A Parade of Errors

Keith Devlin

Throughout its long history, Fermat's Last Theorem seems to have generated errors. The long list of those that were led astray by this most tantalizing of problems almost certainly started with Fermat himself, who surely did not have a proof, and continued with such illustrious names as Euler and Lamé.

Time alone will tell if Andrew Wiles is to join this list. Even if he does, his recent work on elliptic curves will stand on its own merits as a phenomenal piece of research. The same cannot be said for the unfortunate article that appeared in *Parade* magazine on November 21 last year. Written by columnist Marilyn vos Savant, the article was titled "The World's Most Famous Math Problem Has Finally Been Solved…Or Has It?"

"Have you ever tried to prove it, and if so, did you succeed?" a reader had asked, with reference to the Last Theorem.

"No, I never tried," replied vos Savant, "and I don't think I would have succeeded even if I had."

Up to this point, I am sure everyone would agree. It was what came next that caused mathematicians across the country to choke on their Sunday morning muffins. "Moreover, I don't think the current work succeeds in proving 'Fermat's last theorem' either—even if no mathematical errors are discovered in it," the article continued.

Vos Savant then goes on to explain the reasoning behind this extraordinary claim. To make a long story short, it seems that vos Savant had picked up on a mention of hyperbolic geometry that appeared in accounts of recent work connected to Fermat's Last Theorem, including the work of Wiles. Putting 2 and 2 together to make 163, the *Parade* columnist jumped to the con-

clusion that what Wiles had done was prove that the Last Theorem held in a universe governed by hyperbolic geometry. Observing that in a hyperbolic universe it is possible to square the circle, vos Savant concluded her reasoning in this way:

"Has Fermat's last theorem been proved, or has it not? I would say it has not; if we reject a hyperbolic method of squaring the circle, we should also reject a hyperbolic proof of Fermat's last theorem. This is not a matter of merely changing the rules (for example, using a ruler as a measuring device instead of a straightedge). It is much more significant than that. Instead, it is a matter of changing whole definitions. And, regardless, it is logically inconsistent to *reject* a hyperbolic method of squaring the circle and *accept* a hyperbolic method of proving F.L.T!"

For the record, the source of vos Savant's substantial confusion seems to be this. Wiles' proof uses objects called modular curves. These are regular algebraic objects that Fermat himself would have no trouble recognizing were he to come back to life today. Seen from the viewpoint of complex analysis, modular curves may be presented in terms of the upper half plane. The upper half plane can be used to construct a model of hyperbolic geometry. And there, at last, you see mention of hyperbolic geometry. Wiles' proof can be presented with no reference to hyperbolic geometry whatsoever.

In response to the vos Savant article, MAA President-Elect Kenneth Ross wrote to her. He also asked *FOCUS* if it would publish his letter. Along with many other mathematicians, he was concerned that the record be set straight. Mathematicians are well used to finding errors in proofs, but they are hardly so stupid that they would fall into the kind of trap vos Savant described. Ross eventually received a short, ungracious re-

MINNEAPOLIS MATHFEST

FOCUS

Editorial

Image Problems Ahead?

To be or not to be? That is the question when it comes to Andrew Wiles' announced proof of Fermat's Last Theorem, reported in the August 1993 issue of *FOCUS*, not to mention throughout the world's press.

Wiles made his claim at the end of a series of three lectures he gave at a small meeting of number theorists at the Isaac Newton Institute in Cambridge, England, last June. The powerful new techniques he outlined in his proof, together with his own track record as a research mathematician, were enough to convince the audience that the new proof was probably correct. And, since that audience included many of the world's most highly qualified experts in the area, that was good enough for the rest of us. Such was the complexity of Wiles' argument that, even with his 200-page proof in front of us, most of us would in any case have to rely on the judgment of those experts. Not that Wiles was giving out copies of the proof. So we accepted the assurances of others that the argument looked sound.

Several months later, with doubt still hanging over the proof, it seems to me that our attitude was perfectly reasonable. Mathematics is unique to human learning in having an ultimate, decisive notion of proof. But in the form the discipline is actually practiced, things are never so cut and dried. We make guesses, we follow hunches, we make value judgments. Mostly, we are right. But, occasionally, we are wrong.

As I recall, everyone involved said at the time that there was, of course, always the possibility of some subtle error in the proof. This is normal in mathematics, especially with a proof as long, as complex, and as novel, as Wiles'. Wiles himself refused to circulate copies of his paper, preferring to await the outcome of the refereeing process for publication in the journal *Inventiones Mathematicae*. It was very much business as usual in the mathematical community.

What was different in this case was that a proof of Fermat's Last Theorem was big news, not just within mathematics but in the world at large. Within hours of Wiles' announcement, the world's press were converging on Cambridge. A "probable proof" is not news; a theorem is. Unusually for mathematicians, an on-the-spot decision was necessary.

So impressive were Wiles' new techniques, that most people who were able to appreciate fully what he had done were prepared to stick their necks out and vote for it being correct. Even now, when the proof seems to be stuck on a particularly thorny detail, no one has reduced their admiration for what is acknowledged to be one of the most impressive pieces of mathematics produced in this century. That Wiles' work constitutes a major advance in number theory is not in doubt. The only question is, do his results imply Fermat's Last Theorem?

Actually, that is not the only question. Given the immense amount of publicity that has surrounded the whole affair, what do we say if the present proof turns out to be unfixable? Or even if, contrary to everyone's expectations, Fermat's marginal comment turns out to be false? Do we face an "image problem"? We probably do, but I don't think it is because we were wrong about Wiles. There is plenty of evidence to indicate that part of the reason why so many young people are put off by mathematics at an early age is that it seems so cold, so factual and impersonal. Mathematicians portray themselves as a breed apart, perfectly logical beings who always know the right trick, the appropriate substitution, the relevant lemma. We write books that are heavy on fact and logic, but low in passion and personality. Not for us the squabbles of the physicists or the cosmologists, to say nothing of the folks in comp. lit. and economics. Just take a look at almost any mathematics book. To the uninitiated, it must seem as though we have a direct line to God.

What better way to start to dispel this myth than for a quiet, unassuming Englishman in Princeton to think he has solved a famous three-hundred-year-old problem, and for the mathematical community to be so overjoyed that they talk freely to the press and television, write

ply to his letter, but so far there has been no retraction of the article in *Parade*.

Along with Ross' letter, *FOCUS* is also publishing a letter from Harvard number theorist Barry Mazur. Mazur's letter concerns a book vos Savant wrote on the solution to Fermat's Last Theorem. In his letter, Mazur is not so much concerned with the book's contents as its suggestion that he, along with other leading number theorists, had read and endorsed the text prior to publication. As Mazur states, he did no such thing.

Ross' Letter

Dear Marilyn:

I am generally very pleased with how your interest in mathematics has helped publicize the fact that mathematics is an exciting and living discipline. In particular, your columns on the goat and car problem have been widely used in courses throughout the country. Many of us were appalled at some of the rude letters you received from mathematicians questioning your qualifications. And we would have been equally appalled whether you were right or wrong. Happily you were right.

Unfortunately, your November 21 article in *Parade* misrepresents the situation with Wiles' solution of Fermat's Last Theorem. When you get some more rude letters from mathematicians, please be assured that they do not represent the great majority of us. Of course, you have probably heard the rumors that there are some potential holes in his very complicated proof, but that's not the issue before us. Let's assume that all the holes can be patched. You evidently still question the validity of such a proof because it uses hyperbolic geometry.

It is true that one can question whether elliptic geometry is a valid description of the real world. Likewise, one can question whether hyperbolic geometry can be used to describe the physical world. These questions are matters for physicists to decide. But, as you yourself point out, these new systems have their own definitions and systems of logic. As mathematical constructs, their validity is not in question.

Indeed, it is possible to make a model of hyperbolic geometry in the Euclidean plane. The most famous such model was invented

by Poincaré, and used by Escher as the basis of his picture "Limit Circle IV" showing angels and devils in a circular disk. This model shows that hyperbolic geometry is as consistent as Euclidean geometry. The model is, of course, a mathematical construction and does not help us decide the correct geometry of the physical universe.

I fully agree that it's not fair (or relevant) to square the circle in hyperbolic geometry and claim this is valid in Euclidean geometry. Clearly the original problem from the Greeks was set in Euclidean geometry. However, the following is imaginable if the circle could be squared in Euclidean geometry. An ingenious proof might rephrase the problem into a **logically equivalent** statement in hyperbolic geometry, solve the problem in that setting, and then rephrase it back to the original geometry. This would be a perfectly valid argument. Presumably someone would come up with such a proof because they were somehow able to use the intuition and understanding of hyperbolic geometry to shed light on the original problem. However, if such a proof existed it could be rephrased without the language of hyperbolic geometry since at every stage there would be a logically equivalent statement in the usual geometry.

Of course, no such proof can exist to show that the circle can be squared. But this transfer of setting is essentially what has happened with Fermat's Last Theorem. The "theorem" is just a statement in number theory but it has been shown to be logically equivalent to (or a consequence of) some very high-powered theorems some of which happen to be in the setting of hyperbolic geometry. No physics is involved and so the question of whether hyperbolic geometry describes the real world doesn't come up. As you know, some of the most fascinating and exciting results in mathematics have been shown by ingeniously viewing the problem in an entirely different setting. Assuming Wiles' proof survives the tough scrutiny it is getting right now, it is the ultimate example of such a result.

If you haven't already done so, I urge you to discuss this material further with an expert. I recommend Kenneth Ribet at Berkeley. He's a very affable fellow with a full understanding of this complicated story.

Kenneth Ross
University of Oregon

The Hiccup in Wiles' Proof

Though Fermat's Last Theorem is what grabbed the headlines, the work Wiles described in his short lecture course in Cambridge last June was a significant development in the theory of elliptic curves. The connection with Fermat's Last Theorem follows from a result proved by Kenneth Ribet in 1986. Ribet showed that the Last Theorem is true provided the so-called Taniyama-Shimura-Weil Conjecture holds for a certain class of elliptic curves.

What Wiles did is establish this conjecture for a large class of elliptic curves, namely, those for which it is possible to calculate precise upper bounds for the sizes of certain associated algebraic structures known as Selmer groups.

Experts who have seen his work agree that this part of the proof is correct.

At issue is whether the class of elliptic curves for which Wiles' argument works includes those necessary to deduce Fermat's Last Theorem.

There seems to be agreement among the experts that the answer should be yes, or, even if that is not the case, that Wiles' original argument can be modified to include the relevant elliptic curves. But so far, neither Wiles nor anyone else has managed to find the right combination of ideas.

For most mathematicians, the only thing to do is wait and see.

-Keith Devlin

Mazur's Letter

Dear Dr. Devlin:

Ms. vos Savant has written a book titled [*Is It Solved?*] *The World's Most Famous Math Problem*, and in it she includes an acknowledgement to me. This acknowledgement has misled some people.

Before noticing Ms. vos Savant's book in a bookstore, I had never read a word of anything she had written. My only contact with her is that I answered a telephone request by

sending her a reprint of one of my articles. On the basis of this level of familiarity, Ms. vos Savant writes, "And a personal 'thank you' to Barry Mazur, Kenneth Ribet, and Karl Rubin for being such good sports...." Ms. vos Savant goes on to recite my CV for the next eight lines of her text.

All this may give the impression that I had some prior knowledge of Ms. vos Savant's book (I didn't), or that I see some merit in it (I don't).

Sincerely yours,

Barry Mazur
Harvard University

Regional Minicourses

During the past year through the generous funding of IBM and the MAA Interactive Mathematics Text Project (IMTP) minicourses have been and will be offered in the IBM computer labs at the IMTP sites. Most of these regional minicourses have been one to one and a half days in length. These include:

"Teaching Calculus Laboratories Using the Derive Symbolic Computational System," Carl Leinbach and Marvin Brubaker, November 19-20,1993.

"Geometer's Sketchpad," Jim King and Jim Swift, Seattle Central Community College, December 3-4, 1993.

"Use of Computing in the Ordinary Differential Equation Classroom," Robert Borrelli, Los Angeles Pierce College, March 5, 1994.

"Using Derive and Gyrographics in Calculus and Linear Algebra," Jerry Johnson and Benny Evans, Morehouse College, March 25-26, 1994.

These regional minicourses have been well-received. Due to the success of these regional minicourses, the MAA Committee on Minicourses is seeking suggestions for locations, topics, and presenters for future regional minicourses. Regional minicourses would typically continue the same one to one and a half days format. Sites and courses with and without computer labs are being sought. Suggestions for locations, topics, and/or presenters should be sent by June 1, 1994 to: Wade Ellis, (408) 867-2200 x6341; wellis@applelink.apple.com; or Carl Leinbach, (717)337-6630; leinbach@gettysburg.edu.

articles on the new development, and organize public lectures and distribute videotapes of the event. Real mathematics in action, for all the world to see. Real, living mathematicians in action for all the world to see. Hooray!

Regardless of the eventual outcome of the present episode in the history of the Last Theorem, given the events of the past few months, it is probably true to say that our immaculate, all-knowing image has already been tarnished, maybe forever, leaving us looking much more like the rest of humanity. I certainly hope so.
—Keith Devlin

The above are the opinions of the FOCUS *editor, and do not necessarily represent the official view of the MAA.*

Secretary's Report

G. L. Alexanderson

The Secretary's Report on the Cincinnati meeting can be unusually short since the actions taken by the Board of Governors have been reported in the February issue of *FOCUS*. I thought, however, that I should bring the members up-to-date on actions taken at the Business Meeting in Cincinnati. The membership approved (with one slight editorial change) the by-laws revisions proposed by the Board of Governors and described in some detail in the December issue of *FOCUS*, pp. 5-6. In the new Section 5 of Article V, the word "or" was inserted before (2) to make it clear that items could be formally acted on at Business Meetings if *any one* of the three conditions listed is satisfied.

In addition to the formal business before the membership, President Kreider announced the newly named Deborah and

Functioning in the Real World
The Math Modeling/PreCalculus Reform Project
An NSF-Supported Faculty Workshop
Long Island, NY, June 10-11, 1994

See an alternative to standard Precalculus or Algebra/Trig courses in the spirit of the Calculus Reform Movement. The emphasis is on the applications of mathematics, focusing on families of functions, fitting functions to date, difference equations, modeling periodic phenomena, and probability simulations. The course can serve either as a preparation for calculus or as a capstone mathematics experience.

For further information, contact:

Sheldon Gordon
Suffolk Community College
(516) 451-4270
SGORDON@SUNY.EDU
or
Ben Fusaro
Salisbury State University
(410) 543-6470
BAFUSARO@SAE.TOWSON.EDU

Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics. A certificate was presented to the third Pólya Lecturer, Professor Carl Pomerance of the University of Georgia. The selection of the fourth Pólya Lecturer had been approved by the Board of Governors at its meeting a few days earlier: Professor Robert Osserman of Stanford University.

The Joint Prize Session at these meetings was expanded to include the Association for Women in Mathematics; therefore, included among the various prizes given by the MAA and the Bôcher Prize of the American Mathematical Society was the newly established AWM Louise Hay Award for Contributions to Mathematics Education. The Joint Prize Session this year was unusually well-attended.

1994 NSF Calculus Reform Workshops

Don Small

Calculus Instruction, Crucial but Ailing, the panel discussion held during the AMS-MAA Joint Meetings in 1985, opened the door to calculus reform on the national level. With this, the Reform Movement expanded rapidly; a year later, the four panelists were joined by approximately twenty others at the Tulane Conference (*Lean and Lively*) sponsored by the Alfred P. Sloan Foundation. The following year the number of participants had grown to over 600 at the Washington Colloquium, Calculus for a New Century (*A Pump, Not a Filter*), sponsored by the National Academy of Sciences and the National Academy of Engineering.

About this time, technology in terms of graphing calculators and computer algebra systems running on desktop computers became (and continues to be) a driving force for reforming calculus instruction. Recognizing a groundswell becoming a tidal wave, the NSF opened its purses in 1988 in support of the Movement. Numerous small planning grants, as well as a few major multi-year development grants, were funded, currently including the NSF's Instrumentation and Laboratory Improvement program which has helped develop computer labs across the country. The NSF has also been a primary source of funding for conferences and workshops to spread the word on calculus reform.

Listed below, the eight Calculus Reform Workshops for this summer are part of the NSF's efforts to disseminate the work of numerous calculus reform projects that have been undertaken over the past few years. In all of the projects, although to varying degrees, content has been streamlined, applications have been stressed, technology has been exploited, and pedagogy has been changed. The purpose of these workshop programs is to make the fruits of these projects available on a national level wherever calculus is taught: high schools, community colleges, four year colleges, and universities.

Workshop instructors are drawn from the ranks of those who have led the Reform Movement. They will, in their respective workshops, illustrate the use of the particular materials and methods they have developed. They will also share their experiences in developing materials and in overcoming obstacles (need for new resources, skepticism of client disciplines, colleague resistance) that often confront curricular reform.

Besides having the opportunity to participate in the activities of a particular approach to reform, participants will be asked to consider the criticisms that led to the Calculus Reform Movement, will be presented with a national overview of responses that are being tried, and asked to reflect on the goals and expectations they bring to their teaching of calculus. They will then be asked to consider their own situations and formulate plans for action for their home institutions.

All workshop participants' expenses other than transportation will be paid by the National Science Foundation. Early application is recommended as enrollment is limited.

For general information, contact Don Small, Department of Mathematical Sciences, USMA, West Point, NY 10996; (914) 938-2227; email: ad5712@usma2.usma.edu; FAX: (914) 938-2409.

1994 NSF Calculus Reform Workshops

(Call or write Local Contact for information.)

May 22-27, 1994 Harvard Consortium Program
Instructors: Karen and Joe Thrash (University of Southern Mississippi)
Local Contact: Mike Pearson
Department of Mathematics
Mississippi State University
Mississippi State, MS 39762
(601) 325-3414

June 5-10, 1994 *Core Approach to Calculus*
Instructor: Don Small (U.S. Military Academy)
Local Contact: CPT Morgan Cornstubble
Department of Mathematical Sciences
USMA
West Point, NY 10996
(914) 938-5987

June 5-10, 1994 Oregon State Program
Instructor: Tom Dick (Oregon State University)
Local Contact: Jack Porter
Department of Mathematics
University of Kansas
Lawrence, KS 66045
(913) 864-4367

June 19-24, 1994 *Calculus in a Real & Complex World*
Instructors: Frank Wattenberg (University of Massachusetts)
Dick Rogers and Jim Peters (Weber State University)
Local Contact: Kendell Hyde
Department of Mathematics
Weber State University
Ogden, UT 84408-1702
(801) 626-6095

June 19-24, 1994 *Project Calc*
Instructors: David Smith, Lang Moore, Sam Morris (Duke University)
Marcelle Bessman (Frostburg State University)
Local Contact: Sunny Norfleet
St Petersburg Junior College
Clearwater, FL 34624
(813) 791-2561

June 27-July 1, 1994 *Calculus in Context*
Instructor: Ken Hoffman (Hampshire College)
Local Contact: Janet Beery
Department of Mathematics
University of Redlands
Redlands, CA 92373
(909) 793-2121

July 11-16, 1994 ACM/GLCA Materials
Instructors: Anita Solow (Grinnell College)
Phil Straffin (Beloit College)
Local Contact: Wayne Roberts
Department of Mathematics
Macalester College
St Paul, MN 55105
(612) 696-6337

July 31-August 5, 1994 *Calculus with Mathematica*
Instructor: Bill Davis (Ohio State University)
Local Contact: Tom Ralley
Department of Mathematics
Ohio State University
Columbus, OH 43310
(614) 292-2254

Correction

Interactive Mathematics Text Workshops

The following workshops for the Interactive Mathematics Text Project were inaccurately listed in the February 1994 FOCUS. For further information, contact: Project Director, Gerald Porter, Department of Mathematics, University of Pennsylvania, 209 S. 33rd Street, Philadelphia, PA 19104-6395, E-mail: gjporter@math.upenn.edu.

Teaching Calculus with Calculus and Mathematica
July 25–30
Los Angeles Pierce College
Juan Manfredi

Teaching Differential Equations using Interactive Texts
July 25–30
Morehouse College
Dan Schwalbe

Using Mathcad to create Interactive Texts
July 25–August 6
Towson State University
David Royster

Twenty-Second Annual Mathematics and Statistics Conference

Miami University, Oxford, Ohio

September 30–October 1, 1994

Theme: Classical Analysis and General Topology in the Undergraduate Curriculum

Principal Speakers: Mary Ellen Rudin, Walter Rudin, and Grahame Bennett

Abstracts for contributed papers should be sent by June 20, 1994, to:

Zoltan Balogh or Patrick Dowling
Department of Mathematics and Statistics
Miami University
Oxford, OH 45056

Conference programs with information concerning preregistration and housing will be available after July 15, 1994.

Carnegie Planning Grants Awarded to Thirteen Recipients

Bill Hawkins

The MAA awarded $50,000 in SUMMA Small Grants to 13 college and university faculty in February. The awards were intended to assist them in the design and implementation of mathematics-based intervention projects serving underrepresented minority students in middle and high schools.

The Carnegie Corporation of New York gave the MAA a second two-year grant of $350,000 [FOCUS, April 1993] in support of this project. This year's recipients bring the total number of SUMMA awardees to 49. A conference for them to work on project design and to learn proposal-writing techniques was held at MAA headquarters on February 25-27.

As in the past three years, a variety of institutions and regions are represented. The awardees come from minority and majority institutions, four-year liberal arts colleges, comprehensive, and research universities. One mathematician at a tribally controlled college received a grant and five other project directors plan programs for Native American students.

The 1994 awardees are James Bidwell (Central Michigan University), David Boliver (University of Central Oklahoma), Claudette Bradley (University of Alaska-Fairbanks), Dale Brekke (Benedict College, South Carolina), J. Brian Conrey (Oklahoma State University), Abid Elkhader (Northern State University, South Dakota), John Harris (Lemoyne-Owen College, Tennessee), Philip McNeil (Norfolk State University, Virginia), Celestino Mendez (Metropolitan State College of Denver), John Schiller (Temple University), Mazen Shahin (College Misericordia, Pennsylvania), Robert Smith (Miami University, Ohio), Peter Walther (Salish Kootenai College, Montana).

The success of previous SUMMA awardees bodes well for this new class. Eighteen of the previous thirty-six have submitted proposals to the NSF's very competitive Young Scholars Program, of whom ten received funding. All four who submitted to the NSF Summer Science Camps Program have been funded. Seven others have secured Department of Energy and local funding. The Carnegie funds ($575,000 to date including $200,000 in Small Grants) have leveraged more than $5 million in support for new projects. In addition, SUMMA staff have assisted a number of mathematicians who did not receive grants in securing other forms of funding. Last summer, 1300 minority students participated in these projects. Many other minority youngsters will be enriched mathematically this summer, as more and more mathematicians make encouraging pre-college students to pursue mathematics-based careers a part of their professional activities.

Bill Hawkins is Director of MAA's SUMMA Program.

Call For Papers

Seventh Annual MAA Undergraduate Student Paper Sessions

The seventh MAA Undergraduate Student Paper Sessions will take place at the joint MAA/AMS Summer Meetings in Minneapolis, MN, August 15-17,1994. A limited number of awards to support student travel are available through a grant from the Exxon Education Foundation. For further information and/or to submit nominations for fifteen minute papers from MAA sections, mathematics departments and other interested parties, along with brief abstracts, contact: Ron Barnes, Computer /Math Sciences, Univ. of Houston-Downtown, 1 Main St., Houston, TX 77002, or e-mail to barnes@dt.uh.edu. Deadline for nominations and submission of abstracts: June 25.

The New Job Diary

Edward Aboufadel

Our intrepid diarist completes his ac-count of his first year as a university professor. This final episode holds both good and not-so-good news. Stay tuned, from April of 1993 to the end of the aca-demic year, and discover an embarrassment at Toad's Place, what the mathematical profession and law firm partners have in common, a connection with Bulgaria, an idea for a second ca-reer, and last, but not least, Speed Calculus. Will our diarist be satisfied? Let's hope so. Leaving him finding a foothold, we say farewell ...

APRIL 8: The Computer Conference was last weekend and I gave my talk entitled, "Using a Computer as a Mathematician to Develop Intuition." When you are trying to outline your dissertation and how you used computers, twenty minutes goes by very quickly. When the moderator signaled me to wrap it up, I thought I had been talking for only five minutes.

I made some professional contacts at this conference. I met a mathematician from Central Connecticut, one of our sister schools. I asked him a lot of questions about his department, and discovered that things are similar at both institutions. I also met a physicist from Central. Talking with her made me realize that it would be healthy to talk with the chemists, biologists, and physi-cists here at Southern. Unfortunately, there never seems to be enough time.

