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THE NEWSLETTER OF THE MATHEMATICAL ASSOCIATION OF AMERICA

# FOCUS

*"Black Forest" by sculptor Robinson Fredenthal, located on the University of Pennsylnavia campus in Philadelphia, is one manifestation of the artist's fascination with polyhedral forms.*

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*On the cover: "Black Forest" by sculptor Robinson Fredenthal, located on the University of Pennsylvania campus in Philadelphia, is one manifestation of the artist's fascination with polyhedral forms. Photo by: Ivars Peterson, Science News.*

**FOCUS Deadlines**

| | October | November | December |
|---|---|---|---|
| Editorial Copy | | September 15 | October 16 |
| Display Ads | August 21 | October 6 | November 3 |
| Employment Ads | August 10 | September 22 | October 30 |

## Mathematics on the Stage in New York

Mathematics was a significant presence in the New York theater this Spring. In addition to the award-winning **Copenhagen**, which is about physics and physicists, three plays put mathematics on center stage, with varying degrees of success. Successful or not, these plays may help raise the visibility of mathematics within American culture.

First came **The Five Hysterical Girls Theorem,** a play by Rinne Groff about a number theory conference held at an English seaside resort. The "hysterical girls" of the title turn out to be a kind of prime number, and the play, according to the reviews, was full of mathematical references. Most reviewers felt that it didn't really manage to portray the link between the very human characters and the mathematics in which they engage.

Next, there was **Hypatia**, very loosely based on the life of the well-known Greek mathematician, who turns out, in the play, to have discovered zero and invented algebra. Apart from this, the play seems to follow the standard account of Hypatia, with the "Christian mob" duly making its appearance. Most reviews were lukewarm. One reviewer asked, "why exactly has one never heard of her?"

The best of the three seems to be **Proof,** a romantic comedy that involves a mathematically-inclined woman whose recently-deceased father may or may not have left the proof of a significant new theorem among the scribblings he produced while beset by madness in his last years. There isn't much mathematics in the play, but the reviews indicate that there's a real appreciation for mathematicians and their work. The reviewer for the *New York Times* said that "the play takes great pains to depict the study of mathematics as a painful joy, not as the geek-making obsession of stereotype, but as human labor, both ennobling and humbling, by people who, like musicians or painters (or playwrights), can envision an elusive beauty in the universe and are therefore both enlivened by its pursuit and daunted by the commitment." See page 8 for more on **Proof.**

**Copenhagen**, which is about a meeting between Werner Heinsenberg and Niels Bohr in 1941, won the Tony Award as best play of the year. Considering these plays together with the success of recent books about mathematics and mathematicians (e.g., Simon Singh's *Fermat's Enigma* and Sylvia Nasar's *A Beautiful Mind*) and the publication of several novels where mathematics and mathematicians play a significant role (e.g., A. Doxiadis' *Uncle Petros and Goldbach's Conjecture* and P. Schogt's *The Wild Numbers*, both recently reviewed on **MAA Online**), one begins to hope that they signal some sort of change in cultural attitudes towards science and mathematics. ■

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## Clay Mathematics Institute Announces Seven "Millennium Prize Problems"

During its "Millennium Meeting," held on May 24, 2000 at the Collège de France, the Clay Mathematics Institute announced the creation of a seven million dollar prize fund for seven problems which the Institute considers of central importance to mathematics. Inspired by Hilbert's famous list of problems from the 1900 International Congress of Mathematicians, the Institute will pay one million dollars each for the solution of the problems listed in the box.

The Clay Institute web site at http://www.claymath.org has a sub-page dedicated to the problems, with links both to short one-paragraph descriptions of the problems and to technical descriptions written by leading mathematicians. In a press release, the Institute argues that "mathematics occupies a privileged place among the sciences" and expresses the hope that the prize problems will help "celebrate mathematics in the new millennium."

The Clay Mathematics Institute is a private non-profit foundation whose objective is "to further the beauty, the power, and the universality of mathematical thought." Their web page includes more information about their activities. ■

**Millennium Prize Problems**

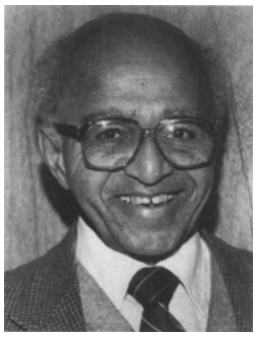
- P versus NP
- The Hodge Conjecture
- The Poincaré Conjecture
- The Riemann Hypothesis
- Yang-Mills Existence and Mass Gap
- Navier-Stokes Existence and Smoothness
- The Birch and Swinnerton-Dyer Conjecture

# Cornell Honors David Blackwell and Richard Tapia with Lecture Series

Cornell University has established a lecture series in honor of two of the nation's most eminent mathematicians, David Blackwell of the University of California at Berkeley and Richard Tapia of Rice University. The lecture series will provide a forum for research by African-American, Latino and American Indian scientists working in the mathematical and statistical sciences. The lecture series provides an honorarium of $1,000 for the guest lecturer.

Carlos Castillo-Chavez, director of the Mathematical and Theoretical Biology Institute at Cornell and professor of biomathematics, said that the objectives of the lecture series are multiple. "The minority communities at Cornell University would like to honor the mathematical and personal achievements of David Blackwell and Richard Tapia. We feel that it is critically important that current and future generations of African Americans, Latinos and Native Americans, as well as current and future generations of non-minorities, learn and remember the achievements of these two extraordinarily talented and productive mathematicians."

On May 7 and 8 a conference was held at the Cornell campus to inaugurate the series, called the "David Blackwell and Richard Tapia Distinguished Lecture Series in the Mathematical and Statistical Sciences." Blackwell, who is professor emeritus of mathematics at UC Berkeley, and Tapia, who is the Noah Harding Professor of Computational and Applied Mathematics at Rice, attended the event.



*David Blackwell*

David Blackwell completed his graduate studies at the University of Illinois at Urbana-Champaign in 1941. He taught on the faculties of Southern University, Clark College and Howard University, where he was chairman of the mathematics department before joining the faculty of UC Berkeley in 1954. He has contributed to several areas of mathematics: set theory, measure theory, probability theory, statistics, game theory, and dynamic programming. His name is attached to a theorem in statistics, the Rao-Blackwell theorem, which is important in estimation theory and tests of hypotheses. He is an author of the classic book "Theory of Games and Statistical Decisions." Blackwell was elected to the National Academy of Sciences in 1965. He also is a member of the American Academy of Arts and Sciences. He is the recipient of numerous honors and awards, including the R. A. Fisher Award and the John von Neumann Theory Prize.

*Richard Tapia*

Richard Tapia, who was born in Los Angeles to parents who emigrated from Mexico as teenagers, received his Ph.D. from the University of California at Los Angeles. In 1992, he became the first native-born Hispanic to be inducted into the National Academy of Engineering. He has contributed to mathematical optimization theory and iterative methods for nonlinear problems. His current research is in the area of algorithms for constrained optimization problems and interior-point methods for linear and nonlinear programming. Under Tapia, the computational and applied mathematics department at Rice has become a leader in promoting women and under-represented minority Ph.D. recipients in the mathematical sciences. His recent honors and awards include the Lifetime Mentor Award, from the American Association for the Advancement of Science, 1998; appointment to the National Science Board by President Clinton, 1996; the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring Program, 1996. ■

## A New Look for FOCUS

*A Note from the Editor*

I'm sure everyone has noticed the new look we have adopted for FOCUS, with color covers and a different type of paper. After some experimentation, we feel that we have found our format.

The new format places new demands on us. To begin with, we will be doing color covers, and this means we are very interested in any color images that our readers may have run across or produced in the course of their research or teaching. If you think you have something neat that we can use, please contact us.

On the inside, we are also running more pictures and other graphics. This means that when you supply us with news items (and you should!) we'll be asking you whether an appropriate image is available. Please keep that in mind as you prepare stories for FOCUS.

Finally, let me point out that we are always interested in news about mathematics, mathematics teaching, and the mathematics community. You will have noticed that we are making space for longer articles about mathematics in addition to our normal coverage of the Association, mathematics and science policy, and other mathematics news.

So if you prove a great theorem, make a new historical discovery, invent a great new way to teach, or have a controversial proposal to make, think of FOCUS! We can be reached at focus@maa.org. ■

## MAA Awards Announced at the Los Angeles Mathfest

**Lester R. Ford Award**

P.J. McKenna
"Large Torsional Oscillations in Suspension Bridges Revisited: Fixing an Old Approximation"
*American Mathematical Monthly*
January 1999

William J. Terrell
"Some Fundamental Control Theory I: Controllability, Observability, and Duality"
"Some Fundamental Control Theory II: Feedback Linearization of Single Input Nonlinear Systems"
*American Mathematical Monthly*
October and November, 1999

Vilmos Totik
"A Tale of Integrals"
*American Mathematical Monthly*
March 1999

**Carl B. Allendoerfer Award**

Donald Teets and Karen Whitehead
"The Discovery of Ceres: How Gauss Became Famous"
*Mathematics Magazine*
April 1999

**Trevor Evans Award**

Stan Wagon
"The Ultimate Flat Tire"
*Math Horizons*
February 1999

Peter Schumer
"The Magician of Budapest"
*Math Horizons*
April 1999

**George Pólya Award**

Ezra Brown
"Square Roots from 1;24,51,10 to Dan Shanks"
*College Mathematics Journal*
March 1999

Martin Gardner
"The Asymmetric Propeller"
*College Mathematics Journal*
January 1999

## Showcasing the Results of Science Funding on Capitol Hill

The Coalition for National Science Funding (CNSF) held its annual Exhibition and Reception on Capitol Hill on May 17. The MAA was one of several exhibitors that attempted to demonstrate to members of Congress the concrete positive results of federal funding of science.

