FOCUS

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The Mathematical Association of America
1529 Eighteenth Street, NW
Washington, DC 20036

Mathematicians Honored by National Academy

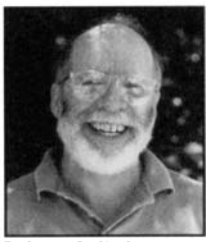
Three mathematicians are among the sixteen individuals selected by the National Academy of Sciences (NAS) to receive awards honoring their outstanding contributions to science. The awards will be presented on April 24th at a ceremony in Washington, DC, during the academy's 132nd annual meeting.

The NAS Award in Applied Mathematics and Numerical Analysis goes to Julian D. Cole, the Margaret Darrin Professor of Applied Mathematics in the Department of Mathematical Sciences at Rensselaer Polytechnic Institute (Troy, New York) and Joseph B. Keller, the Lewis M. Terman Professor of Mathematics and Mechanical Engineering in the Department of Mathematics at Stanford University (Stanford, California). Dr. Cole has made fundamental contributions to applied mathematics and numerical analysis, characterized by deep physical and mathematical insights. Dr. Keller is known for his seminal contributions to applied mathematics, in particular his geometrical theory of diffraction and his work on water-wave propagation. The award is set at $10,000 and was established through funds provided by IBM Corporation.

The NAS Award for Scientific Reviewing is given in a different field each year. The field for the 1995 award is mathematics. Robion C. Kirby, a professor in the Department of Mathematics at the University of California at Berkeley (Berkeley, California), will receive the award for the list of problems in low dimensional topology that he both created and maintained. Generations have been greatly influenced by Kirby's list. The award of $5000 was established by Annual Reviews, Inc. and the Institute for Scientific Information in honor of J. Murray Luck.

Julian D. Cole

Joseph B. Keller



Robion C. Kirby

Albert W. Tucker, 1905–1995

Former MAA president and chair of the Princeton Mathematics Department Albert William Tucker died on January 25, 1995 of complications of congestive heart failure. A pillar of the MAA for many years, he left behind a mathematical career of education, research, and service with few equals.

Albert William ('Al') Tucker was born in Ontario, Canada in 1905. His father was a mathematics teacher and later became a Presbyterian minister. Al Tucker's life reflected his father's in its love of mathematics, high moral standards, and concern for others. While Tucker excelled in school, his only chance to go to a university rested in winning one of two province-wide scholarships to the University of Toronto. When he failed to earn one during his senior year, he was forced to repeat the year to try again—this time successfully. He planned to become a school mathematics teacher, but his love of mathematics led him to delay his teaching career in order to earn a master's degree at Toronto and then a Ph.D. at Princeton. He arrived at Princeton in 1929 and remained there the rest of his life (except for sabbatical and fellowship leaves). His research in topology led to appointment and promotion at Princeton, culminating in the Albert B. Dod Professorship of Mathematics in 1954. He was chair of the Princeton Mathematics Department from 1954 to 1964.

In 1948 George Dantzig, the father of linear programming, visited Princeton to try to interest John von Neumann in studying the mathematical foundations of linear programming. Von Neumann was uninterested, but Tucker, who happened to give Dantzig a ride to the train station on his way home, found the topic intriguing and expressed interest in studying it. Thus be-

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FOCUS

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Editorial

This is the story of one young person at one four-year college. It has a happy ending. But if the story is at all indicative of what happens elsewhere, then it carries a worrying message.

Last December, Melissa, as I will call her, completed her first semester of college mathematics. She was one of a small number of students in the class who scored an A. Her instructor remarked that not only was she one of the brightest students in the class, she was also one of the most active in terms of class participation. Nothing remarkable so far. We might not get as many A-students as we would like, but there are plenty of them about.

Melissa was a little unusual in that she was only 15 when the course began, having enrolled for two college courses while still a junior at the local high school. But again, nothing remarkable. There are plenty of examples of such early developers.

What might surprise you is to learn that Melissa's grade in high school math the previous year had been C and that the high school had refused to let her take any further math courses unless she repeated the entire course and scored a B or better.

You might also raise an eyebrow to hear that the director of Special Education Programs for the district had recently advised Melissa that she should leave school early, forget her desire to study science, and seek a career as an air hostess. (I should perhaps explain the involvement of the Special Education unit. Melissa has a number of diagnosed learning disabilities that qualify her for a modified education program as a 'Section 504' student. The disabilities manifest themselves largely in her writing, and the recommended modifications consist solely of being allowed extra time to take exams and complete assignments.)

"Perhaps Melissa's mathematical talent had been so hidden that the high school mathematics teachers and the Special Ed director had failed to see it," you might hazard. Maybe, but you should know that, as a 504 student, Melissa had undergone an intensive program of testing by an educational psychologist, who had classified Melissa as in the 95 percentile in most intellectual categories and the 99 percentile in some of them. On top of that, Melissa's father is a professional mathematician, and had spent a considerable time trying to explain to the school math teacher that his daughter's relatively minor educational disabilities obscured a remarkable mathematical ability. At the start of the year he had predicted to the teacher that Melissa would score a C on the course if little or no allowance were made for her learning disability (she did score a C) and would perform extremely well if given adequate time (she scored a 97%, the highest mark in the class, when allowed extra time in an end-of-semester examination).

So what on earth went wrong? How could a high school mathematics teacher get it so wrong? How could a trained director of Special Education Programs get it so wrong? I should point out that the school system in question is generally regarded as one of the best public school systems in the nation, with all the numerical indicators putting it in the top 95 percentile.

Before I suggest an answer to the above questions, I should come clean and admit that the "Melissa" of this story really is called Melissa, and she is my daughter. This is how I come to know so much about this case.

Having talked at some length with the math teacher involved, I think that a large part of the problem is that she and I had entirely different conceptions of what mathematics is. Though the teacher espoused all the fashionable rhetoric about mathematics being creative and the importance of focusing mathematics education on open-ended discovery, she did not seem to believe it. For this teacher, when the chalk hit the board, mathematics was about the mastery of dull, mindless, algorithmic procedures. To her, Melissa's 'how' and 'why' questions—questions that were to impress her college instructor a few months later—indicated a lack of basic understanding that simply obstructed progress in the mechanics. For this teacher, success was measured not in striving for genuine understanding but in learning how to solve the problems in the book.

If this is a one off story, then the worst that has happened is that one young child had an unfortunate experience and I have wasted good editorial space. Melissa has left school

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Tucker from page 1

gan Tucker's second mathematical career, in mathematical programming and game theory, a career that produced the famous complementary slackness conditions of linear programming, the Kuhn–Tucker theorem, and more. In the next dozen years, he helped train most of the initial leaders in this field, people such as Kuhn, Gale, Wolfe, Shapley, Goldman, Luce, Balinski, Edmonds, and Lucas. Eight of the graduate students and post-docs supported on his mathematical programming research project went on to become members of the National Academy of Sciences in applied mathematics, economics, and computer science. They included Ralph Gomory, former IBM vice president for research and current head of the Sloan Foundation, and Marvin Minsky, director of the MIT Artificial Intelligence Lab. Another, John Nash, was awarded the 1994 Nobel Memorial Prize in economics for results in his 1950 thesis under Tucker.

Tucker befriended and served as a mentor to hundreds of talented mathematical minds at Princeton and elsewhere at various stages in their careers. For example, von Neumann disapproved of Nash's new approach to game theory but Tucker, unfazed by von Neumann's opinion, encouraged Nash to strike out on his own. During this period, Tucker also taught a score of continuing education summer courses to high school teachers and to faculty from small colleges. He spent half of the 1956–57 academic year on the train as the MAA National Lecturer, giving over one hundred talks and visiting over sixty colleges across the country. (This was a record number of visits in the national lecturer program; when John Kemeny, the succeeding MAA National Lecturer, tried to match Tucker's number, he collapsed in mid-year with a serious bout of pneumonia.)

His instructional style was characterized by great attention to communicating concepts precisely and concisely. A classic example of this style is the now famous Prisoner's Dilemma which he developed in 1950 for a lecture to a group of psychology faculty interested in uses of modern mathematics with psychology.

Al Tucker was one of the first recipients of the MAA's Distinguished Service Award, in 1968, for contributions that included serving as MAA president, AAAS vice-president, and the initial mathematical consultant to the President's Council of Scientific Advisors. He held numerous leadership positions in mathematics education efforts at the doctoral, undergraduate, and school levels, including chair of the influential College Board Commission on School Mathematics. He was an advisor to Alfred P. Sloan on the establishment of the Sloan Fellowship program. He was the founding editor of the *Princeton Mathematics Notes* series and the *Annals of Mathematics Studies* series. His many honors included a 1961 honorary degree from Dartmouth and the 1980 von Neumann Prize of the operations research societies.

His dedication to teaching and to his students is what friends will remember most. When he was a graduate student teaching calculus, he believed that the professor overseeing the course, who taught a section of honors students, was pacing the course too fast for other students. Tucker's repeated protests led to dismissal proceedings from Princeton, but he put his responsibility to his students above everything else (a sympathetic dean rescued him). In 1945 at age 40 he stopped submitting his research papers to journals in order to give younger colleagues a better chance to get published (he used conference proceedings and *Annals Studies* volumes instead). In the 1950s and 1960s while he was department chair, he maintained a full two-course-a-semester teaching load and was the coordinator for the freshman calculus course in fall or spring. He explained: "As chair of the department, I felt it was my duty to lead the freshman calculus course because it was the most important activity of the department."

He is survived by his second wife Mary, three children, and six grandchildren. The children continue his tradition of professional service: sons Alan and Tom are past MAA first vice-presidents and currently serve as chairs of the MAA Education Council and CUPM, respectively, while daughter Barbara is special assistant to the president of Brown University responsible for the $500 million Annenberg Program for Schools.

The friends of A.W. Tucker have established a fund to name a room in the MAA Washington office after him.

Contributions can be sent to the MAA Building Fund, Tucker Room, MAA, 1529 18th St. NW, Washington, DC 20036.

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and is now established in college with a 4.0 GPA. Her love of mathematics and science has been rekindled and she talks of majoring in mathematics. Her intense feeling of being let down by a school system that seemed to care more for its numerical ratings than the education of the individual students has not transferred to a general dislike of learning. As I said at the start, Melissa's story has a happy ending.

But what if this is not a one off story? What if there are hundreds and thousands of Melissas spread across the nation? Melissas whose parents are not mathematicians able to spot their children's abilities. Melissas whose parents are not in a position of being able to persuade a local college to ignore the school record and enroll them in appropriate courses.

What worries me is the thought of Melissa's story being repeated year after year, with student after student, at school after school, in state after state, but without the happy ending. For that would represent a huge and tragic loss of intellectual talent that we can ill afford to squander. And if that is indeed what is happening, then it seems that we, the professional mathematicians of the country, are the ones who have to act. We have to find a way to ensure that future generations of mathematics teachers really understand mathematics, that they acquire not just the rhetoric of good math teaching but the substance, and that they are able to recognize genuine mathematical talent when it is placed in their care. Judy Roitman has something to say on this important issue in this month's Personal Opinion section on page 9.

—Keith Devlin

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

John Nash and the Nobel Prize

David Gale

The December issue of FOCUS had as lead article an excellent and informative exposition by editor Keith Devlin of the accomplishments of John Nash leading to his being awarded the Nobel Prize in economics. I would like to point out, however, that it contains one, well actually two, inaccuracies. First, a minor historical point. I was not, as the article stated, a fellow graduate student of Nash's but was a Fine Instructor, having gotten my degree the year before. The reason I got into the act was that John's official adviser, Al Tucker, was away on sabbatical that year and I was acting as a sort of go between.

On a more substantive mathematical matter, in talking about Nash's proof of the equilibrium point theorem, the article states that, "Both the *Proceedings* announcement and the *Annals* version use the more general Kakutani's Fixed Point Theorem (1946) in place of Brouwer." This is not correct. The quickie proof in the *NAS Proceedings* did use the Kakutani Theorem, but in the *Annals* version Nash's lovely proof, which also takes barely a paragraph, uses only the Brouwer Theorem. I realize that FOCUS does not normally publish proofs, but in view of its historical importance perhaps an exception could be made in this case, so here is Nash's charming argument, slightly expanded for expository purposes.

Recalling Devlin's exposition, we are dealing with a *game* in which each of n players has a finite set of *pure strategies*. A *mixed strategy* $\mathbf{s}$ is simply a probability distribution on (or convex combinations of) these pure strategies: $\mathbf{s} = (p_1, \cdots, p_k)$, where p_i is the probability with which the ith pure strategy is played. For any n-tuple of pure strategies $\mathbf{s} = (\mathbf{s}_1, \cdots, \mathbf{s}_n)$ there is a (real number) *payoff* p_i to each of the players and this payoff extends in the obvious way to n-tuples of mixed strategies. Such an n-tuple is an *equilibrium point* if no player can increase his payoff by switching to a new strategy, assuming the other players do not switch theirs.

