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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: Carol Baxter, MAA; cbaxter@maa.org

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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.

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February 2002

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Inside

On the cover: Dr. Joseph O'Rourke holding a polyhedron.

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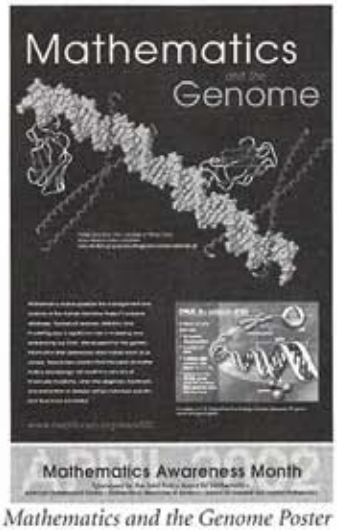
MAM2002: Mathematics and the Genome

April is Mathematics Awareness Month, and the theme will be "Mathematics and the Genome," the Joint Policy Board for Mathematics announced this January. The idea is to focus on the contributions of mathematics to the understanding of the human genome. Recent work on the human genome, hoping to catalog and analyze all our genes, seems to have taken scientists quite close to significant breakthroughs, but there are still many difficult challenges to face. Both in the work on the genome so far and in the work still to be done, mathematics has a central role to play. The Mathematics Awareness Month poster and the accompanying essays emphasize the mathematical aspects of genome research and thus highlight the growing role of mathematics in the biological sciences.

MAM2002 was officially "launched" at the January Joint Meetings in San Diego. Many copies of the "Mathematics and the Genome" poster were distributed at the meetings, and one copy of the poster plus information on MAM2002 were sent to about 3000 department chairs in the United States in mid-January.



Mathematics and the Genome Poster courtesy of The Math Forum.

Mathematics Awareness Month is sponsored by JPBM, a joint endeavor of the MAA, the American Mathematical Society and the Society for Industrial and Applied Mathematics. Started in 1986 as "Mathematics Awareness Week," the yearly celebration of Mathematics is an opportunity for colleges and universities, schools, and other groups to organize events calling attention to the importance of Mathematics. The goal is to increase the visibility of mathematics as a field of study and to communicate the power and fascination of mathematics to as many people as possible.

The Mathematics Awareness Month web site has been enlarged this year. As has been true in the past, the site includes an online version of the poster, the theme essay and related resources (including an extensive list of online resources). New components include a listing of the MAM2002 Advisory Committee, more information on "Planning for MAM" (for example, information on how to get media coverage and links to past MAM activities). A poster order page allows people to order more copies of the MAM poster. All of this can be found at http://www.mathforum.org/mam.

The real action in Mathematics Awareness Month happens at the local level. From mathematics exhibitions to series of lectures, from web-based competitions to big outreach events, local institutions have used MAM as an opportunity to make mathematics more visible and to highlight its usefulness and beauty. The MAM organizers hope that the same and more will happen this year too. ■

MAA Prizes Awarded at the January Joint Meetings

Several important MAA prizes and awards were announced at the January Joint Meetings. First of all, the **Deborah and Franklin Tepper Haimo Awards For Distinguished College or University Teaching of Mathematics** were announced. These were established in 1991 "to honor college or university teachers who have been widely recognized as extraordinarily successful and whose teaching effectiveness has been shown to have had influence beyond their own institutions." This year's Haimo Award winners, as previously announced in FOCUS, were Dennis DeTurck of the University of Pennsylvania, Paul J. Sally, Jr. of The University of Chicago, and Edward Spitznagel, Jr. of Washington University in St. Louis. All three winners gave talks at the January Joint Meetings.

Every year, MAA awards **Certificates of Meritorious Service** to persons who have served the Association well, either at the national level or within their sections. Each January, about six sections have the opportunity to recognize one of their members for their commitment to the MAA. This year's winners were:

- Vivian Dennis Monzingo, Texas Section
- Richard A. Gibbs, Rocky Mountain Section
- Dennis Luciano, Northeastern Section
- John W. Petro, Michigan Section
- Cynthia J. Woodburn, Kansas Section
- Fredric Zerla, Florida Section

The **Beckenbach Book Prize**, established in 1986, is awarded for "distinguished and innovative books published by the Association." This year's winner was Joseph Kirtland, for his book *Identification Numbers and Check Digit Schemes*, part of MAA's "Classroom Resource Materials" series. Kirtland's book was reviewed on MAA Online (see http://www.maa.org/reviews/idnumb.html) and also in the December 2001 issue of the *American Mathematical Monthly*. The **Chauvenet Prize** for expository writing, first awarded in 1925, is given for "an outstanding expository article on a mathematical topic by a member of the Association." It was established through a gift from J.L. Coolidge, then president of the MAA, in honor of William Chauvenet, a professor of mathematics at the United States Naval Academy. This year's winners are Ellen Gethner, Stan Wagon, and Brian Wick, for their article "A Stroll Through the Gaussian Primes," which appeared in the April 1998 issue of the *American Mathematical Monthly*. More information on the Awards Session at the Joint Meetings, including a listing of awards given by other professional associations, will appear in our next issue. ■

NSF's First "Director's Award for Distinguished Teaching Scholars" Honors Seven Educators

Awards highlight excellence and promise in both research and education

Last November 8, the National Science Foundation took a further step to encourage scientists, mathematicians, and engineers to apply their talents to education, inside the classroom and out, by bestowing the first Director's Awards for Distinguished Teaching Scholars. In a ceremony at the National Academy of Sciences, in Washington, D.C., five men and two women, whose research excellence has been shared liberally through education efforts among their student bodies and with the public at large, were recognized for their work. Each will receive $300,000 over four years to continue and expand their work beyond their institutions. The recipients were selected through a national competition based on their outstanding accomplishments. Each awardee submitted a proposal that focused on efforts to improve undergraduate education that show the promise of impact beyond the awardee's institution.

The recipients were Arthur B. Ellis (University of Wisconsin-Madison), Leah H. Jamieson (Purdue University), Gretchen Kalonji (University of Washington), Eric Mazur (Harvard University), Joseph O'Rourke (Smith College, Mass.), H. Eugene Stanley (Boston University) and Carl E. Wieman (University of Colorado), winner of the 2001 Nobel Prize in Physics.

NSF Director Rita Colwell, who presented the awards, has encouraged scientists and engineers to be involved in education, both in the classroom on subjects in which these scientists are already well-versed, or by engaging students and citizens on contemporary issues. She said the new awards should further stimulate broader efforts. Dr. Colwell spoke about the background of the award and of the NSF's goal of "investing in people, ideas and tools," notably pointing out the Foundation's "three core strategies": developing intellectual capital, integrating research and education, and promoting partnerships.

Professor Joseph O'Rourke is holding a polyhedron all of whose faces are rectangles, but which nevertheless has dihedral angles not multiples of $\pi/2$.

"This award embodies our priority to recognize the outstanding contributions of scientists and engineers to the leading edge of scientific knowledge at the same time they are advancing the frontiers of education in science, mathematics, engineering and technology," Colwell said. An interdisciplinary panel reviewed nearly 70 proposals from universities and colleges, with almost 25 percent submitted by women.

"These awards are far-reaching because they will foster innovative educational developments. They will increase and expand awareness of career opportunities in science and engineering. And they will further enhance connections between fundamental research and undergraduate education," said Judith Ramaley, NSF's assistant director for education and human resources. "These distinguished scholars are doing much to improve science and mathematics education to benefit non-majors as well as majors in science and engineering. In addition, they are raising to a higher level knowledge and literacy of the general public, which is very important to the nation's future prominence in science, engineering and technology."

The keynote address at the ceremony was given by John H. Marburger, III, who was appointed Director, White House Office of Science and Technology Policy last October. Dr. Marburger is a physicist who has taught physics and electrical engineering at USC and served as Dean of the College of Arts and Sciences. In the light of the events of September 11, he spoke about an aspect of university life that "needs to be widely understood as our society struggles to respond to the vicious acts of terrorism" that the nation experienced. "Universities function properly only in an open society," he said. Dr. Marburger pointed out three reasons that make this possible: the dynamism inherent in research universities; the absolute standards that are embodied in the work of research communities, which foster an atmosphere of excellence; and the "army of brilliant immigrants, visitors, and foreign collaborators" who all contribute to the making of a literate and free society.