On Monday I got some bad news. My pro-posal for a Connecticut State University research grant, which I applied for in Febru-ary, was rejected, as was the proposal of a colleague in my department. What was par-ticularly depressing was that 50 out of the 64 proposals were funded. I am trying to deter-mine what was inadequate about my proposal. It was very similar to the proposal I submitted a while back for Reassigned Time, and that one was accepted.

Teaching has had its ups and downs lately. I have been feeling a bit unsure in the class-room, and I think it is in part because I haven't had a clear vision of what I want to teach and at which level I want to teach it. For instance, Differential Equations can be taught as a cookbook course, as a rigorous analysis course, or any place in between. How tough do I get? How precise should I be with defi-nitions (which, in my opinion, often disguise the underlying ideas)? These are the types of questions that I don't want to be trying to answer while I am standing in front of the chalkboard.

Also, some of my inexperience with teach-ing certain material has been showing (for instance, in the Qualitative Analysis course). This is the first time I have ever taught prob-ability, and sometimes I don't have a clear enough idea of what I want to stress. As a result, a couple of times this semester I have thought, "Oh, I should have spent more time on that idea and that type of problem." On the other hand, when I teach this course again in the fall, it will be just perfect!

One of my colleagues has students this se-mester that I had last semester. He told me that he went and looked at the grades I gave to see if they matched his perceptions of these students. It turns out that they match pretty well.

About once a month, we have a department lunch, giving us time to sit around and chat. We had one of these meals today. At one point the discussion topic was textbooks and coauthors. I think that multiple authors and multiple editions of textbooks is our profession's version of partners in a law firm. As time passes, authors are added and pres-tige grows.

APRIL 15: I grow more and more fascinated by our chair selection process. Of the three people who received 25% of the vote last month, one has said that he doesn't want to be chair, while the other two are campaign-ing. Today we had another meeting to discuss the future of the department. People who have said practically nothing so far opened up and expressed their opinions. It was hard for me to get a word in today. It was hard for our two "candidates" to get a word in today.

I have had hour-long conversations with three people in the last two days about our department and our next chair. As I listen and ask questions, I am getting a richer view of the recent history of this place and the quality of the interactions among the faculty here. Some people have long memories.

Somewhat in humor, somewhat not, I sug-gested that we need to buy a coffee pot and set it up somewhere. Unfortunately, we don't have a lounge to sit in and chat. Perhaps I'll go buy a coffee pot next week.

On Tuesday, I had a soda with Bill Berlinghoff. He used to be on the faculty here, and now he is a senior writer for an NSF project which is designing new high school mathematics curricula. After read-ing some of my writings, he was wondering if I was interested in working as a writer for the project. Although I have no experience with writing textbooks, I expressed some interest. It wasn't a formal offer, though, and we'll have to see what happens.

APRIL 21: Recently, I spent a little bit of my valuable time as an organizer for a meeting of mathematics majors at Southern. The meeting was last Friday, and we had a good turn out. Thirty-five students attended, and more than half of the department faculty. By our estimates, we have about 80 majors, but it is surprisingly difficult to pin that number down.

Also recently, I made an error in judgment concerning a test. After I returned a test last week, one of my students, who is failing, asked if he could retake the test. I was kind of tired at the time and perhaps not thinking straight, and since the student was failing, I agreed to his proposal. Well, he then went and told his two friends in the class, who were also not doing as well as they liked, and they also asked if they could retake the test. One of the students suggested that I compute the average of the two grades.

Since I had allowed the first student to re-take the test, I was hard-pressed to find a rationale for denying the requests of the other students. So I let the students take another test. After they took the new test, though, I gave them a lecture about being responsible students and being prepared the first time, because I wasn't going to allow them to take make-up tests again. I'll see after the next

test if my lecture made any difference.

The funny thing about make-up tests, though, the students usually don't do any better.

APRIL 23: Today I had a conversation with Harry Haakonsen, a professor in the Chemistry Department at Southern and a member of the committee that decided on the CSU research grants. That was the grant that I didn't receive. Harry gave me some information and some advice.

First of all, there were eight people on the committee to decide these grants. Each one ranked the proposals from 1 to 64 (or roughly so), and the eight opinions were averaged together. My average ranking was 55 out of 64 and only 50 grants were funded.

Harry actually liked my proposal and considered it "fundable." He said that he ranked me in the middle of the pack. Now, I'm a mathematician and can do the arithmetic. If he ranked me at, say, 35, the other seven must have not liked my grant proposal at all.

Harry had some ideas as to why I wasn't very popular. First, I made many connections between my dissertation and what I planned to do in the future. Harry suggested replacing "my dissertation" to "prior work." In this way, grant committee members won't ask, "Why didn't he do this in his dissertation?" You know, though, thinking of my dissertation as "prior work" represents a significant change in my viewpoint. Up until now, my thesis has been my point of reference. To demote it to "prior work" is a bit troubling, although I also see it as inevitable.

A second point Harry made was not to be so certain in my abstract. One line of my grant abstract reads, "The purpose of this project is to answer the question in the affirmative ...." Perhaps I shouldn't try to sound so confident, I guess.

A third point was that a timeline would help. In the grant proposal, I listed five goals of my project, without giving an idea as to how much time I would spend trying to accomplish each goal. Rather, I had a global statement about how I would accomplish these five goals in the next twelve months. Harry felt that a timeline would give people more confidence in me.

The fourth point had to do with the fact that many of the eight committee members were non-scientists and that they had a lot of grant applications to read through. While Harry, a chemist, could appreciate the "profoundness of the questions" (his words) I was planning to explore, a historian, for example, would be harder-pressed to appreciate the scientific merit. It might impress this historian if I clearly point out how my proposal would enhance the visibility of Southern Connecticut State University, or clearly point out how my project had potential for future external funding. (These are both stated in the grant guidelines as priorities for these grants.)

For the most part, Harry's criticisms were about style and not substance. There were other proposals that he objected to because of substance. A couple of these, unfortunately, got funded ahead of mine. (For example, one proposal that was funded was for a professor to write a commercial trade book for which he would also receive royalties. Is this research? Does it deserve to be funded by CSU?) Harry told me that the committee was going to meet again next week to discuss the process that they used to award these grants.

In other news, I voted today in the second Chair Preferential Poll. Results are expected next week.

APRIL 26: Sometimes it is not easy being a young professor, because even though you are different than your students, you are not terribly different. On Saturday my girlfriend and I went to Toad's Place, which is a nightclub in New Haven, for their Saturday Night Dance Party. After some dancing and a beer, I ran into one of my students. I'm not really sure who was more embarrassed by this encounter. When I saw her, I felt that I needed to act "professorial," to maintain the professional space between us. Basically I felt inhibited the rest of the evening. After all, we professors can't be seen as enjoying ourselves, can we?

News travels fast, and today in class my students were staring at me in amazement. Dr. Aboufadel ... at Toad's Place?!! This will probably be a running joke for the rest of the semester.

I hope no one sees me at the mall.

APRIL 27: I just finished talking with Allyn Jackson, who is an editor for the *AMS Notices*. She is writing an article about the attitudes of young mathematicians, and wanted to hear what I had to say about subjects such as the job market, this squabble about flat-rate funding at the NSF, the Young Scientists' Network, and whether or not senior members of the mathematical community care enough about us. Some things that I told her: that I thought the job market wasn't any better this year than last year; that this fracas about flat-rate funding seems rather distant to my concerns at this time; that some of the frustration that young scientists feel in 1993 is in part due to rosy scenarios about the demand for scientists that were tossed around in the middle '80s; and that the senior members of the mathematics community are beginning to understand that something is wrong.

I guess an interview like this is a result of my minor fame. It's nice.

MAY 7: There were further strange twists and turns recently in our unending chair selection process. The second Preferential Poll was invalidated last week because of some irregularities in the ballots. We're not sure who is responsible, but as a result, one of the front-runners decided that he didn't want to be chair after all, and this week we had poll number 2.1. After this vote, there were two people who got a lot of votes: Bob Washburn and Kerry Grant. Kerry declined being chair, too. So, we are going to tell the dean that a lot of people don't want to be chair, while Bob can tolerate the idea. Congratulations, Bob.

Actually, I don't mean to belittle the process or the position of chair. It is an important position. It is also quite time-consuming, and I can understand why some people are not interested.

I received exciting e-mail this week from Bulgaria. Zhivko S. Athanassov from the Bulgarian Academy of Sciences expressed interest in my dissertation. He said that he and his colleagues have been trying to get a copy, but that they have been unable to, so could I send one? I wonder how they found out about me. Was it through *Dissertation Abstracts*? *FOCUS*?

I asked Dr. Athanassov to tell me more about his colleagues. I am awaiting a response.

I am once again faced with students asking to retake a test that they did poorly on. Three students made this request this week after I returned a test on Wednesday. None of these students were the students that I dealt with last month. I told each student that I would think about it.

My first thought was to wonder why so many students were getting this idea in their heads that I would allow them to retake tests. You should do a good job on a test the first time, right? Out of curiosity, I pulled up each student's transcript on the computer. Two of the three were on academic probation, facing academic dismissal if their grades didn't significantly improve. The third was taking the course for a second time because he needed a C in the course for his program, and last time earned a D+. I then pulled up the files on the students from last month and discovered that they, too, were facing academic dismissal. Their requests started to make more sense.

My feelings remained mixed, though. On the one hand, allowing these students to retake the test wouldn't be fair to the rest of the class, although I had already bent the rules once this semester. And maybe, just maybe, granting their requests would help them avoid academic dismissal. My gut feeling, though, is that even if I allow them to take the test over, it isn't going to make much difference. And what about the bigger question of why they are doing so poorly in the first place?

I decided to allow each of the students to retake the test, and that I would average the two grades. I also decided to give this a lot of thought over the summer and perhaps develop some sort of policy that I can be comfortable with.

MAY 8: Dr. Jo Ann Parikh stopped by my office yesterday afternoon. She is a professor in the Computer Science Department here, and is working on a problem that involves minimizing a complicated, many-variable function, subject to many constraints, and some of the functions are two-valued. Since the problem is related to differential equations somehow, she wondered if I had any advice on how to tackle it. I was a little embarrassed at first to say that I didn't even understand some the terminology she was using. (I've got to get a handle on what a "neural net" is.) But then I got over the embarrassment, realizing that I don't know everything, and directed her to the USENET newsgroup sci.math. She didn't know anything about the newsgroups, though, so I demonstrated them to her.

Later, I wondered if this was an opportunity for some sort of future research collaboration.

Although, perhaps I should consider a change of careers. Heidi Allen, one of my students in Calculus both last semester and this one, told me today about a request she considered asking me back in February. Heidi works at a bridal boutique, and the shop was organizing a fashion show. One of the male models fell ill the day before, however, and Heidi considered asking me to substitute for him, "because [I'm] tall and thin like he is." She didn't get up the nerve, though. Too bad. It would have looked good on my vita.

MAY 18: Last night I learned Professional Lesson #344: Never put together a test when you are in a bad mood. The final that I gave last night in my Calculus III class was, I admit, tough. One of my best students said, "They were all cockroach problems," referring to a challenging problem that I put on an earlier problem set. It is a bit of an overstatement, though. (After all, the first question was easy.) But ambitious testing is one reason why we have "the curve" available.

It is finals week, and I am rather busy. Along with a take-home test, my differential equations students are being examined in a twenty-minute oral. The range of knowledge of some of my students is stunning. Others are a lot less impressive. Although these examinations are time-consuming (taking up to seven hours of my time this week), I feel that they are worthwhile.

Also this week I am putting the finishing touches on a manuscript to be sent out to a research journal. I haven't mentioned much recently about doing research because I haven't had a lot of time to do anything. But I have made some time recently.

And that has been a recurrent theme with me, hasn't it? Finding the time, the energy, the motivation, the resources, and the support to do research—it seems like I never can get all five going at the same time. Right now I am more motivated than I was last fall, but I have less energy, because I am teaching more this semester.

How does this look to the world? Am I becoming another one of those PhDs who never gets out of the gate after graduate school? Will I ultimately be judged a failure because my professional career isn't filled with NSF grants, twelve journal articles a year, doctoral students to advise, and invited lectures at AMS meetings? (And who will be doing this judging anyway?)

Is it unfortunate that for years I have been interested in good teaching, so that by the end of graduate school I had one dissertation, no published papers, and several courses taught under my belt? I don't know. Success has many guises. Do I have to choose between scientist and teacher?

MAY 26: Spring semester is over and the first summer semester has already started. I am teaching Calculus I this Summer, a five-week course that meets two-and-a-half hours a day, five days a week. I tell my friends that I am teaching "Speed Calculus."

This week I have made the post office rich. I sent a copy of my dissertation to Bulgaria, and I sent many copies of my manuscript to the *SIAM Journal on Applied Mathematics*. As I said before, research has been a big issue with me all year, and I'm glad to end the academic year on a positive note.

I have some ideas about new mathematical questions to try to answer this summer and fall. And, despite my grumblings the other day, between going to the SIAM meeting in Philadelphia, my reassigned time in the fall, and the possibility of giving a talk at the Joint Meetings in Cincinnati, I am actually beginning to establish a research career.

Looking back over this diary, I see a few other major themes. One is a certain self-consciousness that I think went away after my contract renewal. Another is teaching, which has dominated my life. (I find myself falling asleep at night, thinking about what I am going to lecture on the next day. It must be time for a vacation.)

Another theme has been administration and bureaucracy. Grants, tenure, budgets, and elections are integral parts of the academic life, and I think the events of this year have left a bit of a sour taste in my mouth. Like anything else in life, there are winners and losers, but the arbitrariness of it all has been a bit troubling for me. It's just like the job search—nothing seems rational. It's just like life.

But, all in all, I'm happy with how this first year went. I enjoy teaching, and I accomplished a lot.

Well, as Andy Warhol would say, my fifteen minutes are up.

Postscript A few months later: Since the end of May, a few events have occured in relation to some of the topics in my diary. The

Young Mathematicians' Network was set up this summer, and although I didn't lead the creation of YMN, I am one of the founders. The on-again, off-again budget went on again, as money that was taken away from the department in March was returned to us in July.

On the research front, I got some work done this summer, as I began to see how chaos fit into my problem. The manuscript I sent out in May got passed around to three different journals before it was actually peer reviewed, and then it was rejected. Friends and colleagues implored me to submit it again "Now! Right now! Right this minute!" and I did. I gave my talk in Philadelphia, too, but no one heralded me as the next Poincaré.

I've always heard that mathematicians have low-stress careers. It doesn't look that way from here.

Lately I've been thinking about what I want out of this career as a mathematician. There are three desires that I have that are sometimes at odds with each other. One is the desire to feel secure—to have a secure job. The second is the desire to experience the joy of learning mathematics and teaching mathematics. The third is to earn some glory. Will I be satisfied?

Bringing Women into Mathematics

Would your department like to operate a program to bring more women into mathematics?

With NSF support, Mills College will hold a conference at the University of California at Berkeley, July 14-16, 1994, to bring together people interested in developing projects to increase the flow of women into graduate programs in the mathematical sciences. Some funds are available to help defray travel costs for eight to ten conference participants. Mills College will operate one such project for the fourth summer, in 1994. The NSF has encouraged Mills College to find other institutions wishing to develop related projects beginning in 1995. Out of this conference will come a proposal to the NSF for funding projects at more than one institution. Interested individuals should contact Leon Henkin by sending e-mail to kathyg@mills.edu or by telephoning (510)430-2227.

Edyth May Sliffe Award Winners

Walter E. Mientka

Since the acceptance by the MAA of the bequest of the Sliffe Estate in 1988, 118 high school teachers have been honored as winners of the Edyth May Sliffe Award for Distinguished High School Mathematics Teaching.

The award winners are selected according to directives in Edyth's will, in which she stated that the MAA is "to give awards to high school mathematics teachers whose teams do well on the American High School Mathematics Examination." Specific mechanisms not specified in her will for making the awards were determined by the MAA Edyth May Sliffe Awards Committee.

The list of 1993 winners is given below. They receive a cash award, an elaborate MAA certificate, a one-year membership in the MAA, and a Sliffe lapel pin.

We are pleased to recognize these outstanding teachers.

Patricia J. Yovonovitz, University High School, Tucson, AZ

Elisabeth M. Klein, Albany High School, Albany, CA

April Scott, Monta Vista High School, Cupertino, CA

Richard Klier, Acalanes High School, Lafayette, CA

Walfred L. Lester, Palos Verdes Peninsula High School, Rolling Hills, CA

Paraskevi Steinberg, John F. Kennedy High School, Sacramento, CA

David F. Doster, Choate Rosemary Hall, Wallingford, CT

Thomas E. Morris, Berkeley Preparatory School, Tampa, FL

Edward C. Martin, Nova High School, Davie, FL

Lynne Tsuda, Punahou School, Honolulu, HI

Linda S. Muhly, West High School, Iowa City, IA

John R. Brunsting, Hinsdale Central High School, Hinsdale, IL

Saleh Rahman, Lexington High School, Lexington, MA

Carlton Jack, Swampscott High School, Swampscott, MA

William L. Harris, Huron High School, Ann Arbor, MI

Ross Arseneau, Detroit Country Day School, Beverly Hills, MI

Irene Stein, Fair Lawn High School, Fair Lawn, NJ

David Bock, Ithaca High School, Ithaca, NY

William L. Bagwell, Beavercreek High School, Beavercreek, OH

Shirley Stigler, Lubbock High School, Lubbock, TX

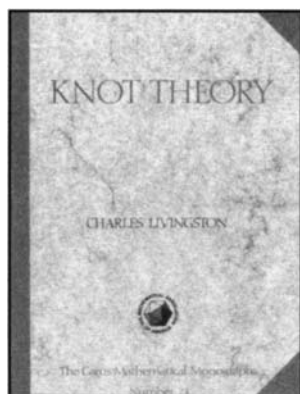**Mark Milner, Western Canada High School, Calgary, Alberta**

Nori Mark, Cedarbrae Collegiate Institute, Scarborough, Ontario

C. G. H. (Kip) Sumner, Upper Canada College, Toronto, Ontario

Bruce J. White, Vincent Massey Secondary School, Windsor, Ontario

Walter E. Mientka is Executive Director of the American Mathematics Competitions.

Personal Opinion

What Society Means By Mathematics

David Fowler

What is mathematics? The answer you will get to this question depends upon whom you ask. What most people in the United States have experienced is not mathematics—it is not even an elementary or student version of mathematics. It is an entirely different subject—one that could be called "schoolmath." Schoolmath has its own terminology. The rational numbers between 0 and 1 are called The Fractions. The multiplicative inverses of these numbers are called The Improper Fractions. Students are taught that the Improper Fractions exist in a sort of unstable equilibrium and should always be reduced to Mixed Numbers. (An article by Hassler Whitney first got me thinking of this.)[1]

Schoolmath has its own protocol ranging from the Story Problem to the Two-Column Proof, the latter taught in a course called Geometry. And schoolmath has its own set of beliefs about the working world—for example, beliefs about how people in all professions use schoolmath to solve problems. A typical belief is that carpenters spend a great deal of time sawing long boards into many short boards, and must therefore be skilled at dividing one mixed number by another. The truth about carpenters is that their work requires highly developed spatial visualization skills—skills that they don't get from schoolmath at any grade level, and certainly not in Geometry. The cognitive psychologist Roger Schank compiled a collection of similar beliefs in an article titled "Let's Eliminate Math from Schools."[2]

Although many people survive schoolmath and may even become mathematicians, most people end up—as Keith Devlin has pointed out in an article in the *Notices of the AMS*[3]—thinking of what they studied as "mathematics."

Is schoolmath a necessary step to learning mathematics? No. In fact, schoolmath pre-

vents most people from doing mathematics in any real way, just as contrived "schoolmusic" pieces discourage most people from being musicians. During the period 1962-72 in the U.S.A., mathematicians and some mathematics educators attempted to replace schoolmath with a version of mathematics that was generally called "new math." This did not work for several reasons; in fact, it inspired a "back-to-basics" movement that returned to schoolmath with a vengeance.

In 1972, Seymour Papert introduced Logo, and argued in a paper called "Teaching Children To Be Mathematicians Versus Teaching About Mathematics" that children could be mathematicians in an authentic sense, just as children could be artists or musicians.[4] Papert was not talking about prodigies. His attempt was not to produce little Bourbakists, as many of the new math people had seemed inclined to do, nor was it to set up phony "discovery" situations where children somehow always came to the conclusion the teacher had previously prepared. Papert used the example of a child trying to construct a Logo procedure for some form that the child wanted the turtle to draw, such as a "squiral," and argued that children engaged in such activities were doing mathematics. In some cases, Logo is now taught as Papert intended. In other cases, teachers are suggesting that Logo be replaced by a "better drawing program," which suggests that the original purposes for Logo were not universally understood.

The mathematics reform movement, whose constitutional document is the *NCTM Curriculum and Evaluation Standards*, offers a rational plan for evolving from schoolmath, first to a better schoolmath, eventually to a version of real mathematics.[5] This plan is, in fact, the official U.S. agenda for mathematics education.

I think that an alternative reform movement is also underway—one driven by emerging technologies rather than by official action. In an earlier *Notices of the AMS* article, Devlin described a student "brought up from early childhood on a diet involving MTV, Nintendo, graphical calculators packed with algorithms, [and] Macintosh-style computers"[6] that might very well bypass schoolmath and directly encounter mathematics in a sense close to that described by Papert.

My phrase "directly encounter mathemat-

ics" includes a bundle of assumptions. One is that mathematics is real, as defined by Penelope Maddy in *Realism in Mathematics*.[7] Another assumption is that "proof" is an inevitable consequence of mathematical discourse. Proof will "die" only when mathematicians stop talking to each other. (This scenario could play out in the realm of "Moravec computers," those machines imagined by computer scientist Hans Moravec that contemplate the universe and keep humans around as amusing pets.[8] Such machines might finally cast mathematics into a vast Kolmogorov hypercube in which proof becomes merely a matter of navigational directions for moving from one vertex to another.)

Meanwhile, we are learning to perceive mathematics through a new set of tools. A commonly reproduced sixteenth century illustration (for example, on the cover of Crump's *The Anthropology of Numbers*)[9] shows the Contest between the Abacist and the Algorist. The Abacist uses a mechanical system and Roman numerals, while the Algorist uses pen and Hindu-Arabic notation. Who won? The Algorist, until now.

Now the Abacists have returned with new devices. No one confuses these devices with mathematics itself, although mathematical notation, which is also a tool, is so closely identified with mathematics, that many people can't tell the difference. (Why else do we learn TEX?) I had a brief glance at these devices at the Minnesota Geometry Center. Seeing a preview of the new video *Outside In* and watching Tamara Munzner run Geomview on a Silicon Graphics computer,[10] I found myself thinking that perhaps Euclid had barely looked at beauty. Still, a month earlier I had watched Barry Mazur outline the Wiles proof at the Vancouver AMS-CMS-MAA meeting,[11] and there I also felt the presence of beauty, but from "outside the temple," which is how Andy Gleason described most people's perceptions of mathematics, in Howard Gardner's book on multiple intelligences.[12]

Which brings us back to what society means by "mathematics." I must agree with the talking doll who said, "Math class is tough." She was referring to what I call "schoolmath," which *is* tough, and for most people barely worth the effort. Real mathematics is also hard work, but hard work directed toward a better goal. If children

could take charge of their own learning and "be mathematicians" in Papert's sense, they would have a better chance of reaching that goal. We might find that some children are intuitively algorists, while others seem to be naturally drawn (or lured by computer graphics such as *Not Knot*)[13] to the abacist camp. They would all end up with a better understanding of what is meant by "mathematics."

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David Fowler is an assistant professor in the Department of Curriculum and Instruction, Teachers College, University of Nebraska-Lincoln.

Letters to the Editor

Dear Professor Devlin:

I submit as my "marginal comment" the following. I have a truly remarkable refutation of Wiles' proof of Fermat's Last Theorem, but it won't fit into the margin contained herein.

While it would be nice if Wiles succeeds, an interesting *FOCUS* editorial would be to explain why the mathematics community, and the MAA in particular, shed its usual conservatism (witness the cover of several publications, including the August 1993 *FOCUS*) and, not being able to wait for verification, proclaimed virtually unequivocally that the theorem was proved.