Nash proves that every game has an equilibrium point by defining a mapping from the set of n-tuples of mixed strategies to itself as follows:

Suppose in a given n-tuple some player is getting a payoff of p by playing the mixed strategy $\mathbf{s}$. We will say that her ith pure strategy is *improving* if by switching from $\mathbf{s}$ to strategy i she would get a payoff p_i which exceeds p (again assuming the other players do not change their strategies). An equilibrium point is then an n-tuple in which no player has any improving pure strategy. Define the *improvement* v_i from switching to strategy i by

$$v_i = \begin{cases} p_i - p & \text{if } i \text{ is improving} \\ 0 & \text{otherwise.} \end{cases}$$

The *improvement k-vector*, $\mathbf{v} = (v_1, \cdots, v_k)$ is the vector whose ith coordinate is v_i.

The Nash mapping is now $N(\sigma) + \sigma'$, where for each $\mathbf{s}$ in σ,

$$N(\mathbf{s}) = \mathbf{s}' = (\mathbf{s} + \mathbf{v})/(1 + \textstyle\sum_i v_i).$$

(The denominator in this formula is necessary in order to make $\mathbf{s}'$ a probability vector.) By the Brouwer Theorem this (clearly continuous) mapping has a fixed n-tuple. If σ is an equilibrium point, then by definition all the $\mathbf{v}$'s are zero so σ is a fixed point. The problem is to show that, conversely, every fixed point is an equilibrium point, so suppose σ is a fixed point, and hence each mixed strategy satisfies

$$(*) \quad \mathbf{s} = (\mathbf{s} + \mathbf{v})/(1 + \textstyle\sum_i v_i)$$

for each of the players.

Thus, the improvement vector $\mathbf{v}$ is *proportional* to the strategy vector $\mathbf{s}$. Now (key observation) there must be at least one pure strategy, say, the kth, such that π_k is positive while k is not improving, for if all such pure strategies gave a payoff higher than p then so would $\mathbf{s}$. It follows that the proportionality constant $\sum_i v_i$ in $(*)$ is zero, so all improvements are zero and $\mathbf{s}$ is an equilibrium point.

This clean and economical proof was typical of Nash the mathematician but it was, of course, not the reason he was awarded the Nobel Prize. Nor was it the fact that he defined the concept of equilibrium point; this rather natural notion had already been defined quite explicitly back in the 19th century. Nash's achievement was to show that, in what was then and probably still is the most important case, equilibrium points actually existed. Since Nash's discovery there have been at least dozens and more likely hundreds of research papers on the subject of non-cooperative games and in almost all of them the primary objective is to find and characterize the properties of the Nash equilibria. It might be said that Nash's result gave birth to an entire theory, and this is a thing that doesn't happen very often.

David Gale is a professor of mathematics at the University of California at Berkeley.

New Undergraduate Research Prize Funded

The new prize for undergraduate students in mathematics (FOCUS, December 1994, p. 4) has recently been funded by a gift from Mrs. Brennie Morgan of Allentown, Pennsylvania. The gift will endow a $1000 prize to be awarded annually for outstanding research in mathematics by an undergraduate student or group of students from any college or university in the U.S. or its possessions, Canada, or Mexico.

The prize, to be known as the Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student, will be awarded jointly by the AMS, MAA, and SIAM.

Frank Morgan, a professor of mathematics at Williams College, whose mother, Brennie Morgan, endowed the prize, said this about the new award: "The new prize ... stands to recognize and encourage the excellent mathematical research that undergraduates are already doing. Undergraduates are working on problems of current research interest, proving theorems, writing up results for publication, and giving talks on their work. They are making significant contributions to mathematics."

To apply, undergraduates submit one or more published or unpublished papers that represent their work. Professors can also nominate students. To be eligible for the first award, students must have been undergraduates in December 1994 and must submit their papers no later than June 30, 1995. Details on the application procedure will be announced on the WorldWide Web SIAM Undergraduate Home Page in the future (http://spicerack.unh.edu/~siamug).

The Craft of Teaching

David S. Moore

Remarks on receiving the MAA's 1994 Award for Distinguished College or University Teaching of Mathematics, San Francisco, California, January 1995.

In thinking about what I might offer on this occasion, I reread the remarks of my illustrious predecessors Alan Tucker and J. J. Price. I can hardly surpass Alan Tucker's account of "The Joy of Teaching,"[13] enriched by his father's experiences as well as his own. My colleague J. J. Price also mentions his father, and I can hardly surpass his enthusiasm and his mix of good advice and instructive anecdotes.[12]

So, at the risk of dishonoring my father—yes, he too was a teacher, and so was my mother—I will offer remarks on a different theme. The theme is announced by my title. I also note that I found nothing to disagree with in Alan's and J. J.'s comments on teaching. Nothing tunes the neurons like a little disagreement, so I'm going to say some things you may disagree with. In fact, since there is no time for nuance, I'll be deliberately provocative and say some things that you *will* disagree with.

Teaching As A Craft

Some teachers may have charisma. Not I. My image of a sound teacher is that of a skilled craftworker, a master machinist, say, who knows exactly what she must do, brings the tools she needs, does the work with straightforward competence, and takes pleasure in a job well done. She does her work right every day, and every day's work fits the larger plan of her project. The craftworker's skill is quite separate from her enthusiasm on that particular day, which, as C. S. Lewis said in another context, depends more on the state of our digestion than on any more cosmic influence.

A craft is a collection of learned skills accompanied by experienced judgment. The great advantage of thinking of teaching as a craft is the recognition that anyone can learn it. Competent teaching requires no special gift, no actor's personality, no divine spark. And if anyone can learn to be a competent teacher, then all who are employed to teach have the obligation to learn. That seems a mild and obvious deduction. It has, however, been denied, in practice if not in words, by the faculty culture of research universities. That culture is now under intense pressure, and will surely change. Requiring that teachers reach at least the journeyman level in the craft of teaching is a change that is already in progress.

Here's a less controversial deduction from the fact that teaching is a craft: *good teaching is based on the teacher's learning.* We teach in large measure because we love learning.

"Learning" naturally means first of all learning our subject. Statistics, which is my subject, is connected with a large body of nonacademic professional practice. The continuing revolution in computing has transformed the practice of statistics in the generation since I left graduate school. A bit more slowly, our standards of what constitutes interesting research have also changed. More slowly yet, the content of introductory instruction has changed. It is fair to say that statistics as a field has drawn a bit away from mathematics back toward its roots in scientific inference and analysis of data. The content of up-to-date instruction, even for beginners, looks quite different now than it did a generation ago. The reports of the ASA–MAA joint focus group on statistics reflect these shifts in the field. If you teach statistics—particularly if you are a mathematician rather than a statistician—their reports are a good place to continue learning the subject.[1] My own views on the content of basic statistics instruction appear in Moore 1992.[9,10] I have considerable empathy for mathematicians who find themselves teaching statistics, because I too was trained as a mathematician. Jack Kiefer, the great mathematical statistician who was my Ph.D. advisor, sent me out into the world with these words, "There's lots of statistics any sociologist knows that you don't know." I have tried to learn.

But learning our subject can be assumed. I want to talk primarily about *learning to teach.* Gerald Alexanderson's letter asking me to make this presentation said that "anecdotal accounts of novel approaches are especially encouraged." I read his letter just after teaching the first class of a statistics course for liberal arts majors, in which I disparaged anecdotal evidence. I'm going to disparage anecdotal evidence about teaching. Remember the statistician's motto: "In God we trust; all others bring data." Our individual experience, both as students and later as teachers, is atypical. As students, we were the survivors, the fittest by some quite esoteric standards of fitness. As teachers, we tend to rely on "what works for me." What we think works for us may in fact be relatively ineffective. There is an abundance of evidence from the study of innovations in all fields that loosely designed uncontrolled studies give innovations a much higher rate of success than more careful studies, especially controlled randomized experiments. A rule of thumb for assessing innovations in education is that all innovations succeed in the hands of the innovator, and that none succeed in other hands. That rule is fortunately not quite true, but it is true enough to be disconcerting.

Learning About Teaching

I am convinced that we mathematical scientists have much to learn from the psychologists and education researchers who can provide data rather than anecdote. So radical a conviction must start with a conversion experience. Here it is.

Near the beginning of my career, I was walking to a meeting with a senior educational psychologist. Out of politeness, I asked what he was doing. He had graduate students sitting in the back of college classrooms with stopwatches. I felt that glow of superiority that comes from knowing that I, unlike my colleague, did *real* research. What had they found? "Wait thirty seconds," he said. "Very few teachers wait long enough when they ask a question of the class. Wait thirty seconds." I tried it. Thirty seconds of silence seems interminable; then the students began to respond to the question. The psychologist was right.

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That put an end to my mathematician's contempt for people who sit in the back of classrooms with stopwatches.

Shortly thereafter, during one of the recurring debates about student evaluation of teaching, I read several surveys on the subject by educational psychologists. What do students respond to when they evaluate our teaching? Here, based on lots of data,[8] are the big three in order:

1. Instructional skill (talk to the class rather than to the board, give clear explanations, foster student participation, give relevant applications, etc.)

2. Respect and rapport (especially not demeaning students)

3. Organization (clear structure, communicate expectations, efficient use of class time).

Our students, with midwifery by educational psychologists, offer us this three-point outline of the craft of teaching.

Enthusiasm is no substitute for craftsmanship. As an undergraduate at Princeton, I once had a teacher, a justly reknowned mathematician, whose enthusiasm for mathematics was unsurpassed. As a difficult proof of a subtle result moved towards its climax, he became more animated. His voice rose, he wrote faster, the chalk dust flew. When the board was full, and we students were writing desperately, hoping to record this wisdom for later digestion, he swept a diagonal swath across the board with the eraser and wrote the triumphal conclusion along the swath.

Notice also that these aspects of the craft of teaching *can be evaluated easily*. Shall we rehearse the usual faculty conversation on evaluation of teaching?

"Of course we want to evaluate learning, not teaching in itself."

"Of course."

"And of course we want to evaluate the value added, not just what the students know, because otherwise we favor teachers of well-prepared students."

"Of course."

"And of course we want to evaluate what students retain after ten years, not at the end of the semester."

"Of course."

"Evaluating value added after ten years isn't feasible. So we can't evaluate teaching."

"Wonderful! I knew that all along."

I suggest that this is simply an attempt to avoid being held accountable for our work. Learning is the student's responsibility. Our job is to provide a framework for learning. One reason why evaluating learning is a poor way to evaluate teaching is that students compensate. If the teacher is poor, they spend more time with the text, or even meet to learn from each other. This last strategy is so effective that a really bad teacher might in principle actually improve learning. In practice, the students drop the course, but imagining what might happen in principle allows us to say that a bad teacher may be better than a good teacher, a statement that catches the Alice-In-Wonderland quality of much faculty talk about teaching. The craftmanship of a teacher, on the other hand, can be evaluated. Data show that students do evaluate it, that they do so consistently, and that student evaluations correlate well with peer evaluations. (They do *not*, by the way, correlate well with self evaluations.) Teachers interested in data rather than anecdote might look at the references given in chapter 48 of Davis.[2]

I learned from education researchers what makes up the craft of teaching. Many experienced teachers have of course learned on their own. If you read Steven Krantz's recent AMS book *How to Teach Mathematics*,[7] you will find similar emphases. The points Krantz makes most often seem to be "Prepare!" and "Respect your students!" Preparation is the key to points 1 and 3 in my outline and respect is exactly point 2. Because I will criticize Krantz a bit, let me first note that he gets the biggest points right. As Krantz remarks, the casual talk of teachers often reveals a quite different attitude. How often do you hear it suggested that this elementary and trivial mathematics can be taught without careful preparation? How often do you hear laments about the sorry state of the students? You are listening to slovenly workers who take no pride in their work, indeed, who appear to think their work beneath them.

What Should We Be Learning Now?

Learning continues through a teacher's life. For example, when I was embarking on a large video project, I consulted a colleague in Purdue's Department of Communications (a discipline even more *déclassé* than educational psychology). He pointed me to literature on the cognitive effects of video. I learned some interesting and helpful principles—see Moore.[11] At the present, teachers who keep learning about teaching ought to be thinking about

- Active learning (alternatives to lectures)
- Technology, especially multimedia
- Total Quality Management.

All of these phrases trigger emotional reaction in many faculty. All are surrounded by hype, but all have genuine promise under the hype. We ought to study before we react.

