workshop proposals is available through the program website, http://www.maa.org/PREP.

Letters to the Editor

Paul Monsky's Real School

In FOCUS, March 2004, bottom of page 28, it is mentioned that "The only perfect score on the 1950 Mathematical Contest was Paul Monsky, from Stuyvesant High School in New York City". This is incorrect. Paul was at Brooklyn Tech when I was there.

Peter Kahn
SUNY Stony Brook

What is an Acronym?

I was amused at the argument about the "acronym" SPSS in the Letters section of the March FOCUS. The point is, SPSS can never be an "acronym" for anything. A sequence of initial letters of a phrase or definition is an acronym, if it forms a pronounceable word. The operative term is "pronounceable." RADAR, for example, is pronounceable, hence is an acronym. It would have been permissible to include the "A" from "Package" (the RA from RADAR stands for "radio"), or the "A" from "and" from the 2nd example giving SPASS, an acronym.

Oren N. Dalton
El Paso, TX

Well, the OED seems to agree with you, since it defines an acronym as "A word formed from the initial letters of other words." The computer community, however, seems to call any sequence of letters an acronym. See, for example, the definition of "TLA" in the Jargon File: http://www.catb.org/~esr/jargon/html/T/TLA.html.

Recently Reviewed Online

The FOCUS Online section of the MAA web site includes a very active book review column called *Read This!*. You can find the main reviews site at http://www.maa.org/reviews/reviews.html. The archive of past reviews is huge: more than 400 books have been reviewed. Here is a list of some recently reviewed books:

The Art of the Infinite
by Robert and Ellen Kaplan

A Smoother Pebble
by Donald C. Benson

When Least is Best
by Paul Nahin

Geometry: Euclid and Beyond
by Robin Hartshorne

Dr. Math Gets You Ready for Algebra
by The Math Forum

A Topological Aperitif
by Stephen Huggett and David Jordan

MAA Contributed Paper Sessions
Atlanta Joint Mathematics Meeting, January 5-8, 2005
PRELIMINARY ANNOUNCEMENT

The organizers listed below solicit contributed papers pertinent to their sessions. Sessions generally limit presentations to ten minutes, but selected participants may extend their contributions up to twenty minutes. Please note that the dates and times scheduled for these sessions remain tentative. See the end of this announcement for specific submission procedures and other details. Each session room contains an overhead projector and screen; black boards will not be available. Persons needing additional equipment should contact, as soon as possible, but prior to September 14, 2004, the session organizer whose name is followed by an asterisk (*).

MAA CP A1 Getting Students To Discuss and To Write About Mathematics
Wednesday morning and Thursday afternoon
Sarah L. Mabrouk*, Framingham State College

This session invites papers about assignments and projects that require students to communicate mathematics through in-class oral presentations, in-class discussions that they must lead and motivate, and written assignments and/or papers. These assignments/projects can include analysis and applications of mathematics, presentations of and analysis of proofs, presentations about famous mathematicians and the mathematics that they studied, and assignments/projects that utilize creative writing. Presenters are encouraged to discuss how the use of the assignment/project helps the student to gain greater understanding of mathematics as well as to improve his/her understanding of mathematics language and his/her ability to communicate mathematics. Of particular interest is the effect of such projects/assignments/presentations throughout the course on the student's understanding of mathematics, his/her communication of mathematics, and his/her attitude toward mathematics.

MAA CP B1 My Favorite Demo—Innovative Strategies for Mathematics Instructors
Wednesday morning and Thursday afternoon
David R. Hill*, Temple University, hill@math.temple.edu
Lila F. Roberts, Georgia College and State University

Mathematics instructors use a myriad of innovative techniques for teaching mathematical concepts. Technology readily available in colleges and universities has provided a means to boost creativity and flexibility in lesson design. Tools an instructor utilizes may include specialized computer applications, animations and other multimedia tools, java applets, physical devices, games, etc. This contributed paper session will focus on novel demos that mathematics instructors have successfully used in their classrooms. Rather than focus on projects or student group activities, this contributed paper session will focus on the instructor's activities to facilitate learning. Mathematical content areas will include pre-calculus, calculus, elementary probability, and selected post-calculus topics. This session invites 1) demos that introduce a topic, 2) demos that illustrate how concepts are applicable, 3) demos that tell a story or describe the development of a procedure, and 4) demos that lead to an activity that involves the class. Presenters of demos are encouraged to give the demonstration, if time and equipment allow, and to discuss how to use it in a classroom setting. Proposals should describe how the demo fits into a course, the use of technology or technology requirements, if any, and the effect of the demo on student attitudes toward mathematics.