The MAA exhibit showcased the Mathematics Across the Curriculum program at Dartmouth College, which was featured in the March, 2000 issue of FOCUS. The program, which is funded by NSF, has developed interdisciplinary courses to replace the usual introductory courses in mathematics. Along with posters describing the courses and their results, the MAA invited two Dartmouth students (Heidi Williams and Shane Smith) to tell about their MATC experience. The exhibit attracted a lot of attention, and the reaction to the MATC project and to the presenters was very positive.

The Coalition for National Science Funding is a loose association of scientific societies that supports government funding for science, especially through the National Science Foundation. The Joint Policy Board for Mathematics, of which MAA is a member, is part of CNSF, and we have been invited several times to be part of the annual Exhibition and Reception. Members of Congress are invited to visit the exhibit to learn more about the results of NSF funding. The message of the event is that NSF money is well spent and that the funded projects, both in education and in research, make a crucial contribution to the American scientific and educational enterprise. ■

## Twenty-Seven Mathematicians Receive Distinguished Teaching Awards

*By J.J. Price*

Twenty-seven mathematicians received this year's Section Distinguished Teaching Awards, which were conferred at the Spring meetings of their sections. The winners represent the ninth group of awardees since the inception of the awards in 1992. See the display on pages 12–13 for information on the 27 winners.

Three of these awardees have been nominated by the Committee on the *Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics* for the national Haimo awards. These will be presented at the annual meeting in New Orleans in January 2001 and the winners will speak about their teaching.

The Committee is gratified that 27 of the MAA's 29 sections selected awardees. This speaks well of the sectional support for the national effort to recognize, reward, and honor outstanding teachers of mathematics in the United States and Canada.

The Committee commends the sections for their efforts and encourages all sections to find ways of recognizing and promoting excellence in teaching, such as inviting their awardees to speak.

Still, two sections did not give awards this year. The Committee urges these sections to nominate and reward outstanding teachers, and encourages all MAA members to nominate worthy candidates. You may even nominate someone outside of your section by writing to that person's selection committee. ■

*J.J. Price is chair of the Committee on the Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics.*

# New Teacher Preparation Standards Emphasize Performance

The nation's schools of education will have to meet rigorous new performance-based standards to be accredited by the National Council of Accreditation of Teacher Education (NCATE), beginning in the year 2001. The Department of Education recognizes the NCATE as the professional accrediting body for teacher preparation in the United States. The new standards shift the emphasis towards academic performance and accountability in education.

"The standards, which focus on candidate performance, represent a revolution in teacher preparation," said Arthur E. Wise, NCATE president. "Performance-based accreditation is based on results—results that demonstrate that the teacher candidate knows the subject matter and can teach it effectively in a real classroom. The institutions will need to provide credible evidence that their schools of education achieve this goal."

The NCATE's new system is a response to policymakers' calls for improved teacher preparation and rigorous standards for teachers. The new standards, which stress "real world" experience, were developed over a three-year period by NCATE's Standards Committee, whose members represent teachers, teacher educators, school specialists and state and local policymakers.

To become accredited, teacher preparation institutions must submit a self-study that describes how they have met the standards. An on-site visiting team will examine the education unit and assess its strengths and weaknesses in relation to the standards. NCATE's Unit Accreditation Board makes a final accreditation decision.

Here are the new NCATE standards:

**Standard 1. Candidate Knowledge, Skills, and Disposition**

NCATE expects candidates to know the content of their field (a major or the substantial equivalent of a major) and possess the necessary knowledge and skill to teach it effectively. In addition, candidates from accredited institutions should gain a liberal arts background along with professional knowledge so that they can develop meaningful learning experiences for all students.

Under the new standards, schools of education must provide evidence that they have used national and state standards to design and deliver the programs, and provide evidence that the candidates can meet the standards. Either a content knowledge test or other measures may be used to assess subject matter knowledge. Candidates' ability to synthesize the content to help students understand it is also evaluated in the new system.

**Standard 2. Program Assessment and Unit Evaluation**

The school of education must have a systematic way to assess its candidates—including data on the qualifications of applicants and the performance of candidates and graduates. NCATE expects the school of education to use this data to evaluate and improve the programs. NCATE also expects the education unit to design candidate assessments using professional, state, and institutional standards as the major reference points. The assessments should be embedded in the preparation programs, and should be conducted on a continuing basis, both to help candidates improve their skills and to evaluate candidate progress and competence.

NCATE expects schools of education to use multiple assessments in a variety of forms. They may come from internal sources within the school of education, including tasks used to teach candidates, activities of teaching, essays, papers, observation of faculty and supervising teachers, videotapes of performance, and other means. Assessment information will also come from external sources such as state licensure exams, evaluations during induction or mentoring, and employer reports.

NCATE expects the institutions to establish criteria for determining levels of acceptable candidate performance. NCATE will also work with national subject matter associations to publish sample benchmarks for acceptable performance in the subject matter areas.

**Standard 3. Field Experiences and Clinical Practice**

The performance-based NCATE system requires university and school faculty to function as partners in the education of teacher candidates. The school of education and its school partners are expected to collaboratively design, implement, and evaluate field experiences and clinical practice and ensure that candidates demonstrate the knowledge, skills, and dispositions to help all students learn. The strong emphasis on the partnership between the university and cooperating schools will engender change in many current programs.

**Standard 4. Diversity**

NCATE expects teacher candidates to be able to help all students learn. Candidates should have experiences working with diverse student populations, along with diverse faculty and peers. This standard reinforces NCATE's commitment to a high quality education for all of America's children.

**Standard 5. Faculty Performance and Development**

NCATE expects faculty to be good teachers; they should model best practice in teaching, scholarship and service. The unit must evaluate faculty performance and provide professional development opportunities.

**Standard 6. Unit Governance and Resources**

This standard ensures that the college has the necessary resources, including technology resources, to offer the programs that it chooses to offer.

For more information on NCATE and the new standards, visit their web page at http://www.ncate.org. ■

# CBMS to Issue Recommendations on Teacher Preparation

*By Alan Tucker*

A forthcoming report of the Conference Board of the Mathematical Sciences (CBMS) recommends that instruction for future teachers focus upon developing a deep mathematical knowledge of school mathematics, knowledge directed at effective classroom teaching. A current draft of this report is available at http://www.maa.org/cbms/metdraft. The final report is due out later this fall.

Too much of current undergraduate mathematics instruction for future teachers involves standard colleges courses, such as college algebra for elementary teachers or advanced calculus for high school teachers. This approach to teacher education is based on the theory that learning more advanced mathematics is the best way to develop mathematical reasoning in future teachers and that this will help them to understand better the school mathematics they will teach.

The report takes a different tack, contending that it is better for teachers to learn deeply the key ideas underlying the mathematics they are going to teach. It tries to communicate to mathematical readers the substantial yet sometimes subtle intellectual content of school mathematics that teachers must understand well.

One well-known example is the place value structure of our number system which implicitly expresses numbers as polynomials in powers of 10 and permits single-digit arithmetic to be easily extended to multi-digit arithmetic (contrast this with doing arithmetic with Roman numerals).

An elementary teacher needs a solid mastery of place value to assess the validity of the following subtraction algorithm, which some students discover:

43 - 27 = (40-20) (tens place subtraction)
+ (3-7) (ones place subtraction)
= 20 + (-4) = 16

The timing of this CBMS effort is particularly propitious. Many states have recently begun scrutinizing the teacher education programs at their public universities and holding faculty more accountable for skills of the prospective teachers they educate. NCATE's new standards for teacher preparation also emphasize knowledge and skills in the content area.

Liping Ma's 1999 book, *Knowing and Teaching Elementary Mathematics,* which compared the mathematical knowledge of samples of Chinese and American elementary school teachers, has convinced many research mathematicians that there is substantial mathematical knowledge involved in teaching mathematics well in elementary grades.

This CBMS effort was begun at the request of the MAA's Committee on the Mathematical Education of Teachers (COMET) and is supported by a grant to the MAA from the United States Department of Education. CBMS's leadership was sought to gain the broadest possible participation of academic mathematical scientists in efforts to improve the mathematical education of future teachers.

The CBMS report seeks to capitalize on the fact that in the years since COMET's 1990 report on teacher education, *A Call for Change,* appeared, an increasing number of college and university mathematicians have become involved in efforts to rethink school mathematics instruction and teacher preparation.

The flight of mathematicians away from school mathematics, following the demise of the New Math movement three decades ago, has finally been reversed. The CBMS report offers an opportunity for chanelling this renewed interest in education in the direction of improved teacher preparation. ■

*Alan Tucker is a former MAA Vice-President and the lead writer for this CBMS project.*

# Congressional Commission Calls for Increased Diversity

With an all-star cast in attendance, the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development (CAWMSET) gave Congress a first look at its final report on July 13. The report issues a call for the American scientific community to be more representative of the actual composition of the overall workforce. The July 21 issue of *Science* highlights the Commission's report, but also calls attention to difficulties and dissenting voices.

The full CAWMSET report will be available at http://www.nsf.gov/od/cawmset by the end of August. A brochure summarizing the report's conclusions was released in July (it is available at the same URL). Entitled "Land of Plenty", it summarizes the report's recommendations under several headings.

To improve pre-college education, CAWMSET recommends the adoption and implementation of high-quality standards for curricula, teachers, equipment, and infrastructure. To enhance access to college, it recommends aggressive and focused intervention efforts targeting women, minorities, and disabled students. A second recommendation in this category is that government significantly expand its funding in support of underrepresented groups.

In relation to professional life, the Commission recommends that employers be held accountable for the career development and advancement of women, minorities, and persons with disabilities. To help attract people to science jobs, the report calls for a coordinated effort to improve the public image of science and scientists.