Active learning is the Big Idea of the current wave of reform in the teaching of the mathematical sciences. Both proponents and opponents have been shouting a bit. The difference between the camps is that the proponents point to a body of systematic study that we ought not to simply ignore. See, for the case of statistics, the surveys by Garfield and Ahlgren[4] and Garfield.[3] Krantz, on the other hand, prefers anecdote to data:

Lectures have been used to good effect for more than 3000 years.... Turn on your television and watch a self-help promoter, or a television evangelist, or a get-rich-quick real estate huckster. These people are not using overhead projectors, or computer simulations, or Mathematica. *In their own way, they are lecturing, and very effectively.* (p. 13)

This is not a nuanced discussion of the advantages and disadvantages of lecturing. His attitude toward technology is similarly simplistic:

We do not want to teach our students to push buttons. We want them to think analytically.... Being able to push some buttons and render a beautiful picture or transparency of a graph in $\mathcal{R}^3$ is not *the same as understanding the information contained in the graph.* (p. 50)

Of course we "do not want to teach our students to push buttons." We nonetheless don't give them tables of the trigonometric functions. We ought to ask, as Krantz never does, what aspects of student work can be fruitfully automated. We ought to ask, as multimedia progress encourages us to do, what aspects of the teacher's work can be fruitfully automated. We ought also to ask, as some multimedia enthusiasts do not, what roles are better reserved for human instructors. And we ought to seek answers from data and systematic study rather than from anecdote.

I hope my message is clear: we can learn from those whose professional subject is the study of teaching and learning. Not of course without critical thinking of our own. Yes, the current wave of reform does undervalue lectures. Yes, technology is often oversold. Nonetheless, we ought not to confuse our personal experience as teachers and our professional expertise as mathematical scientists with professional expertise in the field of teaching and learning. We can learn from those who do serious work in other fields. If we are serious about teaching, we will try to learn from them. Contempt for other tribes is as endemic in academia as it is in human history. It is also narrow-minded and smug.

TQM and All That: Managing Instruction

Recently another interloper has joined educational research in the contempt of those faculty who know about it: Total Quality Management, or TQM. Your administrators almost certainly know about it, as TQM is making a strong movement into the nonacademic parts of colleges and universities. Your local statisticians may also know about it. For example, I spent a week at Motorola two years ago learning how TQM is practiced by an organization that does it very well.

Not long ago our dean was musing about TQM at a meeting of the School of Science faculty council. He was pleased and impressed by the effects of a TQM program in the nonacademic areas at Purdue. How nice it is, he said, and how remarkable a change from past experience, to be treated as a valued customer. The assembled faculty nodded: how nice that those bureaucrats treat us well. Perhaps, the dean went on, our students would also like to be treated as valued customers. The faculty rose howling from their seats. "Students aren't our customers. TQM is an industrial model that doesn't apply to us." There followed half an hour of denunciation almost completely uninformed by understanding of how TQM works in industry or of how its principles have been modified for use in higher education. Those interested in learning before denouncing might read the papers by Hogg and Hogg[5] and Wild.[14]

The point of even mentioning TQM is to remind ourselves that teaching is a system that we should manage. Some system problems are obvious:

- Of what use are the brilliant innovations you made this semester if they are not institutionalized, and so vanish as soon as you leave the course?
- Should not students who sign up for the same course actually experience the same course in all sections every semester, unless change is planned?

Overlooking for the moment the fact that almost all faculty respond "No" to the second question, we see that we face management issues. Denunciation of TQM isn't specific: it is triggered by any mention of the word "management." Management of instruction opposes the attitude that Krantz puts so concisely:

The truth is that, as a college teacher, you are *an autocrat and a monarch and can do pretty much as you please. But there is no need to flaunt this before your students.* (p. 3)

This is touchy, isn't it? Many of us define academic freedom as the right to be "an autocrat and a monarch." I have encountered an enthusiastic young mathematician who was certain that the right way to introduce the derivative to freshmen was via semigroups of operators. I have a colleague who, believing against all evidence that most people learn best when presented with the general case first, introduces integrals and expected values as linear functionals on quite general function spaces—to sophomore business students. Both approaches are mathematically impeccable. Both are pedagogically disastrous. Can these instructors do this? Of course. They are professors. They are "autocrats and monarchs." They can do as they please. It is unthinkable that they should be managed. Have we any notion how irrational and self-centered this faculty culture seems to anyone not carefully socialized into it?

The point is not that someone other than professors should manage our teaching. It is rather that we have a collective responsibility to plan and organize instruction. As industry (there he goes again) has learned, team efforts beat individual activity in both efficiency and quality. From this broader perspective, thinking about TQM returns us to our starting point, the outline of the craft of teaching as evaluated by students. You don't like the word "manage?" Talk about "prepare" and "organize" instead. You don't like thinking of students as (in part) customers? Think about "respect and rapport" instead. We can change the words, but we can no longer avoid the substance of the discussion.

Two Conclusions

My first conclusion is harsh (but true): *To improve teaching in more than local and temporary ways, our culture has to change.*

- Accept that good teaching is a craft. Insist that all who want to practice this craft study it and demonstrate at least basic competence. Admit that students can evaluate competence and have a right to do so.
- Accept that instruction is a shared responsibility that needs collective management.
- Adjust incentives: why learn a craft that isn't rewarded? (We have now heard this so often that I allow it to pass without comment.)

My second conclusion is more positive. Almost all teachers teach because they love learning. With only a little redirection, our love of learning can be applied to improve our teaching. When the poet A. E. Housman was named Professor of Latin in University College, London, in 1892, his introductory lecture concerned the goals of liberal learning. Housman considers the usual justifications, and dismisses them. The purpose of liberal study, he says, is to awaken the joy of learning:

The pleasure of learning and knowing, though not the keenest, is yet the least perishable of pleasures; the least subject

See *Craft of Teaching* on page 8

Craft of Teaching from page 7

to external things, and the play of chance, and the wear of time. And as a prudent man puts money by to serve as a provision for the material wants of his old age, so too he needs to lay up against the end of his days provision for the intellect.[6]

We teachers strive to incite our students to lay up some provision for their intellect. Our own catholicity of interests and obvious pleasure in learning and knowing are our best allies in doing so.

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PERSONAL OPINION

What Will Be the Effect of a *Standards*-based Education on College Students?

Judy Roitman

This was the title of a panel that I spoke on at the symposium Math Reform Goes To College, sponsored by the Mathematical Sciences Education Board, at the National Academy of Sciences last year. None of the panelists had an answer, of course, since no answer exists right now. But the question raised a lot of issues, and it is those issues that I would like to address here.

Just what are the *Standards*?

The National Council of Teachers of Mathematics' *Curriculum and Evaluation Standards*, published in 1989, took some time to be noticed by mathematicians not directly involved in K–12 education, and probably still is not familiar to most of us. The *Curriculum and Evaluation Standards* was followed by the *Professional Standards* and about a dozen short volumes in an addenda series. Soon to appear are the *Assessment Standards* and a *Framework for Constructing a Vision of Algebra*. The *Standards*, as these have collectively been called, is exerting a profound influence on K–12 education in the United States. As those of us not involved directly in K–12 have become aware of the *Standards*, we have tended to divide into two camps: those who defend the *Standards* and those who attack it.

I defend the *Standards*. Here is my version of what they say: The mathematics that children learn in school will be meaningful. It will make sense, it will be creative, it will not be severed from other human activities, technology will be used appropriately, and there will be real mathematical content.

Here are the accusations against the *Standards*: None of the above will happen. Basic skills will be lost, appreciation for algorithm will be lost, in K–12 the sense of the subject's direction will be lost, appreciation of formal systems will be lost, appreciation of abstraction will be lost, mathematical content will be lost, the best and the brightest will be lost, and no one will graduate from high school knowing significant mathematics.

Many opponents of the *Standards* add that in fact this has already happened.

I agree that basic skills, appreciation for algorithm, sense of the subject's direction, appreciation of formal systems and abstraction, and mathematical content are missing in many of my university students, and have been for a long time. I don't think we can blame the *Standards* for this. They simply haven't been around long enough. While back in 1989 there were some curriculum projects compatible with the *Standards* already in existence, they had been around for only a couple of years. No child currently past 9th grade has had the possibility of what is known as a *Standards*-based education, and very few children in 9th grade or earlier have spent the bulk of their mathematical education in what are known as *Standards*-based classrooms. Just because the NCTM formally adopted them doesn't mean the average school district or classroom teacher has changed very much of what she or he does. No, the students in my freshman classes (some of whom are seniors who have taken freshman math courses many times in order to graduate) are products of the old system.

The fact that people of good will and intelligence can disagree so vehemently about the *Standards* tells us that they are, in fact, quite ambiguous. In some sense what you read into them is what you get, and just because someone says that what they do is *Standards*-based doesn't mean it is. I believe the *Standards* provides an opportunity for real mathematics to be done in the classroom. Others believe the *Standards* will drive real mathematics out of the classroom. That is the overriding issue in the debate over the *Standards*.

What are the controversial issues raised by the *Standards*?

The *Standards* emphasizes applications. When I read the *Standards* it is clear to me that "applications" includes applications to other areas of mathematics, and I have heard this view defended quite eloquently by K–12 teachers. But when other people read the *Standards* it is clear to them that, as an award-winning high school teacher once told me, "Meaningful mathematics is something that a child can apply in his or her daily life." What do we mean by applications, and how large a part should they play in the curriculum?

The *Standards* coincides with and strengthens another movement in education, the concern with equity. It's becoming indefensible to teach a course called Business Math in high school which is just arithmetic. But when you decide that no child of remotely normal intelligence is to be thrown on the mathematical junk heap, you have to ask how to teach all children, and what to teach, and this turns out to lead to some very hard questions. What worked for those of us reading this is known not to work for the majority of children—that's why we literally have thousands of students in my university taking essentially high school mathematics (half of them in a course misnamed College Algebra) before they can take a university math course required for graduation. We are not unusual in this. How are we going to teach algebra and geometry successfully and, these days, probability and statistics and a little finite combinatorics, to all children, starting in kindergarten and going through high school? And what is the algebra and geometry and probability and statistics and a little finite combinatorics that we believe all children should learn? That we believe all future college students should learn? That we believe all future engineers and scientists and mathematicians and economists and etc.—the heavy users of mathematics—should learn? These are hard questions. I and many others think that the best an-

swer is to strengthen the curriculum in interesting directions. But others disagree (read on for process vs. content).

The *Standards* calls for the development of mathematical reasoning. But this means very different things to different people. Some very thoughtful high school teachers are throwing out theorem proving in geometry classes—the *Standards* doesn't tell them to do so, but they feel they have permission if they see fit. On the other hand, all teachers who use the *Standards*, from kindergarten on, demand that children defend arguments and explain their reasons. What should mathematical reasoning mean at which level of mathematics? When should formal proofs be introduced, and how?

Less emphasis on algorithms

The *Standards* calls for less emphasis on standard algorithms. This doesn't necessarily mean no emphasis, although some people have interpreted it that way, including mathematicians. (The issue isn't algorithm vs. no algorithm, but standard algorithm vs. a child's discovered algorithm.) How much emphasis on standard algorithms is appropriate?

There is the issue of process vs. content. I see the *Standards* as allowing thinking, if you will, into the mathematical curriculum—that's what seems to be meant by process—hence allowing for more interesting content. A mathematics supervisor I know believes approvingly that process is so much more important than content as to make content almost not matter—the purpose of the mathematics curriculum for her is to teach kids how to think. How much time do we devote to exploring the process of doing mathematics, and how does this effect the content we teach? This is not an easy question.

There is something else about the *Standards* which isn't always publicly talked about, but which probably leads to a lot of the resentment among mathematicians, and that is that very few mathematicians were involved in their creation. People don't talk about it because when you do you get very angry responses of, "Oh yeah, just how do you define 'mathematician,' you elitist mathematician you." But it's a fact that very few of the people involved in writing any of the *Standards* have published a mathematics paper, have a Ph.D. in mathematics, or teach upper division mathematics courses. While every member of the NCTM (the vast majority of whom are K–12 teachers) was given a chance to respond to drafts, classroom realities made it hard to involve K–12 teachers on the *Standards* committees as well. The *Standards*-writing committees were predominantly Ph.D.s in education who do not teach K–12 classes. I'm not sure what effect this had on the actual documents, but it certainly has had its political consequences, both in mathematics departments, and to some extent also in K–12 classrooms.

The questions the *Standards* raise are important ones. Whether or not the mathematics community has been involved in the past, we need to be involved in the future. Each community with a major interest in mathematics education—the K–12 community, the mathematics educators, the mathematicians—has its own perspective, and all of these perspectives are needed if things are going to improve the way they should.

What should we do next?

Now we come to the punch line, which is that nobody's got everything right. We will not improve mathematics education by impugning each other's professional integrity, by sneering at each other's professions, by assuming that we're right and everyone else is wrong. Yet that's exactly what's been happening: K–12 teachers are denigrated by college folks as people to be talked at or even down to; mathematicians are considered unspeakably elitist, arrogant, and naive by non-mathematicians; and folks from education departments are considered dull, obfuscating drones by mathematicians and irrelevant by K–12 teachers. Needless to say, this is not helpful. There are smart people everywhere, and these smart people need to work across disciplinary turf and prejudicial lines.