MAA CP C1 Courses Below Calculus: A New Focus
Wednesday morning and Friday afternoon
Mary Robinson*, University of New Mexico-Valencia Campus
maryrobn@unm.edu
Florence S. Gordon, New York Institute of Technology
Laurette Foster, Prairie View A&M University
Arlene Kleinstein, Farmingdale State University of New York
Norma Agras, Miami Dade Community College
Linda Martin, Albuquerque T-VI

An unprecedented collaborative effort has been developed among members of MAA, AMATYC, and NCTM to launch a national initiative to refocus courses below calculus. The goal of the initiative is to encourage development and implementation of courses that place greater emphasis on conceptual understanding and realistic applications of the mathematics. Courses that better motivate students for and better prepare them to take subsequent mathematics courses, including calculus, statistics and quantitative methods, are needed to better serve the needs of the quantitative disciplines and better prepare students to function effectively in today's workplace, as well as function effectively as citizens in today's increasingly quantitative society. Accordingly, for this session, we specifically seek to address all of the college level courses below calculus, with particular emphasis on offerings in college algebra and precalculus. We seek proposals for presentations that offer new visions for such courses, discuss implementation issues (such as faculty training, placement tests, introduction of alternative tracks for different groups of students, transferability problems, etc) related to offering such courses, present results of studies on student performance and tracking data in both traditional and new versions of these courses and in follow-up courses, discuss the needs of other disciplines and the workplace from courses at this level, discuss connections to the changing school curricula and implications for teacher education. This session is co-sponsored by CRAFTY, the Committee on Two Year Colleges, and the Committee on Service Courses.

MAA CP D1 Mathematics and Sports
Wednesday morning and Friday afternoon
Doug Drinen*, University of the South, ddrinen@sewanee.edu

Sean Forman, St. Joseph's University
Howard Penn, US Naval Academy

When applied to the sporting arena, mathematics can provide both compelling classroom examples and interesting research problems. Baseball has long been mined for interesting statistics examples ranging from regression and probability to the game theoretic aspects of in-game strategy. Recent books on jai alai, football, and a few other sports have studied those sports through a mathematical lens. The economics of sports is now covered by its own journal and the statistics publication *Chance* routinely discusses statistical examples from sporting events. This session invites papers describing interesting classroom examples utilizing examples from sports and papers discussing the application of mathematics to sporting events.

MAA CP E1 Mathematics in the Islamic World
Wednesday afternoon
Glen Van Brummelen*
Bennington College, gvanbrum@bennington.edu
Victor Katz, University of the District of Columbia

This contributed paper session solicits presentations on all facets of the history of the mathematical sciences in the Islamic world, including the relationship of Islamic mathematics to Western mathematics and to Indian or Chinese mathematics. We hope to elaborate both the unity and diversity of Muslim contributions to both pure and applied mathematical disciplines.

MAA CP F1 Mathlets for Teaching and Learning Mathematics
Wednesday afternoon
David Strong*
Pepperdine University, David.Strong@pepperdine.edu
Thomas Leathrum, Jacksonville State University
Joe Yanik, Emporia State University

This session seeks to provide a forum in which presenters may demonstrate mathlets and related materials that they have created or further developed. Mathlets are small computer-based (but ideally platform-independent) interactive tools for teaching math, frequently developed as World Wide Web materials such as scripts or Java applets, but there may be many other innovative variations. Mathlets allow students to experiment with and visualize a variety of mathematical concepts, and they can be easily shared by mathematics instructors around the world. The session is sponsored by the MAA Committee on Computers in Mathematics Education (CCIME).