Finally, CAWMSET calls for "national accountability" in this area via the creation of a public-private body to continue the work of the Commission. ■

# A Beautiful PROOF

*By Don Albers*

Mathematicians sometimes praise a particularly pleasing proof by using words such as **beautiful, elegant** or **inspired**. The proofs that mathematicians like best often are described by words that might just as well be applied to works of art. Thus, it was doubly pleasing for this reviewer to see *Proof*, a work of dramatic art that revolves around a mathematical proof. *Proof*, by playwright David Auburn, is nothing less than beautiful, elegant, and inspired. The cast, set, and lighting combine to produce an outstanding night of drama. After a highly successful run off-Broadway at the Manhattan Theatre Club, *Proof* moves to Broadway next month. I enjoyed *Proof* so much that I saw it twice in one week!

Auburn's script is well-crafted, fast moving, and marked by sparkling dialogue. Mathematicians will be relieved to know that in *Proof* the mathematical statements are accurate, and that the characterizations of mathematicians seem to be within the usual bounds for the species. In fact, the mathematicians portrayed in *Proof* come off as delightfully human and rather attractive people with whom you would probably enjoy having dinner.

*Proof* centers on Catherine, the younger daughter of Robert, a distinguished mathematician at The University of Chicago. Catherine is brilliantly played by Mary-Louise Parker, and is utterly convincing in the role of the insecure, emotionally drained, but still sassy daughter. Robert, before he was twenty-five, made great contributions to game theory, algebraic geometry, and nonlinear operator theory. Unfortunately, he suffered from manic depression for many years following his path breaking work, and Catherine interrupted her college education and life in order to care for him and keep him from being institutionalized.

Upon Robert's death, his last doctoral student Hal is working his way through the 103 notebooks that Robert filled with what Catherine refers to as "gibberish" written by a graphomaniac. Hal hopes that he may find mathematical gold in the notebooks, but Catherine insists that Hal is wasting his time. He claims that she doesn't know enough math to know what is gibberish and what is not. She forcefully reminds him that she spent years caring for her father, and that she might know more mathematics than Hal thinks.

Hal, while finishing his doctorate under Robert, had been attracted to Catherine, and now they are brought together again by her father's death. After a romantic interlude, Hal announces that she seems to be right about the notebooks, whereupon she gives him the key to the desk drawer

*Larry Bryggman and Mary-Louis Parker in PROOF. Photo by Joan Marcus.*

containing one more notebook. A short time later, Hal excitedly reports that the last notebook contains an absolutely amazing proof of an outstanding number theory result. He wants to know why she didn't tell him about finding her father's last notebook. Catherine provides an electrifying end to the first act by responding, "I didn't find it. I wrote it."

Could it be that Robert's mathematical genius has been passed to Catherine? How could she have done the proof if the handwriting so clearly resembles that of her father? Could she have learned on her own the latest work in number theory, and then used it to construct a proof of dazzling proportions? Hal, her new lover, has doubts—certainly a big block to continuing their relationship. He suggests that he and some of his mathematical colleagues need to check the proof closely, and see what really is there.

The doubts of Hal and her successful and domineering older sister Claire combine to demoralize Catherine. Claire is concerned that Catherine may have inherited her father's madness as well as his mathematical talents, and she wants to move her out of South Chicago to the security of New York. How does it end? You'll have to go see *Proof* to find out.

Some mathematicians have complained that *Proof* does not contain enough "actual" mathematics. To that, I can only respond that few plays try to teach subject matter. Why in the world should *Proof* be different? The mathematical milieu works exceedingly well for *Proof*, but you don't need to know any mathematics to enjoy it. There is absolutely no need to ratchet up the quantity or level of mathematics found in *Proof*.

The plausibility of *Proof* is enhanced by Auburn's awareness that very few fields–art, music, and mathematics–are marked by prodigies. Neither art nor music would work very well with the basic story line of *Proof*, because it is very difficult to conceal great accomplishment in art or music.

Those of you familiar with the neighborhoods surrounding The University of Chicago will be pleased by the set, which features an authentic brick house straight out of South Chicago. It fills the stage and contributes mightily to the success of *Proof*.

Great script, wonderful cast, and sensational set! What more could you ask for? *Proof* is truly beautiful. ■

**Cast**

Catherine–Mary-Louise Parker
Claire–Johanna Day
Hal–Ben Shenkman
Robert–Larry Bryggman

*Don Albers is Associate Executive Director and Director of Publications and Electronic Services at the MAA.*

# Panel on Post-Tenure Review Discusses Four Policies

*By Bernard L. Madison*

Wednesday morning, January 19, 2000, at the Joint Mathematics Meetings in Washington, DC, three panelists and a moderator told their audience how the once-feared post-tenure review was being carried out at four universities: Georgia Southern University, Texas A&M University, Virginia Tech, and University of Arkansas.

The panelists were Susan C. Geller, Professor of Mathematics at Texas A&M, who was not only involved in developing her university's post-tenure review policy, but also is the chair of the committee that hears appeals of dismissal for cause; Robert F. Olin, Head of Virginia Tech's Mathematics Department, who led his department in developing its post-tenure review policy; and Jimmy L. Solomon, Dean at Georgia Southern while its policy was developed and implemented. The panel moderator was Bernard L. Madison, Dean at the University of Arkansas while its policy was developed. The panel was organized by John Fulton of Virginia Tech for the MAA Committee on the Profession.

Post-tenure review policies vary considerably. They range from one extreme of periodic renewal (or non-renewal) of tenure to the other extreme of mere recognition that the university has policies that provide for dismissal of faculty members whose performances are consistently unsatisfactory. The four discussed below fall somewhere in between but are closer to the latter.

Many post-tenure review policies have the following features:

- Trigger mechanism; that is, what prompts a post-tenure review.
- Procedures for conducting the review; that is, who does it and how.
- Professional development plans; that is, plans for improving the performance of faculty members if it is found unsatisfactory.
- Possible consequences of receiving an unfavorable post-tenure review.

All four of the policies discussed had these features in some form, but each of the four also had some unique features. All four policies were imposed "from above," that is, they are consequences of policies on post-tenure review covering larger systems of which these institutions are a part.

Virginia Tech's policy was heavily focused on departmental control, and the Department of Mathematics was a leader in pioneering the development of such policies in Virginia. Post-tenure review is triggered by two consecutive unsatisfactory annual review ratings, carried out by a committee of department faculty, and can be preceded by a first step in which duties are reassigned in hopes of improving unsatisfactory performance. It matters what the actual duties are, because unsatisfactory means unsatisfactory in a majority of the duties assigned. The policy contains detailed criteria for faculty performance and procedures for selecting review committees.

Texas A&M University's policy was written to implement a system-wide requirement for post-tenure review in a way acceptable to the faculty. Unless a faculty member is exempted due to mitigating circumstances, a review is triggered by three consecutive unsatisfactory annual departmental evaluations. At this point a professional review is carried out by an ad hoc committee of faculty (or by the department head if the faculty member under review prefers).

The results of a professional review can be either a finding of "no deficiencies" (in which case it supercedes the previous annual review result) or a list of deficiencies, in which case a professional development plan (with a commitment of institutional resources to carry it out) is drawn up to cover a period of no more than three years. After the plan is completed, a final assessment is made. Failure to meet the goals is not, in and of itself, sufficient cause for dismissal. However, unremediated deficiencies may be sufficient for dismissal under a separate dismissal for cause policy.

Georgia Southern's policy on post-tenure review requires that each faculty member be reviewed every five years, beginning five years after the most recent promotion. The reviews are conducted by a committee of three faculty peers and can result in both rewards, in the case of positive reviews, or professional development plans, in the case of unsatisfactory reviews.

The University of Arkansas' post-tenure review policy resulted from legislation requiring such policies. The legislation was not prescriptive and allowed campus faculties considerable control over the final process. Two consecutive unsatisfactory annual review ratings or three unsatisfactory ratings in five consecutive annual reviews trigger a post-tenure review. An elected peer review committee carries out the review, and that committee also prepares a professional development plan covering a period of up to three years. If the results of this plan are unsatisfactory, then dismissal for cause may be recommended, and a separate policy takes control.

There is little information as yet on the results of post-tenure reviews, since, as seen from these four policies, the time required for a post-tenure review to be completed and acted upon is usually 5-7 years, and few policies have been in existence for that long.

It is clear, however, that post-tenure review is here to stay, and we hope that this information may help those who either are writing post-tenure review policies or revising existing ones. For more information, contact the panel members:

Bob Olin (olin@calvin.math.vt.edu), Sue Geller (sue.geller@math.tamu.edu), John Fulton (fultonj@vt.edu), Jimmy Solomon (jsolomon@gsvms2.cc.gasou.edu), and Bernie Madison (Bmadison@comp.uark.edu). ■

# Post-Tenure Review: Two Opinions

## Possible Benefits

*by Bernard L. Madison*

Tenure has been a sacred cow because we all have believed that without it we would lose job security and the academic freedom to teach as we need to teach. Of course, tenure has been seen from the other side as job security for slackards and nogoodniks. Neither view is correct. Tenure did endow some property rights for those who had it, and consequently, those rights required due process if they were to be taken away. Hence, we were not necessarily protected by tenure, but rather by the concomitant property rights and the legal barriers to taking those away. Nevertheless, we were and are protected.

In essence, post-tenure review makes tenure tentative and exposes the holder to the possibility of losing tenure and hence whatever protection it carries. A post-tenure review that results in either renewal or non-renewal of tenure essentially revokes tenure and then re-instates it if the review is positive. This, of course, functions like a term contract (assuming non-renewal of tenure means loss of position). The other extreme of post-tenure review policies only points out that tenure does not protect non-performance of duties and provides a mechanism for institutions to implement dismissal proceedings. Whether or not the legal barriers for removal of property rights are still in place after a negative post-tenure review depends on the nature of the review and the findings. If those property rights are still held, then the dismissal is no easier than before the post-tenure review.