Sincerely,

Elliott A. Weinstein
Baltimore, Maryland

Dear Dr. Devlin,

The understandable excitement over Dr. Andrew Wiles' proof of the Shimura-Taniyama-Weil conjecture for semi-stable elliptic curves which implies Fermat's Last Theorem has prompted me to comment on some of the impressions given by recent publications (e.g., *Time*, *Newsweek*, and *FOCUS*). Firstly, that the Fermat conjecture has held the unofficial status of theorem for so long without comment or correction by mathematicians escapes me. Standards of rigor are usually carefully observed and quickly distinguish conjecture from established theorem. The famous Riemann Hypothesis has at least as much circumstantial evidence in its favor as Fermat's conjecture but has not yet been endowed with the rank of theorem. For just as one counterexample would overturn the Riemann Hypothesis, conceivably so would be the case with Fermat's conjecture. Which brings me to Wiles' proof. I am surprised by the haste in jumping to the conclusion that Fermat's conjecture has been proven ("Fermat's Last Theorem, a Theorem at Last," *FOCUS*, August 1993) before Wiles' proof has been completely checked. I think, therefore, that the posture most suitable at this early stage with respect to Wiles' proof should be similar to that which has been expressed in the past, most notably regard-

ing the proof of the Four-Color conjecture, i.e., to distinguish a proof from a non-proof it must be checked by other mathematicians (see T. Tymoczko's "Computers, Proofs and Mathematicians: A Philosophical Investigation of the Four-Color Proof," *Mathematics Magazine* 53 (May 1980): 131-138). Some may claim, with a measure of justification, that Wiles' proof on initial inspection has the best chance in recent history (maybe a 95+% chance) of being correct. However, as Yoichi Miyaoka discovered in 1988, validation is by no means assured and retractions can be rather disappointing. Although the possibility for error is mentioned in all the articles I have read, it is not given adequate emphasis. I would have expected a more guarded optimism from the mathematics community regarding the status of the proof until its veracity is confirmed.

Should Wiles' proof withstand all scrutiny and be judged rigorous and correct, I would hope that "Fermat's Last Theorem" will at last be granted its rightful status as Wiles' Theorem (first, last, nth, or whichever). So as not to give a false impression, I would be most happy to learn of confirmation of Wiles' proof. He has my deepest respect for his achievements, although I am not familiar with that field of specialty to the extent necessary to fully appreciate what he has done.

Thank you for your attention.

Sincerely,

John M. Coker
Shawnee, Kansas

Dear Dr. Devlin,

In an editorial in the December issue of *FOCUS*, you bemoan the fact that the coverage given in the press to Wiles' proof of Fermat's Last Theorem is so poor. You point out misrepresentations and outright inaccuracies, but most of all that no one picked up on the immense cultural significance of this

proof. For, you ask, "In what other subject can a question raised over 350 years ago be as fresh and crisp and meaningful today as it was when the ink on Fermat's page was still wet? In what other walk of life can one be so sure of the absolute truth of a particular statement as happens with a mathematical proof?"

Given your point that science reporters don't know enough mathematics to appreciate it, must we come to the conclusion that we need to get science reporters to learn more mathematics? To me, this would seem to be an unlikely occurrence. Better we should get mathematicians to be better journalists.

Consider your editorial itself—literate, interesting, perceptive. If the conclusion about science reporters were left out it would make an excellent magazine or newspaper article. Yet instead of appearing in the popular media it appears in *FOCUS*, read only by a limited number of mathematicians. I think the conclusion should be that the mathematical community does a lousy job of P.R.

Now I will be the first to admit that I don't know how to go about getting such an article

out where it will be read. So perhaps *FOCUS* could take on the job of educating us. This might take the form of case studies of successes, tips from journalists or whatever. Then if we are occasionally prodded and given topics we might write about, *FOCUS* could have the positive effect on boosting the mathematical literacy of the public.

Richard R. Patterson
Department of Mathematical Sciences
Indiana University-Purdue University at Indianapolis
January, 1994

Note: The co-editors of the Ohio Journal of School Mathematics, *the journal of the Ohio Council of Teachers of Mathematics, reprinted Keith Devlin's December editorial in their February 1994 issue.*

MD-DC-VA MAA Section Workshop

A five-day workshop, sponsored by the MD-DC-VA Section, will be given at Frostburg State University on the Western Shore of Maryland this May. This is the 19th year that the Section has sponsored a workshop.

"Surfaces, soap bubbles and general relativity," May 31–June 3, 1994, will be given by Dr. Frank Morgan of Williams College. Morgan is an MAA Distinguished Teacher and is widely known for his clear and dynamic lectures on geometry.

The cost for the five-day workshop, including room and board, is $215. For further information, contact Dr. John Biggs, Department of Mathematics, Frostburg State University, Frostburg, MD 21532, (301) 689-5291, or Dr. Ben Fusaro, Department of Mathematics and Computer Science, Salisbury State University, Salisbury, MD 21801, (410) 543-6471.

Two Bing Stories

It was a dark and stormy night ... R H Bing had volunteered to drive some stranded mathematicians from the fogged-in Madison airport to Chicago. Freezing rain pelted the windscreen and iced the roadway as Bing drove on—concentrating deeply on the mathematical theorem he was explaining. Soon the windshield was fogged from the energetic explanation. The passengers too had beaded brows, but their sweat arose from fear. As the mathematical description got brighter, the visibility got dimmer. Finally, the conferees felt a trace of hope for their survival when Bing reached forward—apparently to wipe off the moisture from the windshield. Their hope turned to horror when, instead, Bing drew a figure with his finger on the foggy pane and continued his proof—embellishing the illustration with arrows and helpful labels as needed for the demonstration.

The above story was told, independently, by two of Bing's colleagues, Armentrout and Burgess. Colleagues who knew Bing well report that they avoided raising mathemati-

cal questions when he was driving. The following story links Bing with his teacher and colleague, R. L. Moore.

Bing received his Ph.D. in 1945 under the guidance of R. L. Moore—writing his dissertation on "Planar Webs." Planar webs are topological objects now relegated to the arcana of historical topological obscurity. The results from his dissertation appeared in one of his earliest papers in the *Transactions of the AMS*. Many years later he reported to colleagues that the *Transactions* had sent him fifty reprints at the time and if anyone was interested they could have some because he still had forty-nine or so left.

But Bing did not have long to wait for recognition of his mathematical talent. In June 1945, the month after receiving his Ph.D., he proved a famous, long-standing, unsolved problem of the day known as the Kline Sphere Characterization Problem. When word spread that an unknown young mathematician had settled this old conjecture, some people were skeptical. Moore had not checked Bing's proof since it was his policy

to cease reviewing the work of his students after they finished their degrees. Moore believed that such reviews might tend to show a lack of confidence in their ability to check the work themselves. So when a famous professor wired Moore, asking whether any first-class mathematician had checked the proof, Moore replied, "Yes, Bing had."

R H Bing was born October 10, 1914, and died April 28, 1986.

The above stories were part of a Memorial Resolution to R H Bing prepared by a special committee at the University of Texas at Austin, consisting of Michael Starbird, William T. Eaton, Cameron Gordon, and Robert Greenwood, with the assistance of S. Singh of Southwestern Texas State University. They were kindly submitted to FOCUS by Leonard Gillman.

If readers of FOCUS have any similar stories about famous mathematicians that they are willing to share with the rest of the membership, please send them in to the FOCUS editor.

New from the MAA

Proofs Without Words

Exercises in Visual Thinking

Roger B. Nelsen

Proofs without words are generally pictures or diagrams that help the reader see *why* a particular mathematical statement may be true, and *how* one could begin to go about proving it. While in some proofs without words an equation or two may appear to help guide that process, the emphasis is clearly on providing *visual* clues to stimulate mathematical thought.

Proofs without words have a long history. In this collection you will find modern renditions of proofs from ancient China, classical Greece, twelfth-century India— even one based on a published proof by a former President of the United States! However, most of the proofs are more recent creations, and many are taken from the pages of MAA journals.

The proofs in this collection are arranged by topic into six chapters: Geometry and Algebra; Trigonometry, Calculus and Analytic Geometry; Inequalities; Integer Sums; Sequences and Series; and Miscellaneous. Teachers will find that many of the proofs in this collection are well suited for classroom discussion and for helping students to think visually in mathematics.

160 pp., Paperbound, 1993
ISBN 0-88385-700-6
List: $27.50   MAA Member: $22.00
Catalog Number   PWW

Cryptology

Albrecht Beutelspacher

FR BRX XQFHUVWCQG WKLV? If you can't decipher this coded message, you must read this book!

How can messages be transmitted secretly? How can one guarantee that the message arrives safely in the right hands exactly as it was transmitted? Cryptology—the art and science of "secret writing"—provides ideal methods to solve these problems of data security.

The first half of this book studies and analyzes classical cryptosystems. Here we find Caesar's cipher, the Spartan scytale, the Vigenère cipher, and more. The theory of cipher systems is presented, including a description of the best possible cipher, the one-time pad. An introduction to linear shift registers, which serve as building blocks for most presently used ciphers, is also given.

The second half of the book looks at the exciting new directions of public-key cryptology, which since its invention in 1976, has revolutionized data security. The author also looks at the famous RSA-algorithm, algorithms based on "discrete logarithms," the so-called zero-knowledge algorithms, and the smart cards that bring cryptographic services to the man-on-the-street.

Although the mathematics covered is non-trivial, the book is fun to read, and the author presents the material clearly and simply. Many exercises and references accompany each chapter. The book will appeal to a wide audience including teachers, students, and the interested layman.

176 pp., Paperbound, 1994
ISBN 0-88385-504-6
List: $26.00   MAA Member: $20.00
Catalog Number CRYPT

New from the MAA

In Eves' Circles

Joby Milo Anthony, Editor

A very special volume for all of Eves' thousands of admirers. If your interest is history of mathematics, geometry, or pedagogy, then this book is for you.

Howard Eves celebrated his eightieth birthday in 1991. To honor that occasion, the University of Central Florida sponsored a conference that focused on the lifelong interests of this prominent American mathematician, namely, the history of mathematics, the teaching of mathematics, and geometry.

The conference was unique. Conference participants included pre-college mathematics teachers, community college and university teachers, and research mathematicians. Papers were delivered in sessions devoted to the classroom teacher, to the history of mathematics, and to pedagogical and research interests in geometry. Many lectures combined these subjects. This book presents some of those lectures. Anyone involved with teaching or producing mathematics can find something in this volume that will be interesting to them.

Also included in this volume is a penetrating interview with Eves by Donald J. Albers.

220 pp., 1994, Paperbound
ISBN-0-88385-088-5
List: $24.00
Catalog Number NTE-34

MAA Strategic Plan

The Strategic Plan was approved by the Board of Governors at their meeting in Cincinnati on January 11, 1994. This plan is designed to be a working document that provides the basis for activities of the MAA for the next several years. (See February 1994 FOCUS for a description of the development and approval process of the Strategic Plan.)

Below is a listing of all the initiatives contained in the Strategic Plan. A copy of the full Strategic Plan is available upon request from the MAA Washington office, 1529 18th St., NW, Washington, DC 20036, Attn: Meredith Zimmerman, (202)387-5200, E-mail: MAAHQ@maa.org.

The original 1915 charter of the MAA declared that the purpose of the Association is to "assist in promoting the interests of mathematics in America, especially in the collegiate field." Three-quarters of a century later, that charter still shapes the mission of this organization:

Mission: **To advance the mathematical sciences, especially at the collegiate level.**

Program Goals

The traditions and mission of the MAA lead to four major program goals towards which most activities of the Association are aimed: education, professional development, students, and public policy. These goals express the mission of the Association in particular terms:

A. Education.

Stimulate active learning, promote effective teaching, and encourage appropriate assessment in the mathematical sciences.

• Produce a report for the mathematics community describing highly successful undergraduate mathematics programs.

• Work with AAHE and MSEB to document more sophisticated ways of evaluating teaching.

• Identify and foster graduate programs in the mathematical sciences that are especially effective at preparing students to teach.

• Inform mathematical sciences departments more clearly of the urgency for change in teacher preparation.

• Provide leadership to the mathematical community in the use of new technology-based mathematics classroom materials.

• Propose changes in the content and teaching of courses in the mathematical sciences to reflect better the ways mathematics is used in different disciplines and industrial settings.

• Prepare a set of recommendations for content, pedagogy, and assessment of upper division mathematics courses.

• Encourage research and studies to determine how to be effective in teaching, learning, and assessment.

• Conduct a study of the state of statistics education at the collegiate level, possibly in cooperation with the American Statistical Association.

B. Professional Development.

Foster scholarship, professional development, and a spirit of association among mathematical scientists.

• Promote a broadening of the reward structure.

• Identify, publicize, and work to increase opportunities for faculty to engage in professional development both in corporations and academia.

• Strengthen and broaden MAA's program of campus consultants.

• Establish programs to inform and involve new PhDs in education reform.

• Promote electronic discussion groups; provide access to electronically stored databases, documents, and archives; and provide links to electronic services offered by other organizations or individuals.

C. Students.

Enhance the interests, talents, and achievement of all individuals in the mathematical sciences, especially of

members of underrepresented groups.

• Take steps to recruit actively and to nurture mathematics students at all levels.

• Develop creative activities, both competitive and cooperative, for students in the mathematical sciences at various levels.

• Launch a program to make mathematicians throughout the country aware of the importance of the atmosphere in their departments and to provide them assistance, so that women, and others, will want to continue in mathematics to the extent of their interests and abilities.

• Greatly expand MAA activities that are career-related.

D. Public Policy.

Influence institutional and public policy through effective advocacy for the importance, uses, and needs of the mathematical sciences.

• Continue to work with JPBM and other mathematical organizations to identify key public policy issues that affect the mathematical sciences.

• Advocate continued funding of mathematics education at levels adequate to meet needs.

• Create a Corporate Forum for Collegiate Mathematics, possibly in cooperation with SIAM, in order to link MAA activities more closely with corporations which employ mathematics majors.

Operational Goals

In addition to program goals that directly support the Association's mission, other goals are necessary for effective and efficient operation of the MAA. These operational goals enable the MAA to remain strong, to work effectively towards its mission, and to carry out its program goals:

I. Sections.

Strengthen local opportunities of MAA members for leadership and influence.

• Design a program that will aid Sections in developing Section Action Plans.

• Develop working partnerships between MAA Sections, MSEB state coalitions, and NCTM affiliates to support state K-12 education reform.

II. Publications.

Advance quality exposition of mathematics for students, faculty, professionals, and the public.

• Strengthen the publication offerings designed for MAA members.

• Publish books of career information for students (and faculty).

• Strengthen efforts to publish books designed primarily for educated non-members who have an interest in things mathematical.

• Expand MAA activities related to establishing and maintaining archives.

III. Governance.

Enhance effectiveness of MAA governance.

• Initiate regular Board review of MAA programs in relation to goals and priorities in the Strategic Plan.

• Provide opportunities for MAA leaders to become more knowledgeable about the workings of the Association and about the positions of responsibility that they are assuming.

• Set up electronic services for governors, Section officers, and committee chairs, designed to keep them well informed about the national affairs of the MAA.

IV. Membership.

Expand MAA membership to include those who have a professional stake in college-level mathematics.

• Launch a multi-pronged initiative to shape and strengthen the membership of the Association.

• Launch a special campaign to increase and broaden institutional membership to reflect the variety of higher education and of non-academic institutions that employ mathematicians.

• Develop a strong systematic program for member retention, using special inducements for each segment of membership.

V. Finance.

Enhance financial support for current and new MAA programs.

• Develop new marketing and advertising strategies for publications and meetings.

• Seek to increase MAA's endowment substantially.

• Expand the planned giving program, providing prospective donors with additional information and options for special gifts.

• Increase the capacity of the MAA to secure grants for major initiatives.

• Establish a line item of $25,000 — $50,000 annually for project initiation funds which can be used to develop proposals for initiatives emerging from this Strategic Plan.

Washington Outlook

Lisa Thompson

New National Science and Technology Council to Coordinate Federal R&D

During his campaign for president, Bill Clinton expressed faith in science and technology as engines of economic growth, and hinted he would elevate science and technology policy to a level of highest concern in his administration. Late last year, President Clinton fulfilled many expectations when he issued an executive order establishing the National Science and Technology Council (NSTC).

According to a White House news release, "The principle purposes of the NSTC will be to establish clear national goals for federal science and technology investments and to ensure that science, space, and technology policies and programs are developed and implemented to effectively contribute to those national goals." The president himself will chair this cabinet-level body, which is intended to function as do the National Security Council and the Economic Policy Council.

Originally proposed by the National Performance Review—a set of recommendations to improve the workings of nearly every federal entity—which was formulated under the leadership of Vice President Al Gore, the NSTC will assume the responsibilities of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), as well as two other White House panels on space and materials.

The president has asked the council to conduct an across-the-board review of the federal R&D budget to align spending priorities with national goals. The NSTC will establish nine committees to prepare coordinated R&D strategies and budget recommendations in the following areas:

- Health, Safety, and Food R&D
- Fundamental Science and Engineering Research
- Information and Communication R&D
- Environment and Natural Resources Re-

search
- Civilian Industrial Technology R&D
- Education and Training R&D
- Transportation R&D
- National Security R&D
- International Science, Engineering, and Technology

The FY 1995 budget proposal, which the administration must release soon, will bear some marks of enhanced priority-setting and interagency coordination, a process pioneered by FCCSET over the past several years. White House sources say the full review is expected to be completed in time for incorporation into the FY 1996 budget proposal a year from now.

The president also established at the same time a President's Committee of Advisors on Science and Technology (PCAST), a private-sector advisory group for the president and the NSTC. PCAST will consist of fifteen distinguished individuals from industry, education, and research and will be co-chaired by John Gibbons, the Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy (OSTP).

The president envisions PCAST as a forum to seek advice from the private sector with regard to orienting federal investments in science and technology toward national goals, and as a mechanism to encourage public-private partnerships such as the Clean Car Initiative the administration developed last year with U.S. automakers.

Congressman Rick Boucher (D-VA), chair of the House Science Subcommittee, has introduced legislation to codify Clinton's plans for the NSTC and PCAST, thereby institutionalizing the increased visibility of science and technology within the White House policymaking apparatus.

His bill amending the National Science and Technology Policy, Organization, and Priorities Act of 1976—which established OSTP and FCCSET—would require annual submission of a consolidated R&D budget that identifies the president's priorities for science and technology and the societal goals those priorities are designed to address.

The bill would go even further than Clinton with a proposal to establish a National Sciences and Technologies Assessment Panel to assess the nation's performance in critical technologies and major fields of research.

Such a panel would be in keeping with recommendations made in a recent report from the Committee on Science, Engineering, and Public Policy of the National Academy of Science called, "Science, Technology, and the Federal Government: National Goals for a New Era."

Boucher's bill also adopts the primary recommendation of that report by declaring as policy that the U.S. "should be among the world leaders in all major areas of science, and should maintain clear leadership in selected major areas of science." The decision to select a field for clear leadership would be based on how it contributes to the national goals identified by the NSTC.

With or without the Boucher bill, the Clinton administration clearly intends to reshape the federal science and technology policy process in order to maximize the contributions of federal research and development to the health and prosperity of the nation.

Strong Support for Mathematical Sciences in the Defense Research and Development Budget

Despite a sharp cut in defense basic research spending in FY 1994 and no real growth proposed in FY 1995, combined DOD support for the mathematical sciences would grow at a pace exceeding inflation in both FY 1994 and FY 1995. The FY 1995 budget request for the Department of Defense totals $1.2 billion for basic research, just 2 percent higher than estimated spending in FY 1994. Combined DOD support for the mathematical sciences, however, would rise by more than 6 percent in FY 1995 under the current plans of the DOD research agencies. The Air Force Office of Scientific Research, the Army Research Office, the Advanced Research Projects Agency, the National Security Agency, and the Office of Naval Research all have dedicated programs that sponsor mathematical research in support of defense missions. Planned FY 1995 funding, however, is contingent on congressional approval of DOD's R&D budget request.

A Century of Mathematics:

Through the Eyes of the Monthly

John Ewing, Editor

The American Mathematical Monthly is 100 years old! The MAA celebrates this special birthday with the publication of A Century of Mathematics.

This is the story of American mathematics during the past century. It contains articles and excerpts from a century of the **Monthly**, giving the reader an opportunity to skim all one hundred volumes without actually opening them. It samples mathematics year by year and decade by decade. Along the way, readers can glimpse the mathematical community at the turn of the century, and the divisions between the mathematical communities of teachers and researchers. They read about the struggle to prevent colleges from eliminating mathematics requirements in the 1920s, the controversy about Einstein and relativity, the debates about formalism in logic, the immigration of mathematicians from Europe, and the frantic effort to organize as the war began. At the end of the war, they hear about new divisions between pure and applied mathematics, heroic efforts to deal with large numbers of new students in the universities, and the rise of federal funding for mathematics. In more recent times, they see the advent of computers and computer science, the problems faced by women and minorities, and some of the triumphs of modern research.

335 pp., Hardbound, 1994

ISBN 0-88385-457-0

List: $ 39.50 MAA Member: $32.00

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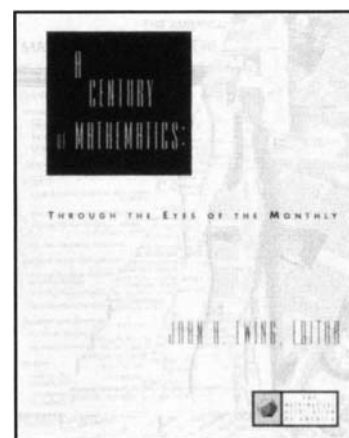
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100 Years of the *Monthly*

The first volume of The American Mathematical Monthly was published 100 years ago, in January of 1894. To celebrate that event, the Association is publishing the four brief talks that followed the Centennial Banquet, which was held on January 15, 1993 in San Antonio. The talks were given by Richard Guy, Raoul Hailpern, Herbert Wilf, and Doris Schattschneider. Talks are meant for listening, not reading. Nonetheless, we hope readers will gain a sense of the evening and a feeling of warm affection held for the Monthly.

— John Ewing, Editor of the Monthly
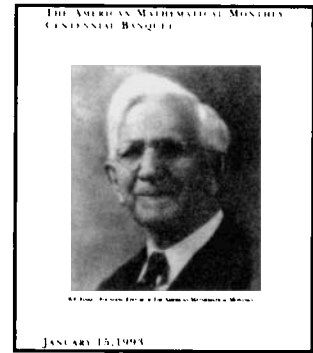
Opening Remarks

John Ewing

As a fledgling editor, my role in the *Monthly* celebration ought to be small. It's easy to be proud of the accomplishments of all those who went before you — only politicians can take credit for them as well. But I want to propose some toasts to those who brought us here tonight.

Benjamin Franklin Finkel: It was 99 years ago that a young school teacher, Benjamin Franklin Finkel, edited, designed, and published the first volume of a journal he hoped would rectify the deplorable state of mathematics teaching in high schools and academies throughout the United States. He called the journal *The American Mathematical Monthly*—a title that his colleagues pointed out was rather ambitious.

A century later—after some 70,000 pages, scores of editors and associate editors, and over 10,000 authors—that title doesn't seem so ambitious. The *Monthly* has given birth to an Association, published articles by the leading mathematicians of our century, and inspired other journals of mathematical exposition. The *Monthly* is a part of American Mathematical culture; everyone knows what it means to be "like the *Monthly*."

Surely Finkel had no idea in January of 1894 that so many people for so many years would nurture and cherish his *American Mathematical Monthly* during the next 100 years. The *Monthly* has changed over the years, but it also remains true to Finkel's original idea. It was a simple act of faith on Finkel's part that brought the *Monthly* to life and brought it through its first quarter century to

adulthood. It was an act of faith we should be grateful for.

There is no head table here, but if there *were* a head table, surely it would have only one person sitting there. Ladies and gentlemen, I propose a toast to the one man without whom the *Monthly* would not exist. I give you Benjamin Franklin Finkel.

Editors: T.S. Eliot once remarked that most editors were failed writers...of course, he went on, so are most writers. Throughout the years, the editors and associate editors have carried forward Benjamin Finkel's vision of the *Monthly* for each new generation, changing it to fit their own vision but paying heed to the traditions that went before. It wasn't easy. We were reminded on Wednesday that the first editor, Finkel himself, published a paper by one Edward J. Goodwin showing that pi was three. There have been worse mistakes in the next 100 years. Editors soon learn that in this business, you either sink or swim or you don't. The *Monthly* editors devoted hundreds of thousand of hours to making the *Monthly* what it is today, and in most cases they did so with little thanks and scant glory. We cannot give them glory, but we owe them our thanks for those hours. Ladies and gentlemen, I give you the editors of the *Monthly*.