MAA CP G1 Drawing on Our Students' Thinking to Improve the Mathematical Education of Teachers
Wednesday afternoon
Dale R. Oliver*
Humboldt State University, dale.oliver@humboldt.edu
Mary Kay Abbey, Montgomery College

The MET document (The Mathematical Education of Teachers, CBMS, 2001) and the PMET project (Preparing Mathematicians to Educate Teachers, MAA, 2003–2006) call for mathematics faculty to re-examine what they teach and how they teach in mathematics courses for prospective teachers. A key component of this re-examination is careful consideration of the mathematical understanding and thinking of the prospective teachers in our courses. Doing so informs faculty decisions about curriculum and pedagogy, and directs their instructional effort toward the individuals in the course. This session invites papers on the mathematical preparation of teachers in which what is taught and how it is taught is being informed by the understandings and thinking of the prospective teachers. This session is sponsored by COMET, the MAA Committee on the Mathematical Education of Teachers.

MAA CP H1 History of Undergraduate Mathematics in America, 1900–2000
Thursday morning
Jack Winn*, SUNY Farmingdale, winnja@farmingdale.edu
Walter Meyer, Adelphi University
Joseph Malkevitch, York College of CUNY
Amy Shell-Gellasch, Grafenwoehr, Germany

This session will sketch how the last hundred years or so have led us to today's state of undergraduate mathematics. Questions that are appropriate to discuss include: what curricular changes occurred; how the changes depended on changes in mathematical knowledge; other reasons why changes in teaching occurred; what effects flowed from the changes; and how changes affected student learning. Papers may focus on: important individuals; important movements involving curriculum or styles of instruction; the evolution or disappearance of particular courses; case studies of particular institutions; the history and role of important organizations such as NSF and MAA; key events or circumstances external to the mathematical community; etc. The speaker's personal views about the best way to teach certain topics are discouraged, unless those views are part of, or help explain historical issues.

MAA CP I1 Initializing and Sustaining Undergraduate Research Projects and Programs
Thursday morning
Margaret M. Robinson*, Mount Holyoke College
robinson@mtholyoke.edu
Suzanne Lenhart, University of Tennessee

Papers are requested describing undergraduate research projects, courses, and programs. Of particular interest will be descriptions of innovative ways to get administrative support or other support that creates a sustainable program. Also of interest will be papers indicating where to find appropriate problems and how to gauge the right level. Also descriptions of courses with undergraduate research as the main goal would be included. This session is sponsored by the CUPM Subcommittee on Undergraduate Research.

MAA CP J1 Projects and Demonstrations that Enhance a Differential Equations Course
Thursday morning

Rich Marchand*, Slippery Rock University
Richard.Marchand@SRU.edu
Shawnee McMurran, California State University
San Bernardino

Differential equations is a diverse mathematical field that affords educators a great deal of flexibility in terms of content. The course can be highly theoretical, applied, or a combination of each. This session invites *novel* projects or demonstrations that enhance a differential equations course either through the facilitation of mathematical theory or exposure to interdisciplinary fields. New and interesting case studies are encouraged, especially those that require computational or qualitative techniques. Demonstrations may be virtual, physical or mathematical. Examples include, but are not limited to, novel proofs, mathlets, or physical demonstrations.

MAA CP K1 Countering "I Can't Do Math": Strategies for Teaching Under-Prepared, Math-Anxious Students
Thursday morning
Suzanne Doree*, Augsburg College, doree@augsburg.edu
Bonnie Gold, Monmouth University
Richard Jardine, Keene State College

How can we create a comfortable learning environment for under-prepared or math-anxious students and, in particular, how can we constructively assess student learning? What classroom practices are especially effective with such students and how does research on student learning inform those practices? How might the recommendations of the 2004 CUPM Curriculum Guide influence our approach in teaching developmental or introductory courses to better reach these students? This session invites papers on all aspects of "what works" in teaching under-prepared, math-anxious students.