Most faculty who have thought through this issue completely will agree that they should be responsible performers. They may disagree about what competent performance is, but most will acknowledge extremes in non-performance that should be unacceptable. These extremes include abusive behavior, not meeting classes, and other actions generally regarded as unacceptable in civilized society. If post-tenure review only addresses this kind of unacceptable behavior, then it will be positive. If it dampens our abilities to teach our subjects without interference, then it will be negative.

Post-tenure reviews may prompt institution of standards of behavior for faculty. Presently, there are very few such standards. "Moral turpitude" has been the standard often referred to when tenure or revoking tenure is mentioned, and few of us knew what that meant, only that it was not good. We need standards of behavior for faculty because irresponsible actions by one of us can undermine the security for all of us, unless we have a standard of our own that condemns the irresponsibility.

In a back-door kind of way, post-tenure review may increase our job security by showing our detractors that we are willing to stand for review. However, if the reviews are cursory this could come back to haunt us. So, our task is clear. Post-tenure review is here and probably here to stay. If we make good use of these reviews by making improvements in our professional performances, protecting in the process the ingredients of healthy academic inquiry, then we will do well. If not, then new policies may emerge. ■

*Bernard L. Madison is Chair of the MAA Committee on the Profession. He was Chair of his department for ten years and dean of his college for ten years. During the 2001 calendar year he will be at the MAA as Visiting Mathematician.*

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## A Skeptic's Concerns

*By William P. Berlinghoff*

The report of the Panel on Post-Tenure Review is disquieting, both in its tone and in its unspoken implications. Describing the spectrum of operative effects of such policies, it says: "They range from one extreme of periodic renewal (or non-renewal) of tenure to the other extreme of mere recognition that the university has policies that provide for the dismissal of faculty members whose performances are consistently unsatisfactory." That is, they range from the explicit elimination of tenure to the "mere" chilling of the climate of academic freedom and intellectual inquiry.

Who benefits from such policies, and at what cost? To answer those questions, we must first be very clear about the meaning and purpose of tenure in higher education. In simplest terms, tenure is a shift in burden of proof. Probationary faculty members must prove that they deserve to be continuing members of their academic community, usually by means of a careful, rigorous peer review; tenured faculty members are presumed to be competent unless and until the institution can *prove* that there is adequate cause to conclude otherwise. That presumption of competence permits a tenured professor to broaden his/her scholarly work to include long-term or innovative projects, to maintain high standards of student performance, to offer constructive criticism of college or university policies, and to exercise appropriate decisiveness in faculty status decisions. Tenure also provides for a stable base of experienced faculty to share with administrators the sometimes difficult and always time-consuming chores of collegial governance. All of these things benefit the institution (and society as a whole) at least as much as they do the individual.

Jeopardizing such benefits is a fairly high price for an institution to pay. When you factor in the faculty time and effort required to implement any procedurally adequate system of post-tenure review, the price gets even higher. What benefits justify such a cost? Is post-tenure review merely a public relations scheme to convince a skeptical body politic that tenure is not a sinecure for superannuated laggards? If so, surely there must be a far less costly and intrusive way to make that point. Is it something more? According to the report's descriptions of the Texas A & M and Arkansas situations, post-tenure review is not a substitute for a careful dismissal-for-cause policy, nor should it be. Most institutions already have such policies in place (though some seem

overly reluctant to use them). Nor is it a substitute for annual reviews, since the report says that it often seems to be triggered by some sort of pattern in annual reviews.

Perhaps professional development is a valid reason for post-tenure review. If so, it should be a positive process that encourages and nurtures productive change, supported by institutional resources for such development, and it should be flexible enough to acknowledge changing expectations at different stages of faculty careers. Above all, it must not be used to limit academic freedom, to stifle constructive criticism, or to undermine due-process protections by easing the institution's burden of proof in cases of dismissal for cause.

I, for one, am not comforted by the tone of this brief report. The shadow it casts looks far more like a stick than like a carrot. The consequences of having such a stick, even if it is never used, are problematic at best. In the words of the AAUP's 1983 policy statement on post-tenure review:

> "The Association believes that periodic formal institutional evaluation of each postprobationary faculty member would bring scant benefit, would incur unacceptable costs, not only in money and time but also in dampening of creativity and of collegial relationships, and would threaten academic freedom."

Selective employment of such evaluations may ease the time and money burden, but it will not increase the benefits nor lessen the costs in collegiality or creativity or the threat to academic freedom. It may be clear that post-tenure reviews are here to stay, but it is not at all clear that they ought to proliferate.

Anyone interested post-tenure review policy might find it helpful to read "Post-Tenure Review: An AAUP Response" in the Sept./Oct. 1998 issue of *Academe*. Also, the topical theme of May-June 2000 issue of *Academe* is tenure. Its thoughtful articles from a variety of faculty and administrative viewpoints provide a useful context for consideration of post-tenure review. ■

*William P. Berlinghoff is a Visiting Professor of Mathematics at Colby College. A former Associate Secretary of the American Association of University Professors, he also chaired the AAUP's Committee N on the Representation of Economic and Professional Interests, and served for six years as a member of its Committee A on Academic Freedom and Tenure.*

# 2000 Award Winners

# for Distinguished Teaching

# Dionysius, Zero, and the Millennium: the Real Story

*By Christian Marinus Taisbak*

With the arrival of the year 2000, two questions have been asked frequently. First, when does the second millennium end, at the end of 1999 or at the end of 2000? Second, how "correct," with respect to the actual date of the birth of Christ, is the number of the year?

The answer to the first question is pretty clear. If somebody had inaugurated the Christian era from its very start, the first year of it would have been called "year 1", the second "year 2" etc. (The leaders of the French Revolution styled the years in just this way in their new calendar from the autumnal equinox 1792. Even though zero had been known and used for a long time, no one insisted on, or even considered, numbering the first Republican year "zero." In fact, see below for Dionysius and zero.) Years are intervals, not points on the number (or time) axis, and intervals are always numbered by the point to the right of the interval. The first mile of the way ends at the first milestone. Therefore the year 1999 started at point 1998 and ended at point 1999, and time will not pass point 2000 until December 31, 2000. We have (so to speak) reached page 2000, but not yet read it, so we still do not know whodunit.

So much for question one. But we all know that the Christian era is like a broken ruler that's missing 500 years at the beginning. It was not invented when it started. The Christian era was made up by one man, Dionysius Exiguus, who in the year *241 Diocletiani* (according to the calendar current at the time) sat down to calculate Easter tables for a ninety-five year period starting on 248 Diocletiani. To suit the Western Church, he decided to edit his tables in Latin and use dates in the Julian calendar, in contrast to his predecessors (and primarily one Cyrillus), who had done it in Greek and used the Alexandrian calendar. In his prefatory letter to his tables he writes

"... since [Cyrillus] ended his tables with 247 Diocletiani, mine ought to start at the year 248 since that despot. But I prefer to denote the years from the incarnation of our Lord Jesus Christ, the Beginning of All Our Hope..." (Migne, *Patrologiae Latinae* 67, 20).

And then, without much arguing, he changes numbers (and history) by equating 248 Diocletiani with anno Domini 532 — as if everyone knew that Jesus had been born 532 years before.

The date of Easter was set by the Council of Nicea as the first Sunday following the first full Moon that occurs on or after the Spring equinox on March 21. Hence, to calculate his tables, Dionysius needed to determine the position and phases of the moon on different dates. The procedure for doing so, known as the *computus*, was quite complicated.

To begin with, one needs to match up the lunar and the solar calendars. Dionysius probably used the *Metonic rule*, which says that 19 solar years equal 235 lunar months. The average lunation being 29.5 days, there was an agreement that lunations of 30 days end in odd months and lunations of 29 days in even months; if a short lunation happens to end in an odd month, an "embolismic" (leap) lunation of 30 days is inserted. Hence, the 235 lunar months break up into 114 lunations of 30 days alternating with 114 lunations of 29 days, with seven extra 30-days' lunations sneaking in as "embolismic" lunar months.[1]

Think of a year in which the age of the Moon is 2 (that is, the Moon is in the second day of its cycle) on March 24 (= 28 Phamenoth, the 7th month in the Alexandrian calendar. This date is chosen because the Moon has the same age on that day as on the Alexandrian New Year's Day, 1 Thoth). The previous full Moon was March 6, too early to serve as the paschal Moon, which must be on or after the equinox, March 21. The next full Moon is April 5, and Easter will be to first Sunday after that day.

What will happen the following year? Since the normal solar year is 11 days longer than the lunar year, the age of the Moon will be 13 next year on March 24.[2] So the next full Moon is March 25, which — being after the Equinox — is the paschal Moon, and Easter Sunday will be on April 1 at the latest.

The Alexandrian computists called the difference between the age of the Moon at the beginning of the reference year and at the beginning of the current year, the "epact." In the example above, the epact was 11. In the third year the Moon gains another 11 days, so the epact is 22, which must be added to our initial 2, making the Moon 24 days old on March 24. But in the fourth year the epact amounts to thrice 11 = 33, and no moon ever grows as old as that; so we subtract 30 (in fact an "embolismic" month has sneaked in during the year), finding a 5 day old Moon on March 24. The previous full Moon was March 3, so the paschal Moon will be the next one, on April 2.

It is not hard to lay down a rule for calculating the epacts: In the first year nothing is to be added. In the second year the epact is 11. In year 3 it is twice 11; in year 4 it is three times 11, and so forth; whenever the sum gets greater than 30, that number is subtracted. In year N it is (N-1) times 11, modulo 30.

In the 19th year the epact is (18 times 11) modulo 30 = 18, so it should be 29 in year 20. But that's where the Moon "leaps" (the Mediaeval "saltus lunae"), so that the next 19 years the cycle can start with epact 30, that is: with zero, as Dionysius writes in his table.