Authors: I remember a Snoopy comic strip in which a perplexed Charlie Brown is reading a letter from the publisher: "Dear contributor," it goes, "Thank you for not sending us anything lately. It suits our present needs..." Editors hate to admit it, but the

Monthly is written by the writers in spite of our best efforts. Writing for the *Monthly* is a special kind of mathematical activity: It's not research, but it surely is mathematics. Whether it's a two-line problem or a 20-page survey, a contribution to the *Monthly* is a contribution to mathematical culture. If editors are the ones who prepare and serve the meal, writers are the ones who cook the food in the first place. The finest menu, no matter how elegant, isn't worth much without any food to serve the guests. Ladies and gentlemen, I give you the authors of the *Monthly*.

Readers: The finest meal ever prepared would sit useless if no one ate the food. The *Monthly* is what it is because everyone sitting in this room routinely samples the food, even if you don't consume every morsel. In a very real sense, the *Monthly* is much more than those thousands of yellowing pages on which all those symbols have been written for the past 99 years. The *Monthly* is its editors and its writers — but above all, the *Monthly* is its readers. Ladies and gentlemen, I give you us, the *Monthly* readers.

Unsolved Problems

Richard K. Guy

I feel sorry for you. Not only do you have to listen to John's introductory remarks, but also to four other speeches. I only have to listen to three.

Aviezri Fraenkel suggested that I start by quoting from Littlewood.

> Do not work within two hours of a substantial meal; blood cannot be in two places at once. I was once trapped into cold salmon at 6.30 p.m., immediately followed by a lecture, which I had to leave largely to the spur of the moment. The lecture was confused and I was poisoned for a week afterwards. I should have starved.

Unsolved Problems? Richard Rado once said to me, "If it's solved, it isn't a problem: it's an exercise." This is a rather purist point of view. One person's exercise is another person's problem. Leo Moser used to ask questions in a deadpan, Buster-Keaton-like fashion; you never knew if they were his latest research project or a quickie for a bright high-school student.

What is unsolved? This is not only a function of the potential solver, but also a function of time. The Four Color conjecture was solved from about 1879 to 1890 and then became unsolved again. Many people believe that it's now solved again, but can you write out a proof?

What is a proof? Many of you will have read Keith Devlin's column in the November 1993 AMS *Notices*. My own definition: a proof is a collection of symbols, a collection of people, and a degree of conviction.

What is mathematics? Bertrand Russell gave several definitions, including "mathematics is the subject in which we never know what we are talking about, nor whether what we are saying is true."

Mathematics is not an exact science. Euclidean geometry was regarded as "correct" for 2000 years. In some ways it still is, and I wish more people would learn more of it. But for certain purposes, certain very important purposes, Euclidean geometry is no good. So we changed the rules.

Mathematics is not a logical subject. It can be arranged logically, perhaps in
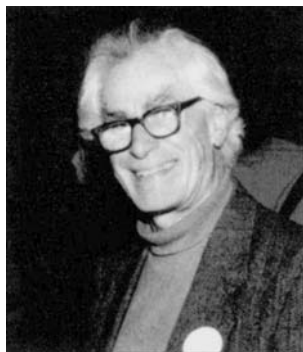
uncountably many ways, but globally it is not developed (or discovered or invented— whatever your philosophy) that way, and locally mathematics is not learned that way, even though some of us think that we teach it logically.

It's not the way the brain works. In the early days of the so-called "electronic brain," Alan Turing said that it was for those who think that a computer differs from the human brain to point out what the differences are. [Those differences include redundancy, randomness, and relative sloth?]

But I'm supposed to be talking about problems. You may have read the reviews by Stan Wagon of Halmos, and Paul Halmos of Klee and Wagon, in the November *Monthly*. If I came from Colorado, I might not quite approve, but there are a couple of good books for you. There's a little of the same phenomenon in the reviews by my co-author, Ken Falconer, and by Dennis DeTurck in the current *Mathematical Intelligencer*.

I conclude by quoting Paul Halmos from the 1980 *Monthly*.

> I do believe that problems are the heart of mathematics, and I hope that as teachers, in the classroom, in seminars, and in the books and articles we write, we will emphasize them more and more, and that we will train our students to be better problem-posers and problem-solvers than we are.

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Bertrand Russell, quoted, for example, in James R. Newman, *The World of Mathematics*, p. 4.

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Monthly Recollections

Raoul Hailpern

Each of my Monthly recollections will be prefaced by a suitable title.

Kismet and Maktoob

I left my birthplace of Alexandria, Egypt in January 1957. That was about three months after the Suez Canal crisis. I shall spare you the details of my trials and tribulations as I traveled throughout Europe as a stateless person. I reached New York City in December 1957; in January 1958, I visited the University of Buffalo in the hope of finding a job as a mathematics instructor. Of the thousands of persons I could have met, the very first person I encountered on the campus was Professor Harry Gehman, the Chairperson of the Mathematics Depart-

ment. Little did I suspect that this meeting would mark a milestone in my life. A Turk would exclaim, "Kismet" (fate); an Arab would say, "Maktoob" (it is written). Harry Gehman was then affectionately known as Mr. MAA. At that time he was Secretary–Treasurer of the Association. I would now like to pay tribute to my mentor and good friend Harry Gehman, for it is thanks to him that I am here tonight, and it makes me so happy to see so many familiar and friendly faces.

In 1963, Harry asked me to help him page the *Monthly*. He gave me three rules: (1) a page should be 48 picas long; (2) facing pages should be equal length; (3) there should be a 4-pica space between successive articles.

As time went on, I held several different hats. Tonight, however, I have one hat only; Production Manager of the *Monthly*.

Three Famous Mathematical Constants

When I started paging the *Monthly* in 1963, the annual dues for individual members of the Association were $5; this included a subscription to the *Monthly*. From 1921 to 1957, the dues had been $4. This was such a long period of time that L.R. Ford, when he was president of the MAA in 1947, referred to Three Famous Mathematical Constants: e, π, and 4 — the latter representing the annual dues. The dues increased to $5 in 1957.

Being a Good English Teacher Does Not Imply Being a Good Copyeditor

I was searching for a copyeditor, and I assumed that a former English teacher, who had applied for the job, would make a good copyeditor. I was dead wrong! I stressed to her, again and again, that she should never, never change an author's style. As an author once told me: "Please leave my manuscript as it is, warts and all!" I remember this lady tried to copyedit, in her style, a paper on

logic that involved necessary and sufficient conditions. The result was a disaster! Naturally, her stay with the MAA was very short lived.

Dreaded Deadlines

The word editors dread most is the word DEADLINE. I had to follow closely deadlines for the receipt of manuscripts, deadlines for galleys, deadlines for sending corrected galleys to the compositors, deadlines for the receipt of pages, and so on, and so on. Maybe I should now give you an idea of the steps involved in getting the magazine ready. The first set of proofs produced by the compositor, who sets the type, is called a galley proof. After the galleys have been corrected, the author received page proofs. And then, finally after the pages have been corrected, the compositor sends the reproduction proofs to the printer who will use them to print the journal. My life was a race against time! This was especially true when my good friend Harley Flanders became editor–in-chief of the *Monthly* in January 1969. Then, in September 1970, his editorial office was transferred to Tel Aviv University, Jerusalem. Some time later, the composition of the *Monthly* was entrusted to the Jerusalem Academic Press. Let me say that they did an outstanding and superb job and were always able to meet their deadlines. Naturally, I often had to work extra hard to ensure that my deadlines were met. For example, I often had to rush to the airport to send material to Jerusalem by Special Delivery Airmail Express whenever, after 5 p.m., the post office nearest to us was closed. Another time, during a blizzard, I had to walk about three miles to the nearest post office to send some urgent manuscripts to Jerusalem. During those years, the first thing I did every morning was to scan the *Buffalo News* and turn on the TV for the latest Middle East news. In the event of a crisis, we did have some contingency plans and could have arranged to have a U.S.A. compositor replace Jerusalem Academic Press at very short notice. Fortunately this did not happen.

Problems with the Problem Section

Since my main concern was to have the *Monthly* appear on time, it was essential for my office to have a large enough backlog of manuscripts in every department of the *Monthly*, so that we would always have suf-

ficient material on hand to fill an issue. At one point, our supply of Proposed Problems and Solutions was dangerously low, and I began to feel panicky. I had to plan ahead to meet future deadlines, and decided to phone the associate editor in charge of the Problems section at his university; no reply! I then tried to phone his home; no reply! I knew then that I had a real problem! I consulted with some of my colleagues, and we decided to have an MAA officer fly to the missing editor's office. He was able to gain access to it where he found—thank goodness!— three cartons full of Proposed Problems and Solutions. A new Problems editor was very soon found, and the crisis was over. I did not try to find out the reason for the sudden disappearance of that associate editor—I was too busy trying to meet my deadlines!

I am asked to Fire my Copyeditor Twice During the Same Week

From 1963 to 1986, I was involved with some 5000 *Monthly* authors. I must have been extremely lucky, because I can remember only two unpleasant incidents with two difficult authors.

The first author was outraged when he found the word acknowledgment had been printed in his *Monthly* article without the e, whereas his manuscript clearly had acknowledgement. He wrote me a three–page letter wherein he insisted that I fire my copyeditor on the spot. I tried to appease him by explaining that we abide by certain *Monthly* house rules, one of which was to spell acknowledgment without an e, for the sake of conformity.

During the same week, the second author, upon sending us his manuscript, had provided us with a set of special delivery labels. He insisted that we apply three labels on the front and three special delivery labels on the back of every envelope addressed to him. Unfortunately, my copyeditor put the three labels on the front only. This time I received a two–page letter, insisting that I fire her immediately. Once again, I had to use diplomacy and friendliness to appease this second author.

A French Article in the *Monthly*

Some of us may not know that an article about tetrahedra was printed in French in the *Monthly* in 1959. Its title was "Sphéres Associées á un Tétraédre." Its author was

Victor Thébault, a French mathematician who lived in the small hamlet of Tennie, population about 200. The *Monthly* added this explanatory note: "This article is printed in French as a tribute to the author and his long and happy association with the *Monthly*." I was very pleasantly surprised when I read the March 1992 issue of the *College Mathematics Journal* which had an article by my good friend Jerry Alexanderson entitled, "A Conversation with Leon Bankoff." The article contains some very interesting information about Victor Thébault.

Miscellanea

I was always very happy whenever I received error-free galleys and pages. I had just received a Classroom Note that looked perfect and was about to file it when something caught my eye; some printed words looked darker that others. I then studied the galleys more carefully, and discovered the reason: the author, with the help of some White–Out and India ink, had been able to correct the typos and errors so as to match the printer's composition almost perfectly. I had to return the galleys to the author with an explanation.

At least three or four times a year, I would receive registered letters containing alleged solutions to the trisection problem, Fermat's Last Theorem, squaring the circle, duplicating the cube, and so on. The authors always requested that their papers be immediately published in the *Monthly*, and I passed them on to the editors-in-chief. I am now sorry that I did not, over the years, take copies of all of them, I now would have enough materials to write a book that might have rivaled Professor Underwood Dudley's best-seller entitled *Mathematical Cranks*, recently published by the Association.

I was engaged in a long–distance telephone call with Paul Halmos; we were discussing some photos that had to appear in the *Monthly*. Out of the blue, something dropped on my desk: a bat was staring at me. I was not overjoyed by the sudden appearance of this uninvited guest. But I remember vividly that my main concern was not to interrupt my telephone call! I lunged towards my wastepaper basket and managed somehow to place it over the bat while I continued my telephone conversation. As soon as the call ended, I phoned the Biology Department of

the University. A graduate student, wearing special gloves, soon came with a cage in which he placed the bat. About ten days later, I received a phone call from the Biology Lab: the bat had rabies.

I shall refrain from giving you the title of this recollection until its very end. I am sure we all remember the time when my good friend Henry Alder was Secretary of the MAA. He was responsible for sending me the manuscript covering every national meeting of the Association. On one such occasion, I checked the manuscript, the galleys, and the pages with extra special care, and I was satisfied that everything was A–OK. Henry had returned his galleys and pages without any correction. I eventually received my advance copy of the *Monthly* and, as was my custom, I read it from cover to cover to ensure that the issue was indeed error–free. Imagine my dismay and deep chagrin when, upon re-reading Henry's account of the MAA meeting for the umpteenth time, I found that his name, as author of the report, appeared as Henry L. Adler (A-D-L-E-R)! I immediately rechecked the galleys; the name was correctly spelled A-L-D-E-R; I rechecked the pages; again A-L-D-E-R. Finally, I checked the repros; I read the name again and again; it was correctly spelled A-L-D-E-R! So, although the galleys, the pages, and the repros were all correct, the final product inexplicably contained a misprint. And there, my friends you have a perfect example of what is called **Gremlins at Work!**

I want to thank all the editors–in–chief and all the associate editors of the *Monthly* without whose tireless work we would not have been here tonight celebrating the *Monthly* Centennial. I also want to thank my wife Fanny, who worked for many years for the Association, for her constant and unfailing help in proofreading, copyediting, and carrying out whatever job had to be done at a moment's notice in order to meet a deadline. Thank you, Fanny!

My ten minutes are up; thank you for bearing with me.

The Impact of the *Monthly* on the other MAA Journals

Doris Schattschneider

When I was invited to make a presentation on this festive occasion, Henry Alder asked me to respond to the question, "What has been the impact of the *Monthly* on the other MAA journals?"

What has been the impact of the *Monthly* on the other MAA journals?

For a long, long time, the *Monthly* was the ONLY MAA journal, therefore, during that period, of over 60 years, the *Monthly* had NO impact on other MAA journals.

In 1962 *Mathematics Magazine*, already in existence for over 35 years, became a publication of the MAA (though it would not become an official journal of the MAA until 1981). In 1970, the *Two Year College Mathematics Journal* was obtained from Prindle, Weber & Schmidt to become an MAA journal.

In 1969, the *Monthly* underwent a dramatic change. As Harley Flanders noted in his inaugural issue as its editor, the *Monthly* was entering the last quarter of its first century, and "the *Monthly* has been blue on blue since 1942" (that has a nice ring to it). Actually, Flanders missed an exceptional case: a special gilt supplement in January of 1967 to mark the 50th anniversary of the founding of the MAA. Flanders dared to challenge tradition: the *Monthly* was now green on white! This change was such a shock that the *Monthly* instituted this format and cover garb for another 10 years.

During this time, editors of *Mathematics Magazine* and the *TYCMJ* observed the *Monthly* and learned how to produce an MAA journal and readers knew what to expect in an MAA journal. But then in 1976, Lynn Steen and Arthur Seebach, a quiet, but unruly pair from Northfield, Minnesota became editors and launched their first issue of *Mathematics Magazine*. Color! Cobwebs! Picture on the cover! No table of contents, just teasers. Sans Serif font and Title printed both vertical and horizontal! (The inside was different, too.)

Not only that, but the taller of the pair, Steen, had the audacity to spread his ideas and indoctrinate the newly elected editor of the *TYCMJ*. And in 1979, Don Albers, the new editor of that journal, to put it in his own words, "knocked our socks off" with his inaugural issue. A cover CARTOON (not a demure mathematical diagram), teasers instead of a table of contents, many new departments inside, with the most bold, an INTERVIEW with George Pólya on his 90th birthday. What was this? *People Magazine*? Mathematicians being revealed as (gulp) REAL PEOPLE that have interesting lives, are fathers (and even mothers), have hobbies, play music; why, some even play the organ in church?

But let me return to the *Monthly* and its impact on the other MAA journals. The Flanders green on white with its tastefully presented Table of Contents cover was abruptly replaced (after its ten year reign) by Ralph Boas in 1979 by—green on white but a drawing on the cover! Teasers instead of a table of contents! And SLANTED title!

The *Monthly* continued to have an impact on its siblings. Under the editors that followed Albers, the color of the cover of the *TYCMJ* changed, photos, drawings and cartoons were used frequently, new sections (notably computer software reviews) were introduced, and the name was changed to *The College Mathematics Journal*. And the interviews continued—interviews of mathematicians, including one that bubbles and interviews of non-mathematicians who were very interesting mathematical people. This feature, incidentally, produced two best-selling books, *Mathematical People* and *More Mathematical People*.

Mathematics Magazine also exhibited changes. The cobwebs disappeared, a five-year rainbow of colors appeared, and there were special issues: one devoted to Leonard Euler in 1983, and one devoted to George Pólya on the centennial of his birthdate. While the *TYCMJ* was emulating *People Magazine*, *Mathematics Magazine* followed the lead of the *National Enquirer* and published an expose that revealed that the MAA had been displaying for a very long time an

impossible icosahedron in its logo. This revelation had far-reaching consequences: a mathematically correct seal was drawn and approved, and all the old official stationery and other items with the seal were discarded and replaced.

But again, back to the *Monthly*. In 1982, at the recommendation of a committee to institute tasteful format and instant MAA recognition, a new cover design graced the inaugural issue of the *Monthly* under editor Paul Halmos. The new cover was a tasteful presentation of the Table of Contents. Unfortunately, this model of what an MAA journal should look like was not embraced by the sibling journals. Evidently the editor of the *Monthly*, then at Santa Clara University along with Jerry Alexanderson, could not control his sibling editor. In 1988 and 1989, these other two journals received facelifts of just their Title format, but continued to insist on using drawings and photos on their covers.

But wait! In 1990, Wilf produced a slick cover special issue of the *Monthly* devoted to Geometry, and in 1992, Ewing launched his first issue with a (oh my!) CARTOON on the cover.

In format and content, I know that by now I have convinced you that the *Monthly* has had a decided impact on the other MAA journals. But there is another measure of impact—the succession of editors. In the beginning, the *Monthly* had a trio of coeditors. Then, beginning in 1916 and for all the remaining years but two, each superb editor was succeeded by another distinguished male mathematician who served as sole chief editor. This had an impact on the other two journals. In 1976, Steen and Seebach, colleagues in the same institution, became coeditors of *Mathematics Magazine*. From 1976 to 1978, the *Monthly* had as its coeditors Rosenberg and Boas. In 1981, Schattschneider, decidedly not a male mathematician, succeeded the Northfield pair as editor of *Math Magazine*. In 1989, the *College Mathematics Journal* chose coeditors, not only with the same last name of Watkins, but of opposite gender and on intimate terms with each other! In 1991, the *Magazine* chose Martha Siegel as editor. *Monthly* editor terms are five years—one wonders if Hillary and Bill can make it to the White House can the *Monthly*...?

But enough on this. Apart from impact, there

are several important relationships that have existed between the three journals and their editors. I feel that these are exemplified by some letters that I have found in my historical research of the journals during the most recent period.

"Dear Professor Alexanderson,

Rejected! My gift to the mathematical community was rejected! You have the most stupid referees in the U.S. Your inability of publishing this result represents your inability of acting as an editor! Since my paper is too good for you, I'm sending my manuscript to the *Monthly*!"

Another letter:

"Dear Ann and Bill,

So glad you sent me Manuscript #7689 to referee. I hope you don't mind if I send you my report on it that I wrote 6 months ago for the *Monthly*. I note the author has revised his paper by changing the title."

There is another extremely important interaction between the MAA journals—editors of the three journals frequently meet and share ideas, stories, and gripes (especially at meetings such as this)—without this group therapy, they might not survive. In the 1980's these sessions focused on trying to articulate the essential differences of the three journals. Here is a memo from that era:

"To all editors of MAA journals: From the Powers that Be:

The Executive and Finance Committee has decided in the interest of efficiency and cost-cutting that there should not be any overlap of material in the three journals. As long as we have overlap, there is clearly no justification for three journals, and, as we have pointed out before, a single journal, the *American College Mathematics Monthly Magazine,* would do a far better job than three separate journals.

Henceforth, the *College Mathematics Journal* will publish only papers on calculus, pedagogy and computer software; the *Monthly* will publish only articles on graduate-level mathematics approved by the Editor and book reviews; and *Mathematics Magazine* will publish only articles on undergraduate mathematics (excluding calculus, and other mathematics not approved for the *Monthly* and problems).

With this clear division of mathematical territory, we are certain that each journal will have a clear identity and the editor's job of accepting papers can be greatly expedited by a convenient check-list, which will be sent by the Washington office."

Although the turf debate will, I hope, never be resolved, there is a fundamental issue on which all the editors agree, and this is best exemplified by an article "Can We Make Mathematics Intelligible"? written by Ralph Boas in his last issue as *Monthly* editor. Ralph has some wise things to say—I recommend his article highly. Here is one small excerpt:

"Why is it that we mathematicians have such a hard time making ourselves understood?...

"To put it another way, why do we speak and write about mathematics in ways that interfere so dramatically with what we ostensibly want to accomplish? I wish I knew...

"Abstract definitions. Suppose you want to teach the "cat" concept to a very young child. Do you explain that a cat is a relatively small, primarily carnivorous mammal with retractile claws, a distinctive sonic output, etc? I'll bet not. You probably show the kid a lot of different cats, saying "kitty" each time, until it gets the idea. To put it more generally, generalizations are best made by abstraction from experience. They should come one at a time; too many at once overload the circuits..."

The Escher print, Sun and Moon, sums up best what I feel is the relationship between the three MAA journals. NONE can exist without the other; each defines the other. They are inextricably locked in their fundamental roles, yet are free to soar independently. I look forward to watching their metamorphosis over the next 100 years.

The Wind, the Trees, and the Flame

Herbert S. Wilf

A centennial is an occasion to look back at what has been, to look at now and what is, and to look ahead at what might be.

We can look back at the first 100 years of the *Monthly* with great satisfaction. If we look at the present, the *Monthly* is in the hands of outstanding and creative stewards, and we

have further cause for satisfaction.

But I am temperamentally incapable of looking anywhere but ahead. I want to talk to you tonight about the next hundred years and what the heavily clouded crystal ball looks like to me.
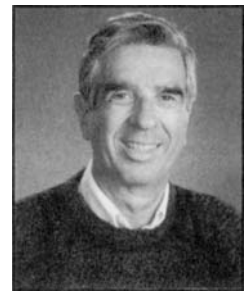
When gales blow across the land, all trees must bend. Strong, supple trees bend gracefully, yielding, but not breaking. Weak trees bow their heads to the ground, and drop their branches.

Among the storms that now rage across our land there are some that threaten us who are here tonight, our trees, our structures. There is one that I particularly want to mention, and which I believe will be an important part of the environment of the *Monthly*, and of mathematical education in general, for years to come, and it is this.

It is my perception that our students, our children, are less well prepared to learn the mathematics that they will need than they were a few decades ago, that they exhibit less intellectual drive and curiosity than they have in the past, and that they are less able to handle the requisite difficult and substantive conceptual tasks.

This matches some feelings that I have about trends in society as a whole. It is my perception that we Americans are growing more and more impatient with lengthy explanations, with deferred gratification, and with complex, detailed thought processes. We are increasingly bottom-line oriented; a people who want things said briefly or not at all.

That attitude can be death to mathematical training. Among all human enterprises, if there is one that demands lengthy explanations, that is vertically structured, that resists summarizing on a bottom line, it is mathematics.

Unfortunately, I have no professional qualifications that would license me to discuss the causes of this phenomenon with you tonight.

But I'll do it anyway.

As a teacher and as a parent, it seems to me that changes in the nature and structure of the American family have a lot to do with it.

Many of these changes have resulted in deficient parenting of our children, with the observed results. My guess would be that this is the single most important cause, but it's also the one that is most beyond our control, so I won't dwell on it here.

The role of the national media in the shaping of these attitudes is also important, since the media systematically pick out what they regard as the trendiest trends in our society, and they exacerbate those trends.

Our national consciousness has been numbed by the media. The newspapers, television, recorded music, motion pictures, etc., have evolved in ways that have both reflected and affected our entire culture.

Say it fast, they tell us; skip the complications, they tell us; they quote the flashiest pieces of the story, out of context; they make 12-second sound bites out of carefully constructed discussions of complex issues; they downplay intellectual substance. The media proclaim, in countless ways, that what we should value is external glitter rather than internal content.

The media in this country, of course, had been cavorting in this fashion for many years before the onset of the attitudes that I am describing. What are new, though, are the power, the pervasiveness, the perceived glamour, and the influence of the media in this age of technically gorgeous TV pictures in blazing color and with stereo-surround sound.

The results have been that the tendencies that all of us have in some degree, towards skipping over the hard parts, have been emphasized and glamorized, while complete, in-depth examinations have been downgraded to a quaint pastime practiced by a small priesthood.

The *American Mathematical Monthly* of the next hundred years will have to live in that kind of a world. Not only the *Monthly*, but all of our publications, and indeed all of our mathematics, will have to be carried on in that setting.

The climate is very difficult. Political figures who attempt to deal with issues of life and death, war and peace, national solvency, health, and so forth, in thoughtful ways, will of course have to spend a fair amount of time talking about them. But on the evening TV news, perhaps only one sentence from the speech, taken out of its context, will appear, in the style of a bumper sticker.