MAA CP L1 Using Real-World Data to Illustrate Statistical Concepts
Thursday afternoon and Friday morning
Thomas L. Moore*, Grinnell College, mooret@grinnell.edu
John D. McKenzie, Jr., Babson College

Guidelines in statistical education emphasize the use of real data instead of the small, contrived data sets that appear in some textbooks. Faculty who have used real-world data to illustrate statistical concepts are invited to submit proposals that describe the data set, its location on the web, and their use of the data set to teach ideas related to an introductory course in statistics: (1) data collection (sampling, design of experiments, potential biases); (2) data description (numerical summaries, graphical displays); (3) sampling distributions; (4) elementary inference (interval estimation and hypothesis testing); (5) other applications, such as ANOVA, regression, and chi-square tests.

MAA CP M1 Environmental Mathematics and the Interdisciplinary
Friday morning
Dr. Karen Bolinger*
Clarion University, kbolinge@mail.clarion.edu
Ben Fusaro, Florida State University
Bill Stone, New Mexico Institute of Mining & Technology

We seek presentations that deal with all aspects of the pedagogy and the modeling of environmental problems suitable for general education, calculus, and above. Readers are invited to take up the challenge of searching the natural sciences, as well as economics, environmental science, and environmental education for problems that can be clarified, extended or solved by undergraduate mathematics. We encourage contributions that emphasize computational, visual or qualitative approaches.

MAA CP N1 Teaching Visualization Skills
Friday morning
Mary L. Platt*, Salem State College, mplatt@salemstate.edu
Catherine A. Gorini, Maharishi University of Management
Sarah J. Greenwald, Appalachian State University

The ability to understand, use, and create diagrams, graphs, and illustrations is essential for students in every area of mathematics. Computers have made graphics of every form widely available, so there is an increasing need to help students develop their ability to handle visual information. This session invites papers on all aspects of visualization in the college classroom: which skills are needed for success in mathematics, how to train students to use visual information, examples of classroom activities that help develop visualization skills, and ways to assess a student's visualization skills.

MAA CP 01 Teaching and Assessing Problem Solving
Friday morning
Alex Heidenberg*, US Military Academy
alex.heidenberg@usma.edu
Michael Huber, US Military Academy

Developing problem-solving skills in the modeling sense is a central component in refocusing courses to emphasize process, conceptual understanding, and student growth. Universities and colleges are now writing institutional goals that address the capabilities of their graduates. How do we measure success in teaching our students to be effective problem-solvers? This session invites presentations about courses that focus on the process of problem-solving as a vehicle to learning mathematics at the pre-calculus / introductory calculus levels, with special emphasis on modeling. These presentations can include course composition, philosophy, teaching ideas, and/or past projects, examinations, or other successful methods of assessment where students have become competent and confident problem-solvers. Each presentation should address the specific goals in developing problem-solvers as well as the assessment techniques used to measure attainment of those goals. In addition, presenters should address how technology (calculators, computer algebra systems, etc.) is incorporated into the teaching plan.

MAA CP P1 Philosophy of Mathematics
Friday afternoon
Charles R. Hampton*
The College of Wooster, Hampton@wooster.edu
Bonnie Gold, Monmouth University

This session, sponsored by the SIGMAA on the Philosophy of Mathematics, invites papers on any topic in the philosophy of mathematics except logic and set theory. Possible topics include the nature of mathematics, the nature of mathematical objects, the nature of mathematical knowledge, the relation between mathematics and the physical world, the role of esthetics in the development of mathematics.

MAA CP Q1 Using Handheld Technology To Facilitate Student-Centered Teaching/Learning Activities At The Developmental Algebra Level
Friday afternoon
Ed Laughbaum*, The Ohio State University
elaughba@math.ohio-state.edu
Maria DeLucia, Middlesex County College

Lecture is the predominate method of choice for teaching remedial level algebra, but handheld graphing devices are often integrated by faculty. However, in many cases, the teaching/learning is still instructor centered. Handheld devices offer the flexibility of enhancing teaching and learning through student-centered activities, which can be used outside of class, or during class through group work. Anecdotal evidence shows developmental algebra teachers often supplement textbook materials with "graphing calculator" activities because even "reform" textbooks do not offer appropriate ancillary packages. Therefore, we invite developmental algebra faculty to submit proposals on creative teaching/learning activities that are student centered, provide a diverse learning environment, offer options for learning and teaching, and use handheld devices.