Dr. Marburger emphasized that "every university needs to work out for itself how it will meet the responsibilities to the larger society during these troubled times," he said, and how to engage its neighbors and elected representatives in frank discussions about such issues as a university's role in enforcing immigration laws, allowing access to some weapons or "means of terrorism," and restrictions on certain fields of study. Once the discussion has begun, he said, "many more questions will arise." He made a point of mentioning the Administration's goal of investing in education, "especially in science and mathematics…to enhance pre-

cisely the kind of performance being rewarded" by the NSF.

Dr. Joseph O'Rourke, a member of the MAA who received his B.S. and M.S. in mathematics from St. Joseph University, has coauthored numerous publications with undergraduates, teaches courses on Computer Literacy, How the Internet Works, and Issues on Artificial Intelligence for nonscience majors. His textbook *Computational Geometry in C* is used widely by undergraduates and practitioners in the industry.

Dr. O'Rourke has been called one of the "founding fathers" of the computational geometry community, initiating the ACM Symposium on Computational Geometry series. Many in the field have used his books for both research and teaching purposes and read his series of Computational Geometry Columns (in SIGACT News and IJCGA). He garnered the Director's Award for his work in adapting the research on folding and unfolding computational geometry for use by students and teachers from sixth grade through graduate school. His project provides an opportunity to demonstrate to students that computer science, mathematics, and engineering are fun, comprehensible, and related to real-world problems.

Computational Geometry

According to Professor Joseph O'Rourke, in his text, *Computational Geometry in C*, computational geometry "is the study of algorithms for solving geometric problems on a computer." One list of topics that has been frequently suggested for computational geometry includes polygon partitioning; geometric intersection problems; convex hulls; Voronoi Diagrams; arrangement of lines, planes, and hyperplanes; geometrical searching; motion planning; and Art Gallery problems.

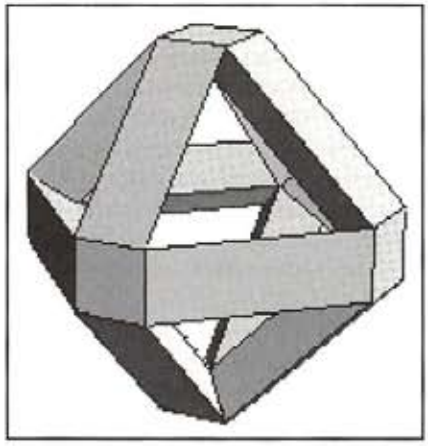
Computational geometry is a relatively new area of computer science, but its applications already have had a far-reaching and significant impact. Michael Shamos's 1978 doctoral dissertation is widely considered to be the foundation document in this area.

Today, in prestigious and diverse research centers around the world such as Bell Labs, Xerox Palo Alto Research Center, DEC Systems Research, The Weizmann Institute of Science, INRIA-Rocquencourt, ETH Zentrum and McDonnell Douglas Aircraft, computational geometers are designing algorithms to solve problems on the cutting edge of technology. Examples of this work include the contour meshing design of a plane's wing, the programming of a robot to avoid obstacles, and constrained navigation in virtual reality environments.

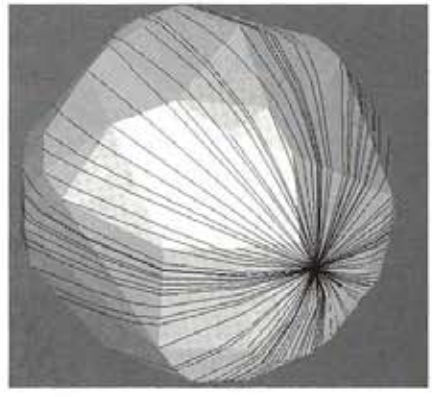
NSF Director Rita Colwell presented the awards for the Distinguished Teaching Scholars.

Dr. O'Rourke's website can be found at http://cs.smith.edu/~orourke. ■

A chain of five equal-length cylindrical links, which is apparently locked even with all universal joints.



The polyhedron below is built entirely from rectangles, but none of its dihedral angles are multiples of $\pi/2$, i.e., it is not an orthogonal polyhedron.



Shortest paths on the surface of a convex polyhedron. It shows the shortest paths from one source point to every vertex on a polytope whose 100 vertices are on a sphere

Images courtesy of Dr. O'Rourke's website.

Osserman Interviews David Auburn, author of *Proof*

By Gerald L. Alexanderson

The play *Proof*, as everyone associated with mathematics must know by now, has been an enormous success on Broadway. Now it has begun a national tour at the Curran Theatre in San Francisco. To mark the occasion the Mathematical Sciences Research Institute (MSRI) at Berkeley arranged to have the playwright, David Auburn, interviewed by Robert Osserman on stage at the theatre two days after the play opened its month-long San Francisco run, on November 29. The *San Francisco Chronicle* reported a $2 million advance ticket sale. Not bad for a play about mathematics and mental illness!

MSRI has arranged events of this kind before, an interview with George V. Coyne, S.J., Director of the Vatican Observatory, and the actor Michael Winters, on the occasion of a Bay Area production of Brecht's *Galileo*, and an interview with Tom Stoppard about his play *Arcadia*. Previous settings for these interviews have been the Berkeley Repertory Theatre and Hertz Hall on the UC Berkeley campus. The Curran is quite another matter, a large and elegant house, built in the 1920's, and home traditionally to traveling companies of Broadway musicals. Never before has there been so much mathematical talk heard in the lobby and in the auditorium.

Auburn is not a well-known name in the theatre like Brecht or Stoppard, at least not until *Proof*, which was his second full-length play. From an initial off-Broadway run at the Manhattan Theatre Club it moved up Broadway to the Walter Kerr Theatre and now to a national tour, after picking up the Joseph Kesselring Prize, the Pulitzer Prize, the Drama Desk Award, and the Tony Award for Best Play of 2001. The New York run continues.

One of Osserman's opening questions concerned Auburn's background. He attended The University of Chicago where he studied political philosophy and where his formal mathematical education ended with calculus. But he had an interest in theatre and wrote sketches in the tradition of Second City and a one-act play while still in college. After graduating he went to New York and worked for a chemical company writing copy for labels for a carpet shampoo! And then he attended Juilliard, acting and writing until he decided to give up acting.

Proof is a play about a young woman who had taken care of her mathematician-father for several years prior to his death that came after a long bout with mental illness. Auburn was asked whether he had planned from the beginning to write about a mathematician. He did not. He started out by being interested in the question of whether mental illness, as well as talent, can be inherited — the mathematical connections came later.

As part of the interview Osserman and Auburn read two provocative and very amusing passages from the play (Osserman played Catherine, the young woman, and Auburn played Hal, a young protégé of Catherine's father). The passages touched on various misconceptions (or are they?) about mathematicians — (1) that it is a young man's profession (and here we emphasize the word "man"), (2) that there is something that predisposes mathematicians to mental instability, and (3) that only brilliant results count in mathematics and that less exalted research and teaching (high school teaching is referred to as a sign of failure) are lesser activities, to be eschewed by those in the lofty realms of the highest level of mathematical research.

Catherine in the play has been trained (up to a certain point) as a mathematician, so a question is raised and tackled in the play — can a woman really do highly original work? The lack of a woman on the list of Fields Medalists and the appearance only a few years ago of the first woman to place among the top five in the Putnam Competition — both of these were cited in the discussion. Clearly, in this area at least, perceptions have changed in the last decade or two. Then the question arose: whether the mathematical life is really all over at the age of 40 (as is implied by the tradition in awarding Fields Medals). Osserman pointed out that though great original breakthroughs might be seen more often in the young, mathematicians continue to carry on productive lives into their 50s, 60s and 70s. The idea that what really matters in mathematics is the highest level research probably still dominates the thinking in many circles.

Auburn touched on all of these questions. He described mathematics as a remarkable subculture. But how did he find out so much about the culture without having seriously studied mathematics? It became clear that he has read a lot and has considerable familiarity with the biographies of Erdös, Nash, Ramanujan, and others. He was asked why the principal character is a woman and he responded that a man would not be expected to stay home to take care of an ailing father.

There are a few claims made in the play that one might question — the level of drug use among mathematicians, for example, obviously something suggested by one of the Erdös biographies. Occasionally there are bits of mathematics. At the mention of Sophie Germain, Hal recalls, after a slight hesitation, Germain primes and Catherine blurts out "$92{,}305 \times 2^{16{,}998} + 1$". Hal is startled that she seems to know this, but then Catherine claims that it is the largest known — not so, though it may have been at the time of the action of the play, which is left ambiguous in the printed version. (According to the web page, http://www.utm.edu/research/primes/lists/top20/SophieGermain.html, the largest Germain prime is $109433307 \times 2^{66452} - 1$.)