When Ross Perot spent a lot of money for the first of his half-hour televised statements of his views, and he spent the time talking about the economic and educational declines that he perceived, complete with bar charts, pie charts, and histograms, all I heard on the a.m. news was that he had said we were "in deep voodoo." I saw his speech, then I heard that summary ... and I thought he was entitled to a refund. It is instructive to note that Perot got a lot of votes, too, which says to me that there are, out there, large unmet needs in the population for substantive discussions of the issues. (No, that was not an endorsement of Perot; but I thought there was a lot to learn from his example.)

Not only is the style of TV programming hazardous to your IQ, but the habit patterns that one forms from sitting in front of the shimmering images, flipping from one channel to another, are conducive to cerebral atrophy.

My former colleague Ed Effros, now of UCLA, suggested that across the bottom of the TV screen there should be a permanent warning from the Surgeon General of the United States, concerning hazards to mental functioning that may result from watching more than one hour per day of TV programs.

Let's put it this way. There's not much on TV besides sex and violence; and I can't stand violence.

The use of computers in mathematical education is a two-edged sword, one of whose edges is like TV.

At their best, computers are powerful extensions of the human mind, creating examples, investigating structures and helping us actively to explore a world that would otherwise have been out of reach.

At their worst, computers can be used merely as a source of passively-viewable color images whose intellectual content rivals that of your favorite Madonna video.

In recent years we have witnessed serious declines in the demands that we make on our students for intensive and solid intellectual achievement in mathematics. When we feed them more baby food every year, we thereby become accomplices to their intellectual softening. We often blur over vital distinctions because we feel that the poor things wouldn't be able to take it straight and undiluted, and we feel that way because we feel their impatience with the details of scholarship. We respond to that impatience by lessening, rather than increasing, the demands that we make upon them.

We must arrest and reverse that decline. We must tell it like it is and demand our students' active involvement and understanding. We must persuade our leaders to reach for the best that is in us, rather than for the lowest common denominator of mindlessness.

Ladies and gentlemen, you and I who are here tonight, and our mathematical colleagues everywhere, stand in the very teeth of this gale, because academic pursuits in general, and the study of mathematics most particularly, are antithetical to these techniques of the media. We depend on difficult, thorough, careful, often lengthy, and highly structured arguments that cannot be packaged in small time-release caplets.

We must bend in the wind. All trees must. There is no choice, because we exist in our society, and we could not ignore it even if we wanted to.

We can bend in many constructive and healthy ways. We can make our teaching, our writing, our *Monthly*, our creation of mathematics, livelier and more appealing. We can spend more time organizing interesting courses and curricula, more time preparing our presentations, and so forth. Ladies and gentlemen, we must bend, but we must not yield our substance. We must use the security of our academic positions and sanctuaries to stand against the gale.

Again following the analogy with trees, if we stand together, in a strong forest, rather than apart as individuals, we will better be able to resist the prevailing winds.

Let us rejoice in the beauty of our subject that is revealed in its depth. Let us celebrate that beauty and transmit the celebration to our students and our readers.

So yes, let's liven up our style and be more caring and thorough in our teaching and in our writing. But there let us draw the line. For in times of sweeping changes in the body politic, academicians must be the keepers of the flame. Society needs us to do that.

The flame never needs keeping more than when gales blow across the land.

Mathfest 1994

Minneapolis, Minnesota

August 14-17, 1994

Sunday, August 14

8:30 - 4:00 **Board of Governors' Meeting**

6:30 - 7:30 p.m. Cash Bar

7:30 - 10 p.m. **AMS-MAA Prize Banquet**

Monday, August 15

8:30 - 9:20 a.m. **AMS-MAA Invited Address:** *Reform in mathematics education: New or simply a variation on an old theme?* Carole LaCampagne, U.S. Department of Education

9:35 - 10:25 a.m. **Hedrick Lecture I:** *Searching for the shortest network,* Ronald L. Graham, AT&T Bell Laboratories

10:40 - 12:10 **AMS Progress in Mathematics Lecture:** *On Boltzmann's equation and its applications,* Pierre Louis Lions, University of Paris IX

12:25 - 12:55 **AMS Business Meeting**

1:30 - 6:00 p.m. **AMS Special Sessions and Sessions of Contributed Papers**

1:40 - 2:30 p.m. **MAA-Mu Alpha Theta Lecture:** Pamela J. Drummond, Kennesaw State College

1:40 - 6:40 p.m. **Contributed Paper Session:** *Environmental mathematics,* Ben Fusaro, Salisbury State University

1:40 - 6:40 p.m. **Contributed Paper Session:** *Recreational mathematics and computing,* Charles Ashbacher, DecisionMark Corporation

1:30 - 3:30 p.m. **Minicourse #1 (Part A):** *Building discrete and continuous ecological models using the SLAM simulation language,* James Caristi, Valparaiso University

1:30 - 3:30 p.m. **Minicourse #2 (Part A):** *Calculus from graphical, numerical and symbolic points of view,* Arnold Ostebee and Paul Zorn, Saint Olaf College

1:30 - 3:30 p.m.. **Minicourse #3 (Part A):** *Combinatorics via functional equations,* Donald R. Snow, Brigham Young University

2:00 - 3:50 p.m. **SUMMA Workshop:** *Intervention projects for minority pre-college students,* William A. Hawkins, Director of SUMMA (Strengthening Underrepresented Minority Mathematics Achievement)

2:45 - 5:00 p.m. **MAA/PME Sessions of Student Papers**

3:45 - 5:45 p.m. **Section Officers' Meeting**

3:45 - 5:45 p.m. **Minicourse #4 (Part A):** *Multivariable calculus using the Harvard Calculus Consortium materials,* Thomas W. Tucker, Colgate University

3:45 - 5:45 p.m. **Minicourse #5 (Part A):** *Mathematical models of epidemics,* Sonja Sandberg, Framingham State College

3:45 - 5:45 p.m. **Minicourse #6 (Part A):** *Unifying themes for discrete mathematics,* Ralph P. Grimaldi, Rose-Hulman Institute of Technology

5:00 - 6:00 p.m. **MAA-PME Student Reception**

6:00 - 9:00 p.m. **Mississippi Dinner Cruise**

Tuesday, August 16

8:30 - 9:20 a.m. **AMS-MAA Invited Address:** *Knots,* Cameron McA. Gordon, University of Texas, Austin

9:35 - 10:25 a.m. **Hedrick Lecture II:** *Some generalizations of* $1 + 1 = 2$, Ronald L. Graham, AT&T Bell Laboratories

10:40 - 11:30 **AMS History of Mathematics Lecture:** *The well-poised thread: Some amazing sums of Gauss, Kummer, Ramanujan and others,* George E. Andrews, Pennsylvania State University, University Park

1:00 - 6:00 p.m. **AMS Special Sessions and Sessions of Contributed Papers**

1:00 - 5:00 p.m. **MAA/PME Sessions of Student Papers**

1:00 - 2:30 p.m. **Panel Discussion:** *Advising undergraduate mathematics majors,* sponsored by ad hoc Committee on Advising, David J. Lutzer, College of William and Mary

1:00 - 6:00 p.m. **Electronic Poster Session:** *Exploring mathematics on the Internet,* sponsored by the Committee on Computers in Mathematics and the Committee on Electronic Services, and organized by Eugene A. Herman, Grinell College, and Lawrence S. Husch, University of Tennessee, Knoxville

1:00 - 3:00 p.m. **Minicourse #7 (Part A):** *Open problems in plane geometry,* William Moser, McGill University, and Janos Pach, City College New York and Mathematical Institute of the Hungarian Academy of Sciences

1:00 - 3:00 p.m. **Minicourse #8 (Part A):** *The Math Modeling/PreCalculus Reform Project: using discrete mathematical models to motivate mathematics,* Sheldon P. Gordon, Suffolk Community College, and B. A. Fusaro, Salisbury State University

2:45 - 4:30 p.m. **Panel Discussion:** *Calculus reform in different settings,* A. Wayne Roberts, Macalester College, and Sharon C. Ross, DeKalb College

4:00 - 6:00 p.m. **Minicourse #1 (Part B):** *Building discrete and continuous ecological models using the SLAM simulation language,* James Caristi, Valparaiso University

4:00 - 6:00 p.m. **Minicourse #2 (Part B):** *Calculus from graphical, numerical and symbolic points of view,* Arnold Ostebee and Paul Zorn, Saint Olaf College

4:00 - 6:00 p.m. **Minicourse #3 (Part B):** *Combinatorics via functional equations,* Donald R. Snow, Brigham Young University

4:45 - 6:00 p.m. **Panel Discussion:** 1994 *International Olympiad winners' stories,* Walter E. Mientka, University of Nebraska-Lincoln and Executive Director of the American Mathematics Competitions

6:45 - 8:15 p.m. **PME Banquet**

8:30 - 9:30 p.m. **PME Frame Lecture:** *Cheating your way to the Knot Merit Badge, by Scoutmaster Mel Slugbate,* Colin Adams, Williams College

8:30 - 10:00 p.m. **Micro-inequities Skits:** sponsored by the Committee on the Participation of Women, Carole LaCampagne, U.S. Department of Education (committee chair)

Wednesday, August 17

8:30 - 9:20 a.m. **AMS-MAA Invited Address:** *Mathematical simulation of flow in porous media,* Todd Arbogast, Rice University

9:35 - 10:25 a.m. **Hedrick Lecture III:** *Juggling drops and descents,* Ronald L. Graham, AT&T Bell Laboratories

10:40 - 12:10 **AMS Progress in Mathematics Lecture:** *Galois representations and modular forms,* Kenneth A. Ribet, University of California, Berkeley

12:25 - 12:55 **MAA Business Meeting**

1:40 - 5:40 p.m. **AMS Special Sessions and Sessions of Contributed Papers**

1:40 - 2:30 p.m. **MAA Student Lecture:** *What's really in the Cantor set?* Gail S. Nelson, Carleton College

1:40 - 5:40 p.m. **Contributed Paper Sessions:** *Innovative projects in first year courses,* Howard Lewis Penn, U.S. Naval Academy, and Aaron I. Stucker, Washburn University

1:40 - 5:40 p.m. **Contributed Paper Sessions:** *Winning women into mathematics,* Marcelle Bessman, Tampa, Miriam P. Cooney, Saint Mary's College, and Gerald J. Porter, University of Pennsylvania

1:45 - 3:45 p.m. **Minicourse #4 (Part B):** *Multivariable calculus using the Harvard Calculus Consortium materials,* Thomas W. Tucker, Colgate University

1:45 - 3:45 p.m. **Minicourse #5 (Part B):** *Mathematical models of epidemics,* Sonja Sandberg, Framingham State College

1:45 - 3:45 p.m. **Minicourse #6 (Part B):** *Unifying themes for discrete mathematics,* Ralph P. Grimaldi, Rose-Hulman Institute of Technology

2:45 - 4:45 p.m. **MAA Student Workshop:** *The theory and practice of juggling,* Ronald L. Graham, AT&T Bell Laboratories

4:00 - 6:00 p.m. **Minicourse #7 (Part B):** *Open problems in plane geometry,* William Moser, McGill University, and Janos Pach, City College New York and Mathematical Institute of the Hungarian Academy of Sciences

4:00 - 6:00 p.m. **Minicourse #8 (Part B):** *The Math Modeling/PreCalculus Reform Project: using discrete mathematical models to motivate mathematics,* Sheldon P. Gordon, Suffolk Community College, and B. A. Fusaro, Salisbury State University

5:45 - 6:30 p.m. **Reception for MAA Banquet**

6:30 - 9:00 p.m. **MAA Banquet for 25-Year Members**

Minneapolis Mathfest
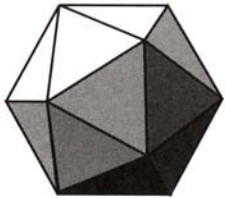
Minneapolis, Minnesota, August 15 – 17, 1994

Preliminary announcement

Opening Banquet

On Sunday evening, all participants are invited to a banquet to officially open the Mathfest. This festive event will feature the awarding of MAA and AMS prizes. Details on the banquet, including how to purchase tickets, can be found in the section on *Social Events*.

The Scientific Program

The Minneapolis Mathfest, including the 72nd Summer Meeting of the Mathematical Association of America, the 96th Summer Meeting of the American Mathematical Society, and the 1994 summer meeting of Pi Mu Epsilon (ΠME), will be held August 15–17, 1994, at the University of Minnesota, Minneapolis. All sessions will take place on the campus of the university.

AMS-MAA Invited Addresses

Todd J. Arbogast, Rice University, *Mathematical simulation of flow in porous media*, 8:30 a.m. on Wednesday.

Cameron McA. Gordon, University of Texas, Austin, *Knots*, 8:30 a.m. on Tuesday.

Carole B. Lacampagne, U.S. Department of Education, *Reform in mathematics education: New or simply a variation on an old theme?*, 8:30 a.m. on Monday.

IMPORTANT DEADLINES	
MAA abstracts of contributed papers	April 26
AMS abstracts	
For consideration for Special Sessions	April 26
Special Sessions and contributed papers	May 17
ORDINARY advance registration	June 11
Hotel/residence hall accommodations (MMSB)	June 11
Tickets through advance registration	June 11
MAA Minicourse advance registration (MAA)	June 11
MAA Student Papers	June 25
Hotel changes and cancellations (MMSB)	July 5
FINAL advance registration (no housing or tickets)	July 14
Cancellations for all banquets and tours (50% refund)	August 1
Residence hall changes and cancellations through MMSB (90% refund)	August 8
Advance registration cancellations (50% refund)	August 11

72nd Summer Meeting of the MAA

Hedrick Lectures: Ronald L. Graham, AT&T Bell Laboratories, Monday, Tuesday, and Wednesday at 9:35 a.m. Titles of the lectures are (I) *Searching for the shortest network*, (II) *Some generalizations of* 1 + 1 = 2, and (III) *Juggling drops and descents.*

MAA-Mu Alpha Theta Lecture: Pamela J. Drummond, Kennesaw College, Monday, 1:40 p.m.

Minicourses: MAA Minicourses are open only to persons who register for the Mathfest and pay the regular registration fee. Participants interested in attending should complete the MAA Minicourse Advance Registration Form and **send it directly to the MAA office** so as to arrive **by June 11**; the Mathfest Advance Registration/Housing Form should be sent to AMS. After the deadline, potential participants are encouraged to call the MAA headquarters at 800-331-1622 or 202-387-5200 to check on availability.

Titles, organizers and their affiliations, tentative times they will meet, enrollment limits, and costs are as follows:

Minicourse #1: *Building discrete and continuous ecological models using the SLAM simulation language*, **James V. Caristi**, Valparaiso University. Part A: Monday, 1:30 p.m.–3:30 p.m.; Part B: Tuesday, 4:00 p.m.–6:00 p.m. Enrollment limit: 30; registration fee: $65.

This minicourse will provide a crash course in using the simulation language SLAM for environmental modeling. SLAM supports discrete and/or continuous modeling, automatically and easily generates appropriate statistics, and can produce animations. We will develop a model of a leaf surface ecosystem involving competing microorganisms, arrivals and departures, temperature changes, moisture presence and absence, and acid rain. This is a basis for a project-oriented junior-senior level course for science majors. Prerequisite: proficiency with a mouse.

Minicourse #2: *Calculus from graphical, numerical and symbolic points of view*, **Arnold M. Ostebee and Paul Zorn**, Saint Olaf College. Part A: Monday, 1:30 p.m.–3:30 p.m.; Part B: Tuesday, 4:00 p.m.–6:00 p.m. Enrollment limit: 50; registration fee: $45.

This minicourse introduces *Calculus from Graphical, Numerical and Symbolic Points of View*, a calculus text developed at St. Olaf College with support from the NSF and FIPSE. The text complements the standard symbolic/algebraic approach to the calculus with pervasive and systematic treatment of geometric and numerical points of view. Technology is used to foster and facilitate graphical and numerical thinking. This minicourse will include brief overviews of philosophy, peda-

Meetings

gogy, and mathematical content; hands-on work on textbook problems; group discussion and critique; practical advice; and reports from experienced field-testers. Participants will be supplied copies of the text. Graphing calculators will be available on site; participants are encouraged to bring their own.

Minicourse #3: *Combinatorics via functional equations*, **Donald R. Snow**, Brigham Young University. Part A: Monday, 1:30 p.m.–3:30 p.m.; Part B: Tuesday, 4:00 p.m.–6:00 p.m. Enrollment limit: 60; registration fee: $45.

We will show that many of the ad hoc methods of combinatorics can be unified by a simple functional equations approach. This approach yields the sums of the powers of the integers (and many generalizations), combinations and permutations (with many types of repetitions), and other standard combinatorial functions, as well as many new results. The method uses the combinatorial description to find a functional equation and then finds the function from that. It gives a means of getting many of the identities, properties, and generating functions, and shows how the functions are related to each other. Spinoffs from the basic approach include the Bernoulli and Euler polynomials, orthogonal polynomials, and other special functions. An understanding of basic combinatorics, calculus, and power series is sufficient background for this minicourse. The small amount of material on functional equations needed will be developed in the course.

Minicourse #4: *Multivariable calculus using the Harvard Calculus Consortium materials*, **Thomas W. Tucker**, Colgate University. Part A: Monday, 3:45 p.m.–5:45 p.m.; Part B: Wednesday, 1:45 p.m.–3:45 p.m. Enrollment limit: 50; registration fee: $45.

The NSF-supported Harvard Calculus Consortium has completed a textbook in single variable calculus and is working on materials for a multivariable course. These materials have been used at a number of institutions. The presenters will give the participants an overview of those materials and their implementation, as well as direct experience with selected portions of the course. Participants will have the opportunity to work in groups on exercises from the text and discuss the pedagogical implications. The presenters will be **Daniel Flath**, University of South Alabama, **Deborah Hughes Hallett**, Harvard University; **Patti Frazer Lock**, St. Lawrence University; **John Lucas**, University of Wisconsin-Oshkosh; and the organizer.

Minicourse #5: *Mathematical models of epidemics*, **Sonja Sandberg**, Framingham State College. Part A: Monday, 3:45 p.m.–5:45 p.m.; Part B: Wednesday, 1:45 p.m.–3:45 p.m. Enrollment limit: 80; registration fee: $45.

This minicourse will discuss the many ways that mathematics has been and can be used to describe the behavior of epidemics of infectious diseases. Examples of models appropriate for undergraduate mathematics courses, such as probability and statistics, differential equations, finite mathematics, and mathematical modeling will be presented. The history of quantitative descriptions of epidemic trends will be covered using malaria as an example. Focusing on AIDS,

models for risk to an individual, population models for predicting future trends and the utility of mandatory premarital screening for the AIDS virus will be discussed. Homework will be assigned between the two sessions.

Minicourse #6: *Unifying themes for discrete mathematics*, **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology. Part A: Monday, 3:45 p.m.–5:45 p.m.; Part B: Wednesday, 1:45 p.m.–3:45 p.m. Enrollment limit: 80; registration fee: $45.

As discrete mathematics courses impact the college curricula, some students express concern about the apparent fragmented nature of the concepts. To dispel this feeling of fragmentation, certain unifying themes are 1.) the function—with its role in enumeration, the analysis of algorithms, finite state machines, and the preservation of discrete structures; and 2.) enumeration—as it reinforces the study of partial orders, equivalence relations, graph theory, and summation formulas.

Minicourse #7: *Open problems in plane geometry*, **William O. J. Moser**, McGill University; **Janos Pach**, City College of New York and Mathematical Institute of the Hungarian Academy of Sciences. Part A: Tuesday, 1:00 p.m.–3:00 p.m.; Part B: Wednesday, 4:00 p.m.–6:00 p.m. Enrollment limit: 80; registration fee: $45.

Drawing figures (graphs) in the plane is one of the oldest human activities. Yet, conventional graph theory and geometry often break down at the simplest possible questions about graph drawings. The course will survey some classical questions of this kind in recreational geometry (e.g. Turan's brick factory problem and Conway's thrackle conjecture) some of which have important practical applications. We shall also suggest some promising new approaches to these problems (using elementary results from combinatorics and topology), but in all of the results discussed there will be plenty of room for improvement. The nonspecialist is just as likely to make progress in this field as the organizers! Participants can expect to leave with an understanding of many problems which they and their students can investigate in the future.

Minicourse #8: *The Math Modeling/PreCalculus Reform Project: using discrete mathematical models to motivate mathematics*, **Sheldon P. Gordon**, Suffolk Community College; **B. A. Fusaro**, Salisbury State University. Part A: Tuesday, 1:00 p.m.–3:00 p.m.; Part B: Wednesday, 4:00 p.m.–6:00 p.m. Enrollment limit: 40; registration fee: $45.

The Math Modeling/PreCalculus Reform Project, under support from the NSF, is developing an alternative to precalculus courses which emphasizes the broad applicability of mathematics using mathematical modeling based on methods such as difference equations, data analysis, probability, and matrix algebra. The ideas and skills needed for calculus are developed in the context of solving interesting and important problems. This minicourse will provide an overview of the project and its goals as well as illustrations and hands-on experience with some specific models. Copies of the project materials will be provided to all participants.

MAA Contributed Paper Sessions

Contributed papers are being accepted on several topics in collegiate mathematics for presentation at the meeting. The session titles, organizers, and tentative days they will meet are given below. Procedures and deadlines are given following the list of sessions.

- *Environmental mathematics*, **Ben Fusaro***, Department of Mathematics and Computer Science, Salisbury State University, Salisbury, MD 21801; e-mail e3fafusaro@sae. towson.edu; phone 410-543-6470; fax 410-548-5597; Monday afternoon.

Papers that deal with concepts or contents that can be used in introductory mathematics courses, such as precalculus, applied ("baby") calculus, and mathematics in culture are especially welcome. However, all undergraduate applications of mathematics to the environment are welcome.

- *Innovative projects in first-year courses*, **Howard Lewis Penn***, Mathematics Department, U.S. Naval Academy, 572 Holloway Road, Annapolis, MD 21402-5002; e-mail hlp@usna.navy.mil; phone 410-267-3892; and **Aaron I. Stucker**, Washburn University; Wednesday afternoon.

This session, sponsored by the MAA Committee on Computers in Mathematics Education, will focus on innovative teaching approaches in first-year mathematics courses such as college algebra, trigonometry, precalculus, and finite mathematics. Projects that use technology are especially encouraged; however, other projects are also welcome.

- *Recreational mathematics and computing*, **Charles D. Ashbacher***, DecisionMark Corp., 300 Second Ave. SE, Suite 300, Cedar Rapids, IA 52401; e-mail 71603.522@ compuserve.com; phone 319-363-6235; fax 319-365-5694; Monday afternoon.

Mathematicians at all levels often engage in mathematical play, and the results are always interesting and occasionally revolutionary. This session will feature papers describing such play. Due to the broad spectrum of possibilities, no topic should be considered forbidden. Problems where a computer was used in the solution are particularly welcome. To make the results understandable to the widest possible audience, all programs should be written in a well-known language such as BASIC, FORTRAN, Pascal, or C.

- *Winning women into mathematics*, **Marcelle Bessman***, 644 Geneva Place, Tampa, FL 33606; e-mail jtaylor@ madonna.coedu.usf.edu; **Miriam P. Cooney**, Saint Mary's College, Indiana; and **Gerald J. Porter**, University of Pennsylvania, Philadelphia; Wednesday afternoon.

Papers on successful programs to recruit and retain women in mathematics are solicited. Submissions should include a description of the program, documentation of its success, discussion of its transferability to other institutions or groups, and available materials and resources for implementation.

Submission Procedures for MAA Contributed Papers: Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes. Individuals wishing to submit a paper for any of these sessions should note the following: The name(s) and address(es) of the author(s) and a one-page summary of the paper should be sent directly to the organizer of the session marked with an asterisk (*). The summary should enable the organizer(s) to evaluate the appropriateness of your paper for the selected session, so you should include as much detailed information as possible within the one-page limitation. Your summary should reach the designated organizer **by Tuesday, April 26, 1994**; the organizer will acknowledge receipt of all paper summaries. If the paper is accepted, you will receive an MAA abstract form and further instructions.

Other MAA Sessions

SUMMA Workshop: This workshop on *Intervention projects for minority precollege students* is scheduled from 2:00 p.m. to 3:50 p.m. on Monday. It is being organized and directed by **William A. Hawkins**, Director of SUMMA (Strengthening Underrepresented Minority Mathematics Achievement). There will be three presenters.