Obviously, things would be easier if the number of the year is divisible by 19, that is, if the first year was no. 19 or 38 or 19*n* in some era, because then the epact rule will be epact = [11 times year (mod 19)] (mod 30). So I imagine Dionysius looking for a count of years that would make the first year of his new table a multiple

[1] *Cf. W.E. van Wijk, Le nombre d'or, Nijhoff, Haag 1936, p. 5 ff. He also inspired the vital point of my thesis: that the year 532 was chosen "par raisons computistiques," ibidem p. 17.*

[2] *By some miraculous accident it is possible to ignore leap years, since the tiny fraction by which the average lunation is greater than 29.5 days "eats up" the quarter of a day each year.*

of 19. He knew (as did everybody else in the Church) that about half a millennium had passed since Pilate was prefect in Jerusalem. So it occurred to him that 532 after the incarnation of Christ would fit quite well, and would even make leap years (which that year was supposed to be) divisible by 4.

He would not have bothered about the precise date of the birth of Christ. December 25 had been chosen a couple of centuries earlier. He was thinking in the Alexandrian calendar, so there was no doubt about the counting of years. In the eras of sovereigns the first year is that in which they took over, thus "the first year of Diocletianus" started on August 29 (Thoth 1 in the Alexandrian style), even though he was not declared emperor until November 17. So the first year of Christ would be the one in which he was — at some time — born. Furthermore, it was not his birth, but his resurrection that mattered, March or April were the months to keep track of, and probably Dionysiyus never really thought of changing the dating system in his new era. The date of Easter during the coming 95 years was his problem. Did he believe in the 532? Who knows? But who was there to contest him? He certainly was considered an authority, and he needed his multiple of 19.

To find the Sunday following the paschal Moon one must observe that each year the date of Sundays moves one day, in leap years two days. Dionysius (like his predecessors) noted the dates of March 24 in a table of "concurrentes", running days, in a 28-year scheme, as follows (1 meaning Sunday): 4, 5, 6, 7, 2, 3, 4, 5, 7, 1, 2, 3, 5, 6, 7, 1, 3, 4, 5, 6, 1, 2, 3, 4, 6 , 7, 1, 2. He makes little noise about this cycle, so that one might think he did not really see its significance. But of course he did, 532 being 28 times 19.

If this reconstruction is right, the question of the correctness of our year numbering becomes meaningless. The count is chosen arithmetically, not historically, to make the computations easier.

Many attempts have been made in the last few years to save the Big Bang in honour of 2-and-Three-Zeroes. Even the year Zero has been dragged in, "forgotten or unknown by the stupid monk Dionysius Exiguus." That he not only knew his zeroes, but in a way invented them for calendric purposes, can be seen from his tables, where he indicates that the epact is zero for the Anno Domini 532. There's no way of avoiding it: the millennium ends on December 31, 2000. But the 2000 isn't really 2000 years after any particular historical event. Rather, it's the result of Dionysius' making sure that his computations went well. ■

*Christian Marinus Taisbak, who completed this article on "vi Idus Februarias MM," retired from a Chair in Classical Philology at Copenhagen University in 1994 and is now Reader in History of Ancient Mathematics at the same university.*

**Two selections from Dionysius' tables, with commentary**

First, the last entry in what he pretends to be Cyrillus' table:

| | | |
|---|---|---|
| *Anni Diocletiani* | CCXLVII | of Diocletianus' years 247 |
| *quae sint indictiones* | VIIII | indictio 9 (in a 15 years' cycle) |
| *epactae, id est adiectiones lunae* | [ XVIII ] | epact = 18 (scribal error corrected) |
| *concurrentes dies* | II | weekday no 2 (March 24 = Mon) |
| ... | | |
| *quae sit Luna XIIII Paschalis* | XV kal. mai. | Easter Full Moon April 17 |
| *dies Dominicae Festivitatis* | XII kal. mai | Easter Sunday April 20 |

Then the first entry in his New table:

| | | |
|---|---|---|
| *Anni Domini* | DXXXII | A.D. 532 (leap year) |
| *quae sint indictiones* | X | indictio 10 |
| *epactae, id est adiectiones lunae* | nulla | epact = zero! |
| *concurrentes dies* | IIII | weekday no 4 (March 24 = Wed) |
| ... | | |
| *quae sit Luna XIIII Paschalis* | non. april. | Easter Full Moon April 5 |
| *dies Dominicae Festivitatis* | iii id. april. | Easter Sunday April 11 |

# The MAA and the New NCTM Standards

*by Susanna Epp and Ken Ross*

In 1989 the National Council of Teachers of Mathematics (NCTM) published *Curriculum and Evaluation Standards for School Mathematics* (the "1989 Standards"). This document had considerable national influence on textbook development and both pre-service and in-service teacher training, but it also stirred controversy.

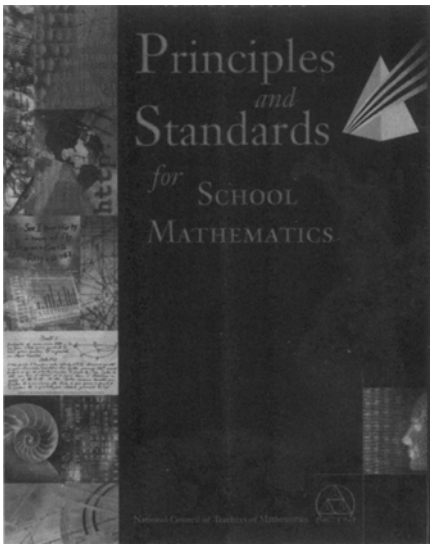
In 1996 the MAA and several other professional organizations were each asked to appoint a committee to help the NCTM reassess and revise the 1989 Standards. The MAA appointed the *President's Task Force on the NCTM Standards* to "serve as a review group that will provide sustained advice and information concerning K-12 mathematics and the NCTM Standards." From 1997 through early 1999, this Task Force responded to four sets of questions supplied by the NCTM and to a draft of the proposed revision of the 1989 Standards. The final version of the revision was published in April 2000 as *Principles and Standards for School Mathematics* ("PSSM").

Members of the PSSM writing groups have indicated that input from our MAA Task Force was very helpful. Part of the reason may be that our Task Force was able to make consensus reports despite our sometimes diverse views. This article is a summary of a report on the MAA website (see http://www.maa.org/past/maa_nctm.html) which discusses the extent to which PSSM reflects the Task Force's concerns.

**Concern 1:** Most members of the Task Force wanted the revision of the 1989 Standards to be more specific with regard to both skills and expectations for students' intellectual growth from one grade level to the next. They believed that many classroom teachers share this desire and also felt that performance expectations by grade would help states formulate their own standards and would ease the problem of student movement from one region to another. A few members felt, however, that expecting specific performance standards by grade is unrealistic since neither the United States nor Canada has a national curriculum and the variability across states and provinces is great.

**Comment:** Most Task Force members were disappointed that PSSM does not specify performance expectations for each grade.

**Concern 2:** Task Force members were concerned that mastery of basic skills was not sufficiently addressed in the 1989 Standards. None advocated "mindless drill," but they agreed that drills of important algorithms, which enable students to master topics while at the same time learning the mathematical reasoning behind them, can be used to great advantage by a knowledgeable teacher.




*Principles and Standards for School Mathematics* ("PSSM").

**Comment:** PSSM addresses this concern as follows: "Knowing basic number combinations – the single-digit addition and multiplication pairs and their counterparts for subtraction and division – is essential" (page 32). "The point is that students must become fluent in arithmetic computation – they must have efficient and accurate methods that are supported by an understanding of numbers and operations. 'Standard' algorithms for arithmetic computation are one means of achieving this fluency" (page 35).

**Concern 3:** Task Force members expressed the belief that the 1989 Standards did not sufficiently address issues of mathematical reasoning, the need for precision in mathematical discourse, and the role of proof throughout the curriculum. The growing appreciation of the important role of experimentation and conjecture in mathematical thinking may have obscured the fact that reasoning is the foundation of mathematics. While science verifies through observation, mathematics verifies through logical, deductive reasoning. Students need to be consciously aware of the distinction between exploring topics and providing more rigorous arguments. In particular, they need to use terminology in a precise manner and be able to specify their hypotheses, particularly if these are implicit.

**Comment:** PSSM contains significantly more balance than the 1989 Standards between pure mathematics, where reasoning and proof are so important, and exploration and applications. It is notable that the 1989 Standards avoided the use of the word "proof" whereas this word is used throughout PSSM.

PSSM contains many statements similar to these: "By the end of secondary school, students should be able to understand and produce mathematical proofs—arguments consisting of logically rigorous deductions of conclusions from hypotheses—and should appreciate the value of such arguments... Reasoning and proof cannot simply be taught in a single unit on logic, for example, or by 'doing proofs' in geometry... Reasoning and proof should be a consistent part of students' mathematical experience in pre-kindergarten through grade 12" (page 56). "Beginning in the elementary grades, children can learn to disprove conjectures by finding counterexamples" (page 59). Finally, "students should understand that having many examples consistent with a conjecture may suggest that the conjecture is true but does not prove it, whereas one counterexample demonstrates that a conjecture is false" (page 345).

**Concern 4:** Task Force members were concerned that the 1989 Standards' focus on "mathematics for all" appeared to neglect the needs of "some." The task force

agreed that there are good reasons to emphasize that all students can learn mathematics. They recommended, however, that the revision of the 1989 Standards should address the needs, especially at the high school level, both of those students who will eventually become significant users of mathematics and also of the majority of students who will not.

**Comment:** PSSM claims that "there is no conflict between equity and excellence," and it states that "Equity does not mean that every student should receive identical instruction" (pages 12-13). However, little detailed guidance is given about how to meet the needs of a diverse student population.

**Concern 5:** Task Force members agreed that, in order to grow intellectually, students must have significant intellectual demands placed upon them. The 1989 Standards emphasized the responsibility of our profession to stimulate and "mathematically empower" students, but they did not simultaneously emphasize the necessity for students to work hard and stretch their attention spans. Students need to be aware that mathematics is not an inborn inherited trait and that everyone finds it difficult at some stage. They need to realize that in order to succeed they must not stop even when discouraged or frustrated.