MAA CP R1 My Three Favorite Original Calculus Problems
Saturday morning
J.D. Phillips*, Wabash College, phillipj@wabash.edu
Tim Pennings, Hope College

This session is for those who, while teaching single and multivariable calculus over the years, have thought of a few clever or novel problems with solid pedagogical value, which they would like to share with others. In particular, we are looking for original problems suitable for homework assignments or challenging test questions. (We are not looking for extended modeling projects and open-ended problems since good collections of these already exist.) We hope to organize these into a booklet for publication, which could be used as a resource for calculus courses. Thus, we ask that each submission adhere to the following template: i) Statement of the problem, ii) Brief explanation of why it is interesting and pedagogically valuable, iii) Complete solution leading to an answer in closed form. Submissions may include from two to four problems. Participants should bring copies of their problems to the session for distribution. Each problem should begin on a new page. To include as many as possible, each participant will be given 10 minutes for presentation of the problems.

MAA CP S1 MEETING the CHALLENGE: Relationship Between Mathematics and Biology in the 21st Century
Saturday morning
Catherine M. Murphy*, Purdue University Calumet
murphycm@calumet.purdue.edu
G. Elton Graves, Rose Hulman Institute of Technology
David A. Smith, Duke University

"Biology as Information," the title of the 2004 Gibbs lecture by Eric S. Lander, Professor of Biology at MIT, emphasizes the fundamental changes that the science of biology is undergoing, especially since the connections between biology and mathematics are becoming broader and deeper. This contributed paper session will provide a forum for mathematicians with experience working with the interface of mathematics and biology to present papers which discuss the mathematics needed by contemporary biologists, the opportunities for mathematicians and biologists to collaborate in teaching, curriculum development, student research projects, or professional research. Talks especially valued are those that make practical suggestions concerning how to establish fruitful communication between mathematicians and biologists, and, how to stimulate mathematics and biology students to prepare themselves to participate in this swiftly changing field. This session is sponsored by the Subcommittee on Mathematics Across the Disciplines.

MAA CP T1 Mathematics Experiences in Business, Industry and Government
Saturday morning
Phil Gustafson*, Mesa State College, pgustafs@mesastate.edu
Michael Monticino, University of North Texas

This contributed paper session will provide a forum for mathematicians with experience in Business, Industry and Government (BIG) to present papers or discuss projects involving the application of mathematics to BIG problems. BIG mathematicians as well as faculty and students in academia who are interested in learning more about BIG practitioners, projects, and issues, will find this session of interest. This session is sponsored by the MAA Business, Industry and Government Special Interest Group (BIG SIGMAA).

MAA CP U1 Mathematical Experiences for Students Outside the Classroom
Saturday afternoon
Kay Somers*, Moravian College, somersk@moravian.edu
Jody Sorensen, Grand Valley State University

Mathematics "happens" both inside and outside the classroom and, in fact, many mathematics majors are drawn to the subject through a special event sponsored by a Student Chapter or Math Club. This session seeks presentations by academic, industrial, business, and/or student mathematicians so that the audience will be encouraged to organize and run special events for their students. Descriptions of non-classroom activities could include, but are not limited to, special lectures, workshops for students, Math Days, Math Fairs, research projects for students, Math Career Days, student conferences, recreational mathematics activities, problem solving activities and contests, general community-building activities, and student consulting projects. Information on how such

activities are organized and carried out, what activities especially grab students' interests, how students are contacted and encouraged to participate, and how the events are funded will be especially helpful. This session is organized by the MAA Committee on Undergraduate Student Activities and Chapters.