Exploring Mathematics on the Internet: This electronic poster session on Tuesday afternoon, 1:00 p.m. to 6:00 p.m., is sponsored jointly by the Committee on Computers in Mathematics Education (L. Carl Leinbach, chair) and the Committee on Electronic Services (Eugene A. Herman, chair). In this hands-on session, several presenters will demonstrate and encourage exploration of a variety of services on the Internet of interest to mathematicians. Among these will be the mathematics archives and "gophers" maintained by various professional societies in mathematics. Each presenter will give a short formal presentation and will be available throughout most of the session to help conference attendees explore Internet services. The organizers are **Eugene A. Herman**, Grinnell College, and **Lawrence S. Husch**, University of Tennessee, Knoxville.

Advising Undergraduate Mathematics Majors: The MAA ad hoc Committee on Advising is sponsoring this panel discussion, which will take place on Tuesday from 1:00 p.m. to 2:30 p.m. This committee was appointed to study the advising of mathematics majors. In this panel presentation, members of the committee and others will discuss advising methods that work at various colleges and universities. In addition, the session will include a discussion of career-related advising materials that are available to assist mathematics advisors. The organizer and moderator is **David J. Lutzer**, College of William and Mary. Possible participants include the moderator, **Diane L. Herrmann**, University of Chicago, and **Andrew Sterrett, Jr.**, MAA.

Calculus Reform in Different Settings: This panel discussion is scheduled from 2:45 p.m. to 4:30 p.m. on Tuesday and is being organized by **A. Wayne Roberts**, Macalester College, and **Sharon C. Ross**, DeKalb College. "Different settings" is to be interpreted in two ways. "Different types of schools" (high schools without AP, high schools with AP, two-year colleges, private liberal arts colleges, state universities) and "different approaches" (formal labs, adoption of all new materials, use of standard text with supplements).

1994 International Olympiad Winners' Stories: There will be a panel discussion scheduled from 4:45 p.m. to 6:00 p.m. on Tuesday in which the USA International Mathematical

Olympiad (IMO) team members will describe their experiences at the IMO held in Hong Kong, July 8–20, 1994. The organizer and moderator is **Walter E. Mientka**, University of Nebraska, Lincoln, and executive director of the American Mathematics Competitions.

Micro-inequities Skits: On Tuesday evening from 8:30 p.m. to 10:00 p.m., the Committee on the Participation of Women (Carol B. Lacampagne, chair) is presenting its ninth program of skits about the incidents that reveal the current relationship between the sexes within our mathematics community. The events to be dramatized were reported within the past year. Following the skits, discussion groups will consider how these incidents might have been resolved and related issues which may arise. The skits will be dramatized by **David E. Bolivar**, University of Central Oklahoma; **Susan C. Geller**, Texas A&M University; and **David J. Pengelley**, New Mexico State University. Additional contributions are desired. Brief descriptions of incidents which should be dramatized may be sent to David E. Bolivar, Department of Mathematics and Statistics, University of Central Oklahoma, 100 N. University Drive, Edmond, OK 73034-0197; or by e-mail to dbolivar@aix1.ucok.edu.

MAA Student Activities

Student Lecture: Gail S. Nelson, Carleton College, *What's really in the Cantor set?*, Wednesday, 1:40 p.m.

Student Workshop: *The theory and practice of juggling*, Wednesday, 2:45 p.m. to 4:45 p.m., organized by **Joe P. Buhler**, Reed College, and **Ronald L. Graham**, AT&T Bell Laboratories and president of AMS, who also will make presentations. Please check the appropriate box on the Advance Registration/Housing Form if you would like to register for this workshop. There is no extra charge.

Student Paper Sessions: Monday and Tuesday afternoons. Students are invited to present papers at the Mathfest. Papers should be sent to **Ronald F. Barnes**, Department of Mathematics, University of Houston Downtown Campus, 1 Main Street, Houston, TX 77002, **prior to June 25**.

MAA-ΠME Student Reception: Monday, 5:00 p.m. to 6:00 p.m. All students welcome.

MAA Committee on Student Chapters Hospitality Center: Open during the same hours as registration. All students welcome.

Breakfast for MAA Student Chapter Faculty Advisors and Section Coordinators and ΠME Advisors: Tuesday morning. Contact **Aparna W. Higgins**, chair, Committee on Student Chapters.

See also the activities of ΠME in the *Activities of Other Organizations* section.

Other MAA Activities

Board of Governors: Sunday, August 14, 8:30 a.m. to 4:00 p.m. This meeting is open to all members of the Association.

Section Officers: Monday, 3:45 p.m. to 5:45 p.m.

Business Meeting: Wednesday, 12:25 p.m. This meeting is open to all members of the Association.

MAA Banquet for 25-Year Members: This traditional event will take place on Wednesday evening, 6:30 p.m. to 9:00 p.m. See *Social Events*.

96th Summer Meeting of the AMS

History of Mathematics Lecture: George E. Andrews, Pennsylvania State University, University Park, *The well-poised thread: Some amazing sums of Gauss, Kummer, Ramanujan, and others*, 10:40 a.m. on Tuesday.

Progress in Mathematics Lectures: Pierre Louis Lions, University of Paris IX, *On Boltzmann's equation and its applications*, 10:40 a.m. on Monday.

Kenneth A. Ribet, University of California, Berkeley, *Galois representations and modular forms*, 10:40 a.m. on Wednesday.

Special Sessions and Contributed Papers: For Special Sessions, the names and affiliations of the organizers, the topics, and the tentative days they will meet are:

George E. Andrews and **Dennis W. Stanton**, University of Minnesota, Minneapolis, *q-Series*, Monday, Tuesday, and Wednesday afternoons.

Thomas L. Drucker, Modern Logic Publishing, *History of mathematical logic and theoretical computer science*, Monday, Tuesday, and Wednesday afternoons.

Dennis M. Roseman, University of Iowa, Iowa City, *Computer graphics as a research tool in geometry and topology*, Monday, Tuesday, and Wednesday afternoons.

While most of the papers presented in these Special Sessions are invited papers, any member of the Society may submit an abstract for consideration for presentation, provided it is received by **April 26**. There is a limitation in size of a single Special Session, so that sometimes all places are filled by invitation. Papers submitted for consideration for a Special Session but not accepted will receive consideration for a 10-minute contributed paper session, unless specific instructions to the contrary are given.

Contributed papers will be grouped by related *Mathematical Reviews* subject classifications into sessions, insofar as possible. Contributed paper sessions are scheduled for Monday, Tuesday, and Wednesday afternoons.

Papers submitted for all sessions must be received by **May 17** or **April 26** (see above) by the Abstracts Coordinator, AMS Meetings Department, P.O. Box 6887, Providence, RI 02904. See the January issue of the *Notices* for submission details. Unfortunately, late papers cannot be accommodated.

Committee on Science Policy Panel Discussion: 2:00 p.m. to 3:30 p.m. on Monday.

Committee on Education Panel Discussion: 2:45 p.m. to 4:15 p.m. on Tuesday.

Activities of Other Organizations

The **Army High Performance Computer Research Center** (AHPCRC) will sponsor an event during the Mathfest. Look for details in the second announcement in the May/June *Notices*.

Meetings

Association of Women in Mathematics (AWM) Panel Discussion: Monday, 3:00 p.m. to 4:30 p.m.

AWM Open Reception: Monday, 9:30 p.m. to 11:00 p.m. See *Social Events*.

The Geometry Center, located at 1300 South Second Street, is an NSF science and technology research center whose mission is to foster research in geometry and related fields and the communication of mathematical ideas among mathematicians and to the public, using modern computation and visualization tools.

The Center is sponsoring several exciting activities, both at the Center and at the Mathfest:

- Interested participants should see the article on the August 13–14 workshop, *Basic issues in computer-aided math visualization*, which follows the Mathfest announcement.
- A poster and video session displaying aspects of the Center's work, Monday, 2:00 p.m. to 4:00 p.m.
- Geometry Center participation in the AMS special session *Computer graphics as a research tool in geometry and topology*.

Participants should also see the *Social Events* section for details of the Center's open house and reception.

Institute for Mathematics and its Applications (IMA) Session: IMA was founded by the Mathematical Sciences Division of NSF in 1982. The mission of the IMA is to demonstrate the power of sophisticated mathematics to solve problems that arise in the other sciences, engineering, and industry, and to encourage mathematicians to work on these problems. IMA's presentation is *Mathematical modeling for instructors* conducted by **Donald A. Drew**, Rensselaer Polytechnic Institute; **Patrick Hagan**, Los Alamos National Laboratory; **David Ross**, Eastman Kodak; and **Colin Please**, Southampton University, England; Monday, 4:30 p.m. to 5:30 p.m., in IMA's main offices in Vincent Hall on the East Bank campus.

The **National Science Foundation** (NSF) invites participants to meet informally with staff members from noon to 1:00 p.m. daily.

Pi Mu Epsilon (ΠME) prepares their own detailed program for their sessions; ask for your copy at the Registration Desk.

ΠME J. Sutherland Frame Lecture: Colin Adams, Williams College, *Cheating your way to the knot merit badge, by Scoutmaster Mel Slugbate*; Tuesday, 8:30 p.m.

Sessions for ΠME Contributed Papers: Monday and Tuesday afternoons.

ΠME Council: Monday, noon to 2:30 p.m.

Reception: Monday, 5:00 p.m., cosponsored by ΠME and MAA.

ΠME Banquet: See *Social Events*.

Other Events of Interest

Book Sales

Book Sales: Books published by the AMS and MAA will be sold at discounted prices somewhat below the cost for the same books purchased by mail. **These discounts will be available only to registered participants wearing the official meetings badge.** Visa and MasterCard will be accepted for book sale purchases at the meetings. The book sales will be open Monday and Tuesday from 9:00 a.m. to 5:00 p.m., and Wednesday from 9:00 a.m. to 2:00 p.m.

Information Booths: All meeting participants are invited to visit the AMS and MAA membership information booths during the meetings. A representative will be available at each booth to answer questions about membership, publication, and other programs. Complimentary coffee will be available at the AMS booth. These booths will be open the same days and hours as the book sales.

Joint Books, Journals, and Promotional Materials: This display will be open the same hours as the book sales and will afford participants the opportunity to order publications from various commercial publishers not represented at the meetings.

Other commercial publishers may be represented at the meeting, although not in the Mathfest Book Sales and Exhibits area. Look for announcements of these exhibits in the program or at the Mathfest.

Social Events

It is strongly recommended that tickets for events be purchased through advance registration, since only a very limited number of tickets will be available for sale on-site. Tickets purchased through advance registration will be mailed with your badge and program from Providence. Should participants wish to pick up their ticket(s) at the meeting at the same time as their badge and program, they must indicate this on the Advance Registration/Housing (ARH) form. To get a 50% refund, **returned tickets must be received by the Mathematics Meetings Service Bureau (MMSB) by August 1.** After that date no refunds can be made. Special meals are available upon request at all banquets, including vegetarian and kosher (except for the dinner cruise on Monday), but this must be indicated on the ARH form in advance.

Opening Banquet: The special feature of this banquet will be the awarding of AMS and MAA prizes. For AMS, recipients of three Leroy P. Steele Prizes: one for writing a truly fundamental paper, one for a work or sequence of works that has been shown to be of lasting value, and one for an outstanding career will be announced. For MAA, the recipients of awards for outstanding journal articles, namely the Carl B. Allendoerfer, Lester R. Ford, and George Pólya Awards will be announced. Diners will have the opportunity to meet with each of them on Sunday, August 14, at 7:30 p.m. The banquet will be preceded by a cash bar reception at 6:30 p.m. The entrée is roasted top sirloin of beef with wild mushroom sauce. Vegetarian and kosher meals are available upon advance request. Tickets are $25 per person, including gratuity and all taxes. This event will be held in the University Ballroom, Radisson Hotel Metrodome. Shuttle buses will take participants from Middlebrook and Comstock Halls to the Radisson beginning at 6:00 p.m. and return participants until 10:30 p.m.

Meetings

Because this event occurs the evening before the first day of the meetings and **seating is very limited**, very few, if any, tickets will be available for purchase on site, so be sure to purchase your ticket when you register in advance.

Children's Special Event: A special event for children of participants attending the Opening Banquet will be held from 6:30 p.m. to 10:00 p.m. on Sunday, in the Alumni Room near the University Ballroom in the Radisson. There will be a bonded and licensed individual to watch over the children. Light refreshments will be served; however, parents should be sure that their children have eaten dinner before dropping them off. The evening's entertainment will be provided by a visit from a clown from Miles of Smiles. The room will be equipped with a VCR and monitor and videotapes suitable for children. The cost for this event is $20 per child, and participants must reserve places for their children in advance on the ARH form. If fewer than ten children are registered, this event will be canceled and full refunds issued. Children must be at least three years of age.

Dinner Cruise Aboard a Paddleboat and Barge: On Monday, August 15, from 6:30 p.m. to 9:00 p.m., participants may sample traditional Mississippi cruising and dining aboard the paddleboat *Anson Northrup* as she pushes the *Betsey Northrup* passenger barge down the Mississippi. This scenic cruise will show you Minneapolis from a decidedly different perspective as you learn about the area and people along the mighty Mississippi. One of the most fascinating aspects of your journey will take you through the system of locks so important to river navigation. You will go through the Upper St. Anthony Falls Lock to descend 50 feet to the next level of the river.

As if the cruise and scenery were not enough to make this an unforgettable event, extraspecial entertainment will be provided by The Medicine Show Music Co. This trio has been described as a living encyclopedia of vaudeville, so get ready for a little singing, some down-home humor, a touch of tap dancing, and a tweak of sleight-of-hand, tempered by the strains of saxophone and banjo! If your funnybone doesn't get tickled by this group, you're in serious need of a transplant!

There will be a cash bar where participants can relax and mingle with their colleagues and guests. The dinner served on board features old-fashioned bratwurst. Tickets are $26 each for the cruise and dinner, including all taxes. Vegetarian meals are available with advance request; regretfully, no kosher meals are available. Buses will leave from Middlebrook and Comstock Halls **promptly** at 6:00 p.m.

AWM Reception: The AWM will top off the night on Monday at 9:30 p.m. with one of their spectacular parties. All participants are invited for camaraderie, music, and refreshments.

Geometry Center Open House and Reception: All participants are invited to an open house from 1:00 p.m. to 7:30 p.m. on Tuesday at the Center located at 1300 South Second Street. Demonstrations of software and videos produced at the Center, plus discussions with the developers of the software and with students, researchers, and staff will

be available. Computers for reading e-mail will be available.

Participants are also cordially invited to a complimentary reception from 5:30 p.m. to 7:30 p.m. on Tuesday as part of the open house.

IIME Banquet: This popular annual event will take place on Tuesday, August 16, at 6:45 p.m. at the H. H. Humphrey Center dining room. The buffet dinner features chicken and beef burgundy as entrées. Tickets are $17, which includes a donation to the university's scholarship fund in lieu of a gratuity. Tickets for IIME members are $10. Vegetarian and kosher meals are available through advance request.

MAA 25-Year Member Banquet: The MAA is planning its seventeenth annual banquet on Wednesday for those individuals who have been members of the Association for twenty-five years or more. After a reception beginning at 5:45 p.m. dinner will be served in the Humphrey Center dining room at 6:30 p.m. The entrée is grilled swordfish. Tickets are $26 each, including a donation to the university's scholarship fund in lieu of a gratuity. Alcoholic beverages will not be available. Vegetarian and kosher meals are available through advance request.

Tours

Because of its many attractions and marvelous climate, the Minneapolis area is a premier vacation destination. The following tours are recommended as typical of the area in the summer and are available exclusively to mathematicians and their families. Tickets should be purchased through advance registration, as seats are limited and many tours may sell out early. Please indicate preference for tour(s) on the ARH form and include applicable payments. NOTE: Should these tours not meet a minimum of 30, they will be canceled and full refunds issued. All tours will take place as scheduled, rain or shine, and no refunds will be made because of weather.

No food is included in the prices of the tickets listed below unless specified. For those persons staying in residence ahlls, box lunches will be available as part of your room and board package and will be distributed on the bus for all tours, even those which include lunch. Unfortunately, there is no reduction in price if one declines the tour provided lunch. **Pick up and drop off will be at Middlebrook Hall.**

Take the Plunge! Tube down the beautiful Apple River in Somerset, Wisconsin, to a beautiful waterpark filled with multiflume waterslides. A shuttle will take you back up to the drop-off point in the river to tube back down, or you may wish to stay in the waterpark zooming down the slides. This trip is wet and wild; a great day of family fun! Sunday, August 14, and Thursday, August 18, departs 10:00 a.m. and returns at 5:00 p.m. Cost is $32 per person and includes a box lunch.

Fort Snelling and a Cruise on the Mighty Mississippi River: First you will visit restored Fort Snelling and go back in time to the 1820s at this historic site set on a bluff high above the juncture of the Minnesota and Mississippi rivers. This is a living museum where you will see characters in the uniform of the era going through daily activities as they did more than 150 years ago. Then off to Harriet Island to recapture

the thrill of a cruise on a sternwheeler—the *Josiah Snelling*, pride of the nineteenth century. Listen to the rhythmic swish of the paddlewheel and the deep-throated blast of the whistle. There is a snack bar aboard where you can purchase a light lunch. Sunday, August 14, departs at 9:15 a.m. and returns at 2:30 p.m. Cost is $26 per person ($23.50 for children 11 and under).

A Tale of Two Cities: See the fantastic diversity of two cities, Minneapolis and St. Paul, a comfortable blend of old and new with magnificent art deco and Victorian reminders of the past nestled next to gleaming skyscrapers. Your expert guide will narrate a tour of the two downtown areas, the Guthrie-Walker Complex, mansion-lined Summit Avenue, St. Paul's Cathedral, and the mighty Mississippi River. Stop and enjoy the Minneapolis Sculpture Garden, Minnehaha Falls (the inspiration for Henry Wadsworth Longfellow's "Song of Hiawatha"), and the State Capitol. Monday, August 15, departs at 9:00 a.m, returns at 1:00 p.m. Cost is $16 per person.

A Walk on the Wild Side: Your deluxe motorcoach will take you to the Raptor Center, located on the campus of the University of Minnesota-St. Paul campus to get a first-hand look at birds of prey. After a slide presentation, you can see the live eagles, hawks, owls, and falcons that make the center their home.

Next stop is the Minnesota Valley National Wildlife Refuge, which encompasses 7,500 acres and stretches for 34 miles. This is an area where over 300 species of wildlife continue to thrive within a short distance from the city. At the center you can enjoy a boxed lunch and any of the activities offered, such as nature hikes, bird watching, nature photography, and wildflower identification.

Lastly you will visit historic Murphy's Landing overlooking the beautiful Minnesota River Valley. Here you will learn about the joys and hardships of Minnesota's early settlers in this unique community of historic buildings. The authentic houses of this village were transported here and reflect life as it was from 1850–1880. Monday, August 15, departs 9:00 a.m. and returns at 4:00 p.m. Cost is $34 per person, including the box lunch.

Wildlife at the Minnesota Zoo: This zoo is Minnesota's first without bars and is a 500-acre conservatory designed to duplicate natural habitats. There will be a brief orientation session when you arrive at the zoo. Then there are many wonderful exhibits for you to choose from, including a dolphin feeding and show, the tropics, children's zoo, a koala exhibit, a coral reef exhibit, and the spectacular bird show in the outdoor amphitheatre. Ride the monorail for an overhead view (extra charge)! Tuesday and Wednesday, departs 9:00 a.m. and returns 1:00 p.m. Cost is $22 per person ($20 for children 12 and under).

Shop 'til You Drop! The Mall of America, largest mall in the United States, has hundreds of specialty stores and four major anchor stores—Bloomingdales, Macy's, Nordstroms, and Sears. In the center of the mall is Camp Snoopy, a seven-acre family amusement park complete with 26 rides and attractions. Visit The LEGO Imagination Center, where young and old can make the LEGO castle of their dreams! Like golf? Enjoy the 18-hole Golf Mountain Adventure. Whatever you like for lunch is available in the dozens of restaurants. Prefer to enjoy a movie? There are 14 cinemas to choose from. There will be an official greeting, a brief orientation to the mall, and you will receive a small gift bag with maps. A trip not to be missed. Tuesday, August 16, departs 9:30 a.m and returns at 3:30 p.m. Cost is $13 per person.

Gardens and Goodies: The lovely University of Minnesota Landscape Arboretum is the first stop on this trip. The arboretum will provide a guided tour orienting you for further exploration of the grounds. You can pick up many ideas for your garden back home.

Next, off to a one-of-a-kind facility, the General Store. This multilevel rustic store features the work of over 300 local Minnesota artists.

End this tour with a unique shopping experience at Byerly's, a SUPERmarket with 92,000 square feet of carpeted elegance housing millions of dollars of delectables and collectibles. Wednesday, August 17, departs 9:30 a.m. and returns at 3:00 p.m. Cost is $18 per person.

Historic Stillwater: Stillwater, located on the Saint Croix River, has all the charm of a New England town with its regal nineteenth-century mansions on residential hills, steepled churches, and a beautifully restored turn-of-the-century business and shopping district.

Your professional guide will tell you the story of this logging capitol. Tour an elegant private residence. Enjoy a delightful lunch at the Lowell Inn, Minnesota's proud entry in *Back Roads & Country Inns*, named one of this country's ten best inns. You'll have time to shop at the restored Post Office Building, Grand Garage Gallery, and Staples Antique Mill. Thursday, August 18, departs at 9:15 a.m. and returns at 3:45 p.m. Cost is $34 per person, lunch included.

How to Register in Advance

The importance of advance registration cannot be overemphasized. Those who register in advance pay fees considerably lower than those who register at the meeting (on-site registration fees will be 30% higher than the advance registration fees listed below). There are two separate advance registration deadlines, each with its own advantages and benefits.

ORDINARY advance registration
(and housing)   June 11
FINAL advance registration
(no housing or tickets)   July 14

Ordinary Advance Registration: Those who register by the **ordinary** deadline of **June 11** may make housing reservations at special rates offered only through the MMSB. They will receive formal acknowledgments prior to the meetings as well as their badges, programs, and appropriate tickets by mail two to three weeks before the meeting unless the appropriate box signaling the contrary was checked on the Advance Registration and Housing (ARH) form.

Meetings

Because of possible delays in delivery of the U.S. mail to Canada, it is strongly suggested that advance registrants from Canada choose to pick up their registration material at the meeting as opposed to having it mailed. There will be a special Registration Assistance desk at the meeting to assist individuals who either do not receive this mailing or who have a problem with their registration. Please note that a **$2 replacement fee** will be charged for programs and badges that are mailed but are not brought by participants to Minneapolis.

Final Advance Registration: Those who register by the **final** deadline of **July 14** must pick up their badge and program at the meeting. Unfortunately, it is not possible to provide final advance registrants with housing or tickets to special events in advance. **Please note that the July 14 deadline is firm and any forms received after that date will be returned!**

It is essential that the ARH form (found at the back of this issue) be completed fully and clearly. **Each** person must complete a separate copy of the ARH form, but all registrations from one family may be covered by one payment. Please print or type the information requested, and be sure to complete all sections. Absence of information (missing credit card numbers, incomplete addresses, etc.) will cause a delay in processing.

If you wish to be included in a **list of individuals sorted by mathematical interest**, please provide the one *Mathematical Reviews* classification number of your major area of interest on the ARH form. (A list of these numbers appears on the back of the MAA and AMS abstract forms.) The master copy of this list will be posted on the meetings bulletin board near the registration area.

Advance Registration Fees: The AMS-MAA Joint Meetings Committee is responsible for maintaining a sound fiscal position for these meetings while still providing the very best meeting facilities and services to the participants. Registration fees only partially cover the expenses of holding meetings.

The **registration fees at the meeting will be 30% higher** than the advance registration fees listed below. One-day registration fees will also be available at the meeting (these fees are not payable through advance registration).

Minneapolis Mathfest

Member of MAA, Canadian Mathematical Society, AMS, ΠME	$125
Emeritus Member of MAA or AMS Graduate Student, Unemployed, High School Teacher, Librarian, Third-World Country Participant	35
Undergraduate Student	20
Nonmember	194
High School Student	2

MAA Minicourses

Minicourses #2, 3, 4, 5, 6, 8, 9	$ 45
Minicourse #1	65

All mathematicians who wish to attend sessions are expected to register and should be prepared to show their badge, if so requested. Badges are required to obtain discounts at the MAA and AMS Book Sales and to cash a check with the meeting cashier. If advance registrants arrive too late in the day to pick up their badges, the acknowledgment of registration received from the MMSB acts as proof of registration.

Advance registration forms accompanied by insufficient payment either will be returned, therefore delaying the processing of any hotel housing request, or a $5 charge will be assessed if an invoice must be prepared to collect the delinquent amount. Overpayments of less than $2 will not be refunded.