I started off saying that I defend the *Standards*. This doesn't mean that I agree with everything that supposedly supports the *Standards*—I couldn't, because there are too many contradictory claims—or that I consider them etched in stone for all time. Yes, I believe that there are some trends which could be dangerous in mathematics education—there are always dangerous trends in education, although one person's danger is another person's opportunity. I absolutely believe that mathematicians need to be listened to in K–12 education, and that our role is considerably more than simply nodding our heads in agreement with whatever other people have cooked up. But if we want to be listened to, we have to listen. We have to admit that, whether or not we agree with their conclusions, some folks who are not mathematicians know some things we can learn from.

And we have to watch our rhetoric, or we'll continue to ensure that the mathematics community has no voice in what is going on in K–12 education.

Judith Roitman is a professor of mathematics at the University of Kansas.

Volunteers Wanted

The Association is always looking for ways to involve more members in its activities. If you would like to participate more by joining an MAA committee please write me or contact me by e-mail requesting a form to volunteer for committee work. Let me know which committees you might be interested in joining and your experience in the relevant area. Naturally, we cannot promise to get you onto the committee of your choice. Many committees do not have openings every year. There are also some committees for which there are more volunteers than we can appoint. But the Committee on Committees will do what it can. Please let me hear from you.

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A Building for Mathematicians

If you were asked to design a brand new building for your campus in which to teach and do mathematics, what would it look like and what would you put in it? ***Geraldine Wojno Kiefer****, a marketing consultant for the architectural firm of van Dijk, Pace, Westlake & Partners, in Cleveland, Ohio, describes the process and the outcome for one campus that did just that.*

Kent State's new mathematics building with its geometric outlines and sine curve roof.

Entrance lobby shows colorfully clad geometric forms and Fibonacci sequence floor pattern.

The mathematics library with its sine curve ceiling.

A close view of the library ceiling and clerestory windows.

When Kent State's Department of Mathematics and Computer Sciences found themselves in need of a new building a few years ago, they decided they wanted more than the simple four walls and a roof: what was required, they felt, was a building that captured the spirit of the disciplines that would be in the new building.

Rapid growth and differentiation within the department, among other factors, had led to the university's decision to house it in its own facility. Originally located on two floors of an older building, with courses taught campus-wide, by the late 1980s Mathematical Sciences was feeling a double strain: overcrowding and dispersion. Faculty offices were too few in number for needed privacy, the mathematics library was too small, and there was little space for interaction. Although highly focused in program and curriculum, the department lacked a physical focus. The expansion of the campus had resulted in the construction of three adjacent science buildings to the east of a new student union and library complex.

There was an obvious location for the new building—opposite the Biology and Chemistry buildings and facing Summit Street, the main east–west artery. The oblong site suited the building perfectly, and rotating the main classroom/office building back from the adjoining computer labs provided space for a welcoming outdoor court.

The architectural firm chosen to carry out the design, van Dijk, Pace, Westlake & Partners, was a known presence on campus, having designed the Biology Building in 1968. Other academic credits included facilities for the University of Akron, Cleveland State University, and a number of private colleges and secondary schools in northeastern Ohio.

The process of realizing the new building began with a detailed program worked out by the department, led by Richard K. Brown, director of operations at ICM (Institute for Computational Mathematics, a department program which supports research in mathematics and computer science), and Olaf P. Stackelberg, chair of the Department of Mathematics and Computer Science. Not only did this program outline needed facilities and space requirements, prioritizing three key areas (a mathematics library, colloquium room, and lounge), it also diagrammed, in "bubble" fashion, key departmental and interdepartmental relationships. For example, the colloquium room was given a centralized place, easily accessible from faculty and graduate student offices, and adjacent to seminar rooms, classrooms, and computer labs. Although the planning and design process would result in alterations to this initial diagram, particularly since the functions were rearranged over three floors, key relationships remained intact.

This and other "simple" resolutions, not the least of which was the timely and on-budget completion of the building, reflected a highly successful collaborative process in which the architect and departmental representatives functioned as a team.

At the initiation of the project, the architect made two lengthy visits of existing departmental facilities, discussing, then refining relevant issues, problems, and potential solutions. In addition, the project team visited other facilities on campus which met the department's criteria, for example, an auditorium for industrial engineering. During the initial, schematic design process, a number of schemes were essayed in a hands-on review process. A consensus was reached very quickly and what the building would become emerged. During the next design stage, three-dimensional physical models called "layer cakes" were prepared, showing floor-to-floor relationships and major volumes. These were also made explicit in isometric and perspective color drawings generated through the architect's CAD system. Again the colloquium room provides an apt example: parabolic and asymmetrical, thus complex in plan, this space was represented in several drawings and from various positions to show that its shape would provide optimum visibility for audiences as well as for resident and visiting lecturers.

Further stages of design development resulted in the preparation of detailed plans, elevations, and a model, which were made available to faculty and graduate students for review and comment. The final design emerged from a complex approval pro-

cess involving numerous representatives of the state and the university, as well as the departmental-architectural project team. The department was so fully behind the design that when state officials twice challenged the library—the building's flagship space—Brown and Stackelberg convinced them that it was not only necessary, but to be retained exactly as designed.

The department wanted a facility that was not only functional, but distinctive. The architect responded with shapes, volumes, materials, and detailing that symbolize mathematics. "One look at the building makes it clear that it has to be a math department," Stackelberg said.

The roof is expressed as a sine wave which is repeated in the interior linear metal ceiling. An undulating, sloping roof plane, the ceiling drops down from the clerestory which gives even, north lighting. Natural lighting is controlled to protect the department's volumes. Up and down fluorescent lighting, perpendicular to the stacks, is also controlled to reduce glare and eliminate shadows. The colloquium, computer lab wing, ground floor classroom wing, and stair and elevator tower are interrelated mathematical forms, expressing the "building blocks" of the program. The manipulation of economical materials—metal, brick, and Dryvit on the exterior, and paint and vinyl wall covering in the interior—is innovative and striking.

A variety of sophisticated, elegant, yet preeminently functional cues mark Kent State's Mathematical Sciences Building as an architectural and mathematical success, including ample, well lit hallways with "break-out" spaces for discussion and vistas to the surrounding campus; ample offices, each with a blackboard, flexible storage area, and its own window; a modulated primary color scheme with each primary keyed to a single floor; a thoughtfully designed faculty lounge whose progressively expanding volume culminates in a spacious, dramatic view to the countryside; and a commodious student lounge easily accessed from both entrances. Even the classrooms, the bare bones, cannot be dismissed as standard. Radiant ceiling heating provides unobstructed floor space for a variety of seating and discussion situations.

Flexibility and functionality are apparent throughout the building, including its competently integrated computer network. The network, controlled through a centralized computer facility on the first floor, interconnects every office, classroom, seminar, and presentation room. The department is also electronically linked to the campus-wide computer network, to the Ohio Academic Research Network (OARNET), and the worldwide Internet. The construction budget did not permit utilization of state-of-the-art fiber optics technology, but the design team was able to integrate that capability into the design by wiring the building for future fiber connections.

If one word were to be selected to describe Kent State's new Mathematical Sciences facility, it would be "interactive." The product of an intensive, continual dialogue between faculty, graduate students, and architects, the facility fosters interaction. Every effort was made to maintain the intimacy and camaraderie that characterized the department in its original location.

Perhaps the finest accolade, recently given by a student, was comparison of the building to a temple, a place with abiding spirit. A spirited expression for the 90s, it promises to energize its functions and the university well into the millennium.

Letter to the Editor

Dear Keith,

Having just read for the second time your editorial in the December 1994 FOCUS, I can only second your comments. Our students have been taught to take and pass tests. They have come to desire algorithms for passing exams, and have little patience, if any, for understanding. They can not be legitimately blamed, for we have made them what they are, even if it is painfully annoying. When I teach freshman calculus, I spend an enormous amount of time directly and indirectly ironing out the wrinkles put in their minds by some poorly prepared high school teacher.

As part of a very successful college team to help the teaching of mathematics in high schools, I have great sympathy for the usual American high school teacher. I have anecdotes sufficient to fill a barge, painful, exciting, and heartbreaking in the extreme.

Roger Pinkham
Stevens Institute of Technology

Underwood Dudley New Pólya Lecturer

Professor Underwood Dudley of DePauw University in Indiana has been chosen by the Board of Governors to be the MAA's fifth George Pólya Lecturer. Previous Pólya Lecturers have been John Ewing, Patricia K. Rogers, Carl Pomerance, and Robert Osserman.

Professor Dudley received his bachelor's and master's degrees from the Carnegie Institute of Technology and his Ph.D. from the University of Michigan, Ann Arbor, where he wrote his dissertation in number theory under the supervision of William LeVeque. After two years at Ohio State University he moved to DePauw where he has taught since 1967 and where he was department chair from 1990 to 1993. He is the author or editor of several popular books: *Elementary Number Theory*, *A Budget of Trisections*, *Mathematical Cranks*, and *Readings for Calculus*. He holds the record for length of service as an associate editor of *Mathematics Magazine*—eighteen years and still counting. He has also served as associate editor of the *American Mathematical Monthly* (1992–), as editor of the *Pi Mu Epsilon Journal* (1993–), and as editor of the *New Mathematical Library* series of the MAA (1994–). From 1979 to 1980 he was president of the MAA's Indiana Section. His Erdös number is 1.

ATLAST 1995 Linear Algebra Workshops

ATLAST is an NSF project to augment the teaching of linear algebra through the use of software tools. Two faculty workshops on the use of software in teaching linear algebra will be offered this summer. Participants will learn about existing commercial linear algebra software packages and will be trained in the use of the *MATLAB* software package. Attendees will learn how to incorporate computer exercises and laboratories into undergraduate linear algebra courses effectively.

Participants will work with exercises from the forthcoming ATLAST book and will be expected to design additional computing exercises at a level suitable for assigning to an undergraduate linear algebra class. These exercises will be class tested during the school year following the workshop and then submitted to the project director for inclusion in the ATLAST database. Some of these exercises will either be included in later editions of the ATLAST book or made available to the general public through the Mathematics Archives at the University of Tennessee, Knoxville.

The project was conceived by the Education Committee of the International Linear Algebra Society (ILAS). Steven J. Leon of the ILAS Education Committee serves as the ATLAST project director and the assistant director is Richard Faulkenberry. Both are in the Mathematics Department of the University of Massachusetts at Dartmouth. The ATLAST project is funded by a National Science Foundation faculty enhancement grant.

This is the fourth year of ATLAST workshops. Past workshops have been a rousing success. We are confident that the 1995 workshops will be even better.

1995 ATLAST Workshops and Presenters

June 21–24
Seattle University, Washington
Dr. Jane Day, San Jose State University

July 19–22
College of William & Mary, Virginia
Dr. David Hill, Temple University

All teachers of undergraduate linear algebra courses at colleges or universities in the U.S. are invited to apply. The deadline for applications is March 20, 1995. Late applications will be accepted on a space available basis. Each workshop is limited to thirty participants. The ATLAST Project provides room and board for all participants accepted. A screening committee will review applications and notify applicants early in April. For further information and application forms, contact Steven Leon, ATLAST Project Director, Department of Mathematics, University of Massachusetts at Dartmouth, Dartmouth, MA 02747; (508) 999-8320; fax: (508) 999-8901; e-mail:atlast@umassd.edu.

Calculus in a Real and Complex World

July 17–21, 1995, University of Massachusetts at Amherst

Due to the large number of applicants and the great success of last year's workshop, this NSF-funded workshop will be offered again this summer.

All expenses for tuition, room, board, and study materials will be provided for high school, college, and university calculus instructors. There will be hands-on experience with *Mathematica* computer software and TI-82 calculator-based laboratory and graphing calculator; small and large group discussion on pedagogy, assessment, and content; an overview of calculus reform efforts nationally; and experience developing course materials.

The presenters include Frank Wattenberg, who developed and wrote the textbook and *Mathematica*-based lab manual for Calculus in a Real and Complex World and taught it for six years, and Mary Ann Connors, who has taught the course for two years.

Information and applications are available from Mary Ann Connors, Department of Mathematics and Statistics, Lederle Graduate Research Tower, University of Massachusetts, Amherst MA 01003; (413) 545-0907; e-mail: mconnors@math. umass.edu.

Mathematics Labs for *DERIVE*

June 5–9, 1995

The MD–DC–VA Section will sponsor this five-day workshop at Frostburg State University on the western shore of Maryland. This is the twenty-first year that the section has sponsored a workshop.

Dr. Marvin Brubaker (Messiah College) and Dr. Carl Leinbach (Gettysburg College) will be the presenters. They have been very active in presenting regional and national workshops on the applications of *DERIVE* to mathematics. This popular, inexpensive, and easily-learned computer algebra package will be used to amplify and extend learning experiences in calculus, linear algebra, and differential equations. The cost for the workshop, including fees, room (double occupancy), and board is $260.

Further information is available from Jack Biggs, Dept. of Math, Frostburg State University, Frostburg, MD 21532; (301) 689-4181; or Ben Fusaro, Dept. of Math Sciences, Salisbury State University, Salisbury, MD 21801; (410) 543-6470.