Osserman raised the question of whether Auburn was consciously aware of the parallel between *Arcadia* and *Proof*. In both plays there is a very clever young woman

who has remarkable insights into mathematics and is "mentored," in a way, by a slightly older man who is well-trained in mathematics but much less original in his thinking. Auburn appeared unaware of the parallel but admitted to being an admirer of Stoppard and his plays. But when asked whether he was strongly influenced by Stoppard, he said that he was more influenced by the people who wrote sketches years ago, like Mike Nichols and Elaine May, and by John Guare and David Mamet.

2001-2002 TOUR ITINERARY	
San Francisco	Curran Theatre
Sacramento	Community Theatre
Houston	Cullen Theatre
Boston	Wilbur Theatre
Boston	Merriam Theatre
Baltimore	Mechanic Theatre
Dallas	Majestic Theatre
Minneapolis	State Theatre
Chicago	Shubert Theatre
Detroit	Fisher Theatre
Pittsburgh	Byham Theatre
Los Angeles	Wilshire Theatre

A much discussed aspect of *Proof* has been made even more interesting of late with the imminent appearance of the film, *A Beautiful Mind*, based, we understand quite loosely, on the biography of John Forbes Nash by Sylvia Nasar. What about this connection between insanity and mathematics? Is it really true that a special kind of person is drawn to mathematics? Auburn had said earlier that he was fascinated by the "romantic quality of mathematical work," the solitary worker in an attic somewhere (obviously an idea inspired by Andrew Wiles) working on a problem and coming up with something entirely original. He also said that mathematicians have rather edgy personalities and they make leaps of the mind that most people just cannot make. So he thinks there may be some kind of causal relationship between being a mathematician and suffering from a mental breakdown. Osserman cited four people whom he considers to be "romantic" figures in mathematics: Hypatia, Galois, Turing and van Heijenoort. Their stories are well-known to a mathematical audience — but others could be added to this short list: Abel and Ramanujan (if Hardy was a good judge) come to mind. But not one of these could be viewed as being insane — eccentric in one or two cases, maybe, but not insane.

Osserman cited a study that ranked various professions by the numbers of adherents to the field who have also suffered from mental illness. Poets ranked at the top of the list. People in the creative arts are two or three times as likely to suffer from psychosis as scientists (mathematicians were not cited separately), according to K. R. Jamison in *Touched with Fire*. Auburn said he had read of enough cases to justify writing his play about mathematicians. Besides, people are used to hearing about mad scientists. Who would want to read about a perfectly sane scientist? Osserman responded by saying they might want to read about mad poets.

Those who have seen the excerpts of *Proof* on the Tony Awards or the interview on the Charlie Rose Show with the Tony Award winning star, Mary-Louise Parker, from the New York cast, may not realize how funny this play is. The excerpts at the Curran were read to a very receptive audience. They picked up every joke.

So what will the author do next? He said he has decided not to follow *Proof* with another mathematical play. He's working on two projects, one on the Spanish Civil War and the other on twentieth-century spiritualism, including Houdini!

Meanwhile, until he produces another mathematical play, watch the MSRI website for the next event in this series, an interview with Michael Frayn, author of *Copenhagen*, the play about Niels Bohr and Werner Heisenberg which won the Tony Award for Best Play the previous year. That play opens at the Curran in San Francisco in January. ■

Read This!

Recently Reviewed on MAA Online

The MAA Online book review column is still going strong. We now have over 200 book reviews and brief notices online. The latest reviews are featured at the main *Read This!* page at http://www.maa.org/reviews/reviews.html. Recently reviewed books include:

Gardner's Workout: Training the Mind and Entertaining the Spirit, by Martin Gardner
Statisticians of the Centuries
edited by C.C. Heyde and E. Seneta
Fragments of Infinity: A Kaleidoscope of Math and Art, by Ivars Peterson
Oxford Figures: 800 Years of the Mathematical Sciences, ed. by John Fauvel, Raymond Flood & Raymond Wilson
Mathematics and Democracy: The Case for Quantitative Literacy
ed. by Lynn Arthur Steen
Becoming a Reflective Mathematics Teacher, by Alice F. Artzt and Eleanor Armour-Thomas
Solve This, by James Tanton
Teaching First, by Thomas W. Rishel
Symmetry, by Hans Walser
George Green: Mathematician and Physicist, 1793 - 1841, By D. M. Cannell
Misteaks, by Barry Cipra
Stamping Through Mathematics
by Robin Wilson
Mathematical Reminiscences
by Howard Eves
Drawbridge Up
by Hans Magnus Enzensberger
Computers, Ltd., By David Harel
The Fermat Diary, By C. J. Mozzochi
Mathematical Perspectives on Theoretical Physics, By Nirmala Prakash

Quantitative Literacy: Why Numeracy Matters for Schools and Colleges

By Lynn Arthur Steen

"As our society is driven increasingly by science and technology," observed NSF Director Rita Colwell at a recent Washington forum, "the need to establish levels of quantitative literacy becomes ever more important." Using the anthrax crisis as an example, Colwell showed how the public would have benefited from better scientific and quantitative literacy. "When we have little direct control over our fate, a firm understanding of probability can alleviate some of the stress."

Colwell's remarks were made to an audience of over 100 scientists, mathematicians, educators, and policy leaders at a forum on quantitative literacy (QL) held at the National Research Council last December. Supported by the Pew Charitable Trusts, the forum was sponsored by the National Council on Education and the Disciplines (NCED) and hosted by the Mathematical Sciences Education Board (MSEB) in cooperation with the MAA. A report on the forum, including background papers distributed to participants and a white paper on quantitative literacy will be published later this spring. (The current version of the white paper is online at http://www.woodrow.org/nced/QLwhitepaper.pdf.)

For purposes of discussion, the forum's white paper defines quantitative literacy (also called "numeracy") as the "quantitative reasoning capabilities required of citizens in today's information age." Speakers elaborated on this broad definition in various ways. Harvard mathematician Daniel Goroff illustrated QL with applications of Bayes' theorem to health policy; Yale mathematician Roger Howe emphasized the policy implications of understanding orders of magnitude and significant digits.

Retired General Electric engineer William Steenken, citing the importance of "six-sigma" performance expectations in industry, said that business would be "ecstatic" if high school and college graduates were quantitatively literate. Limnologist David Brakke, Dean of Science and Mathematics at James Madison University, spoke of the need to understand rates, risks, and variability in managing natural resources, and of the increasing role of quantitative reasoning in legal matters such as DNA fingerprinting and interpretation of laws about endangered species. "The most important constraint on public policy," argued Johns Hopkins economist Arnold Packer, "is public ignorance."

Lynn Arthur Steen

Business would be "ecstatic" if graduates were quantitatively literate.

Despite occasional confusion about the curricular relations between mathematics, statistics, and quantitative literacy, participants spent relatively little time seeking a precise definition. Indeed, prior to the forum participants had studied a surfeit of proposed definitions, some provided by authors of nine background papers, others by the recent NCED volume *Mathematics and Democracy* (available from the MAA). Most of the discussion focused on implications for educational policy of a commitment to achieve the appropriate levels of quantitative literacy that Rita Colwell emphasized in her remarks.

One challenge was conveyed by Anthony Carnevale, Vice President for Public Leadership of the Educational Testing Service (ETS). He asserted, with uncommon eloquence, that quantitative literacy is not so much about mathematics and democracy as about the "democratization of mathematics." Citing data from many sources, he argued that mathematics education has always been about separation — of rich from poor, of boys from girls, of elites from plebeians. Mathematics, reported Carnevale, is the "biggest barrier to upward mobility in educational attainment."

Because of the strong association of mathematics with economic success, mathematics education has had the effect — if not the aim — of affirming existing social structures. Carnevale argued that the QL movement is really part of a much larger societal effort towards increased democratization. While conceding that a segregated economy headed by mathematically trained elites is efficient from a strictly economic perspective, he urged the QL movement to focus on egalitarian rather than economic goals.

A different challenge came from Janis Somerville, Senior Associate with the National Association of (College and University) System Heads. Somerville described the incoherence of messages about mathematics conveyed in the transition from high school to college, where different tests (high school exit, college admissions, college placement) administered at different times for different purposes stress very different aspects of mathematics. For many reasons, these inconsistencies have disparate impact on students from different socio-economic groups so that by age 24, the proportion

of youth from high-income families who have graduated from college is seven times that of those from low-income families. And, as Carnevale's data shows, mathematics is the biggest contributor to this differential.