MAA CP V1 Research on the Teaching and Learning of Undergraduate Mathematics
Saturday afternoon
Bill Martin*, North Dakota State University
william.martin@ndsu.nodak.edu
Barbara Edwards, Oregon State University
Draga Vidakovic, Georgia State University

Research papers that address issues concerning the teaching and learning of undergraduate mathematics are invited. Appropriate for this session are theoretical or empirical investigations conducted within clearly defined theoretical frameworks, using either qualitative or quantitative methodologies. Of highest priority are proposals that report on completed studies that further existing work in the field.

MAA CP W1 In-Service Training Programs For K-12 Mathematics Teachers
Saturday afternoon
Zsuzsanna Szaniszlo*, Valparaiso University
zsuzsanna.szaniszlo@valpo.edu
Judith Covington, Louisiana State University, Shreveport
Tamas Szabo, Weber State University

All over the country many small and large scale projects exist aimed at providing in-service training for K-12 mathematics teachers. The directors of these projects will share their experiences developing and implementing the projects, including both mathematical and organizational issues. Mathematicians contemplating starting similar projects will be able to learn about successful strategies and potential pitfalls for these outreach activities. The session invites talks that showcase successful in-service training programs for K-12 mathematics teachers. The talks should reflect on every aspect of the program including funding sources, organizational details, information on co-operations with the school districts, mathematical content and methodology, follow-up, evaluation and dissemination. Programs that are easily replicable will be given priority.

MAA CP X1 General Contributed Paper Session
Wednesday, Thursday, Friday, Saturday mornings and afternoons
Daniel E. Otero, Xavier University
otero@xavier.xu.edu
Thomas A. Hern, Bowling Green State University
James K. Strayer, Lock Haven University of Pennsylvania
Michael A. Jones, Montclair State University

Papers may be presented on any mathematical topic. Papers that fit into one of the other sessions should be sent to that organizer, not to this session.

Submission Procedures for MAA Contributed Papers

Send your abstract directly to the AMS. At the same time, send a detailed one-page summary of your paper, preferably by e-mail, directly to the organizer–indicated with an (*). In order to enable the organizer to evaluate the appropriateness of your paper, include as much detailed information as possible within the one-page limitation. The summary need not duplicate the information in the abstract. A proposal should not be sent to more than one organizer. Participants may speak in at most two MAA contributed paper sessions. If your paper cannot be accommodated in the session it was submitted, it will be automatically considered for the general session. Speakers in the general session will be limited to one talk because of time constraints. The summary must reach the organizer by Tuesday, September 14, 2004. Abstract must reach the AMS by Tuesday, October 5, 2004.

The AMS will publish abstracts for the MAA talks. Abstracts must be submitted electronically to the AMS. No knowledge of LaTeX is necessary, however, LaTeX and AMSLaTeX are the only typesetting systems that can be used if mathematics is included. The abstracts' submissions page is at http://www.ams.org/abstracts/instructions.html. Simply fill in each field as instructed. Submitters will be able to view their abstracts before final submission. All questions concerning the submission of abstracts should be addressed to:

abs-coord@ams.org.

Here are the codes you will need: MEETING NUMBER: 1003

The EVENT CODE is the seven characters appearing before the title of the sessions shown below, e.g., MAA CP A1

The SUBJECT CODE is the last two-character letter/number combination from the event code list, i.e., A1.

New 2004 MAA Section Governors

Eastern PA/Delaware	Doug Ensley
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MAA President Ronald L. Graham Testifies Before House Appropriations Subcommittee on Funding for Mathematics Education

By Harry Waldman

On March 25, 2004, Ronald L. Graham, President of the Mathematical Association of America, testified before the House Subcommittee on Veterans Affairs, Housing and Urban Development, on NSF funding for mathematics education.

MAA President Ronald L. Graham testifying before the Appropriations Subcommittee.

Thanking the Subcommittee for its steadfast support of the National Science Foundation in recent years—during which it provided increases well above the Administration's requests for scientific education and research—Graham urged continued support for the NSF's investments that "have been and continue to be vitally important for this Nation's long-term economic and national security."

Right from the start President Graham focused in on the one area of the NSF's portfolio which, he said, "affects not only every field of science and engineering but also, the nation's long-term economic development, national security, and general welfare. This area is mathematics education, particularly at the undergraduate level."