Functioning in the Real World

The Math Modeling/PreCalculus Reform Project

An NSF-Supported Faculty Workshop
Long Island, NY, June 9-10, 1995

See an alternative to standard Precalculus or Algebra/Trig courses in the spirit of the Calculus reform movement. The emphasis is on applications of mathematics, focusing on families of functions, fitting functions to data, difference equations, modeling periodic phenomena, probability simulations, and applications of matrix algebra. The course can serve either as a one- or two-semester preparation for calculus or as a capstone mathematics experience.

For further information, contact Sheldon Gordon, Suffolk Community College; (516) 451-4270; e-mail: sgordon@ccmail.sunysb.edu.

Calculus Reform Workshop Program

Ten years ago at the Anaheim Joint Mathematics Meetings, the AMS–MAA panel discussion on "Calculus Instruction, Crucial But Ailing" launched a movement to reform the way calculus is taught in this country. Numerous reformed programs have been developed, several with seed money from the NSF, in which content has been streamlined, applications have been stressed, technology has been exploited, and pedagogy has been changed. Small group projects, writing assignments, multiple representation of functions, and a renewed emphasis on learning how to learn mathematics are characteristic of reformed programs.

The NSF has recently renewed funding for a program of calculus reform workshops directed by Don Small (U.S. Military Academy). The purpose of these workshops is to disseminate the fruits of the reformed programs on a national level wherever calculus is taught—high schools, community colleges, four-year colleges, and universities. There will be sixteen one-week workshops offered, eight each in the summers of 1995 and 1996, at sites nationwide. Each workshop will have twenty-four participants chosen not only because they teach calculus, but because they exercise leadership in the high schools, community and four-year colleges, and universities in their areas. All expenses except travel will be paid by the NSF grant.

These five important threads will be woven through each workshop.

1. History and present state of the Calculus Reform Movement
2. Participant involvement as a student under the pedagogy being promoted by the Calculus Reform Movement
3. In-depth experience in the reform program associated with the workshop instructors and a general overview of other major reform programs
4. Experience in the use of technology for teaching mathematics
5. Participant input ("My Favorite Problem," development of a curriculum topic, etc.)

In addition, participants will be asked to consider their own situations and formulate plans of action for their home institutions.

Workshop instructors will be drawn from the ranks of those who have led the reform movement. They will share their experiences as curriculum reformers and, in particular, how they overcame obstacles that often accompany curriculum reform (e.g., the need for new resources, skepticism of client disciplines, colleague resistance).

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

1995 NSF Calculus Reform Workshops

Call or write the local contact for specific information.

May 28–June 2 Calculus Reform: Activities and Projects

Instructors: Don Small (U.S. Military Academy) and Willie Taylor (Texas Southern University)
Local Contact: Della Bell
Dept. of Math
Texas Southern University
Houston, TX 77004
(713) 527-7002

June 5–10 Integrated/Core Approach to Calculus

Instructors: Chris Arney and Don Small (U.S. Military Academy)
Local Contact: Marie Vanisko
Dept. of Math
Carroll College
Helena, MT 59625
(406) 447-4451

June 11–16 Calculus in Context

Instructors: Harriet Pollatsek and Don O'Shea (Mount Holyoke College)
Local Contact: David Ford
Dept. of Math
Emory University
Atlanta, GA 30322-2390
(404) 727-7962

June 18–23 Project Calc

Instructors: David Smith and Lang Moore (Duke University)
Local Contact: Joel Cohen
Dept. of Math
University of Denver
Denver, CO 80208-0001
(303) 871-3292

June 18–23 St. Olaf Project

Instructors: Arnie Ostebee and Paul Zorn (St. Olaf College)
Local Contact: Clayton Dodge
Dept. of Math
University of Maine
Orono, ME 04469-5752
(207) 581-3908

June 18–23 Harvard Consortium Project

Instructors: Wade Ellis, Jr. and Ed Lodi (West Valley Community College)
Local Contact: Denny Burzynski
Dept. of Math
West Valley Community College
Saratoga, CA 95070-5697
(408) 374-0741

June 18–23 Calculus Resources

Instructors: Wayne Roberts (Macalester College) and Marcella Beacham (Daly College)
Local Contact: James Wilson
Dept. of Math
Daly College
6741 S. Indiana Ave
Chicago, IL 60637
(312) 838-7632

July 9–14 An Active Approach with Projects

Instructors: Steve Hilbert and Diane Schwartz (Ithaca College)
Local Contact: Chris Christensen
Dept. of Math
Northern Kentucky University
Highland Heights, KY 41076
(606) 572-6672

Program in Mathematics for Young Scientists (PROMYS)

Boston University, July 2–August 12, 1995

PROMYS offers a lively mathematical environment in which ambitious high school students explore the creative world of mathematics. Through their intensive efforts to solve a large assortment of unusually challenging problems in number theory, the participants practice the art of mathematical discovery—numerical exploration, formulation and critique of conjectures, and techniques of proof and generalization. More experienced participants may also study abstract algebra, combinatorics, and the Riemann zeta function. Problem sets are accompanied by daily lectures given by research mathematicians with extensive experience in Professor Arnold Ross's long-standing summer Mathematics Program at Ohio State University. In addition, a highly competent staff of eighteen college-aged counselors lives in the dormitories and is always available to discuss mathematics with students. Each participant belongs to a problem solving group which meets with a professional mathematician three times per week. Special lectures by outside speakers offer a broad view of mathematics and its role in the sciences.

PROMYS is a residential program designed for sixty high school students entering grades 10 through 12. Admission decisions will be based on the following criteria: applicants' solutions to a set of challenging problems included with the application packet; teacher recommendations; high school transcripts; and student essays explaining their interest in the program. The estimated cost to participants is $1300 for room and board. Books may cost an additional $100. Financial aid is available. PROMYS is dedicated to the principle that no student will be unable to attend because of financial need.

PROMYS is directed by Professor Glenn Stevens. Application materials can be obtained from PROMYS, Department of Mathematics, Boston University, 111 Cummington Street, Boston, MA 02215; (617) 353-2563. Applications will be accepted until June 1, 1995.

1995 Summer Graphing Calculator Short Course for College Faculty

Organized by Frank Demana and Bert Waits , Ohio State University

Twenty-seven one-week short courses are scheduled for the summer of 1995 for college faculty at sites around the United States. There is a $150 registration fee. To obtain more information, write Bert Waits and Frank Demana, Short Course Program, Department of Mathematics, The Ohio State University, 231 West 18th Ave., Columbus, OH 43210.

1995 American Regions Math League Competition

The American Regions Math League announces its 1995 competition, June 2–3, at Pennsylvania State University and the University of Iowa. If teams are interested, ARML is ready to open a third site at the University of Nevada at Las Vegas.

The ARML competition is the largest on-site event of its kind in the country, drawing fifteen-member teams of high school students from every region. Teams are organized on a local basis. For information on organizing an ARML team or joining an existing team, contact Mark Saul, 711 Amsterdam Avenue, New York, NY 10025; (212) 666-5188; e-mail: 73047,3156@compuserve.com or Barbara Rocrow, Bronx High School of Science, 75 West 205 St., Bronx, NY 10468.

Eleventh Annual Allegheny Mountain Section Summer Short Course

The course will be held June 26–30 and will be given by Fernando Gouvea of Colby College. The five-day workshop examines the background work necessary to understand the basic mathematics behind the current work in the proof of Fermat's Last Theorem.

Topics include:

- Modular forms, the easy part (definition, Hecke operators, eigenforms, L-functions)
- Elliptic curves, the easy part (definition, minimal Weierstrass form, invariants, group structure, reduction mod p, L-functions)
- Elliptic Curves, the fancy part (torsion points, Galois representations)
- Modular forms, the fancy part (functional equation for the L-function, the Hecke algebra, Galois representations, the Taniyama conjecture)
- Ribet and Wiles: the Frey curve and its Galois representation, deformation theory and Wiles' theorem.

The course will be held at Allegheny College. Course registration is $120 and room and board is $140, for a total of $260.

For further information and an application, contact George Bradley, Department of Mathematics and Computer Science, Duquesne University, Pittsburgh, PA 15282; (412) 396-5115; e-mail: BRADLEY@DUQ3.CC.DUQ.EDU.

MAA to Dedicate Headquarters Room to Benjamin Banneker

On May 19, 1995 the MAA will dedicate a room in honor of Benjamin Banneker in the refurbished Dolciani Mathematical Center in Washington, DC.

Banneker was a self-taught mathematician, astronomer, and free man of color, who was born in 1731 in Baltimore County, Maryland, near what is now Ellicott City. He had only a few years of schooling, during which arithmetic was the only mathematics he was taught. The one-room schoolhouse he attended was open only during winter months, and when Banneker was old enough to farm full-time with his father, he could no longer attend class. Later in his life he studied more advanced topics, including trigonometry and logarithms. At age 57, he used borrowed instruments and texts to teach himself astronomy.

His first scientific achievement was the completion of a wooden clock which he hand carved and assembled after having seen only two timepieces, a pocket watch and a sundial. People came from miles around to see it and hear it strike the hour. Completed in 1753, the wooden clock operated with precision until his death over fifty years later.

In 1791, he made the astronomical observations to determine the survey lines for the District of Columbia. It has been said that he was the first African American federal employee. That same year, he completed calculations of the motions of the sun, moon, planets, and tides for the first of his seven almanacs, which appeared in 1792.

Banneker wrote to Secretary of State Thomas Jefferson in August 1791, attacking notions of Black inferiority and including his almanac in manuscript form. Jefferson forwarded the almanac to the Academy of Sciences in Paris with a letter citing it as evidence of the equal talents of Blacks and describing its author as "a very respectable mathematician" who had been employed in the survey of the District. Jefferson also referred to the very elegant solutions of geometrical problems by Banneker. Both Banneker's letter and Jefferson's reply were published in the almanac of 1793 to strengthen the anti-slavery movement.

He was known to be extremely well read, a lover of nature, devout, and talented in music and rhyme (he would sometimes pose mathematical problems in rhyme).

Residing on a farm his entire life, people would travel to visit him throughout his later years. He supposedly kept a log of the ones who he felt were most important.

Banneker died peacefully on an October Sunday in 1806, following a walk. He was 74 years old.

Many of the scientific instruments and books Banneker used were returned to his friend George Ellicott, but only two of his personal items survived him: his Bible and a featherbed. All other possessions, including manuscript copies of his almanacs as well as his famed clock, were destroyed in his house, which caught fire while he was being buried.

Although numerous rooms in the Dolciani Center have been named to commemorate mathematicians, until now none have been for a prominent minority mathematician. This recognition for Benjamin Banneker will make the mathematics community and society at large more aware of his contributions and those of other minority mathematicians.

Planned Giving Program off to a Good Start

Many MAA members have enthusiastically responded to former President Don Kreider's request of last November to include the MAA in their estate planning. This request was accompanied by a copy of the new MAA newsletter *LEGACY*, devoted to ideas and practical advice about estate planning. It was sent to all members aged 50 or older.

Since the MAA has a small endowment for an organization of its size, the Board of Governors approved a planned giving campaign to ensure the Association's future fiscal strength and its capacity to respond positively to the needs of its members and the mathematical community in general.

As a result of the new program, several Board members announced planned gifts to the MAA, totalling about $278,000. President Kenneth Ross disclosed a major charitable gift from his parents, Edward and Edith Ross Brinn, in the form of a charitable remainder trust. Gerald Porter, MAA Treasurer, told the Board how easy it was to donate the proceeds of a life insurance policy and announced that he was making the MAA the beneficiary of a life insurance policy. Linda Hill, the Chair of the MAA Committee on Sections and member of the Executive Committee, also announced a gift of life insurance, as did Marcia P. Sward, MAA Executive Director.

If you would like a copy of *LEGACY, How to Make a Will that Works*, and *Better Estate Planning*, or a personal financial affairs record that will help you organize all your major financial records into one document, contact Maureen Callanan at the MAA by e-mail at mcallana@maa.org or by phone at 1-800-331-1622. If you would like to discuss the planned giving program in more detail, please call Marcia P. Sward at the same number.

MAA Mastercard

The MAA has signed an agreement with MBNA to create an MAA MasterCard that will be offered to all MAA members with no annual fee. The MAA will receive a royalty for each new account that remains open 90 days and a percentage of all charges made on the MAA cards.

The agreement was approved by the Board of Governors at its meeting on August 14, 1994 as a service to members and as a way of raising funds to support the MAA. You should have received a flyer in the mail describing the card. You are, of course, under no obligation to accept it. As part of the marketing agreement, MBNA will call selected individuals as a follow up to the mailing. We apologize for any inconvenience this may cause.

In Memoriam

Bertil Anderson, retired, Plandome, NY, died on September 22, 1994 at 90. He was an MAA member for 24 years.

Frank Ayres, retired, Dickinson College, died on August 6, 1994 at 93. He was an MAA member for 73 years.