Somerville cautioned participants not to make a bad situation worse by adding quantitative literacy to this mix without first resolving the dilemma that might be created if schools adopted two different tracks — algebra, trig, calculus for elites, quantitative literacy for others, most of whom will be either poor or minority. NCTM president-elect Johnny Lott observed that in such a system the calculus-bound students might be the most ill-served since they receive a much narrower foundation in mathematics.

Several papers and participants added an international perspective to the forum's QL discussions. MSEB member Jan de Lange of the Freudenthal Institute in Utrecht argued in a background paper that "mathematical literacy" is a broader and better term than QL. Moreover, he asserts, if mathematics were taught as it should be taught — for reasoning rather than for mastery of algorithms — there would be little need for a distinction between mathematics and mathematical literacy. Michel Merle of the University of Nice described plans of a commission in France to refocus school mathematics on four areas of contemporary importance: geometry, numeracy, statistics, and computer science. Mogens Niss of Roskilde University in Denmark, former secretary of the International Commission on Mathematical Instruction (ICMI), described similar changes under way in Denmark in which the school mathematics curriculum will be defined not by a list of topics but by the characteristics of different levels of proficiency in relation to a core set of mathematical competencies (e.g., reasoning, argumentation, communication, modeling, representation).

In a robust discussion, participants reacted to what they had heard in the context of what they know from their own experiences. Linda Kime (University of Massachusetts) and Don Small (US Military Academy) suggested focusing QL efforts on college algebra because "that is what everybody takes." Linda Rosen, Vice President for Education of the National Alliance of Business, reminded participants of the "accountability juggernaut" that is bearing down on education, and urged advocates of QL to think more carefully about how to "scale up" to levels that can have a measurable impact. Charlotte Frank, vice president of McGraw Hill and a member of the New York State Board of Regents, pointed out that QL will not happen unless it is measured in assessments. Gene Bottoms of the Southern Regional Education Board (SREB) urged greater flexibility in mathematics instruction: "It shouldn't take 36 weeks to fail Algebra I." Arizona mathematician William McCallum said that other disciplines need to take ownership of QL, since QL cannot succeed if it remains only an initiative within mathematics departments.

Quantitative literacy is not a curriculum but an approach to pedagogy.

Indeed, Jeanne Narum opened the forum by suggesting how QL can support the "what works" philosophy of the science-oriented Project Kaleidoscope which she directs. George (Pinky) Nelson, director of AAAS Project 2061 — a major national K-12 program designed to bring science to all Americans — saw in QL an opportunity for much-needed increased cooperation between science education and mathematics education. He suggested that the social sciences may be best suited to take the lead in supporting QL across the curriculum.

In summarizing major themes of the forum, AMS President and former MSEB chair Hyman Bass noted the nearly unanimous view that quantitative literacy must be taught across the curriculum (or perhaps "in the disciplines," which is not quite the same thing). While mathematics and statistics contribute central knowledge and skills, other disciplines provide the contexts which are so important for quantitative literacy. A second observation, echoed by many participants, is that quantitative literacy is not a curriculum (and certainly not a single course), but an approach to pedagogy. Russell Edgerton, former president of the American Association of Higher Education (AAHE) linked these observations together: "The more that QL education is about pedagogical practices (for example, the kinds of assignments students are given), the wider the possibilities are that many courses across the curriculum can contribute to students' quantitative literacy."

One outgrowth of the forum is a National Numeracy Network (NNN) that is being created to help support schools and colleges that are exploring ways to infuse QL into their curricula. The NNN will provide support in five areas: policy, practice, professional development, dissemination, and assessment. Several centers will serve as the core of NNN; current centers and directors include :

Trinity College
Judith Moran
judith.moran@trincoll.edu

Dartmouth College
Kim Rheilander
kim.v.rheilander@dartmouth.edu

The Washington Center
Emily Decker
deckere@evergreen.edu

The K-12 TORCH program
Richard Bennet
bennett@woodrow.org

Susan Ganter (sganter@clemson.edu) of Clemson University is director of National Numeracy Network.

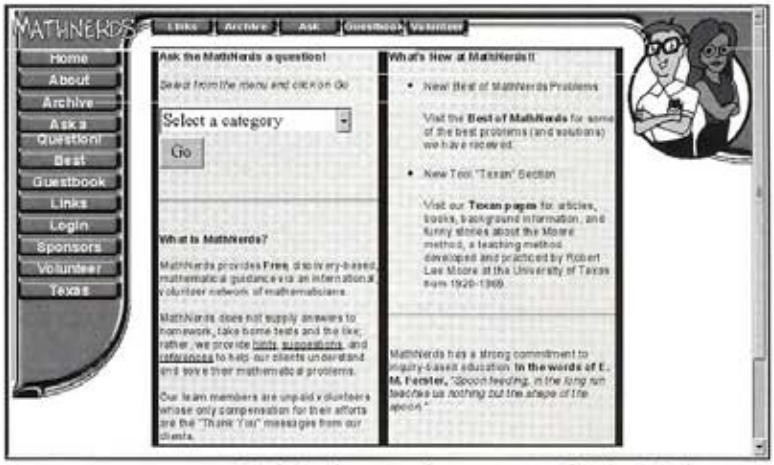
Further information about NNN can be obtained from Ganter or from one of the NNN Centers; further information about the NCED initiative in quantitative literacy is available on the web at http://www.woodrow.org/nced/quantitative_literacy.html. ■

Lynn Arthur Steen is Professor of Mathematics at St. Olaf College and a former president of the MAA.

MathNerds Offers Discovery-Style Mathematics on the Web

By Valerio De Angelis, Paul Dawkins, W. Ted Mahavier, and Allen Stenger

This article is about the web site *MathNerds* (http://www.mathnerds.com), a discovery-style, volunteer-based, free service providing help in mathematics to students, teachers, parents and industry. The project grew out of two ideas, which we believe are both of interest to educators in mathematics. First, we hoped to develop a resource for teachers and students that made essential use of the potential provided by the spread of the Internet and the web. Second, we wanted to provide a setting to implement and promote the use of a discovery-style approach in the teaching of high school and college mathematics. Of course, we make no claim as to the originality of either idea. But we believe that the combination has resulted in an innovative project. That project is the *MathNerds* website.



MathNerds screenshot courtesy of CajunWorks.com.

In its simplest description, *MathNerds* is a web-based question-and-answer service. What distinguishes it from a host of other such websites is the commitment to a discovery-based style in the replies sent to its users. In general, no complete answers are provided by the team of volunteers. Instead, hints and suggestions are given, which often result in an exchange of several messages. This gradually enables the students to reach the solution by themselves.

This discovery-style method seems natural enough and easy to describe. But its practical implementation is more challenging than expected. As many of the *MathNerds* volunteers can testify, giving good and insightful hints and suggestions for the solution of a problem is often more difficult than working out the problem in its entirety.

However, the attractive feature of the approach is that "more difficult" in the previous paragraph almost never means "more time consuming," and always means "more rewarding." We believe that this aspect of the project has enabled us to attract and retain our current team of competent teachers and distinguished mathematicians.

The birth of *MathNerds*

MathNerds was born in 1999, but dates back to 1996, when Valerio De Angelis and W. Ted Mahavier began operating an e-mail-based mathematics service called *The Math Doctor* at Nicholls State University. In 1998 De Angelis moved to Xavier University where additional faculty began participating. The idea of using volunteers who would be assigned questions was born, and with a grant from Xavier's Center for Advancement of Teaching, we redesigned the site and developed an algorithm for distributing problems. Using a volunteer selection process, we quickly built a substantial team. In 2001, Mahavier moved to Lamar University, where Dawkins joined the team as the lead programmer for the project.

As of November 2001, about 100 volunteers have been accepted. They are faculty at places such as California, Chicago, Delaware, Dillard, Georgia Tech., Lamar, N. Texas, Rochester, SUNY, Temple, US Military Academy, Washington, Xavier, and Youngstown.

During the last year, an average of 600 questions per month were received with more than 75% answered. Average response time per question was less than 35 hours. Still, the need for an ever-expanding team is strong, because we receive a larger number of questions than the volunteers can handle.