All **full-time students** currently working toward a degree or diploma qualify for the student registration fees, regardless of income.

The **unemployed** status refers to any person currently unemployed, actively seeking employment, and not a student. It is not intended to include any person who has voluntarily resigned or retired from his or her latest position.

Persons who qualify for **emeritus** membership in either the Association or the Society may register at the emeritus member rate. The emeritus status refers to any person who has been a member of the MAA or AMS for twenty years or more and who is retired on account of age or on account of long-term disability from his or her latest position. This rate is also extended to any CMS member who has retired from his or her position.

The **high school teacher** status refers to any person whose primary employment is teaching in any high school or secondary school.

The **librarian** status refers to any person who has a degree in library science and whose primary employment is working in a library.

Third-world country status refers to those participants from the third world where salary levels are radically non-commensurate with those in the U.S.

Nonmembers who register at the nonmember fee will receive mailings containing information about a special membership offer from MAA and AMS after the meeting is over.

There is no extra charge for members of the families of registered participants, except that all professional mathematicians who wish to attend sessions must register independently.

Participants should check with their tax preparers for applicable deductions for education expenses as they pertain to this meeting.

Electronic Advance Registration: This service is available for advance registration, and housing arrangements if desired, by requesting the forms via e-mail from **meet@math. ams.org**, or by telnetting to e-MATH, selecting [10] GOPHER from the main menu, then selecting [11] Meetings and Conferences and following the instructions for the required forms. **VISA or MasterCard is the ONLY method of payment which will be accepted for electronic advance registration,** and charges to credit cards will be made in U.S. funds. These forms will be treated in the same manner as forms received through U.S. mail. Receipt of the completed form and payment will be acknowledged by the MMSB. Participants are

advised to bring a copy of this acknowledgment with them to Minneapolis. The same deadlines apply as for advance registration by mail.

Miscellaneous Information

Audio-Visual Equipment: Standard equipment in all session rooms is one overhead projector and screen. (Invited 50-minute speakers are automatically provided with two overhead projectors.) **Blackboards are available only in rooms where they currently exist and cannot be produced upon request.**

Speakers in MAA sessions requiring additional equipment may make written requests for one additional overhead projector/screen, 35mm carousel slide projector, or VHS video cassette recorder with one color monitor. Such requests should be addressed to the MAA Associate Secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403). These requests should be received by **June 1.**

All other speakers requiring additional equipment should contact the Audio-Visual Coordinator for the meetings at the AMS office in Providence at 401-455-4140, or electronic mail to wsd@math.ams.org by **June 1.**

Requests for equipment made at the meeting most likely will not be satisfied because of budgetary restrictions.

Camping and RV Facilities: There are several campgrounds, most with RV facilities, in the general area. Interested participants should contact the MMSB at 401-455-4143 or meet@math.ams.org for a list.

Car Rental: Alamo Rent A Car has been designated as the official car rental company for the Minneapolis Mathfest. To reserve a car at special rates, call 800-732-3232 and request group **ID# 247733** and rate code **GR**. Also have the reservationist check **Code 7G** for additional convention discounts that may apply. Included in the rental fee is $3,000 maximum personal responsibility limit which covers damage to the rental car only. Taxes, Waiver Savers ($11.99/day or less), fuel, drop charges, additional driver fees, and other optional items are additional. These rates are applicable one week prior to and one week after the Mathfest and include unlimited mileage. Rates are higher for renters under age 25. Weekly rates require a five-day minimum rental or daily rates will apply. A 24-hour advance reservation is required. Availability of these rates is limited. Valid driver's license and credit card are required. You may receive credit on your frequent flyer accounts on Delta, United, Hawaiian Airlines, Alaska Air, and USAir.

Car Class	Daily	Weekly
Economy	$22	$105
Compact	$27	$119
Midsize	$29	$149
Full size	$34	$179
Luxury	$36	$199

Four-door models may be requested at the time of reservation for an additional charge of $2/day or $10/week for midsize or larger.

The Alamo counter at the Minneapolis/St. Paul International Airport is located near carousel #9 in the baggage claim area. Once the paperwork is completed at the counter, you must take a complimentary shuttle to the car rental building.

Children's Activities: A parent-child lounge will be furnished with casual furniture, a crib, and a changing area. Any child using this lounge must be accompanied by a parent (not simply an adult), who must be responsible for supervision of the child. This lounge will be unattended, and parents assume all responsibility for their children. This lounge will be open only during the hours of registration, and all persons must leave the lounge at the close of registration each day.

Also, please see the *Social Events* and *Tours* sections for other children's activities.

The City of Minneapolis offers summer programs for children up to sixth grade in city parks. Van Klee Park is six blocks from East Campus at 901 15th Ave., SE. For detailed information on these programs you may contact Candice or Bobbie at 612-348-8131.

E-mail: Computer terminals for contacting your university's computer using the Internet will be available on campus at a location to be announced. Participants are advised to check with technicians at their own college or university to identify the numerical address of their machine, as well as its name, and bring this information with them. Not all locations can be contacted by name alone.

Employment Opportunities: There will be an opportunity for the posting of both applicant résumé forms and employers announcements of open positions in a designated area on the meetings bulletin board. No provisions will be made for holding interviews; while interviews are encouraged, arrangements will be the responsibility of each employer and applicant. Messages may be left on the meetings message board. A very limited number of rooms will be available for short periods for informal interviews. Interested participants should check with the Logistics Coordinator or the Meeting Manager at the Registration Desk.

Applicant and employer forms will be available at the transparencies section of the Registration Desk. There is no charge for this service. Please note that no printed lists of employers or applicants who fill out forms will be published.

Information Distribution: A table is set up in the registration area for dissemination of information of possible interest to participants.

A second table is set up in the book sale area for the dissemination of information of a **mathematical** nature **not** promoting a product or program for sale.

Those who wish to display information of a mathematical nature promoting a product or program for sale may do so in the book sale area at the Joint Books, Journals, and Promotional Materials display for a fee of $35 per item.

Those who would like to display material separate from the Joint Books table must reimburse the meeting for room rental and any extra furnishings requested (tables, chairs, easels, etc.) (This latter display is also subject to space availability.)

Meetings

The administration of these tables is in the hands of the Exhibits Coordinator. To request a contract or more information, please contact Exhibits Coordinator, MMSB, PO Box 6887, Providence, RI 02940; 401-455-4143; meet@math.ams.org.

Mail: All mail and telegrams for persons attending the meeting should be addressed as follows: Participant's name, Minneapolis Mathfest, c/o Lori Graven, Continuing Education and Conferences, University of Minnesota, 131 Nolte, Minneapolis, MN 55455. Those received will be posted on the message board near the registration area. Mail not picked up will be forwarded after the meeting to the mailing address given on the participant's registration record.

Parking: Participants staying in hotels or residence halls should refer to the housing page for parking instructions. There are several public parking areas on campus; Mathfest participants may find the most convenient to the meetings is the West Bank Ramp near Middlebrook Hall. Cost is approximately $1.50/day with no in/out privileges.

AMS Petition Table: At the request of the AMS Committee on Human Rights of Mathematicians, a table will be made available in the registration area at which petitions on behalf of named individual mathematicians suffering from human rights violations may be displayed and signed by meetings participants acting in their individual capacities. Those interested in displaying material should contact the Director of Meetings, hhd@math.ams.org, 401-455-4137.

Registration Desk: This will be located in Middlebrook Hall. Those who did not want their badges, programs, and tickets mailed should pick them up here. A list of services provided by registration staff will be provided in the program.

Telephone Messages: A telephone message center will be located in the registration area to receive incoming calls for participants. **The center will be open from August 14 through August 17 during the hours that the Registration Desk is open.** Messages will be taken and posted on the meetings message board. In the case of a bona fide emergency, every attempt will be made to contact the participant as soon as possible; otherwise, each participant must take responsibility for checking the message board. Once the Mathfest Registration Desk has closed for the day, there is no mechanism for contacting participants other than calling them directly at their hotel or campus residence. Messages for participants staying in the residence halls may be left at the front desk. See the housing page for numbers and hours of operation.

Travel

The campus is located along the Mississippi River, which divides the East Bank Campus from the West. These are connected by a covered bridge on Washington Avenue. Bus #16 runs along this major avenue. Another main artery, University Avenue, is along the north border of the West Campus; Washington Avenue intersects it slightly east of the campus.

Complimentary shuttle service is provided on the campus Monday through Friday. Service begins at 7:10 a.m. from Blegen Hall and runs every half hour until 5:30 p.m. Route details will be available at the meeting.

Continental and **Northwest** Airlines have been selected as the official airlines for the meeting for their generally convenient schedules to Minneapolis. We strongly urge participants to make use of these special deals if at all possible, since the AMS and MAA can earn complimentary tickets on these carriers. These tickets are used to send meetings' staff (not officers or other staff) to the Mathfest, thereby keeping the costs of the meeting (and registration fees) down. The following specially negotiated rates are available only for this meeting.

Continental Airlines is offering 40% off Full Coach or Full First-Class fares and 5% off restricted round-trip fares, applicable five days prior to and five days after the meeting. No discounts apply to Business First. These fares are based on travel within the continental U.S., including Alaska. For reservations call 800-468-7022 Monday–Friday from 7:30 a.m. to 8:00 p.m. and Saturday and Sunday from 8:00 a.m. to 6:00 p.m. Central Daylight Time. Refer to Easy Access Number **ZM34**. You may pay for your ticket at the time of reservation and the tickets will be sent to you, or you may purchase your tickets from your local travel agency, any Continental ticket office, or airport ticket counter.

Northwest Airlines is offering 5% off applicable published fares for travel within the domestic 48 states or travel to and from Canada, applicable August 12–20. For reservations call 800-328-1111 Monday-Friday from 7:30 a.m. to 7:30 p.m. Central Daylight Time. Refer to Worldfile Number **NC79U**. You may pay for your ticket at the time of reservation and the tickets will be sent to you, or you may purchase your tickets from your local travel agency, any Northwest ticket office, or airport ticket counter.

Travel from the airport: A taxi from the Minneapolis/St. Paul International Airport to the campus costs approximately $20–25 for the 10-mile ride. The Airport Express shuttle will take you to some of the major hotels near the campus for $7.50 one way or $10 round trip. (Comstock and Middlebrook Residence Halls are a five- to ten-minute walk from the Holiday Inn Metrodome.) Their office is located near baggage carousel #9.

Bus #7 runs from the airport to downtown every 20 to 30 minutes. You must transfer to the #16 bus to the campus area. Fare is $1.25, exact change required.

AMTRAK: The nearest AMTRAK station is located about three blocks north of University Avenue, a few miles east of the campus. Taxis are available to take you to your hotel. If you wish to take a public bus, walk south down Transfer Road to University Avenue. At the northeast corner of the intersection, take the #16 bus going west to the campus. Call 800-872-7245 for AMTRAK reservations.

Weather: During August, daytime weather is usually warm and humid. For evenings, sweaters or jackets may be needed.

Corollary Conference

Basic Issues in Computer-aided Math Visualization
August 13–14, 1994

This two-day workshop, organized by the Geometry Center and cosponsored by the AMS, will be held at the Geometry Center, University of Minnesota. The Geometry Center is an NSF Science and Technology Research Center whose mission is to foster research in geometry and related fields, and the communication of geometric ideas among mathematicians and to the public, using modern computation and visualization tools.

Computer visualization has become an important tool in several fields of mathematics, helping mathematical understanding and communication, the formulation of conjectures, and the development of proofs. *Basic issues in computer-aided math visualization* is designed as an introduction to the subject for mathematicians. While standard references such as *Computer Graphics, Principles and Practice* provide a detailed background to computer graphics in general, we will concentrate on issues likely to be of particular interest to mathematicians. Here are some sample questions that we will try to address:

- How can I visualize surface X? or map Y? or the solutions of differential equation Z?
- How should I spend my hardware grant of X thousand dollars?
- How can I get hard copy of this image? How much work is it to make a video?

The focus will be on how to find out about, evaluate, and use existing software. A certain amount of basic material must be covered first, before we address these specific issues. Also, we will make no attempt to cover the broad subject of volume visualization.

The course will include lectures, software demonstrations, a question and answer session, and supervised participant experimentation on graphics workstations. Printed notes will be distributed, including a full bibliography.

For a preliminary syllabus and registration form see the April issue of the *Notices*, or contact the AMS at 401-455-4138 or meet@math.ams.org

MAA Minicourse Advance Registration Form

Minneapolis, Minnesota

August 14–17, 1994

To register for MAA Minicourse(s), please complete THIS FORM or a PHOTOCOPY OF THIS FORM and return it with your payment to:

> Minicourse Coordinator
> Mathematical Association of America
> 1529 Eighteenth Street, N.W.
> Washington, DC 20036
> Telephone: 202-387-5200

_____ Telephone: _____
(Please print)   Surname   First   Middle

_____
Street address   City   State   Zip

- Deadline for MAA Minicourse advance registration: June 11, 1994. (After this date, potential participants are encouraged to call the MAA headquarters at 800-331-1622 for availability of Minicourses.)

- Deadline for cancellation in order to receive a 50% refund: August 11, 1994*.

- Each participant must fill out a separate Minicourse Advance Registration Form.

- Enrollment is limited to two Minicourses, subject to availability.

- Please complete the following and send both form and payment to the Minicourse Coordinator at the above address:

    I would like to attend   ☐ 1 Minicourse   ☐ 2 Minicourses

    Please enroll me in MAA Minicourse(s):   #___ and #___

    In order of preference, my alternatives are: #___ and #___

- PAYMENT

    Check enclosed: $ _____   Credit card type: ☐ MasterCard   ☐ Visa

    Credit card # _____ Expiration date: _____

_____   _____
Your Employing Institution   Signature (as it appears on credit card)

*☐   I plan on registering in advance for the Minneapolis Mathfest meetings **ONLY** in order to attend the MAA Minicourse(s) indicated above. It is my understanding that should the course(s) of my choice be fully subscribed, a full refund of the Mathfest meetings advance registration fee will be made.

* If the box above is not checked off, the Mathfest advance registration fee will be processed and the 50% refund rule will apply. Your intention regarding the Mathfest registration should be made clear when cancelling a Minicourse registration. If no instruction is given, the Mathfest registration will also be cancelled. Advance Registration/Housing forms for the Mathfest should be mailed to the Mathematics Meetings Service Bureau in Providence.

See course descriptions, enrollment limits, and registration fees on the reverse.

How to Get a Room

GENERAL: Participants are required to register in advance in order to obtain residence hall and hotel accommodations through the Mathematics Meetings Service Bureau (MMSB). All reservation requests for the residence halls and the Holiday Inn Metrodome must be received in writing and processed through the MMSB to receive the rates listed below. Be sure to complete the Housing Section of the Advance Registration/Housing (ARH) Form (located at the end of this issue) completely to insure accurate housing arrangements. Reservations at other hotels listed can be made directly with the hotels. Mention of attending the Mathfest will insure the convention rates listed below.

University Housing

Rates:	• $33.50 single*
(per day)	• $29.50 (per person) double–two adults*
	• $13.60 (per person) children under 12 yrs. (in rollaway beds only)*
Deadlines:	• **reservations thru MMSB – June 11****
	• **changes/cancellations thru MMSB – August 8**
	• **90% refund on Residence Hall Package – August 8**
Payments:	• by personal checks or credit card (VISA, MC)
	• all money collected by MMSB
	• no refunds issued for missed meals

* All rates include room and board (no exceptions); no tax applicable. Daily meal packages include breakfast and lunch. A limited number of meals will be available for purchase directly at the dining halls on a first-come, first-serve basis. These meals can be purchased by meal card only. Meal cards can be purchased at the main desk of each hall at adult prices of $3.36 for breakfast, $4.85 for lunch, and $6.95 for dinner and at children (under 12) prices of $1.65 for breakfast, $2.40 for lunch, and $3.45 for dinner. Unlimited seconds are provided. A sufficient number of vegetable dishes will be offered. Sorry, kosher meals cannot be provided. The rates also include reserved parking spaces if prearranged with the MMSB via the ARH form.

** Please call the MMSB (800-321-4267, ext. 4143) after June 11 for information on and assistance with obtaining university accommodations. Only a LIMITED number of rooms will be available on-site for arrivals with no previous reservations.

UNIVERSITY HOUSING: Participants desiring confirmed reservations for on-campus housing must register in advance and send payment in full for housing to the MMSB prior to the June 11, 1994, deadline. All rooms on campus are offered through a room/board package only. Two residence halls will be used: Comstock Hall, which is located on the East Bank Campus, will be assigned for single accommodations, and Middlebrook Hall, which is a high-rise located on the West Bank Campus, will be assigned for double accommodations. Special sections or floors such as nonsmoking, family, or group can be arranged through the MMSB upon request. With the exception of locations, both halls are basically the same. The university will not accept direct reservations.**

Other Infomation

- **dining hall:** located in each hall: meal cards accepted at either hall
- **dining hours:** Mon.–Fri. – Breakfast 7:00–8:30 a.m., Lunch 11:30 a.m.–1:15 p.m., Dinner 5:00–6:15 p.m.; Weekends – Continental Breakfast 7:00–8:00 a.m., Brunch 11:00 a.m.–1:00 p.m., Dinner 5:00–6:00 p.m.
- **check-in desks:** located in the lobby of each residence hall; fully staffed – 7:00 a.m. to 11:00 p.m.; periodically staffed – 11:00 p.m. to 7:00 a.m.; number posted on door for assistance; participants check in at hall assigned to them; check out time: noon
- **received at check-in:** key, meal card, parking permit, two towels, washcloth, and soap; clean linen; daily exchange of bath towels and washcloth
- **each room contains:** desk with built-in light, closet, drawer space, and telephones (unrestricted for local use only); no carpeting; windows which open
- **sleeping bags** are not allowed; cribs are not available; maximum of two adults and one child (not including infants) to a room
- **shared bathroom facilities** located on each floor; no private bathroom facilities
- **all halls air conditioned and accessible to physically challenged; all halls contain:** common living areas on each floor with refrigerator, sink, and microwave; change, ice, vending and amusement machines; coin-operated laundry room; computer room with stand-alone Macintoshes ($3 weekly charge for use of machines)
- **penalties:** lost key – $20, lost meal card – $10
- **mail/messages:** (Room Number), Middlebrook Hall, 412 22nd Avenue South, or (Room Number), Comstock Hall, 210 Delaware Street SE, Minneapolis, MN 55455-0307
- **parking:** Middlebrook Hall – lots C58, C59, C85; Comstock Hall – lot C70

HOTEL HOUSING: Participants desiring confirmed reservations at the Holiday Inn Metrodome must register in advance and send in the ARH Form prior to the June 11, 1994, deadline. Participants are required to guarantee their reservations at the Holiday Inn Metrodome with either a $50 deposit by check or a major credit card. **The Holiday Inn Metrodome will not take reservations directly.** Reservations at the other hotels listed must be reserved through the hotels directly prior to July 22, 1994 (July 8 for suite reservations at the Radisson); guarantees required. After this date, the MMSB cannot guarantee the availability of the special convention rates listed below. Rates listed are subject to a 12% sales/occupancy tax. Nonsmoking rooms and rooms accessible to the physically challenged (king-bedded only at the Holiday Inn) are available at all properties. Suite rates listed are starting rates. Please call the MMSB for further information.

Holiday Inn Metrodome (Headquarters) (West Bank)
1500 Washington Avenue South
Minneapolis, MN 55454
(612) 333-4646
single–$77, double–$87, suites $109+
each additional person–$10 per day
rollaways–$10 per day
children under 17 yrs. free
parking–$6.50 per day
lounge, restaurant
indoor pool, exercise room
windows do not open
computer modem hookups in rooms
check-in at 3:00 p.m.
check-out at noon

Radisson Hotel Metrodome (East Bank)
615 Washington Avenue
Minneapolis, MN 55414
(612) 379-8888
(800) 822-6757
single–$69, double–$79
triple/quad–$89;suites–$95+
rollaways–$10 per day
children under 18 yrs. free
parking $7.60 per day
lounge, restaurants
exercise room
windows which open
check-in at 3:00 p.m.
check-out at noon

Days Inn (East Bank)
2407 University Avenue SE
Minneapolis, MN 55414
(612) 623-3999
single/double–$55
children under 17 yrs. free
free parking
restaurants off premises
windows which open
check-in at 3:00 p.m.
check-out at 11:00 a.m.

Econolodge (East Bank)
2500 University Avenue SE
Minneapolis, MN 55414
(612) 331-6000
(800) 55-ECONO
single/double–$45
children under 18 yrs. free
free parking
restaurants off premises
windows which open
outdoor pool
check-in at 2:00 p.m.
check-out at noon
limited number of rooms w/kitchenettes

Advance Registration/Housing Form
Minneapolis Mathfest
August 15–17, 1994

Please complete this form and return to: Mathematics Meetings Service Bureau (MMSB)
P. O. Box 6887
Providence, Rhode Island 02940 U.S.A.
401-455-4143; 1-800-321-4267, Ext. 4143

DEADLINES

Ordinary Advance Registration (including tickets)	June 11, 1994	
Hotel/Residence Hall Reservations through MMSB	June 11, 1994	
Final Advance Registration (no housing or tickets)	July 14, 1994	
Hotel Changes/Cancellations through MMSB	July 5, 1994	
Residence Hall Changes/Cancellations through MMSB	August 8, 1994	
90% Refund on Residence Hall Package	August 8, 1994	(no refunds after this date)
50% Refund on Banquets & Tours*	August 1, 1994	(no refunds after this date)
50% Refund on Mathfest Advance Registration*	August 11, 1994	(no refunds after this date)

REGISTRATION FEES
Advance Registration by
July 14, 1994

MINNEAPOLIS MATHFEST

Member of AMS, CMS, MAA, ΠME	$ 125
* Emeritus Member of AMS or MAA	35
* Nonmember	194
* Students:	
High School	2
Undergraduate	20
Graduate	35
* High School Teachers or Librarians	35
* Third World Country Participants	35
* Unemployed	35

(N.B.: A separate form appears in this issue for advance registration for MAA Minicourses)

* See the section on "How to Register in Advance".

ADVANCE REGISTRATION SECTION:

1) _____ Telephone _____
    (Please print) Surname   First   Middle

2) _____   _____
    (Mailing address)   (e-mail address)

☐ **I do not wish my badge and program to be mailed; however, the mailing address for my acknowledgment is given above.**

3) Badge information: Affiliation _____   MR Classification # _____

Names for Guest Badges: _____

4) Member of AMS ☐ CMS ☐ MAA ☐ ΠME ☐ Nonmember ☐   Member of other organizations: AWM ☐ NAM ☐

5) Students: Grad ☐ Undergrad ☐ High School ☐ 6) Emeritus ☐ Third World ☐ Unemployed ☐ Librarian ☐ HS Teacher ☐

7) Mathfest fee $_____   8) Hotel Deposit (if applicable) $_____   9) Dormitory Payment $_____

10) Subtotal of Payments for Social Events (see reverse) $_____   11) Total amount enclosed for 7 through 10 $_____

Method of Payment: ☐ Credit Card (Visa or MasterCard only)   ☐ Purchase Order (original institutional PO attached)

☐ Check (payable to AMS). Canadian checks must be marked "U.S. Funds".

Credit card type: _____ Card number _____ Expiration date _____
If this is your credit card, please print your name as it appears on the credit card on the line below and sign your name.
If this is not your credit card, please print card holder's name as it appears on the credit card on the line below and have the card holder sign:

☐ I plan to attend the MAA Student Workshop on Wednesday, August 17, 1994.

See reverse for registration for social events and reservations for hotel and residence halls.

For office use only:

Codes:	Options:	Hotel:	Dorm:	Room type:
Dates:	Hotel Deposit		Total Amt. Paid:	
Special Remarks:				

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SOCIAL EVENTS SECTION:

Event	Tickets	Event	Tickets
Opening Banquet:	___ @$25 each = $ _____ _____ Vegetarian _____ Kosher	Children's Special Event: (opposite Opening Banquet)	___ @$20 each = $ _____
MAA 25-Year Banquet:	___ @$26 each = $ _____ _____ Vegetarian _____ Kosher	ΠME Banquet:	___ @$17 each = $ _____ ___ ΠME member @$10 each = $ _____ _____ Vegetarian _____ Kosher
Mississippi Dinner Cruise:	___ @$26 each = $ _____ _____ Vegetarian	Take the Plunge:	___ @$32 each = $ _____ _____ 8/14 Tour _____ 8/18 Tour
Fort Snelling and Cruise:	___ adult @$26 each = $ _____ ___ children* @$23.50 each = $ _____	A Tale of Two Cities:	___ @$16 each = $ _____
A Walk on the Wildside:	___ @$34 each = $ _____	Wildlife at the Minnesota Zoo:	___ adult @$22 each = $ _____ ___ children* @$20 each = $ _____ _____ 8/16 Tour _____ 8/17 Tour
Shop 'til You Drop: Historic Stillwater:	___ @$13 each = $ _____ ___ @$34 each = $ _____	Gardens and Goodies:	___ @$18 each = $ _____

Total enclosed for social events: $ _____ (Enter this amount in item #10 on the reverse side of this form.)