**Comment:** PSSM contains several statements about the importance of making mathematics challenging. For example: "Students should view the difficulty of complex mathematical investigations as a worthwhile challenge rather than as an excuse to give up" (page 21). We were only able to find one statement about homework, however.

**Concern 6:** Task Force members were concerned that the 1989 Standards recommended the inclusion of more topics (including statistics and discrete mathematics) and types of activities than the traditional curriculum without giving sufficient guidance about what material should be reduced or eliminated.

**Comment:** PSSM does not explicitly address the issue of how to deal with the increased number of topics and activities proposed for inclusion in the K-12 curriculum. Unlike the 1989 Standards, however, it suggests that "in the middle grades, the majority of instructional time would address algebra and geometry" (page 30). This would ease the pressure on the high school curriculum but may be difficult to implement.

**Concern 7:** Task Force members agreed that the Standards should acknowledge that students learn in a variety of ways and that good pedagogical models should reflect that reality. They also wanted it noted that teachers teach in a variety of effective ways and should be encouraged to develop a good balance of approaches. They recommended that the revision of the 1989 Standards should explicitly caution against any doctrinaire adoption of one particular pedagogy exclusively.

**Comment:** PSSM does not contain the kind of explicit caution recommended by the Task Force, but the general concern that led to the recommendation is addressed: "Teachers have different styles and strategies for helping students learn particular mathematical ideas, and there is no one 'right way' to teach" (page 18).

When PSSM discusses pedagogy, however, it tends to focus on student self-discovery, probably to encourage traditionally-trained teachers to experiment with new approaches. But some of its statements may be construed as minimizing the value of correcting misconceptions before they become entrenched (e.g., page 24).

The pedagogical vignettes seem convincing through grade 5 but are less so later on. Given the large number of topics proposed for the middle and high school curricula, it would appear necessary that the percentage of time devoted to group-discovery activities decrease in later grades, but this issue is not addressed.

**Concern 8:** Task Force members expressed considerable concern about the recruitment and education of future teachers, especially since the 1989 Standards appeared to demand much more of teachers than the traditional curriculum.

**Comment:** The NCTM has explicitly deferred this important issue to other documents and groups. However, the last chapter of PSSM discusses the crucial role of teacher education, including "mathematics teacher-leaders" and "mathematics specialists" in the upper elementary grades, "special teacher-preparation programs" for grades 6-8, and "extended and sustained professional development of teachers" in grades 9-12.

**Concern 9:** The Task Force did not address the issue of technology per se, but it did express general concerns about how technology may be used in mathematics education.

**Comment:** PSSM strongly supports the use of technology in mathematics education but cautions that "Technology should not be used as a replacement for basic understandings and intuitions... As with any teaching tool, it can be used well or poorly" (page 25).

We believe that PSSM outlines an ambitious, challenging and idealized program whose implementation would be a vast improvement over the current state of mathematics education. We hope that the mathematical community will now focus its energy on helping this program achieve its potential, especially by improving teacher education and by becoming more involved with producing high quality precollege texts and teachers' supplements. ■

*Susanna S. Epp is Professor of Mathematics at DePaul University and a member of the President's Task Force on the NCTM Standards. She also serves on the MAA Committee on the Undergraduate Program in Mathematics and the Committee on Calculus Reform and the First Two Years.*

*Kenneth A Ross is Professor of Mathematics at the University of Oregon and a past president of the MAA. He is chair of the MAA Coordinating Council on Meetings, of the Carus Monographs Editorial Board, and of the President's Task Force on the NCTM Standards.*

# Letters to the Editor

### On the 1999 Putnam Competition

After the December 1999 Putnam competition, I mentioned to a friend that it seemed hard to me this year. The friend commented: "Those who find the Putnam difficult are showing signs of their age." Well, I am getting older. But the Putnam *was* hard this year. Too hard. I do not know if this has ever happened before, but the median score for the 2900 participants was 0 points (out of 120; over 60% of the participants scored 0). A score of 1 gave one a ranking of 1116.5 out of 2900.

Now I am sure that, despite the emphasis on making the contest succeed at distinguishing the very best students, the problem setters did not intend to get a median score of 0. But it is worth underscoring how critically important it is that the Putnam not discourage students from pursuing mathematics.

Traditionally, math professors have had a reputation for teaching difficult material and posing difficult problems. But a successful teacher must show some understanding of his audience's capabilities. Many of us encourage our best students to try the Putnam. I and many of my colleagues and my students feel that it is a worthwhile endeavor with some great traditions. But the success of the event is in danger if it regularly happens that over half the participants score 0.

This letter does not mean that we seek an easy Putnam next year. But past versions of this event have had a median score in the 9-11 range, and surely the tradition of having most of the students who take the Putnam come away with a sense of accomplishment rather than of failure and discouragement should be maintained.

Stan Wagon
Macalester College

### G. L. Alexanderson Replies

Professor Wagon is correct, of course, in worrying about the consequences of a 0 median. Those of us involved in the administration of the Putnam Competition are ever aware of the possible consequences of such a difficult examination. For many years 0 medians were routine, and in recent years we have encouraged the Questions Committee to include a few problems that are more accessible so that more students will have a chance to experience some level of success. Still, in spite of the best efforts of all of us, an occasional test turns out to be hard. It should be noted, however, that in spite of the evidence this past year that the test was hard — unusually low scores — we have actually received some complaints that the test was too easy. Some longtime Putnam aficionados are critical of the easier problems, saying that these "are not real Putnam problems". So it's hard to please everyone.

G. L. Alexanderson
Associate Director
William Lowell Putnam Competition

### An Instance of the Fingerpost

I have just finished reading *An Instance of the Fingerpost* by Iain Pears. It is a mystery novel set in the 17th century. Each chapter is told in the first person by a different character. One of the chapters is by John Wallis, Savillian Professor of Geometry at Oxford. He tells of his research along with unflattering opinions of Isaac Newton, Vieta, and the "scribbler" Fermat. His self-revelatory remarks are quite pejorative. As one example he lobbies against the adoption of the Gregorian calendar because it is a Papist construct. One reading this book may find out more about Wallis than he would like to know.

Albert Wilansky
Lehigh University

*Pears' book is one more example of the use of mathematicians as fictional characters; the portrayals are by no means always sympathetic. For another take on this book, see the review on* ***MAA Online:*** http://www.maa.org/reviews/fingerpost.html.

*See also Alex Kasman's web page on "Mathematical Fiction" at* http://math.cofc.edu/faculty/kasman/MATHFICT/.

### Standards-Based Education

There are obvious advantages and obvious disadvantages to Standards-Based Education at the College/University level. The question is really one of conformity versus diversity. Currently, we use a wide variety of personal teaching styles. Is that a good thing or a bad thing?

My own feeling is, if it ain't broke, don't fix it. Mathematics is a respected discipline and our graduates tend to do very well when we send them out into the world. Unlike the K-12 educational system, which has come in for heavy criticism in recent years, college education in the United States is viewed by most people as very good. A change to greater conformity might produce better results. But it might also produce worse results. And it would certainly make a lot of people mad. People who are independent, successful, and self-motivated don't like being told what to do.

Standards-Based Education at the College level sounds to me a lot like one of these ideas that come down from administration, for example: mission statements, faculty activities plans, and time accounting (how many minutes did you spend on research on Friday?). The result is usually a lot of busy work accomplishing nothing.

Rick Norwood
East Tennessee State University

*I expect that we'll see more discussion of Standards-Based Education in future issues of FOCUS.*

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

# USA Team Places Third at the 2000 International Mathematical Olympiad

The the 41st International Mathematical Olympiad (IMO) was held in Taejon, South Korea, on July 19 and 20, 2000. Competing against teams representing 82 countries, a team of six American high school students each won medals, three gold and three silver, and ended up in third place overall.

China had the winning team, scoring 218 out of 252 possible points. The other top teams and their scores were Russia (215), USA (184), South Korea (172), Bulgaria (169), Vietnam (169), Belarus (165), Taiwan (164), Hungary (156), Iran (155), Israel (139), and Romania (139).

The USA Team Leader was Titu Andreescu, Director of the American Mathematics Competitions Program of the Mathematical Association of America. "This year's USA participation was a great success," he said. "It was called a triple-triple: three of our students received a gold medal, three received a silver medal, and three was the rank of our team. We have worked very hard to prepare the team, and all of the students performed remarkably."

The USA team was chosen from a field of 500,000 students taking a series of competitive tests, culminating in the 29th annual USA Mathematical Olympiad, at the University of Nebraska-Lincoln, June 6-July 4, 2000.

**The 2000 USA IMO Team members were:**

Reid Barton, Homeschooled
Arlington, MA
GOLD Medalist

George Lee, Jr., Aragon High School
San Mateo, CA
GOLD Medalist

Ricky Liu, Newton South High School
Newton, MA
SILVER Medalist

Po-Ru Loh, James Madison Memorial HS
Madison, WI
SILVER Medalist

Oaz Nir, Monta Vista HS
Saratoga, CA
GOLD Medalist

Paul Valiant,
Milton Academy
Belmont, MA
SILVER Medalist

*USAMO Winners. Front row from left to right: Yian Zhang, Gabriel D. Carroll, Po-Shen Loh, David G. Arthur, Ian T. Le. Back row from left to right: Thomas F. Banchoff, MAA President, Kamaldeep S. Gandhi, Po-Ru Loh, Reid W. Barton, George Lee, Ricky I. Liu, Oaz Nir, Paul A. Valiant. and Tina H. Straley , MAA Executive Director. Photograph courtesy of Robert Allen Strawn.*

In addition to Andreescu, Deputy Leader Zuming Feng of Phillips Exeter Academy, Exeter, New Hampshire, and USA Leader Observer Richard Gibbs from Fort Lewis College, Durango, Colorado, accompanied the team.