Question and answer service

From the user side (students, parents, teachers, or industry), the service is straightforward. Users choose a category, complete a form, and submit a question, which is then assigned to a member of the team. From the volunteer side, potential team members complete applications choosing the categories they desire (currently K-5 through graduate level) and the maximum number of questions (per category) they are willing to receive each week (their *caps*). The applicant is then tested. If evidence of satisfactory ability is observed regarding knowledge of the subject, clarity of the exposition, and adherence to the discovery-style method, then the candidate is accepted.

Once on the team, volunteers receive questions, forming their *Personal Queue (PQ)*. They may then answer the question, move it to the *General Queue (GQ)* where it is available to other members, or *lock* it (to keep it in their PQ). If no option is chosen within 48 hours, the question is automatically moved to the GQ. Team members may visit their PQ at any time to answer questions, seek ad-

ditional questions in the GQ, view their exchanges, or alter their profiles.

Features

The *Archive* is a searchable database including 14,000 answered questions. Each entry may contain several exchanges between a team member and student, and comments may be added by any team member. The *Best of MathNerds* is a polished exposition of samples pulled from the archive, maintained by Stenger and De Angelis. The *Texan Section* offers a collection of inquiry-based instruction materials, maintained by Mahavier. The *Links* section offers readers other on-line resources in mathematics.

Sample exchanges from *MathNerds*

This section transcribes some actual exchanges held on the *MathNerds* site. They are verbatim except that they have been slightly edited for length and for spelling.

I. Grades 6-8 Middle School question. The volunteer gives the first step of the solution, and the student is able to complete the solution from there.

User: 1) Ms. Vaccaro's class surveyed 1500 sixth graders about television viewing habits. They surveyed twice as many girls as boys. How many boys did they survey? 2) Students rated two dozen programs excellent and 5 poor. How many fewer poor than excellent ratings were given?

I know the answer to the first question is 500 boys and 1000 girls. But I don't understand how one arrives at that number. Please explain. The second question I simply don't understand. Thanks for your help. The questions come from Progress in Mathematics by Sadler-Oxford.

MathNerds: Hint for 1: Let's write B for the number of boys. Write an expression, in terms of B, for the number of girls. We know the sum of the number of boys and the number of girls is 1500. What's the next step?

Hint for 2: This is the same as asking "what's the difference in the number of excellent ratings and the number of poor ratings?"

User: Thank you for taking the time to help me with my homework.
b+2b=1500
3b=1500
b=500
There are 500 boys and 1000 girls.

24-5=19
There are 19 fewer poor ratings.

II. An extended exchange about a Complex Analysis question where the volunteer leads the student through several ideas until the student discovers a solution.

User: Suppose that f(z) is analytic in the set 0 < abs z < 1 and that the integral of f(z) is zero along every C: abs z = r where 0<r<1. Is f(z) necessarily analytic at z=0? I might be missing an important theorem here, because this question is only worth 2 marks. I'm guessing that the answer is no. Any hints, please? Thank you so much!

MathNerds: Suppose f was a surface whose domain was the unit circle plus its interior and that a plane was tangent to f at every point of its domain except zero. Does this suggest an analogue to your problem? Write back if you need more help.

User: I still am having difficulties with this question. Do I want to show an example where f(z) is analytic in the deleted neighborhood but not at zero i.e. f(z) = 1/z, ... do I have to choose an example where the integral is zero? Do you have an example that you could suggest, or do I just need to reason it out? Sorry that I'm not clueing in very well. Thank you for your help.

MathNerds: Suppose the answer to the original question is no. What has to be true? Write back if you need more help.

User: Thank you for your help. I think that I figured it out. I think that the answer is no and that you can use f (z) = $1/z^2$ and show that it is analytic on the unit circle except at the origin, but its integral is zero because it has an antiderivative! Thanks!

MathNerds: Nice example!

Conclusion

The *MathNerds* project shows that discovery learning is still a viable method, even in the rapidly changing world of the Internet. In fact, rapid electronic communication opens new possibilities for this kind of learning, both for the learners and for the teachers.

The reach of the Internet transcends geographic and economic boundaries. We have fielded queries from Canada, China, Iran, Mexico, Thailand, and Turkey to name a few countries. Several members have replied in Spanish and Italian as needed. As such, *MathNerds* reaches those who have no one else to turn to including the single parents, the home schooled, the commuters, and the rurally isolated students.

The informal nature of the *MathNerds* system allows volunteers to set their own level of participation on their own time. As a result, it is possible to recruit not only many who are already teaching full-time, but also talented hobbyists and industry mathematicians who would be unable to teach a full-time traditional course because of lack of time, inclination, or credentials. Just as the open source software movement and MIT's OpenCourseWare project are providing free materials, *MathNerds* seeks to provide free expertise with a discovery-based flair. ■

MathNerds thanks the volunteers who have contributed their time and expertise to answer questions, and recognizes the following for answering over 400 questions each: Valerio De Angelis, Doug Dillon, Esther Fontova, Mark Morse, Jose Antonio Perez, Murray Siegel, and Allen Stenger. We give special thanks to our first programmer, Donald P. Lasseigne, for the HTML and database programming, and to graphic designers Bart P. Everson and Ryan J. Hutchinson for the web site design. Finally MathNerds thanks Lamar University and Xavier University of Louisiana for their generous support.

History of Mathematics on the Web

By Andrew Leahy

What information about the history of mathematics can be found on the web? Typing the phrase "history of mathematics" into a search engine such as www.google.com can yield tens of thousands of results. So perhaps a better question would be: where should somebody start to look for information about the history of mathematics on the web?

The power of the web stems from its capacity to carry *hyper*text — that is, text along with links to related pieces of information. So a good place to start is a page which collects links related to the history of mathematics. Some popular destinations include:

http://www.dcs.warwick.ac.uk/bshm/resources.html, from the British Society for the History of Mathematics, contains more than 70 sites having information about the history of mathematics, organized into different categories — including biography, online books, bibliographies, and educational material. Each link on the list is annotated with a description and a brief assessment of the quality of the material. Note that a few of the links are broken or out-of-date.

http://archives.math.utk.edu/topics/history.html, maintained by the Math Archives at the University of Tennessee, Knoxville, also contains more than 70 different sites with information relevant to the history of mathematics. It's an eclectic collection with information appealing to elementary school teachers, professional mathematicians, and all points in between. Icons explaining the minimum skill level required to understand a web page and highlighting other important features of the site accompany most entries, but the annotation for each link is usually limited to a few keywords.

http://mathforum.org/library/topics/history, from the Math Forum, contains links to more than 550 pages related to the history of mathematics. Each entry consists of a brief description of the page accompanied by the "level", "language", and "resource type" categories it belongs to. The list can be searched by keyword and the search can be restricted to specific categories.

http://www.maths.tcd.ie/pub/HistMath/Links, maintained by David Wilkins of Trinity College, Dublin, contains more than 200 entries which are divided into more than a dozen different categories (including links to biographies, electronic texts, bibliographies, and mailing lists). The range of links is extensive. However, there is no annotation accompanying the entries. The list is part of a larger site he's developed which has many other resources for the history of mathematics.

In general, the web works exceedingly well at providing small pieces of information such as brief biographies. Type the name of a prominent mathematician into a search engine and there will usually be an abundance of material available. One of the first places that will appear in the search is the *MacTutor History of Mathematics Archive* at the School of Mathematics and Statistics at the University of St. Andrews: **http://www-groups.dcs.st-andrews.ac.uk/~history/.**

A highlight of this site is an index that contains more than 1500 brief biographies of historical and contemporary mathematicians, complete with bibliographical references. There is also another index for women mathematicians. Altogether, the MacTutor site is a treasure-trove of information for people with an interest in the history of mathematics. Aside from biographical information, there are also time lines, chronologies, photos, quotations, maps, and an index of famous mathematical curves.

Original historical sources are also gradually starting to appear on the web. Probably the most extensive example is Euclid's *Elements*, which David Joyce has made available in an on-line version, complete with interactive Java-enabled figures, at **http://aleph0.clarku.edu/~djoyce/java/elements/elements.html.**

Numerous smaller works are also available at other sites. For instance, David Wilkins has transcribed various works from Hamilton and Riemann and made them available on his site (mentioned above). George Berkeley's *The Analyst*, an important criticism of seventeenth century analytical methods, is also available there. Ed Sandifer has gathered together some translations of the works of Euler and made them available at **http://vax.wcsu.edu/~sandifer/eulerproject.htm.**

The most important piece missing from all of this is peer review. Anyone is free to put up a web site about the history of mathematics. Search engines do a wonderful job of finding this information, but they're lousy at sorting it all out and assessing its quality. So when students blindly go out onto the web to do historical research, they take their chances. Even for the sites that I've highlighted, I can only say that I have found them very useful. I cannot vouch for the accuracy of every page they contain and I certainly can't vouch for the accuracy of the hundreds of other pages they link to.