He called undergraduate education "the crucial link in the educational system preparing mathematicians, scientists, health care professionals, engineers, technological workforce, and the teachers of the next generation of students." The National Security Agency, he pointed out, is the largest employer in the world of mathematicians at all levels of educational background.

The NSF funds undergraduate mathematics education through two divisions: the Division of Undergraduate Education (DUE), located in the Education and Human Resources Directorate, and the Division of Mathematical Sciences (DMS), located in the Mathematics and Physical Sciences Directorate. Both are considered essential to ensure that the number of mathematically trained U.S. citizens does not drop below the level needed to maintain U.S. technological leadership.

DUE and DMS, for instance, collaborated in funding the Calculus Reform effort of the first half of the 1990's. Not only did this program change and modernize the teaching of calculus in high schools and colleges, the program was largely responsible for spurring renewal across science, technology, engineering and mathematics undergraduate education throughout the country. In Graham's view, he told the Subcommittee, no single educational program "has ever had such widespread impact."

Further, a National Academy of Sciences report in 1998 concluded that, "based on present trends, it is unlikely that the U.S. will be able to maintain world leadership in the mathematical sciences."

In response to this report and others, NSF and Congress have increased funding for mathematical sciences research significantly in the past 5 years, doubling the research budget from about $100 million in FY 1998 to $200 million in FY 2005.

"We at MAA," Graham said, "strongly support this increased investment, and believe that the nation would be well served by continuing to increase mathematical sciences research funding. However, we also believe that research funding alone will not solve the nation's difficulties in attracting and educating students and teachers in the mathematical sciences."

The Division of Undergraduate Education at NSF aims to improve mathematics and science education through the reform of courses, curricula, and instructional materials, and to increase the quality and quantity of the mathematics and science workforce. DUE programs fund innovative efforts at colleges and universities in every state and at every level, all in an effort to find the best ways to increase the scientific and technological literacy of the nation's youth.

DUE administers the Advanced Technological Education program, which is a program that was created by a member of the Subcommittee—Congressman David Price. The ATE program enables two-year colleges to collaborate with industry in the development of programs and courses for the education of the nation's technological workforce. DUE is responsible for programs in teacher training.

"Not getting the education of teachers right the first time," said Graham, "results in large expenditures for teacher training later."

While the NSF budget has grown overall, Graham noted, "undergraduate education has actually declined." In FY 2004 alone, he said, DUE was cut by nearly $20 million from the FY 2003 level. In FY 2005, DUE would receive $159 million

under the Administration's request – an increase of 2%.

"Report after report has stated that the key to continued economic vitality is a better educated workforce, particularly in mathematics and science," stressed Graham. Thus, the MAA "urges Congress to provide $200 million for NSF's DUE program in FY 2005. This amount would reverse the nearly $20 million reduction these programs suffered in FY 2004 and put it on a path that will enable the nation's institutions of higher education—including our community colleges—to more fully participate in NSF's undergraduate programs."

Another program that Graham urged the Subcommittee to support, which is offered by DMS, is VIGRE (Vertical Integration Grants for Research and Education in the Mathematics Sciences), which brings together university professors, graduate students, and undergraduate students on research projects and education. Universities with VIGRE grants have reported a dramatic increase in the numbers of highly qualified U.S. citizens pursuing graduate degrees in the mathematical sciences. The program was recently broadened to support faculty and students from all types of institutions to improve the pipeline from the undergraduate years through positions in the workforce and academe.

"Not getting the education of teachers right the first time results in large expenditures for teacher training later."

--Ron Graham

Graham also briefly touched upon the Mathematics and Science Partnership program, which is slated to be transferred to the Department of Education under the FY 2005 budget request. MSP funds projects aimed at addressing the lackluster performance of U.S. children in K-12 science and mathematics by creating partnerships among teachers and researchers.

"The MAA believes," Graham said, "that if transferred to the Department, 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. We at MAA urge you to keep MSP at the National Science Foundation."