The next International Mathematical Olympiad will be held in Washington, DC, July 5-10, 2001.

The USA Mathematical Olympiad is a program of the Mathematical Association of America, with 14 other mathematics-related organizations as co-sponsors.

Additional support is provided by the Army Research Office, the Office of Naval Research, the Microsoft Corporation, and the University of Nebraska-Lincoln.

**Two representative questions that appeared on the 2000 IMO are as follows:**

**Problem 2.** *Let a, b, c be positive real numbers such that abc =1.*
Prove that

$$(a - 1 + 1/b)\ (b - 1 + 1/c)\ (c - 1 + 1/a) \leq 1.$$

(proposed by USA, Titu Andreescu)

**Problem 4.** A magician has one hundred cards numbered 1 to 100. He puts them into three boxes, a red one, a white one, and a blue one, so that each box contains at least one card. A member of the audience selects two of the three boxes, chooses one card from each, and announces the sum of the numbers on the chosen cards. Given this sum, the magician identifies the box from which no card has been chosen. How many ways are there to put all the cards into the boxes so that this trick always works? (Two ways are considered different if at least one card is put into a different box.) (proposed by Hungary, Sandor Dobos)

## Short Takes

### Putting Mathematics to Music

Larry Lesser of Armstrong Atlantic State University has been described as "the most mathematical songwriter since Tom Lehrer." He has combined his backgrounds in music and mathematics to write an entertaining article on the use of songs in mathematics class. The article, entitled "Sum of Songs: Making Mathematics Less Monotone!", appeared in the May 2000 issue of *Mathematics Teacher*, and is also online at http://www.nctm.org/mt/2000/05/songs.html.

### Newsweek Highlights Mathematics at Williams College

The June 5, 2000 issue of *Newsweek* includes an article on mathematics at Williams College. Accompanied by a photo of "Mel Slugbate" (Colin Adams), the article says that "at Williams College, even calculus is cool." The article emphasizes the success of the Department of Mathematics at Williams in attracting students. The basic technique, says the article, is "fun, imaginative teaching." In contrast with most other departments, described in the article as "arrogant and uncompromising," the Williams professors make their subject friendly by using humor and working hard at "being great teachers." The article tends to trivialize the issues, but all in all its message is that it is possible to make mathematics accessible and fun while not making it trivial.

### Bruce Palka will be Editor-Elect of the *Monthly*

The MAA Board of Governors has chosen Bruce Palka of the University of Texas at Austin as the new Editor-Elect of the *American Mathematical Monthly*. In keeping with MAA tradition, Palka will serve as Editor-Elect during Roger Horn's last year as Editor of the *Monthly*, then will become Editor for a five-year term running from 2002 to 2006.

### AAAS Checks Out Mathematics Textbooks

For some time now, the American Association or the Advancement of Science (AAAS) has been sponsoring **Project 2061**, dedicated to improving the mathematics and science teaching. This April, they released evaluations of mathematics textbooks for middle grades and for high-school algebra based on their previously-released *Benchmarks*.

The report on middle-school textbooks is generally not positive about the state of mathematics textbooks. Their assessment of high school algebra texts is also negative: the press-release is entitled "Algebra for All – Not with Today's Textbooks, Says AAAS."

Check out the web site at http://www.project2061.org for the full text of the Project 2061 report and more information about the project and its goals. See also the **MAA Online** review of Project 2061's *Blueprints for Reform: Science, Technology and Mathematics Education* at http://www.maa.org/reviews/2061.html.

### Symposium celebrates *L'Enseignement Mathématique*

The international journal *L'Enseignement Mathématique* was established in 1899 by Henri Fehr and Charles Laisant. To celebrate its one-hundredth anniversary, the International Commission on Mathematical Instruction (ICMI), together with the University of Geneva, is organizing a symposium to be held at the University of Geneva on October 20-22, 2000. The symposium will also be a contribution to the celebration to the World Mathematical Year 2000. The theme of the symposium is "One hundred years of *L'Enseignement Mathématique:* Moments of mathematics education in the 20th century". The main focus of the symposium will be on secondary education.

See the *EM* home page at http://www.unige.ch/math/EnsMath for more information, or contact the Local Organizing Committee, Symposium EM-ICMI, Caisse Postale 240, CH-1211 Geneva 24, Switzerland. ■

## Read This!

*Recently Reviewed on MAA Online*

Looking for something to read? The MAA Online book review column brings you timely reviews of interesting books related to mathematics. New reviews are posted approximately every two weeks at http://www.maa.org/reviews/reviews.html, from which you can also access the index of past reviews. Recently reviewed books include:

*Arabesques and Geometry,* a video by A. F. Costa & B. Gomez

*The Beginnings and Evolution of Algebra,* by Isabella Bashmakova & Galina Smirnova

*Contemporary Issues in Mathematics Education,* Edited by Estela A. Gavosto, Steven G. Krantz, & William McCallum

*Exploring the Number Jungle,* by Edward R. Burger

*Geometry,* by David. A. Barnnan, Matthew F. Esplen, and Jeremy J. Gray

*How to Ace Calculus: The Streetwise Guide,* by Colin Adams, Abigail Thompson, & Joel Hass

*The Importance of Being Fuzzy,* by Arturo Sangalli

*Inverse Problems: Activities for Undergraduates,* by Charles W. Groetsch

*The Kingdom of Infinite Number,* by Bryan Bunch

*Miles of Tiles,* by Charles Radin

*Reading the Principia,* by Niccolò Guicciardini

*Revolutions in Differential Equations,* Edited by Michael J. Kallaher

*Touching Soap Films,* a video by A. Arnez, K. Polthier, M. Steffens, & C. Teitzel

*Uncle Petros and Goldbach's Conjecture,* by Apostolos Doxiadis

*The Wild Numbers,* by Philibert Schogt

# Employment Opportunities

## CALIFORNIA

**LOYOLA MARYMOUNT UNIVERSITY**
**Clarence J. Wallen, S.J. Endowed Chair in Mathematics**

The Mathematics Department of Loyola Marymount University invites applications for the Clarence J. Wallen, S.J. Endowed Chair in Mathematics. The individual holding the Chair shall teach two classes per semester, carry out his/her own research agenda, develop programs that involve the undergraduate mathematics majors in research or professional activities and engage in departmental and University service. Individuals working in any mathematical area, including mathematics education (especially K-12 teacher preparation), are invited to apply.

The appropriate candidate will have an established scholarly and academic record and should be able to demonstrate success at involving undergraduates in research or professional activities. The appointment to the endowed Chair will be provided a competitive salary at the rank of associate or full professor and budgetary support for program development and research activities. Applications must include a letter of interest that briefly outlines a plan for the development of a program that will involve undergraduates in research or professional activities, a curriculum vita and the names of three references. References may be contacted during the initial screening of applications; finalists for the position will be asked to provide three letters of reference.

We will begin screening applications on October 16, 2000 but will continue to accept applications until the position is filled. The appointment could begin either in the Spring of 2001 or in the Fall of 2001.

Loyola Marymount University is a comprehensive Catholic university whose focus is excellence in undergraduate education. The Mathematics Department, housed within the University's College of Science and Engineering, is a community of fifteen full-time faculty members and 30-40 mathematics majors who work in an atmosphere of mutual respect and collegiality. Additional information about the LMU Mathematics Department and this position can be found on the web at www.lmu.edu/math.

Please send applications and inquiries to:

Dr. Gerald S. Jakubowski
Dean, College of Science
and Engineering
Loyola Marymount University
7900 Loyola Boulevard
Los Angeles, CA 90045-8135
gjakubow@lmumail.lmu.edu
310-338-2834

## CONNECTICUT

**WESLEYAN UNIVERSITY**

The Department of Mathematics and Computer Science invites applications for a senior position in mathematics to begin in the academic year 2001-2002. Candidates for this position must have a Ph.D. in mathematics and are expected to have strong records in research, teaching, and leadership.

Professor/Associate Professor of Mathematics: We seek candidates for a tenured appointment. We are particularly interested in candidates who can support the department's long-standing activity in dynamical systems. Outstanding candidates in all areas of mathematics are encouraged to apply.

Note: We anticipate two junior level openings in the department as well; these will be advertised later in the fall.

Normal teaching duties in mathematics are two courses per semester. These courses range from calculus to graduate topics. It is expected that the successful candidate will assume an active leadership role in the department, including advising doctoral students, participating in the appointment of junior faculty, and chairing the department in due course.

Wesleyan University is committed to increasing the diversity of its faculty and is an equal opportunity/ affirmative action employer.

Applications must be submitted by October 27, 2000, and early application is welcome. Applicants should arrange for at least four letters of recommendation, including one which evaluates teaching, to be sent to the address below.

All correspondence and applications should be submitted to:

Mathematics Search Committee
Department of Mathematics
Wesleyan University
Middletown, CT 06459

Email inquiries may be directed to mathjobs@wesleyan.edu

More information concerning the Department of Mathematics and Computer Science and about Wesleyan University can be found via http://www.math.wesleyan.edu/.

## INDIANA

**FRANKLIN COLLEGE**

Franklin College, a private four-year liberal arts college, invites applications for a tenure-track

assistant professor of mathematical sciences beginning August 2001. Position requires teaching a variety of courses at all levels in a department recognized for innovative approaches to teaching college mathematics. PhD or ABD required. For details see our web page at www.franklincollege.edu/hrweb/faculty_positions.htm.