This question of evaluating web-based material is probably the biggest issue facing the development and use of mathematics on the web. It's especially important in the history of mathematics, where speculation and interpretation often walk hand-in-hand with established fact. But as we worry about the accuracy of the information students find on the web we should also look at how peer review and external evaluation would help motivate and reward academics for producing web-based material in the same way they are rewarded for producing paper publications. Web sites like the ones highlighted above are very good, but the web is capable of producing much more. We just need to figure out how to encourage these developments. ■

Andrew Leahy is assistant professor of Mathematics at Knox College in Galesburg, Illinois.

Short Takes

Call for Student Papers for MathFest 2002

The Pi Mu Epsilon Council encourages students who are interested in presenting papers at MathFest 2002 to begin making plans soon. Members of Pi Mu Epsilon representing their chapters at this meeting are eligible for partial travel support. The application deadline is June 28, 2002. More information about Pi Mu Epsilon and application materials can be found at the PME web site, http://www.pme-math.org. or contact jgalovich@csbsju.edu.

GIMPS finds 39th Mersenne Prime

The Great Internet Mersenne Prime Search has once again had a sucess. On December 6, GIMPS announced that Michael Cameron, a 20-year-old GIMPS volunteer, discovered the 39th (and largest to date) Mersenne prime. Cameron used his PC and software by George Woltman and Entropia, Inc. to conduct his part of the search. The new Mersenne prime is $2^{13466917} - 1$.

For more information on GIMPS and the newly discovered prime, visit http://www.mersenne.org/13466917.htm or http://www.utm.edu/research/primes/notes/13466917/. Richard Crandall has once again put together a poster containing the complete printout of the over four million digits in the new prime. Visit his Perfectly Scientific web site at http://www.perfsci.com for more information.

Massachusetts Students Like Web Tutor

To help students who have failed the state graduation exam, Massachusetts asked the Princeton Review to create an online tutoring program. In December, the state renewed the contract, citing a very high level of interest. By that date, over 5000 students had visited the site, and more than 3000 of them had visited more than once. Since there had been little publicity for the program, officials felt that these were phenomenal numbers and decided to continue the program. The online tutorials are designed to supplement tutoring by teachers in the schools.

President's Science Council Chosen

The 22 members of the President's Council of Advisors on Science and Technology were appointed in December. The council members, ranging from academics to representatives of industry and finance, serve as the president's advisors on policy issues related to scientific research and high technology. Led by John Marburger, the president's science advisor, and E. Floyd Kvamme, the council's goal is to gather advice from leaders in higher education and in industry, at the policy level rather than the scientific level.

Bayesian Paleobiology

An article in the December 14 issue of *Science* discusses the impact of Bayesian inference techniques on the study of Mammalian evolution. Given information (observable traits, the fossil record, and genetic data) about relationships between different animals, one must try to construct the evolutionary tree that best captures the available information. This is essentially a mathematical problem, and William Murphy and Eduardo Eizirik of the National Cancer Institute worked with Mark Springer of the University of California, Riverside, to apply Bayesian inference techniques to DNA data in order to obtain an optimal tree. The results are controversial, but serve to highlight once again the importance of mathematical techniques in biological research.

Hudson River Undergraduate Mathematics Conference, 2002

The ninth annual Hudson River Undergraduate Mathematics Conference will be held on Saturday, April 27, 2002, at Hamilton College in Clinton, NY . The conference 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. The keynote speaker for this year's conference will be Robert L. Devaney, Professor of Mathematics at Boston University. He will be speaking on "Chaos Games and Fractal Images."

You can find out more about HRUMC by visiting the conference web site: http://www.skidmore.edu/academics/mcs/hrumc.htm. Those wishing to present at the conference should submit electronically an abstract by March 1. Abstracts can be submitted via the website. ■

Call for Papers
Contributed Paper Sessions at MathFest 2002

The Mathematical Association of America will hold its annual MathFest from Thursday, August 1, 2002 through Saturday, August 3, 2002 in Burlington, Vermont. The complete meetings program will appear in the April 2002 issue of FOCUS. This announcement is designed to alert participants about the MAA's contributed paper sessions and their deadlines.

Please note that the days scheduled for these sessions remain tentative. The organizers listed below solicit contributed papers pertinent to their sessions; proposals should be directed to the organizer whose name is followed by an asterisk (*). Proposals should not be sent to more than one organizer. Email submissions are preferred.

Sessions generally limit presentations to ten or fifteen minutes. Each session room contains an overhead projector and screen; black/white boards will not be available. Persons needing additional equipment should contact the organizer of their session as soon as possible, but prior to May 4, 2002.

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.

Your summary must reach the designated organizer by Tuesday, May 4, 2002. Early submissions are encouraged. The organizer will acknowledge receipt of all summaries. If your paper is accepted by the organizer you will be directed on how to submit a formal abstract.

Contributed Paper Sessions

MAA CPS A1 Creative Use of Technology in Teaching Mathematics
Thursday afternoon

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. The session is sponsored by the MAA Committee on Computers in Mathematics Education (CCIME).

Mary L. Platt (*)
Department of Mathematics
Salem State College
Salem MA 01970
Phone: (978) 542-6928
Fax: (978) 740-7175
Email: mplatt@salemstate.edu

Marcelle Bessman
Jacksonville University

MAA CP B1 E-Learning 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 welcome.

This session is sponsored by the Committee on Computers in Mathematics Education (CCIME).

Elias Deeba (*)
Department of Computer
and Math Sciences
University of Houston-Downtown
One Main Street
Houston, Texas 77002
Tel: (713) 221-8550
Fax: (713) 745-3505
Email: Deebae@dt.uh.edu

Ananda Gunawardena
Department of Computer Science
Carnegie-Mellon University

MAA CP C1 Independent Learning Experiences for Undergraduates in Mathematics
Thursday afternoon

Many colleges and universities require undergraduates to fulfill an independent learning requirement. This is a general education distribution requirement that is intended to prepare students for lifelong learning and that emphasizes student initiative, planning, and implementation. One way mathematics majors can meet this graduation requirement is through independent study of an advanced topic, under the direction of a faculty member. Other options include senior thesis, integrative seminar, fieldwork, and internship.

This session invites college and university professors to describe exemplary independent learning experiences they have supervised, addressing their role as supervisor, how meeting time was structured, the nature of the student's work, and how the final grade was determined.

Donna L. Beers (*)
Simmons College
300 The Fenway
Boston, MA 02115
Tel: (617) 521-2389
Fax: (617) 521-3199
Email: donna.beers@simmons.edu

MAA CP D1 The Use of Recent History of Mathematics in Teaching.
Thursday afternoon

This session invites submissions that discuss the use of recent (last 200 years) mathematics history, including the development of statistics, computers, pro-

gramming, or other more recent topics, into undergraduate mathematics courses. Submissions may address ways to use recent history to motivate student involvement, student projects, ways to broaden and deepen student understanding of the subject matter, or alternative ways to present topics using recent history.

Amy Shell (*)
United States Military Academy
Department of Mathematical Sciences
West Point, New York 10996
Tel: (845) 938-2413
Fax: (845) 938-2409
Email: amy-shell@usma.edu

Dick Jardine
Keene State College

MAA CP E1 Recreational Mathematics in the Classroom

Friday afternoon

Topics in recreational mathematics can be effectively introduce and involve undergraduates students both in discovering concepts in courses for themselves and in extracurricular research experiences. Papers in this session may be on any area of recreational mathematics, but preferences will be given to those proposals that link a recreational topic through student-based discovery to some traditional subjects within the mathematics curriculum.

Doug Ensley (*)
Department of Mathematics
Shippensburg University
Tel: (717) 477-1477
Fax: (717) 477-4009
Email: deensl@ship.edu

Cheryl Olson
Shippensburg Univrsity

MAA CP F1 Using Popular Culture in the Mathematics and Mathematics Education Classroom

Friday afternoon

This session invites presentations on how appearances of and references to mathematics in popular culture, including music, movies, television, artwork and other media, have been used creatively and effectively in mathematics and mathematics education courses. Of particular interest are descriptions of how the materials reduced math anxiety and motivated students to explore significant mathematics. Presentations detailing student reactions, educational benefits and difficulties encountered, and the effect of the pop culture math activities on teaching and learning are especially encouraged.