Stewart Baker, retired mathematician, National Security Agency, died on January 16, 1994. He was an MAA member for 62 years.

Gerald Becker, professor emeritus, San Diego State University, died on July 3, 1994 at 70. He was an MAA member for 36 years.

Raymond Frank Bell, professor emeritus, West Virginia Institute of Technology, died on October 25, 1994 at 83. He was an MAA member for 61 years.

Mabel Nowlan Bomhoff, retired, St. Petersburg, FL, has died at 98. She was an MAA member for 61 years.

J. Maxey Brooke, retired, Dallas, TX, died on April 13, 1993. He was an MAA member for 31 years.

Paul Clifford, retired professor, Montclair State College, has died. He was an MAA member for 46 years.

Ronald Deford, professor emeritus, University of Texas at Austin, died at 92. He was an MAA member for one year.

James Desmond, associate professor, Pensacola Junior College, died on August 17, 1993, at 58. He was an MAA member for 28 years.

Elden Egbers, retired, Olympia, WA, died on March 20, 1994 at 72. He was an MAA member for 34 years.

Richard Eiseman, consultant, Rand Corporation has died. He was an MAA member for 29 years.

Nathan Fine, retired, Pennsylvania State University, died on November 18, 1994 at 78. He was an MAA member for 52 years.

Joseph Fontana, associate professor, University of Alabama, died on July 3, 1994, at 62. He was an MAA member for 5 years.

Leonard Fuller, retired professor, Kansas State University, has died. He was an MAA member for 47 years.

Aaron Galuter, Chelsea Publishing, New York, NY died at 77. He was an MAA member for 32 years.

Basil Gillman, professor emeritus, Drake University, died on November 22, 1994 at 81. He was an MAA member for 48 years.

Robert Goldrick, software specialist, Grumman Aerospace, died at 39. He was an MAA member for 9 years.

Dennis Grantham, associate professor, East Texas State University, died on January 24, 1995 at 55. He was an MAA member for 28 years.

Frank S. Hawthorne, retired, New York State Education Department, died on February 11, 1995 at 80. He was an MAA member for 52 years.

Clarence Heinke, professor emeritus, Capital University, died on July 8, 1994 at 81. He was an MAA member for 48 years.

Adrien Hess, retired, Montana State University, died on May 23, 1994 at 86. She was an MAA member for 38 years.

Aughtum Howard, retired, Eastern Kentucky University, died on October 14, 1994 at 87. She was an MAA member for 50 years.

Jerry W. Jones, department chair, Aiken Technical College, has died at 49. He was an MAA member for 24 years.

Andrew Kirby, retired, Fordham University, has died. He was an MAA member for 48 years.

Anita Levine, professor emeritus, Cupertino, CA, has died at 83. She was an MAA member for 49 years.

John Lewis, retired, Teaneck, NJ, died on August 13, 1994 at 84. He was an MAA member for 55 years.

Mrs. R. McLean, retired, Loyola University, died on November 6, 1994 at 72. She was an MAA member for 42 years.

Lyle Mehlenbacher, professor emeritus, University of Detriot, has died at 84. He was an MAA member for 57 years.

William Meyer, retired professor, University of Chicago, died on November 17, 1993 at 78. He was an MAA member for 51 years.

Clark C. Miller, president, Clark C. Miller Corporation died on July 28, 1994 at 51. He was an MAA member for 13 years.

William Miner, retired, Raleigh, NC, died on December 23, 1993 at 77. He was an MAA member for 30 years.

Bill C. Moore, retired, Texas A&M, died on October 3, 1993, at 86. He was an MAA member for 60 years.

William Munro, retired professor, University of Minnesota, died on January 20, 1993 at 77. He was an MAA member for 53 years.

R. Kent Nagle, professor, University of South Florida, died in October 1994, at 47. He was an MAA member for 14 years.

Peter O'Halloran, associate professor, University of Canberra, Australia died on October 25, 1994 at 63. He was an MAA member for 16 years. He also was the founder of the Australian Mathematics Competitions and the Australian Mathematical Olympiad Committee, and past president of the Canberra Mathematical Association.

John Oxley, retired, New York, NY, died on September 22, 1994 at 67. He was an MAA member for 44 years.

Hasell Palmer, retired, North Augusta, SC, died on June 2, 1994. He was an MAA member for 46 years.

Joseph Pekarsky, retired, New Jersey Institute of Technology, has died at 77. He was an MAA member for 19 years.

O. Peterson, retired department chair, Emporia State University, died in November 1994 at 92. He was an MAA member for 71 years.

Ted Raburn, vice-president, Internet Systems Corporation, has died at 48. He was an MAA member for 7 years.

Joseph Rich, retired physicist, G.E. Corporation, Research and Development Center, died in March 1994 at 77. He was an MAA member for 34 years.

Leon Robbins, Wayne, PA, died on December 19, 1993. He was an MAA member for 39 years.

E. Roessler, professor emeritus, University of California, Davis, has died. He was an MAA member for 55 years.

Bertram Ross, professor emeritus, University of New Haven, died in October 1993 at 76. He was an MAA member for 33 years.

Rafael Sanchez-Diaz, professor emeritus, New Mexico Institute of Mining and Technology, died on January 1, 1993 at 91. He was an MAA member for 42 years.

Leslie Whitford, retired, Dayton, OH, has died. She was an MAA member for 35 years.

Annie John Williams, Durham High School, Durham, NC, died on November 19, 1994 at 81. She was an MAA member for 45 years.

William Wooten, Lake San Marcos, CA, has died. He was an MAA member for 36 years.

Royal Zeigler, retired, Radium Springs, NM, died on September 10, 1994 at 74. He was an MAA member for 47 years.

MathFest, Burlington, Vermont

August 5-9, 1995

Sweet New England

What do you get when you combine Doris Schattschneider, Andrew Granville, a teddy bear factory, a cider mill, a museum, and a cruise on Lake Champlain?

If you are a mathematician or a family member of a mathematician, the answer is a good time. Burlington, Vermont is the place. August 5–9 is the time. And the MAA–AMS MathFest is the occasion.

Competing with the gorgeous scenery and the friendly welcome of summertime New England, the MAA and AMS have planned a varied array of sessions for those who decide to combine business with pleasure and make the trip to Burlington.

Schattschneider's MAA Earle Raymond Hedrick Lectures will cover the topics of tiling, symmetry and order, and aperiodicity and quasicrystals, and Granville will give an AMS–MAA invited address titled *It's as easy as ABC*. These are just two of the many mathematical highlights on the packed three-day program of events.

Non-mathematical attractions include a dinner and cruise on Lake Champlain, a visit to the Shelburne Museum, a trip in the Green Mountains, a visit to Cold Hollow Cider Mill, and a tour of the Vermont Teddy Bear Factory.

Who could bear to miss this event?

SATURDAY, AUGUST 5

9:00 a.m.-5:00 p.m. MAA BOARD OF GOVERNORS

Noon-4:00 p.m. MATHFEST REGISTRATION

1:00 p.m.-5:00 p.m. OPTIONAL TOUR OF SHELBURNE MUSEUM

1:00 p.m.-6:00 p.m. AMS COUNCIL MEETING

6:30 p.m.-10:00 p.m. OPENING BANQUET AND RECEPTION

SUNDAY, AUGUST 6

8:00 a.m.-4:00 p.m. MATHFEST REGISTRATION

8:30 a.m.-9:20 a.m. AMS-MAA INVITED ADDRESS *It's as easy as ABC.* Andrew J. Granville

9:00 a.m.-5:00 p.m. MAA COMMITTEE ON STUDENT CHAPTERS HOSPITALITY CENTER

9:00 a.m.-5:00 p.m. BOOK SALES AND EXHIBITS

9:35 a.m.-10:25 a.m. MAA EARLE RAYMOND HEDRICK LECTURES: Lecture I *The fascination of tiling.* Doris J. Schattschneider

10:40 a.m.-12:10 p.m. AMS PROGRESS IN MATHEMATICS LECTURE *Fully nonlinear elliptic second order equations: Recent development.* Nicolai V. Krylov

12:25 p.m.-12:55 p.m. AMS BUSINESS MEETING

1:00 p.m.-2:30 p.m. PME COUNCIL MEETING

1:15 p.m.-2:05 p.m. MAA-MU ALPHA THETA INVITED ADDRESS *A mathematical kaleidoscope for motivation and understanding.* Jeanne F. Nelson

MAA CONTRIBUTED PAPER SESSIONS

1:15 p.m.-4:05 p.m. *Implications of the NCTM Standards for College Level Teaching, I*

1:15 p.m.-4:05 p.m. *Symbolic Computation in the Undergraduate Mathematics Classroom, I*

1:15 p.m.-4:05 p.m. *Innovative Teaching in First-Year College Mathematics Courses, I*

1:15 p.m.-2:35 p.m. MAA PANEL DISCUSSION *NCTM: A vision of algebra.*

1:15 p.m.-3:15 p.m. MAA MINICOURSE #1: PART A *Interdisciplinary lively applications.*

1:15 p.m.-3:15 p.m. MAA MINICOURSE #4: PART A *An activity-based approach to teaching introductory statistics.*

2:00 p.m.-3:30 p.m. AMS COMMITTEE ON SCIENCE POLICY PANEL DISCUSSION

2:45 p.m.-5:00 p.m. MAA STUDENT PAPER SESSIONS

2:45 p.m.-5:00 p.m. PME CONTRIBUTED PAPER SESSIONS

3:00 p.m.-4:30 p.m. AWM PANEL DISCUSSION

2:50 p.m.-4:10 p.m. MAA PANEL DISCUSSION *The SSIs and systematic reform in mathematics.*

3:15 p.m.-5:15 p.m. MAA MINICOURSE #3: PART A *Calculus: An active approach with projects.*

3:15 p.m.-5:15 p.m. MAA MINICOURSE #5: PART A *The use of software in an introductory linear algebra course.*

4:00 p.m.-6:00 p.m. MAA SECTION OFFICERS MEETING

4:30 p.m.-5:00 p.m. AWM MEMBERSHIP MEETING

MAA CONTRIBUTED PAPER SESSIONS

4:10 p.m.-6:00 p.m. *Achieving K–12 and Higher Education Collaboration in Systemic Reform Programs, I.*

4:10 p.m.-6:00 p.m. *Interactive Mathematics Video Games, I.*

4:10 p.m.-6:00 p.m. *Popularizing Mathematics, I.*

4:25 p.m.-5:45 p.m. MAA PANEL DISCUSSION *Reform of the preparation of mathematics teachers.*

4:25 p.m.-5:45 p.m. MAA PANEL DISCUSSION *Using real data in an introductory statistics course.*

5:15 p.m.-6:15 p.m. MAA—PME STUDENT RECEPTION

6:30 p.m.-9:30 p.m. OPTIONAL DINNER AND CRUISE ON LAKE CHAMPLAIN

9:30 p.m.-11:00 p.m. AWM OPEN RECEPTION

MONDAY, AUGUST 7

7:00 a.m.-8:30 a.m. BREAKFAST FOR MAA STUDENT CHAPTER FACULTY ADVISORS, SECTION COORDINATORS, AND PME ADVISORS

8:00 a.m.-4:00 p.m. MATHFEST REGISTRATION

8:30 a.m.-9:20 a.m. AMS-MAA INVITED ADDRESS *Strings, beams, membranes, and plates: Finding properties of vibrating systems from nodes or nodal lines* Joyce R. McLaughlin

9:00 a.m.-5:00 p.m. MAA COMMITTEE ON STUDENT CHAPTERS HOSPITALITY CENTER

9:00 a.m.-5:00 p.m. BOOK SALES AND EXHIBITS

9:35 a.m.-10:25 a.m. MAA EARLE RAYMOND HEDRICK LECTURES: Lecture I *Symmetry and order.* Doris J. Schattschneider

1:00 p.m.-1:50 p.m. NAM DAVID BLACKWELL INVITED ADDRESS *Speaker and title to be announced.*

1:00 p.m.-3:00 p.m. MAA MINICOURSE #4: PART B *An activity-based approach to teaching introductory statistics.*

1:00 p.m.-3:00 p.m. MAA MINICOURSE #5: PART B *The use of software in an introductory linear algebra course.*

MAA CONTRIBUTED PAPER SESSIONS

1:00 p.m.-3:35 p.m. *Achieving K–12 and Higher Education Collaboration in Systemic Reform Programs, II.*

1:00 p.m.-3:55 p.m. *Interactive Mathematics Video Games, II.*

1:00 p.m.-5:00 p.m. MAA STUDENT PAPER SESSIONS

1:00 p.m.-5:00 p.m. PME CONTRIBUTED PAPER SESSIONS

1:00 p.m.-2:25 p.m. MAA PANEL DISCUSSION *An interdisciplinary view of changes in undergraduate SMET education.*