## MARYLAND

**LOYOLA COLLEGE**

Applications are invited for one, possibly two full time entry level tenure track positions beginning in Fall 2001. Candidates should be recent Ph.D.'s in theoretical or applied mathematics. For the first position, preferential areas are discrete mathematics, algebra, or allied areas, especially coding theory and cryptography. For the possible other position, the department seeks expertise in numerical analysis, differential equations, dynamical systems, mathematical finance, or related areas. Candidates must have demonstrated excellence in teaching and research potential. Experience with innovative teaching techniques, including technology, is a plus. Our homepage, www.loyola.edu/mathsci, provides further information. Loyola College is a Jesuit Catholic institution which welcomes applicants from all backgrounds who can contribute to our unique educational mission. Please submit a resume, statement of research objectives, outline of teaching philosophy, and arrange to have three letters of reference, at least one of which addresses the applicant's teaching ability, sent to Dr. Christopher Morrell, Chair, Department of Mathematical Sciences, Loyola College, 4501 N. Charles Street, Baltimore, MD 21210. EOE.

## MICHIGAN

**MICHIGAN STATE UNIVERSITY**
**Lyman Briggs School**
**Assistant/Associate Professor of Mathematics**

Michigan State University invites applications for a tenure track, academic year, assistant/associate professorship of mathematics position in the Lyman Briggs School, an undergraduate, residential, liberal arts science program within the College of Natural Science. Candidates must have a Ph.D. in mathematics, mathematics education, or statistics and a research record commensurate with an appointment at the assistant or associate professor rank. Preference will be given to applicants with at least five years experience and who are particularly passionate about teaching mathematics to undergraduates. Duties include teaching two of the four Lyman Briggs mathematics courses offered each semester and supervising undergraduate teaching assistants.

This position offers exciting opportunities to collaborate with faculty in the Department of Mathematics, the Division of Science and Mathematics Education, the College of Education, and the Drew Science Enrichment Program on questions about the teaching and learning of mathematics at the undergraduate level. The Briggs School environment offers additional opportunities for integrating mathematics with the other science courses.

A complete application package consists of a cover letter, curriculum vitae, a representative scholarly paper, a personal teaching philosophy statement, a list of undergraduate mathematics courses taught in the last five years, and the names and addresses of three references, all sent in a single mailing. The material should be sent to the Mathematics Search Committee, Lyman Briggs School, Holmes Hall, Michigan State University, East Lansing, 48825-1107. Complete applications should be received by November 1, 2000; later submissions may be considered if suitable candidates have not yet been identified. Questions should be directed to Ms. Kathie Ellis at the above address or (517) 353-6486 or ellisk@pilot.msu.edu

Michigan State University is an Affirmative Action/Equal Opportunity Institution. Applicants who are not U.S. citizens or permanent residents must provide a document of employment authorization for the U.S. Persons with disabilities have the right to request and receive reasonable accommodation. Women and minorities are strongly encouraged to apply.

See www.msu.edu and www.msu.edu/unit/lbs.

## NEW YORK

**SUNY GENESEO**

SUNY Geneseo. 2 year tenure track Assistant Prof. position available Fall 2001. Required: Ph.D. in math, math ed, or stats in hand or expected by June 2001. Semester load 12 hours max of undergraduate courses. For complete description see http://www.geneseo.edu/~math/job.html or e-mail request to west@geneseo.edu.



# MAA Meetings

## Fall Section Meetings

**EASTERN PA and DELAWARE**
November 4, 2000
Penn State Abington
Abington, PA

**INDIANA**
October 28, 2000
University of Southern Indiana
Evansville, IN

**MD-DC-VA**
November 17-18, 2000
American University
Washington, DC

**NEW JERSEY**
October 28, 2000
DIMACS Rutgers University
Piscataway, NJ

**NORTH CENTRAL**
October 20-21, 2000
Bemidji State University
Bemidji, MN

**NORTHEASTERN**
November 17–18, 2000
Providence College
Providence, RI

**OHIO**
October 27-28, 2000
Wittenberg University
Springfield, OH

**SEAWAY**
November 3-4, 2000
SUNY at Fredonia
Fredonia, NY

**SOUTHERN CALIFORNIA**
October 7, 2000
Whittier College
Whittier, CA

## National Meetings

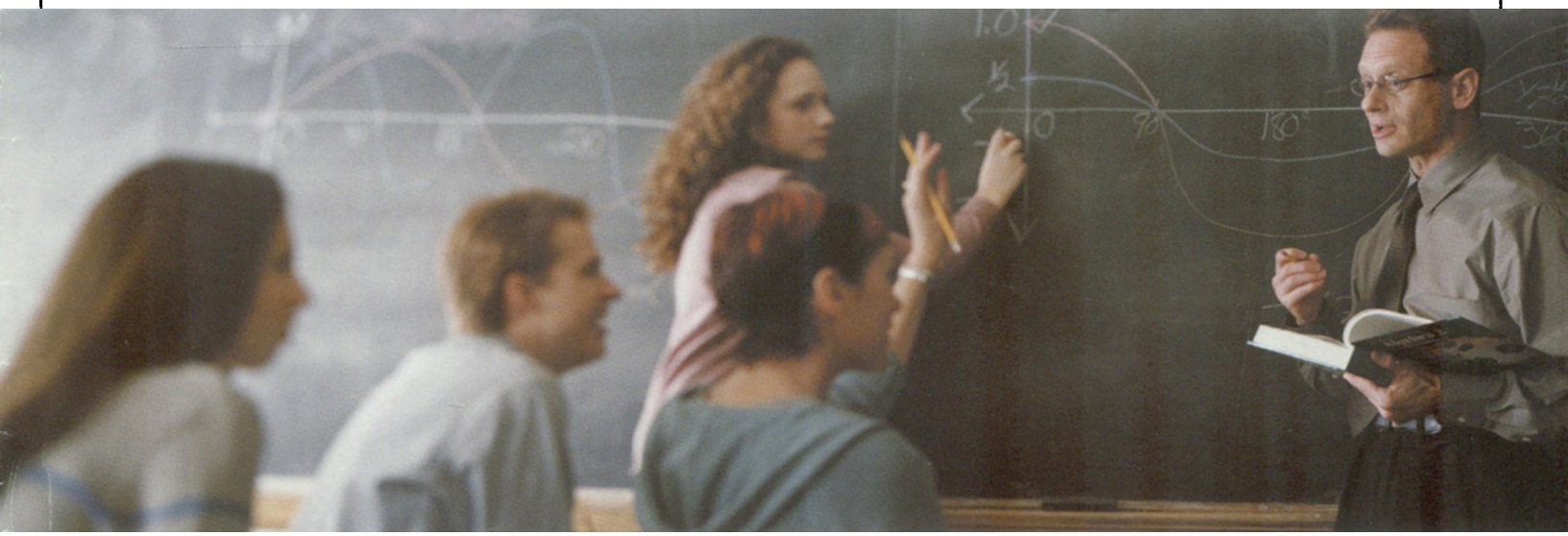
**JOINT MATHEMATICS MEETINGS**
January 10–13, 2001
New Orleans, LA

**MATHFEST**
August 2–4, 2001
Madison, WI

**JOINT MATHEMATICS MEETINGS**
January 6–9, 2002
San Diego, CA

# What Sculpture Is To A Block Of Marble, Education Is To The Soul.

– JOSEPH ADDISON





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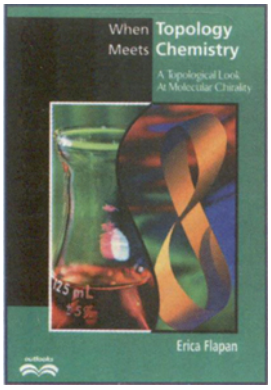
# Two New Interdisciplinary Titles From the MAA



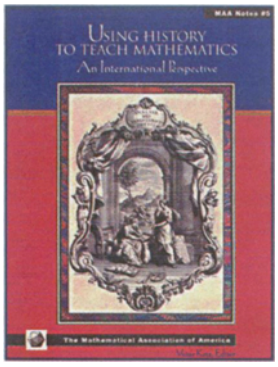

**Catalog Code: TPC/JR**
**250 pp., Paperbound, 2000**
**ISBN 0-521-66482-9**
**List: $29.95**
**MAA Member: $24.95**

## *When Topology Meets Chemistry*

### *Erica Flapan*

The applications of topological techniques for understanding molecular structures have become increasingly important over the past thirty years. In this topology text, the reader will learn about knot theory, 3-dimensional manifolds, and the topology of embedded graphs, while learning the role these play in understanding molecular structures. Most of the results that are described in the text are motivated by questions asked by chemists or molecular biologists, though the results themselves often go beyond answering the original question asked. There is no specific mathematical or chemical prerequisite; all the relevant background is provided. The text is enhanced by nearly 200 illustrations and more than 100 exercises. Reading this fascinating book, undergraduate mathematics students can escape the world of pure abstract theory and enter that of real molecules, while chemists and biologists will find simple and clear but rigorous definitions of mathematical concepts they handle intuitively in their work.

Contents: Stereochemical Topology; Detecting Chirality; Möbius Ladders and Related Molecular Graphs; Different Types of Chirality and Achirality; Intrinsic Topological Properties of Graphs; Symmetries of Embedded Graphs; Topology of DNA.




**Catalog Code: NTE-51/JR**
**300 pp., Paperbound, 2000**
**ISBN 088385-163-6**
**List: $32.95**
**MAA Member: $25.95**

## *Using History to Teach Mathematics*

### *Victor Katz, editor*

This book is a collection of articles by international specialists in the history of mathematics and its use in teaching, based on presentations given at an international conference in 1996. Although the articles vary in technical or educational level and in the level of generality, they show how and why an understanding of the history of mathematics is necessary for informed teaching of various subjects in the mathematics curriculum, both at secondary and at university levels. Many of the articles can serve teachers directly as the basis of classroom lessons, while others will give teachers plenty to think about in designing courses or entire curricula. For example, there are articles dealing with the teaching of geometry and quadratic equations to high school students, of the notion of pi at various levels, and of linear algebra, combinatorics, and geometry to university students, as well as articles showing how to use historical problems in various courses and one dealing with mathematical anomalies and their classroom use. Although the primary aim of the book is the teaching of mathematics through its history, some of the articles deal more directly with topics in the history of mathematics not usually found in textbooks.

**www.MAA.ORG**
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