Sarah J. Greenwald (*)
Appalachian State University
Tel: (828) 262-2363
Fax: (828) 265-8617
Email: sjg@math.appstate.edu

Andrew Nestler
Santa Monica College

MAA CP G1 RUME SIGMAA Session

Friday afternoon

The Special Interest Group of the MAA on Research in Undergraduate Mathematics Education aims to foster a professional atmosphere for quality research in the teaching and learning of undergraduate mathematics through contributed paper sessions for mathematics educators and mathematicians interested in research on undergraduate mathematics education. Research papers that address issues concerning the teaching and learning of undergraduate mathematics are invited.

This session will be devoted to expositions of research results and uses of research (RUME) in teaching. Summaries of research results together with implications for the classroom or specific examples describing how research results have informed work in actual college classrooms are especially encouraged.

Jim Cottrill (*)
Department of Mathematics
Illinois State University
Campus Box 4520
Normal, Illinois 61790-4520
Tel: (309) 438-7830
Fax: (309) 438-5866
Email: jfcottr@math.ilstu.edu

MAA CP H1 Innovative Methods in Courses for Non-Majors

Saturday afternoon

There is a real need to develop courses that will attract students who do not major in mathematics. This session will allow those who have had success with such courses to share those experiences with others.

Richard J. Maher (*)
Department of Mathematics
and Statistics
Loyola University Chicago
6525 N. Sheridan Road
Chicago, IL 60626
Tel: (773) 508-3565
Fax: (773) 508-2123
Email: rjm@math.luc.edu

MAA CP I1 Enlivening Multivariate Calculus

Saturday afternoon

This session invites papers about the use of applications, unique proofs, projects/assignments, or demonstrations that enliven a multivariate calculus course, helping students to explore concepts, to understand the meaning of mathematics that they study, and to develop an appreciation of mathematics. Each presenter is encouraged to discuss how the use of the application, unique proof, project/assignment, or classroom demonstration fits into and enlivens the course, how its use helped/motivated students to learn course material, to explore course concepts, and/or to develop a greater appreciation of mathematics.

Of particular interest are project/assignments that continue in-class analysis, applications, demonstrations, or proofs, student reaction, and the instructor's impressions of how the use of applications, proofs, demonstrations, and/or assignments/projects helped the students to

gain a deeper understanding of multivariate calculus.

Sarah L. Mabrouk (*)
Mathematics Department
Framingham State College
100 State Street
PO Box 9101
Framingham, MA 01701-9101
Tel:(508)626-4785
Fax: (508)626-4003
Email: smabrouk@frc.mass.edu

MAA CP J1 The Role of Proof in Teaching Mathematics

Saturday afternoon

Recently, many colleges have instituted courses with names like "Transition to Higher Mathematics," or "Introduction to Proofs." This proliferation raises questions that range from what the content of such courses should be, to their efficacy.

We invite talks and papers on the nature and the value of the "proof course" in teaching undergraduate mathematics. Contributions from various perspectives — model courses, alternative intervention strategies, pedagogical analyses, research-based or experience-based reflections — are welcome. We anticipate publishing selected contributions.

Morris Orzech (*)
Queen's University
Kingston, Ontario, Canada K7L 3N6
Tel: (613) 533-2436
Fax: (613) 533-2964
Email: orzechm@mast.queensu.ca

Olympia Nicodemi
SUNY Geneseo

MAA CP K1 Math & Society

Saturday afternoon

The last decade or so has witnessed enormous growth in non-skills based mathematics courses. Many of these are designed for non-majors, possibly to address general education requirements or to enhance quantitative literacy.

This session will focus on topics that have a political or social flavor such as social choice (weighted voting, voting methods, e.g.), mathematics of the Census, apportionment, fair division, equity, allocation, and others. We invite papers describing innovative ideas faculty have developed in conjunction with these courses: specific classroom activities, assignments, projects, use of original sources (historical and contemporary), etc.

Stan Seltzer (*)
Department of Mathematics and
Computer Science
Ithaca College
Ithaca, NY 14850
Tel: (607) 274-3561
Fax: (607) 274-1588
Email: seltzer@ithaca.edu

John Maceli
Ithaca College

MAA CP L1 General Contributed Paper Session

Thursday afternoon

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 those organizers, not to this session.

Tony Julianelle (*)
Department of Mathematics
University of Vermont
Burlington, VT
Tel: (802) 656-4352
Fax: (802) 656-2552
Email: tjuliane@emba.uvm.edu

Bob Wright
University of Vermont

Mizan Khan
Eastern Connecticut State University.

Call for Student Papers

Students who wish to present a paper at the Burlington MathFest 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 the faculty sponsor.

Nomination forms for the MAA Student Paper Sessions are located on the MAA Online at http://www.maa.org under STUDENTS, or can be obtained from Dr. Thomas Kelley by e-mail at tkelley@hfcc.net or by phone at (313) 845-6492.

PME student speakers must be nominated by their chapter advisors. Application forms for PME student speakers can be obtained from Bob Woodside, Secretary-Treasurer of PME. He can be reached at mapme@ecuvm.cis.ecu.edu .

Students who make presentations at the MathFest, and who are also members of MAA Student Chapters, are eligible for partial reimbursement. The deadline for receipt of applications is June 28, 2002.

Letters to the Editor

More on Happy Abstract Algebra Classes

I tried an approach similar to Fraleigh's here at Wayne State University three years ago. The students could not get help anywhere else because people were either unwilling or unable to give help. Since the students knew that it was crucial to do the preparatory problems, they were more insistent on getting help from the instructor. The strongest critics of my approach were the conscientious students. Perhaps they were also being badgered to provide assistance. At the end of the semester I was exhausted and I felt like a pander. I plan in the future to try an approach where students "discover" definitions for themselves, "pose" problems and then attempt solve their own problems.

Frank Okoh
Wayne State University
okoh@turing.math.wayne.edu

Correction on the Board of Governors Meeting

I'd like to correct a mistake in the article "Student Section Members at Board of Governors Meeting" that I wrote with Messrs. Holt, Leger, and Schoenfeld and that appeared in the November 2001 issue of FOCUS. It was in fact Walter Mientka, not Titu Andreescu, who gave a moving account of the Mathematical Olympiad at the Board of Governors meeting referred to in the article (cf. paragraph 4 on page 18).

Joseph Corneli
Massachusetts Institute of Technology
jcorneli@mit.edu

On Partial Credit

In the December FOCUS, Jay Beder asks about partial credit. When I first started teaching, I, too, gave partial credit. I discovered three effects of giving partial credit, all of them detrimental to learning. First, it rewarded carelessness. Second, it focused the attention of the student on how much partial credit the student could talk me into, rather than on how to work the problem. Third, it wasted a great deal of my valuable time, time I could better spend giving individual help to students.

The last straw came when I was teaching a course in Differential Equations, and all of the students passed the course due to partial credit, even though none of the students got the correct answer to any of the questions on the final exam. From that day to this, all of my tests have ten questions, ten points each, no partial credit.

Here is what I have discovered. The students do just as well in my courses as they do in courses where they get partial credit. In my courses, they are more careful and check their answers. Time spent with students is spent talking about mathematics, not about grades. And I can always return papers the class period after they are turned in.

It is true that I get complaints from some students who consider partial credit an entitlement. I wish partial credit had never been invented. It is worth repeating: students who know they are not going to get partial credit do not get lower grades, they just learn to be more careful.

Rick Norwood
East Tennessee State University
norwoodr@etsu.edu

On FOCUS

Just a note to tell you how much I enjoy "FOCUS". It is newsy, entertaining, informative and overall truly enjoyable reading (even the stuff I don't really understand) I recently joined MAA and really like all of the publications included in my membership.

I am not a teacher, nor a scientist, nor an engineer...(anymore)...just an old (76) retired guy living here in Santa Barbara with a life long love of Mathematics, all stemming from a math teacher in high school who "turned me on" in a 2nd year Algebra class when I was 17. I never looked back. From there on to a Maritime Academy, MIT, Harvard Graduate School and then...Whoosh!...the years went by...until now when I have some time to return to the things that I love to do...and solve...like the hat problem in your November edition.

Many thanks for a truly enjoyable magazine.