1:00 p.m.-2:50 p.m. MAA WORKSHOP ON SCHOOL REFORM

1:00 p.m.-5:00 p.m. OPTIONAL TOUR OF VERMONT TEDDY BEAR FACTORY/SHELBURNE FARMS

2:35 p.m.-4:00 p.m. SUMMA SPECIAL PRESENTATION *Intervention projects for minority precollege students.*

2:45 p.m.-4:15 p.m. AMS COMMITTEE ON EDUCATION PANEL DISCUSSION

4:00 p.m.-6:00 p.m. MAA MINICOURSE #2: PART A *Instructional aspects of mathematics on the Internet.*

MAA CONTRIBUTED PAPER SESSIONS

4:05 p.m.-6:00 p.m. *Implications of the NCTM Standards for College Level Teaching, II.*

4:05 p.m.-6:00 p.m. *Symbolic Computation in the Undergraduate Mathematics Classroom, II.*

4:15 p.m.-5:40 p.m. MAA SPECIAL PRESENTATION *Does the culture in mathematics really need changing?*

4:30 p.m.-6:00 p.m. MAA PANEL DISCUSSION *Using EPIC in calculus and pre-calculus classes.*

4:30 p.m.-6:00 p.m. MAA PANEL DISCUSSION *Assessment in the age of the graphing calculator.*

6:45 p.m.-8:15 p.m. PME BANQUET

8:30 p.m.-9:30 p.m. PME J. SUTHERLAND FRAME LECTURE *Tilings as diffraction gratings.* Marjorie Senechal

8:30 p.m.-10:00 p.m. COMMITTEE ON THE PARTICIPATION OF WOMEN SPECIAL PRESENTATION *Are we there yet? The Off-Off-Broadway version.*

TUESDAY, AUGUST 8

8:00 a.m.-Noon MATHFEST REGISTRATION

8:30 a.m.-9:20 a.m. AMS-MAA INVITED ADDRESS *Title to be announced.* Brian C. White

9:00 a.m.-5:00 p.m. MAA COMMITTEE ON STUDENT CHAPTERS HOSPITALITY CENTER

9:00 a.m.-5:00 p.m. OPTIONAL TOUR STOWE/GREEN MOUNTAINS/ COLD HOLLOW CIDER MILL

9:00 a.m.-5:00 p.m. BOOK SALES AND EXHIBITS

9:35 a.m.-10:25 a.m. MAA EARLE RAYMOND HEDRICK LECTURES: Lecture III *Aperiodicity and quasicrystals.* Doris J. Schattschneider

10:40 a.m.-12:10 p.m. AMS PROGRESS IN MATHEMATICS LECTURE *Compactifications of spaces of lattices.* Robert D. MacPherson

12:25 p.m.-12:55 p.m. MAA BUSINESS MEETING

1:40 p.m.-2:30 p.m. MAA STUDENT LECTURE *Cauchy, Dirichlet, and the birth of real analysis.* David M. Bressoud

MAA CONTRIBUTED PAPER SESSIONS

1:40 p.m.-3:35 p.m. *Innovative Teaching in First-Year College Mathematics Courses, II.*

1:40 p.m.-4:45 p.m. *Popularizing Mathematics, II.*

1:40 p.m.-3:40 p.m. MAA WORKSHOP ON SCHOOL REFORM

1:45 p.m.-3:45 p.m. MAA MINICOURSE #1: PART B *Interdisciplinary lively applications.*

1:45 p.m.-3:45 p.m. MAA MINICOURSE #2: PART B *Instructional aspects of mathematics on the Internet.*

1:45 p.m.-3:45 p.m. MAA MINICOURSE #3: PART B *Calculus: An active approach with projects.*

2:45 p.m.-4:45 p.m. MAA STUDENT WORKSHOP ON THE INTERNET

3:15 p.m.-4:40 p.m. MAA SPECIAL PRESENTATION *A reform college algebra curriculum integrating technology.*

4:00 p.m.-5:30 p.m. MAA PANEL DISCUSSION *NCTM's core curriculum: Making mathematics count for everyone—The big ideas.*

5:45 p.m.-9:00 p.m. MAA RECEPTION AND BANQUET FOR 25-YEAR MEMBERS

WEDNESDAY, AUGUST 9

9:15 a.m.-3:30 p.m. OPTIONAL TOUR LAKE CHAMPLAIN SCENIC FERRY/ AUSABLE CHASM

Burlington, Vermont

University of Vermont

August 6-8, 1995

Burlington MathFest including the 97th Summer Meeting of the AMS, 73rd Summer Meeting of the Mathematical Association of America (MAA), and summer meetings of the Association for Women in Mathematics (AWM) and Pi Mu Epsilon (PME).

The Joint Meetings Committee which bears the financial responsibility for these meetings has made decisions to reduce costs by eliminating some traditional services at MathFests and making substitutions for some others. We hope that participants will support these changes as a way to make the MathFest financially viable. Associate secretary: Robert J. Daverman.

A special MAA task force on the school-college interface, chaired by R. D. Anderson, is organizing several panel discussions, workshops, and a session of contributed papers dealing especially with the NSF's initiatives on systemic reform and with several NCTM reports.

AMS-MAA Invited Addresses

Andrew J. Granville, University of Georgia, *It's as easy as ABC*, Sunday, 8:30 a.m.

Joyce R. McLaughlin, Rensselaer Polytechnic Institute, *Strings, beams, membranes, and plates: Finding properties of vibrating systems from nodes or nodal lines*, Monday, 8:30 a.m.

Brian C. White, Stanford University, *Title to be announced*, Tuesday, 8:30 a.m.

73rd Summer Meeting of the MAA

MAA Invited Addresses

Doris J. Schattschneider, Moravian College; Lecture I: *The fascination of tiling*; Lecture II: *Symmetry and order*; and Lecture III: *Aperiodicity and quasicrystals* (Earle Raymond Hedrick Lectures); Sunday, Monday, and Tuesday, 9:35 a.m.

Jeanne F. Nelson, Kamehameha Schools (Honolulu), *A mathematical kaleidoscope for motivation and understanding*, (MAA-Mu Alpha Theta Lecture); Sunday, 1:15 p.m.

MAA Minicourses

Minicourse # 1: *Interdisciplinary lively applications*, organized by **Frank R. Giordano** and **David C. Arney**, United States Military Academy. Part A: Sunday, 1:15 p.m.-3:15 p.m.; Part B: Tuesday, 1:45 p.m.-3:45 p.m. Enrollment limit: 40; registration fee: $45. Interdisciplinary applications can be used to weld mathematics with the concepts of other disciplines to provide student growth in modeling and problem solving. This minicourse will discuss projects that can be used in a wide range of mathematics courses, with the applications related to subjects in chemistry, biology, physics, engineering, economics, technology, and social sciences. Projects are designed to take four to six hours of student effort and can be done in groups or individually, and some require a computer or calculator. Participants will work with materials prepared for students and instructors in printed, video, and multimedia formats.

Minicourse # 2: *Instructional aspects of mathematics on the Internet*, organized by **Brian E. Smith**, Dawson College (Montreal), and **Sandra Villas**, Dona Ana Community College. Part A: Monday, 4:00 p.m.-6:00 p.m.; Part B: Tuesday, 1:45 p.m.-3:45 p.m. Enrollment limit: 40; registration fee: $65. The orientation of this minicourse is on locating mathematics resources on the Internet and using them in the mathematics classroom or laboratory. One part of the course will focus on identifying different types of mathematical resources and the Internet search tools which are required to locate them. We will describe how to find FTP sites for archived files, using ARCHIE servers; Gopher servers, and the VERONICA searches that find them will also be discussed. The second part of the course will deal with applications of the Internet in the teaching of undergraduate mathematics, and specific examples will be presented. The course will involve a combination of demonstrations and hands-on experience; handouts will be provided.

Minicourse # 3: *Calculus: An active approach with projects*, organized by **Stephen R. Hilbert, John C. Maceli, Diane D. Schwartz, Stanley E. Seltzer,** and **Eric E. Robinson**, Ithaca College. Part A: Sunday, 3:30 p.m.-5:30 p.m.; Part B: Tuesday, 1:45 p.m.-3:45 p.m. Enrollment limit: 40; registration fee: $45. This minicourse will address issues relating to the use of group projects and in-class activities in calculus, including an overview, examples of projects and activities, and the impact on the curriculum. The organizers, who have been teaching calculus using group projects since spring 1989, have found that open-ended projects challenge students to develop problem-solving skills beyond looking for a similar problem solved in the text or class notes. They use in-class activities to help the students to become active learners and to develop the skills to successfully complete the projects.

Minicourse # 4: *An activity-based approach to teaching introductory statistics*, organized by **Richard L. Scheaffer**, University of Florida, and **Ann E. Watkins**, California State University, Northridge. Part A: Sunday, 1:15 p.m.-3:15 p.m.; Part B: Monday, 1:00 p.m.-3:00 p.m. Enrollment limit: 40; registration fee: $45. This minicourse is for teachers of introductory statistics who want to change their course from a traditional lecture-and-listen model to activity-based lessons. Participants will be engaged in a series of field-tested, hands-on activities that illustrate many of the key concepts taught in an introductory statistics course. They will play the role of students, actually working through a selection of activities. Experienced instructors will explain how they have made use of the activities in various settings. Each participant will be supplied with copies of the student pages and the instructor notes, which include suggestions for assessment for the activities. This Activities-Based Statistics (ABS) project is funded by the NSF.

Minicourse # 5: *The use of software in an introductory linear algebra course*, organized by **Homer F. Bechtell**, University of New Hampshire. Part A: Sunday, 3:30 p.m.-5:30 p.m.; Part B: Monday, 1:00 p.m.-3:00 p.m. Enrollment limit: 80; registration fee: $45. The focus of this minicourse is on developing goals and strategies for the successful implementation of computer-aided instruction into an undergraduate introductory linear algebra course.

Emphasis is on introducing software in order to increase mathematical maturity and the depth of understanding for the concepts without compromising the theoretical development. Problem sets will be distributed and the construction of problem sets will receive special attention. Familiarity with software for linear algebra is a prerequisite. During the course, participants will not have access to computer software, but will develop outlines for problem sets based on their experience with linear algebra software.

MAA Minicourses are open only to persons who register for the MathFest and pay the regular registration fee. Interested participants should complete the MAA Minicourse Advance Registration Form at the back of this issue and send it directly to the MAA office so as to arrive by June 30, 1995; the MathFest Advance Registration/Housing Form must be sent to AMS. After the deadline, potential participants should call the MAA headquarters at 800-331-1622 to check on availability. The MAA reserves the right to cancel any Minicourse which is undersubscribed. Should this occur, those registered in advance will be notified and will receive a full refund.

MAA Contributed Paper Sessions

• *Implications of the NCTM standards for college level teaching,* Sunday and Monday afternoons. Organized by **Darien Lauten***, Department of Mathematics, University of New Hampshire, Durham, NH 03824-3591; phone: 603-868-7133; FAX: 603-862-4096; e-mail: dlauten@christa.unh.edu. New secondary mathematics curriculum projects funded by the National Science Foundation engage students in learning situations aligned with the NCTM Curriculum and Evaluation Standards for School Mathematics. Characteristics of these projects include changes in mathematics content, use of technology, new pedagogical approaches, mathematics in context, inclusion of all students, and emphasis on student understanding of mathematics. As a result of these projects, students will arrive at postsecondary institutions with new expectations and experiences. This session will address project approaches, teacher development issues, evaluation, and student learning.

• *Symbolic computation in the undergraduate mathematics classroom*, Sunday and Monday afternoons. Organized by **Ronald I. Sklar** *, Department of Computer Science, St. John's University, St. Vincent's College, Grand Central & Utopia Parkways, Jamaica, NY 11439; phone: 718-990-6161 (X7212); FAX: 718-990-1882; e-mail: ymrscus@sjumusic.stjohns.edu; and **Richard C. O'Lander**, St. John's University. The creative use of computer algebra systems is resulting in a revolution in the way we teach mathematics. These systems have been effectively used in teaching calculus, linear algebra, differential equations, combinatorics, probability, and statistics. This session invites papers on experiences with the use of a symbolic computation system in teaching mathematics. Subject areas not mentioned above are especially welcome.

• *Innovative teaching in first-year college mathematics courses*, Sunday and Tuesday afternoons. Organized by **Aaron I. Stucker***, Department of Mathematics and Statistics, Washburn University, Topeka, KS 66621; phone: 913-231-1010 (X1491); e-mail: zzstuc@acc.wuacc.edu; and **Howard L. Penn**, U.S. Naval Academy. This session will present talks describing innovative techniques in the teaching of mathematics courses typically taught in the first year of college. Innovative techniques include (but are not limited to) the use of technology, writing projects, and cooperative learning.