* Children prices: Fort Snelling and Cruise - 11 yrs. and younger; Wildlife at the Minnesota Zoo - 12 yrs. and younger

ACCOMMODATION SECTION: Where applicable, please check off one of the following:

_____ I will make reservations at a local hotel/motel directly. Name of hotel/motel: _____

_____ I live in the area or will be staying privately with family or friends in the area.

_____ I plan to share a room with _____ who is making reservations at the Holiday Inn Metrodome.

University of Minnesota

NOTE: Full prepayment for room and board is required. **Purchase of a room and board package (breakfast and lunch) is required by the University of Minnesota, and the price of meals is included in the rates below.** All rates are per person. Mathfest participants may occupy the residence hall rooms from Saturday, August 13 to Thursday, August 18, 1994 only. Acknowledgment of your residence hall reservations will be sent to address indicated on reverse.

Please circle applicable rates listed below and enter the totals, where applicable. A maximum of two adults or two adults and one child (not including infants) is allowed to a room. All children under 12 years will be given rollaway beds and must reside in a room with a parent. All children 12 years and over pay adult rates. There is no charge for infants in arms. The grand total amount should be inserted in #9 on the reverse.

_____ (number of) Adults - $33.50 (single), $29.50 (double-two adults) × _____ (nights) = $ _____

_____ (number of) Children (under 12) - $13.60 × _____ (nights) = $ _____

_____ (number of) Computer room usage - $3.00 per week = $ _____

Grand total cost of residence hall package = $ _____

☐ I am part of the ΠME student group and wish to be housed with others in the group.   ☐ I will need a parking permit.

Special housing requests, physically challenged needs, etc.: _____

I am female _____ male _____ and will arrive on (date) _____ at _____ a.m./p.m., and depart on (date) _____ at _____ a.m./p.m.

SHARER(S)' FULL NAME(S)   ARRIVAL DATE(S)   DEPARTURE DATE(S)

_____ female ___ male ___ child ___ (give age) spouse ___

_____ female ___ male ___ child ___ (give age) spouse ___

Holiday Inn Metrodome

GUARANTEE REQUIREMENTS: $50 by check, or supply your VISA, MasterCard, or American Express number on the reverse side of this form, together with mailing address for confirmation of room reservation. Group rates quoted are subject to a 12% sales/occupancy tax.

Please circle room type/rate requested: (NOTE: Added rollaways are $10 each per night.)

Single: $77   Double(one/two beds): $87   Triple: $97   Quad: $107   Suites: $109.50 (s/d) $119.50 (t/q)   + Rollaway

I will arrive on (date) _____ at _____ a.m./p.m., and depart on (date) _____ at _____ a.m./p.m.

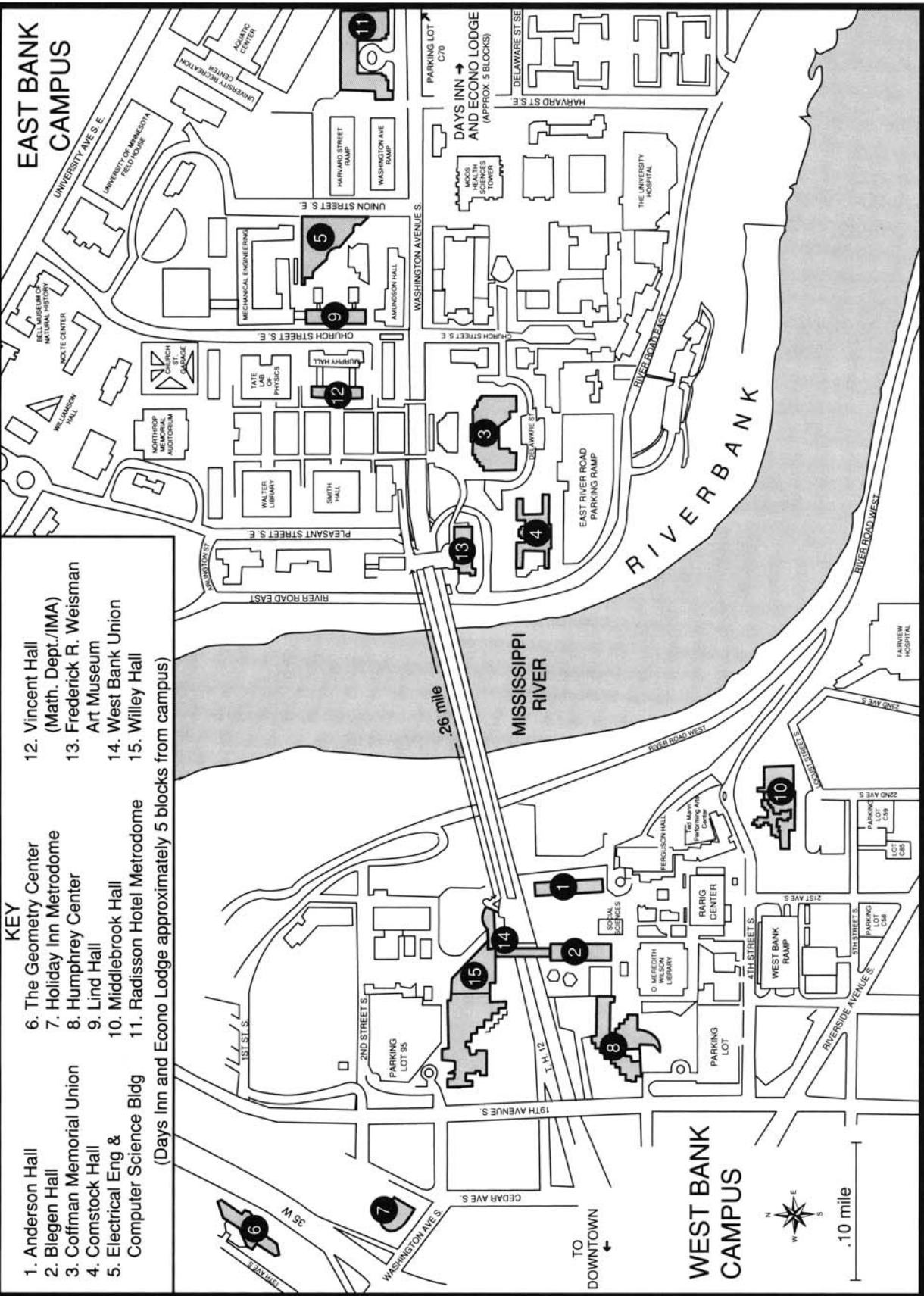SHARER(S)' FULL NAME(S)   ARRIVAL DATE(S)   DEPARTURE DATE(S)

_____ spouse ___ child ___ (give age)

_____ spouse ___ child ___ (give age)

Please list any special requests below:

_____

UNIVERSITY OF MINNESOTA, MINNEAPOLIS

EAST BANK CAMPUS

WEST BANK CAMPUS

KEY

1. Anderson Hall
2. Blegen Hall
3. Coffman Memorial Union
4. Comstock Hall
5. Electrical Eng & Computer Science Bldg
6. The Geometry Center
7. Holiday Inn Metrodome
8. Humphrey Center
9. Lind Hall
10. Middlebrook Hall
11. Radisson Hotel Metrodome
12. Vincent Hall (Math. Dept./IMA)
13. Frederick R. Weisman Art Museum
14. West Bank Union
15. Willey Hall

(Days Inn and Econo Lodge approximately 5 blocks from campus)

MISSISSIPPI RIVER

RIVERBANK

.26 mile

TO DOWNTOWN

.10 mile

AQUATIC CENTER
UNIVERSITY RECREATION CENTER
UNIVERSITY OF MINNESOTA FIELD HOUSE
UNIVERSITY AVE S. E.
BELL MUSEUM OF NATURAL HISTORY
NOLTE CENTER
WILLIAMSON HALL
CHURCH ST GARAGE
NORTHROP MEMORIAL AUDITORIUM
TATE LAB OF PHYSICS
MURPHY HALL
MECHANICAL ENGINEERING
AMUNDSON HALL
HARVARD STREET RAMP
WASHINGTON AVE RAMP
UNION STREET S. E.
CHURCH STREET S. E.
WASHINGTON AVENUE S.
MOOS HEALTH SCIENCES TOWER
THE UNIVERSITY HOSPITAL
PARKING LOT C70
DAYS INN AND ECONO LODGE (APPROX. 5 BLOCKS)
DELAWARE ST SE
HARVARD ST SE
WALTER LIBRARY
SMITH HALL
PLEASANT STREET S. E.
DELAWARE ST.
EAST RIVER ROAD PARKING RAMP
RIVER ROAD EAST
ARLINGTON ST
RIVER ROAD EAST
RIVER ROAD WEST
RIVER ROAD WEST
FAIRVIEW HOSPITAL
23RD AVE S
22ND AVE S
LOCUST STREET S
LOT C65
PARKING LOT C59
FERGUSON HALL
Ted Mann Performing Arts Center
SOCIAL SCIENCES
RARIG CENTER
O. MEREDITH WILSON LIBRARY
21ST AVE S
PARKING LOT C58
WEST BANK RAMP
4TH STREET S
5TH STREET S
RIVERSIDE AVENUE S.
PARKING LOT
1ST ST. S.
2ND STREET S.
PARKING LOT 95
CEDAR AVE S.
WASHINGTON AVE S.
19TH AVENUE S.
T. H. 12
35 W
19TH AVE S

N E S W

EMPLOYMENT OPPORTUNITIES

MATHEMATICS EDUCATION. Probationary position with rank of assistant professor to begin September 1994.

Responsibilities: Instruction, research, and service in mathematics education. Teaching assignment may include classes in mathematics for elementary education, secondary mathematics methods and mathematics. The current teaching load is 3 classes per quarter. Off campus assignments may be required which include teaching classes (off campus and/or ITV), outreach programs, special projects, and student teacher supervision. Actively engage in departmental and University activities including committee work, projects, and student advising.

Qualifications:

Required: Earned Doctorate in Mathematics Education, Graduate level coursework in Mathematics. Certified to teach pre–college (within K–12).

Desired: Evidence of a strong background in Mathematics such as a Master's Degree or substantial graduate level coursework. Demonstrated excellence in teaching. Evidence of research in Mathematics Education.

Application should include: Resume, transcripts, and a list of at least 3 references, with addresses and telephone numbers. Apply to: MATH Ed. SEARCH, Affirmative Action Office, Winona State University, P.O. Box 5838, Winona, MN 55987. Screening begins March 11, 1994. An AA/EOE.

Arts, Sciences, Business Professor/Dept. Head

Kansas State University–Salina is seeking applicants for Professor/Dept. Head of the Arts, Sciences, & Business Dept. This position reports directly to the Dean of College of Technology and is responsible for the administration, management, evaluation & development of the dept. Some teaching is required. The dept. provides the core curriculum for both two and four year programs within the various technologies & offers Arts, Science & Business courses to meet the needs of the community.

QUALIFICATIONS: Candidates must have a minimum of a Ph.D., or an appropriate earned terminal degree in Arts, Science, or Business. Candidates must have administrative & leadership experience in facilitating effective teamwork, teaching & professional growth & development. Candidates must also have at least 5 years of college level teaching experience in one of the subject fields characterized by the mission of the dept. We are looking for a Renaissance person who combines a love of the humanities with an equally strong concern for technology. Candidates should have experience in their field outside the academic world. APPLICATION DEADLINE: 04-20-94, START DATE: 08-01-94. SEND LETTER OF APPLICATION, RESUME, TRANSCRIPT & THREE PROFESSIONAL REFERENCES TO:

Mitch Barnes, Chair
ABS Search Committee
Kansas State University - Salina
College of Technology
2409 Scanlan Avenue
Salina, KS 67401

Kansas State University is an equal opportunity employer & actively seeks diversity among its employees.

TEMPORARY POSITIONS 1994-1995
DEPARTMENT OF MATHEMATICS SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE

Temporary positions are anticipated starting on August 16, 1994 as Lecturer. Masters degree in mathematics or admission to candidacy required; Ph.D. preferred. Applicants should provide evidence of excellence in teaching and foreign applicants must provide evidence of ability to teach in English effectively. Preference given to applicants with research interests compatible with those of the faculty. The duties will consist of 12 hours of undergraduate mathematics each semester. Closing date May 15, 1994 or until positions are filled. Send applications (including transcripts) to:

Temporary Positions
c/o Ronald Kirk, Chair
Department of Mathematics
Southern Illinois University at Carbondale
Carbondale, Illinois 62901
SIUC is an Equal Opportunity/Affirmative Action Employer.

MATH–ASSISTANT PROFESSOR

Potsdam College of the State University of New York invites applications for two full-time temporary positions in math for the 1994-95 academic year. Responsibilities of the position are to teach twelve hours per semester of undergraduate and first year graduate courses. Required qualifications are a Ph.D. in any area of math with experience in teaching, beginning undergraduate math courses preferred. A strong interest and preparation for teaching undergraduate major mathematics courses highly desirable. Application review will begin as received and continue until the position is filled. The department has 13 members and offers a BA and an MA in mathematics. Send a letter of application, a vita, three letters of recommendation describing teaching experience and abilities, and a transcript (copy is ok) to Kerrith B. Chapman, Staffing Committee, Mathematics Department, Potsdam College, Potsdam, NY 13676.

Potsdam College is the oldest among the thirteen arts and science colleges in the 64-unit State University of New York. A co-educational, primarily residential college with an enrollment of approximately 4,500, it is among the 300 colleges profiled in the second edition of *Barron's Best Buys in College Education.* Potsdam's curricular offerings include degrees in liberal arts, education and music found in three schools: The School of Liberal Studies, The School of Professional Studies, and The Crane School of Music. As a member of the Associated Colleges of the St. Lawrence Valley, a consortium comprised of St. Lawrence University, Clarkson University, Canton College of Technology, and Potsdam, all located within ten miles of each other, the College has ready access to the resources of these institutions.

The College occupies a 240-acre, contemporary campus in the pleasant village of Potsdam. Located 20 miles from the St. Lawrence River in Upstate New York, Potsdam is close to Lake Placid and the Adirondacks and an hour and a half from Ottowa and Montreal.

Potsdam College is an equal opportunity affirmative action employer committed to excellence through diversity.

MATHEMATICS. Tenure–track/Assistant Professor/August 1994 to teach college core and math major courses, including contemporary math, calculus, discrete math, linear algebra, and geometry. Ph.D. required. Seton Hill College, located 35 miles east of Pittsburgh, is a four-year Catholic liberal arts college for women with a strong commitment to teaching excellence. Women and minorities are encouraged to apply. Send letter of application, curriculum vitae, undergraduate/graduate transcripts, statement of teaching philosophy, and three (3) letters of recommendation by

April 15, 1994 to Robert Frank, Chair, Mathematics/Computer Science Department, Seton Hill College, Greensburg, PA 15601. Applications accepted until position is filled. AA/EOE.

Visiting Position - Department of Mathematics

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY has a one year visiting position available starting August 1994. Depending on funding and departmental needs, extension of the appointment may be possible. The position involves teaching three courses per semester in classical applied mathematics, such as Junior level courses in Differential Equations or Vector Calculus: Sophomore level classes in Multivariate Calculus or Linear Algebra; and possibly, a senior level course. Candidates must be able to communicate effectively in written and spoken English. A Ph.D. in mathematics or related field required. Experience in college teaching is desirable. The department has a strong interdisciplinary program in cooperation with other departments and research groups on campus. Areas of application include atmospheric physics, biology, computer science, engineering, groundwater hydrology, environmental problems, and reservoir simulation. Tech is a small scientific and engineering school dedicated to excellence in teaching and research. This is a full-time position: salary is negotiable. health insurance is available. Screening will begin April 15, 1994, and continue until the position is filled. Send applications and curriculum vitae, copies of acquired degrees, and have three letters of reference to New Mexico Institute of Mining and Technology, Human Resources, Wells Hall Box C-0812A, Socorro, NM 87801. AAEOE.

Wright State University
Department of Mathematics and Statistics
Mathematics Education

Tenure-track assistant professorship in mathematics education anticipated for Fall 1994. Applicants should expect to complete all requirements for the Ph.D. or Ed.D. by September 7, 1994. Excellent research record or potential and commitment to quality teaching required. Three or more years of experience successfully teaching mathematics at the secondary-level preferred. Competitive salary and excellent fringe benefits. Two-course teaching load. Department has 35 Ph.D. faculty and offers a master's degree. Please send vita, graduate transcript(s), and three letters of reference to: **Mathematics Education Search Committee, Wright State University, Department of Mathematics and Statistics, Dayton, Ohio 45435.** Closing date: February 15, 1994, then every two weeks thereafter until selection or July 1, 1994. WSU is an AA/EOE.

Pacific Lutheran University, Tacoma, WA—Mathematics Dept. One year visiting assistant professor, fall 1994. Possible extension (contingent upon funding) beyond next year. Ph.D. in Statistics or in Math with expertise in statistics and a commitment to quality teaching in an undergraduate program. Teach six courses in statistics and mathematics. Application review begins April 18. Send cover letter with brief statement of teaching philosophy and scholarly interests, resume, transcripts and 3 reference letters (at least one on teaching ability) to: Prof. Michael B. Dollinger, Search Committee, Mathematics Dept, Pacific Lutheran Univ., Tacoma, WA 98447. AA/EOE

Costal Carolina University Department of Mathematics

The Mathematics Department of Costal Carolina University announces a visiting replacement mathematics teaching position beginning August 1994 through December 1994 with a possibility of extension thru the spring 1995 semester. A Ph.D. in mathematics is preferred. Applicant should have a strong commitment to quality undergraduate teaching. College level teaching experience is preferred. Review of applications will begin April 15, and continue until the position is filled.

Applicants should send a letter of applications, a complete resume, and the names, addresses, and telephone numbers of three references to: Deborah A. Vrooman, Mathematics Department, Costal Carolina University, P.O. Box 1954, Conway, SC 29526. An Affirmative Action/Equal Opportunity Employer.

CONNECTICUT COLLEGE - Department of Mathematics - Anticipated one or two year visiting position, probably at assistant professor level, beginning Fall 1994. Department has six full-time faculty. Background in applied mathematics and probability preferred. Three courses each semester. Require doctorate, excellence in teaching and research. EEO/AA employer, strongly encouraging applications from women and minority candidates. Send cover letter, curriculum vita, and names of three references to Professor Bridget Baird, Connecticut College, Box 5412, New London, CT 06320-4196, bbbai@mvax.cc.conncoll.edu

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Third Conference on the Teaching of Calculus
University of Michigan in Ann Arbor, June 24-25, 1994

The Calculus Consortium based at Harvard University will host a summer conference in conjunction with the National Science Foundation and John Wiley & Sons, Inc., on June 24&25, 1994 at the University of Michigan at Ann Arbor. A program of invited speakers, panels, and contributed papers should provide something of interest for everyone in the way of calculus is taught. The scope is broad; there will be more emphasis on contributes papers and discussions and less on formal presentations this year. Two and four year college, university, and secondary school faculty are welcome. The Conference Program Committee, consisting of Deborah Hughes Hallett (Harvard University), Wayne Roberts (Macalester College), Thomas Tucker (Colgate College), Shelly Gordon (Soffolk Community College), Harvey Keynes (University of Minnesota), and Morton Brown (University of Michigan), is assembling the speakers and panelists.

Panels are planned on the following topics:

• Reports on the Implementation of a Variety of Calculus Reform Settings, Calculus Around the World, Evaluation, and Assessment.

• The Changing Curriculum: Precalculus, Multivariate Calculus, Differential Equations and Linear Algebra.

• The Changing High School Curriculum, and its Implications for Calculus.

Contributed papers are invited for the following sessions:

• Using Technology: Computers
• Using Technology: Calculators
• Linking Calculus to Other Courses (e.g., Precalculus, Linear Algebra, D.E., etc.)
• Pedagogical Issues (e.g. Co-operative Learning, Writing, Projects, etc.)
• Politics of Reform (e.g. Funding, Dealing with Faculty/Administrators, Setting up Labs, etc.)
• Assessment/Evaluation/Favorite Problems
• Special Topics

Sessions will be run paralled with fifteen minutes for each paper. Send the title of the paper, the category of your choice (from above), and a 25 word abstract to: Karen or Joe Thrash, Mathematics, University of Souther Mississippi, 730 East Beach Blvd. Longbrach, MS 39560, or via E-mail: calculus@bull.cc.usm.edu. The deadline for submissions is April 1, 1994. Selected candidates will be notified by May 1, 1994. For more information on the Third Conference on the Teaching of Calculus, contact: Ethan Goodman, John Wiley and Sons Publishers, 605 Third Avenue, New York, NY 10158, E-mail: math@wiley.com.

Calendar

National MAA Meetings

August 15-17, 1994 Sixty-ninth Annual Joint Summer Meeting, Minneapolis – MATHFEST 1994

January 4-7, 1995 Seventy-eighth Annual Meeting, San Francisco (Board of Governors, January 3, 1995)

Sectional MAA Meetings

ALLEGHENY MOUNTAIN, April 8-9, 1994, West Virginia University, Morgantown, WV

ILLINOIS, April 22-23, 1994, Parkland College, Champaign, IL

INTERMOUNTAIN, April 8-9, 1994, Westminster College, Salt Lake City, UT

IOWA, April 15-16, 1994, Grinnell College, Grinnell, IA

KENTUCKY, April 8-9, 1994, Morehead State University, Morehead, KY

MD–DC–VA, April 15-16, 1994, St. Mary's College of Maryland, St. Mary's City, MD

METROPOLITAN NEW YORK, May 1, 1994, Merchant Marine Academy, Kings Point, NY

MICHIGAN, April 29-30, 1994, Alma College, Alma, MI

MISSOURI, April 8-9, 1994, Missouri Southern State College, Joplin, MO

NEBRASKA, April 22-23, 1994, Nebraska Wesleyan University, Lincoln, NE

NEW JERSEY, April 23, 1994, (Joint meeting with the MATYCNJ), Rutger's University, Busch Campus, Piscataway, NJ

NORTH CENTRAL, April 22-23, 1994, Winona State University, Winona, MN

NORTHEASTERN, June 3–4, 1994, Salve Regina University, Newport, RI

OHIO, April 8-9, 1994, Miami University, Oxford, OH

PACIFIC NORTHWEST, June 16-18, 1994, University of Oregon, Eugene, OR

ROCKY MOUNTAIN, April 15-16, 1994, South Dakota School of Mines & Tech., Rapid City, SD

SEAWAY, April 22-23, 1994, SUNY at Albany, Albany, NY

SOUTHEASTERN, April 8-9, 1994, Carson Newman College, Jefferson City, TN

SOUTHWESTERN, April 8-9, 1994, Glendale Community College, Glendale, AZ

TEXAS, April 7-9, 1994, Texas A&M, College Station, TX

WISCONSIN, April 22-23, 1994, University of Wisconsin-Eau Claire, Eau Claire, WI

Other Meetings

April 13-16, 1994 Seventy-second Annual National Council of Teachers of Mathematics Meeting, Indianapolis. For more information, contact: NCTM, 1906 Association Drive, Reston, VA 22091-1593.

April 14–15, 1994 Scientists, Educators, and National Standards—Action at the Local Level, a Sigma Xi Forum, Omni Hotel at CNN Center, Atlanta. Scientists, engineers, teachers, and representatives of industry and government will review proposed national K-12 science education standards and define a role for professional researchers in improving science education. Sponsored by Sigma Xi, The Scientific Research Society. For more information, contact: Dee Windley, Sigma Xi, P.O. Box 13975, Research Triangle Park, NC 27709; (800) 243-6534, FAX (919) 549-0090.

April 18-20, 1994 Conference on Emerging Issues in Mathematics and Computation from the Materials Sciences. Pittsburgh Vista Hotel, Pittsburgh, PA. Organized by the Center for Nonlinear Analysis, Carnegie Mellon University, and SIAM. For more information, contact SIAM Conference Coordinator, 3600 University City Science Center, Philadelphia, PA 19104-2688; (215) 382-9800; FAX (215) 386-7999, E–mail: meetings@siam.org.