Doug Van Sicklen
Santa Barbara, CA

Thank you! It is always good to be reminded of the wide variety of members of the MAA, and of the thing that most of us have in common: a love for mathematics itself. FOCUS is always looking for short expository articles aimed at a wide range of readers and dealing with interesting new (or old) mathematics, such as the one on the hats problem.

Note from the Editor

A few months ago, I solicited articles dealing with the Internet and how it has impacted the teaching and learning of mathematics. The first fruits of that request can be seen in this issue, and further articles will appear in issues still to come. I hope the articles will raise interesting issues, present ideas worth thinking about, and stimulate further discussion.

Fernando Q. Gouvêa

Ideas Want To Be Free! How Do We Pay for Them? (Part One)

By Al Buccino

Today all of us recognize that scholarly communication is undergoing a profound transformation owing to the Internet and related technologies. But the path the transformation might take is influenced by many issues including how skillful we are in resolving conflicts, contradictions and trade-offs among many factors and players in exploiting the potential of the Internet.

This two-part paper offers observations on problems and issues associated with scholarly communication including ideas that are new, original, or both. [1] The purpose of this brief article is to alert all of us — as subscribers, creators and users of scholarly communication through media such as publications and library systems — that it is essential for us to be attentive, learn about the issues, penetrate the conundrums, and contribute to our collaborative approach of navigating the transition.

The discussion is organized around three subjects: Innovation and Intellectual Property Rights, Innovation and the Internet, and Challenges. The last of these subjects carries over to the second part of this article, scheduled to appear in the March issue of FOCUS.

Innovation and Intellectual Property Rights.

The U.S. Constitution vests in Congress the power "to promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." This provision is seen as key to providing incentives and stimulation for innovation, invention, and building the store of ideas.

Despite a strong consensus favoring the protection of ideas by patents and copyrights, there were reservations. For example, in 1813 Thomas Jefferson expressed the view to a friend that ideas should freely spread, that they were like the air we breathe, "incapable of confinement or exclusive appropriation." [2]

Until well into the 20th century, patents and copyrights were associated with more or less tangible objects. An applicant for a patent had to submit a "working model" of the device for which she was seeking protection and a copyright registrant was expected to file a book or some other print product that embodied the composition to be protected by the copyright.

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But in recent years, changes have been introduced into the system for governance of patents and copyrights — Intellectual Property Rights (IPR), as they are collectively referred to these days. Note that the Constitution mandates a system, but leaves the details of its implementation to our democratically elected Congress. These changes were brought about at the height of the era of "stagflation," low economic productivity growth and high inflation. An important feature was believed to be low rates of innovation by U.S. business and industry owing to the slowness of transfer of research results generated in universities and government laboratories. The Japanese economic miracle of the time was thought to arise from its greater agility in transferring research to use and even that the research frequently originated in the U.S.

The government turned to IPR law to seek remedies. For patents, these remedies were encompassed by (1) the Patent and Trademark Amendments Act (commonly known as the Bayh-Dole Act) of 1980, amended in 1984, (2) the Federal Technology Transfer Act of 1986, (3) the National Competitive Act of 1993, and (4) other laws, amendments, and executive orders. There were two main thrusts of these government actions.

The concept of Intellectual Property Rights seems strange to academics, who tend to think about scholarly activity and ideas in Jeffersonian terms quoted earlier. But the first big change involved academics. Its goal was to facilitate transfer of technology developed by federally supported R&D to use, from university and government labs to private sector business and industry.

In earlier times the government held title to these inventions and issued non-exclusive licenses to anyone who wanted to use them. In the 19th century land-grant days, non-exclusive licenses may have been workable, but by 1980 it was recognized that they were not up to the needs of the day. A company that claimed such rights might find that a competitor got the same rights and undercut the original company's investment in the development of the idea. In 1980, the government held title to approximately 28,000 patents, but fewer than 5 percent were licensed to industry for commercial development.

One thrust of the changes brought about by the aforementioned legislation allowed ownership of inventions to vest in university grantees. A university was now in a position to enter into an exclusive agreement with a company that would now have a better incentive to invest further development for the marketplace. For more complicated agreements, CRADAs (Cooperative Research and Development Agreements) were enabled between government labs and industrial concerns. It is alleged that Ross Perot's Electronic Data Systems (EDS), a company worth billions, started as a small government contractor and grew with the help of these new kinds

of agreements for greater private-sector use of inventions developed partly by federal funds.

The second thrust of changes in IPR law was to enlarge the scope of inventions protected with patents and especially to allow patenting of "business methods." A famous legal decision was the one upholding Amazon.com's patent protection for its "one click" shopping" button at its web site. A competitor, Barnes and Noble, argued in its own defense that the underlying code was so simple to write that it did so without even knowing how Amazon.com had implemented the procedure. Nevertheless, the judge found in favor of Amazon.com's claim of protection for a "business method" and Barnes and Noble, among others, is proscribed from using it. The scope of patent protection was extended to include even what some observers saw as absurd inventions. [3]

As for copyright, the most recent legislation is the Digital Millennium Copyright Act (DMCA) of 1998. This act strengthened copyright in a number of ways, but also included an "anticircumvention" provision. This provision regulates digital code that cracks other digital code that is intended to protect copyrighted material.

The aim of this provision is to provide legal protection for the tools the owners of copyright use to protect their copyrighted material. But like patents for relatively trivial inventions, this provision has had troubling consequences. There have been three cases brought under the Digital Millennium Copyright Act late in 2001; two have been decided in favor of the entertainment industry (while critics say the decision undermines First Amendment Rights) and the third that has been deferred.

Intellectual Property Rights and The Internet.

For many of us, the Internet means e-mail. Of course, e-mail is not new, but it surely was the original *killer app* of the IT age. Ray Tomlinson authored the first e-mail program in 1971. Colby College, home of our esteemed editor, Fernando Gouvêa, was the first college or university to offer e-mail service through its mainframe to all students and faculty in 1983. Internet applications continued to develop through FTP, Gopher, and Archie, to HTML and XML.

Many individuals and organizational leaders believe of the Internet that "... we have tripped into this Walden Pond of creativity and innovation, and we have no idea about what inspires its magic." [4] A business Internet mantra is *keep government regulation out, but keep the IPR flowing*, reflecting Thoreau's libertarian side. This mantra fails to recognize IPR is, in fact, a form of government regulation. At the same time, a conflicting mantra that might be called the libertarian Internet mantra is *information wants to be free!* — that is, free in the Jeffersonian sense of *unbound, not confined*, and not in the sense of *without cost*. That's the play intended by the title of this piece and it highlights the heart of the challenges — a challenge that itself is a challenge to understand, let alone resolve.

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The Challenge

The challenge in its general form is how to manage the Internet in light of both the mantra of business and the mantra of scholarship: don't let the government regulate but keep ideas unbound. In the next issue of FOCUS, we will discuss this challenge and some of the things that are being done to address it — some good and some not-so-good.

This discussion will include roles and relations among the principal players in scholarly communication: including (1) scholars (the creators of IPR), (2) publishers of the scholarly results and findings including professional associations like MAA and commercial publishers, (3) libraries, and (4) users of the outputs produced by the second group of players.

With regard to scholars, we will discuss the incentives for them to continue to be creative. With regard to libraries, we will discuss the "serial pricing problem" and the problem of low use in endeavoring to cope with the flood of publications and to make them accessible (which includes the maintenance of archives).

It is convenient to combine groups (1) and (4) so that the number of player-groups, for purposes of our discussion, is reduced to three — scholars, publishers, and libraries. The intertwining of the players and their interest will also be discussed.

Finally, a selected list of readings, most of which are online, will also be included. Meanwhile, feedback and comment are invited to abuccino@earthlink.net or policy@maa.org. ■

[1]Jean–Claude Guédon makes an eloquent and profound distinction between *novelty* and *originality* in scientific publishing on page 5 of *In Oldenburg's Long Shadow: Librarians, Research Scientists, Publishers, and the Control of Scientific Publishing.* Association of American Libraries: Washington, DC (2001). See http://www.arl.org/arl/proceedings/138/guedon.html.

[2] Thomas Jefferson in correspondence with Isaac McPherson in 1813.

[3] James Gleick, *Patently Absurd. New York Times Magazine*, Issue of March 12, 2000. Available at Mr. Gleick's Web Site at: http://www.around.com.

[4] Lawrence Lessig. *Cyberspace Architectural Constitution*, Draft 1.1 (1999). Text of lecture given at www9 in Amsterdam, Netherlands in June 2000, online at http://cyberlaw.stanford.edu/lessig/content/writings/works/www9.pdf.