• *Achieving K-12 and higher education collaboration in systemic reform programs*, Sunday and Monday afternoons. Organized by **Richard D. Anderson***, Louisiana Systemic Initiative Program, 1885 Wooddale Boulevard, 11th floor, Baton Rouge, LA 70806; phone: 504-922-0690; FAX: 504-922-0688. With much national emphasis on systemic reform of mathematics education at both the K-12 and higher education levels, this session targets examples of effective collaborative efforts involving personnel and/or institutions at the two levels. The collaboration, formal or informal, can be in either or both directions. Hopefully, the examples will point the way for others to get involved.

• *Interactive mathematics video games*, Sunday and Monday afternoons. Organized by **Richard L. Stephens***, Department of Mathematics and Computer Science, Western Carolina University, Cullowhee, NC 28723-9049; phone: 704-227-7245; FAX: 704-227-7240; and **Ralph DeVane**, Western Carolina University. We live in the "video age", so why not make it work for us within our mathematics classes? Make a math lesson out of some video game. Utilize some "math game" software. Write your own math game software (computer or calculator). This is only one aspect of using technology, but if you have done any of the above, share your experience with others. Please include a clear statement of your equipment needs.

• *Popularizing mathematics*, Sunday and Tuesday afternoons. Organized by **Eric R. Muller***, Department of Mathematics, Brock University, St. Catharines, Ontario, L2S 3A1 Canada; phone: 905-688-5550 (X3297); FAX: 905-682-9020; e-mail: emuller@spartan.ac.brocku.ca; and **Bernard R. Hodgson**, Université Laval. Papers on successful activities to popularize mathematics are solicited. Of special interest are activities aimed at popularizing mathematics both outside the classroom, among families, seniors, policy makers, etc., and in the university classroom for students enrolled in mathematics "service" courses, including prospective elementary school teachers. Submissions should include some documentation of the activities, some information on who developed and ran them, the segment of the population to whom they were aimed, how often the programs have run, and some indication of their degree of success.

Submission procedures for MAA contributed papers: Sessions generally must limit presentations to ten minutes, but selected participants may extend their contributions up to 20 minutes. Individuals should forward the following directly to the organizer (indicated above with an *): the name(s) and address(es) of the author(s) and a one-page summary of the paper. The summary should enable the organizer(s) to evaluate the appropriateness of your paper for the selected session. Consequently, you should include as much detailed information as possible within the one-page limitation. Your summary **must reach the designated organizer by Monday, April 24, 1995**. The organizer will acknowledge receipt of all

paper summaries. If the organizer accepts your paper, you will receive a standardized abstract form and further instructions.

Other MAA Sessions

NCTM: A Vision of Algebra: Sunday, 1:15 p.m. to 2:35 p.m., organized by **Gail Burrill**, University of Wisconsin, Madison, and president-elect of the National Council for Teachers of Mathematics (NCTM). This is a discussion of the many issues inherent in a reconceptualization of algebra at the school level. It is clear that changes in algebra for life in the 21st century must be carefully coordinated and jointly addressed at the K-12 and higher education levels. The graphing calculator is beginning to have a profound effect on what aspects of algebra students must know, understand, and be able to do; at the college level, the emerging school changes are forcing college placement officers and mathematics faculty to rethink placement policy and course content, respectively.

The SSIs and Systemic Reform in Mathematics: Sunday, 2:50 p.m. to 4:10 p.m., moderated by **Stephanie Williamson**, Louisiana Systemic Initiatives Program. Four of the ten original SSIs (Connecticut, Louisiana, Montana, and Nebraska) have had mathematicians in key leadership roles. These SSIs will report on their experiences in effecting standards-based mathematics reform in their states, both at the K-12 and higher education levels.

Reform of the Preparation of Mathematics Teachers: Sunday, 4:25 p.m. to 5:45 p.m., moderated by **Genevieve M. Knight**, Coppin State College. A panel of representatives of the initial three NSF Collaboratives of Excellence in Teacher Preparation (Louisiana, Maryland, and Montana) will give reports on their roles in the reform of teacher preparation in mathematics. All have been active in reform initiatives and have much to share with others concerned with this issue.

Using Real Data in an Introductory Statistics Course: Sunday, 4:25 p.m. to 5:45 p.m., moderated by **Robert W. Hayden**, Plymouth State College, for the joint AMS-MAA-ASA Statistics Committee. Panelists include Richard J. Cleary, St. Michael's College, Richard L. Scheaffer, University of Florida, and J. Laurie Snell, Dartmouth College.

An Interdisciplinary View of Changes in Undergraduate SMET Education: Monday, 1:00 p.m. to 2:25 p.m, organized by **Susan L. Forman**, Mathematical Sciences Education Board (MSEB). In April the NRC and the NSF cosponsored a two-day convocation, From Analysis to Action: Undergraduate Education in Science, Mathematics, Engineering, and Technology (SMET). Workshops addressed issues concerning the changing climate of undergraduate SMET education for students, faculty development and preparation, and institutions. The panel will present a summary of the issues and recommendations that emerged from the workshops. Panel members include Hyman Bass, Columbia University and chair of MSEB, and Jay Labov, Colby College and staff director of the NRC Committee on Undergraduate Science Education.

Workshops on School Reform: Monday, 1:00 p.m. to 2:50 p.m., and Tuesday, 1:40 p.m. to 3:40 p.m., organized by **Richard D. Anderson**, Louisiana Systemic Initiative Program. The intent is to provide opportunities for broader dissemination and dialogue within the higher education community about school mathematics curriculum projects and reform issues at the K-4, 5-8, and 9-12 levels. The projects involve substantial rethinking of what and how mathematics should be learned and understood.

SUMMA Special Presentation on Intervention Projects for Minority Precollege Students: Monday, 2:35 p.m. to 4:00 p.m., organized by **William A. Hawkins**, MAA, director of SUMMA (Strengthening Underrepresented Minority Mathematics Achievement).

The Urban Systemic Initiative Program—Getting Mathematicians Involved: Monday, 3:00 p.m. to 4:20 p.m., moderated by **Madeleine Long**, National Science Foundation. This panel will discuss issues surrounding the Urban Systemic Initiatives recently funded by the NSF. There are opportunities for university-level mathematicians and school personnel to help design and implement effective professional development programs, as well as teacher preparation programs affecting inner-city systems. The need for collaborative efforts leading to a change of culture is evident.

Using EPIC in Calculus and Pre-calculus Classes: Monday, 4:30 p.m. to 6:00 p.m., organized by **James Burgmeier** and **Larry L. Kost**, University of Vermont. Panelists will discuss the pedagogical aspects of using EPIC (Exploration Programs In Calculus), a computer package designed to assist students and teachers with the concepts and problems of calculus. It is menu-driven, supports textbook-style function input, and does both numerical and symbolic calculations.

Assessment in the Age of the Graphing Calculator: Monday, 4:30 p.m. to 6:00 p.m., moderated by **Mary M. Lindquist**, Columbus College. Panelists will address assessment issues in the interface of grades 9-12 and 13-14 mathematics. In some locales high school mathematics is adapting more quickly to the existence of the graphing calculator than is college-level mathematics. Thus, important issues of placement, of assessment, and of course content are emerging. Both the ACT and the SAT are being invited to send representatives to participate in the panel discussion.

Are We There Yet? The Off-Off-Broadway Version: Monday from 8:30 p.m. to 10:00 p.m. The Committee on Participation of Women (Carole B. Lacampagne, chair) is presenting a dramatized program on evolving gender issues in the mathematics community. This is a preview of a presentation at the winter meetings in Orlando. Emphasis is placed on incidents where faculty have learned how to encourage young women or resolve difficulties with colleagues. Discussions will be used to revise the script for the presentation in Orlando. Additional contributions are desired. Please be assured that the identity of all contributors will be treated with the utmost confidentiality. Brief descriptions of incidents thought suitable for dramatization may be sent to the scriptwriter, David E. Boliver, Department of Mathematics & Statistics, University of Central Oklahoma, 100 North University Drive, Edmond, OK 73034-5209; e-mail: dboliver@aix1.ucok.edu.

A Reform College Algebra Curriculum Integrating Technology: Tuesday, 3:15 p.m. to 4:40 p.m. **Ongard Sirisaengtaksin, Linda Becerra,** and **William Waller**, University of Houston-Downtown, will present this session to intro-

duce a reform college algebra curriculum that integrates technology as a fundamental medium. The major emphasis is on conceptual understanding based on real-world applications rather than rote drill and artificial examples. The materials are in the form of a series of laboratory modules. Each module consists of closed laboratory worksheets, open laboratory assignments, postlaboratory quizzes, and expository materials. The modules create a collaborative environment that motivates students to explore and experiment with mathematical concepts. *Mathematica* high-level functions have been developed as a tool to nurture this learning environment for students with very little knowledge of computers.

NCTM's Core Curriculum: Making Mathematics Count for Everyone—the Big Ideas: Tuesday, 4:00 p.m. to 5:30 p.m., moderated by **James R. C. Leitzel**, University of Nebraska, Lincoln. This panel will discuss various initiatives designed to change the nature of 9-12 mathematics, in particular programs that concentrate on "Mathematics for All" at that level. The implications for changes in introductory courses at the college level are important at both the developmental and nondevelopmental levels.

MAA Student Activities

David M. Bressoud, Macalester College, *Cauchy, Dirichlet, and the birth of real analysis*, Tuesday, 1:40 p.m. (Student Lecturer).

Student Workshop on the Internet: Tuesday, 2:45 p.m. to 4:45 p.m., organized by **Dennis DeTurck**, University of Pennsylvania. All students planning to attend should check the appropriate box on the Advance Registration/Housing Form.

Student Paper Sessions: Sunday and Monday afternoons. Interested students are invited to send papers to Ronald F. Barnes, Department of Mathematics, University of Houston-Downtown, One Main St., Houston, TX 77002-1094 (barnes@dt.uh.edu) by June 26.

MAA-PME Student Reception: Sunday, 5:15 p.m. to 6:15 p.m.

MAA Committee on Student Chapters Hospitality Center: Open Sunday, Monday, and Tuesday, 9:00 a.m. to 5:00 p.m.

Breakfast for MAA Student Chapter Faculty Advisors, Section Coordinators, and PME Advisors: Monday morning. Contact Aparna W. Higgins, University of Dayton, chair of the MAA Committee on Student Chapters (higgins@udavxb.oca.udayton.edu).

Other MAA Activities

Board of Governors: Saturday, August 5, 9:00 a.m. to 5:00 p.m. Open to all MAA members.

Section Officers: Sunday, 4:00 p.m. to 6:00 p.m.

Business Meeting: Tuesday, 12:25 p.m. Open to all MAA members.

MAA Banquet for 25-year Members: Tuesday, 6:30 p.m. to 9:00 p.m. Featured speaker is **Colin C. Adams**, Williams College, *Mel Slugbate's bus tours of the universe and beyond.* See the Social Events section for ticket details.

AMS Invited Addresses

John H. Ewing, Indiana University at Bloomington, *A century ago; a century from now* (History of Mathematics Lecture), Monday, 10:40 a.m.

Nicolai Krylov, University of Minnesota, Minneapolis, *Fully nonlinear elliptic second order equations: Recent development* (Progress in Mathematics Lecture), Sunday, 10:40 a.m.

Robert D. MacPherson, *Institute for Advanced Study, Compactifications of spaces of lattices* (Progress in Mathematics Lecture), Tuesday, 10:40 a.m.

AMS Special Sessions

Topological graph theory, **Dan Archdeacon**, University of Vermont; Sunday, Monday, and Tuesday afternoons.

Algorithms for graphs and matroids, **Olivia M. Carducci** and **Gary P. Gordon**, Lafayette College; Sunday and Monday afternoons.

Classical harmonic analysis, **Roger Lee Cooke** and **Mike Wilson**, University of Vermont; Sunday, Monday, and Tuesday afternoons.

Analysis on Lie groups and homogeneous spaces, **Hongming Ding**, Saint Louis University; Sunday and Monday afternoons.

Number theory related to Stark's Conjecture, **David R. Dorman**, Middlebury College, and **David S. Dummit** and **Jonathan W. Sands**, University of Vermont; Sunday, Monday, and Tuesday afternoons.

Potential theory, **Kohur N. Gowri Sankaran**, McGill University; Monday and Tuesday afternoons.

Ramsey theory, **Bruce M. Landman**, University of North Carolina, Greensboro; Sunday, Monday, and Tuesday afternoons.

Soap bubble geometry, **Frank Morgan**, Williams College; Sunday, Monday, and Tuesday afternoons.

There also will be sessions of ten-minute contributed papers. See the January issue for details on how to submit abstracts for all AMS sessions. Note that the deadlines listed above for receipt of abstracts are firm and late papers cannot be accommodated.

Other AMS Sessions

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

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

Other AMS Activities

Council Meeting: Saturday, August 5, 1:00 p.m. to 6:00 p.m.

Business Meeting: Sunday, 12:25 p.m.

Activities of Other Organizations

Association for Women in Mathematics (AWM)

Panel Discussion: Sunday, 3:00 p.m. to 4:30 p.m.

Membership Meeting: Sunday, 4:30 p.m. to 5:00 p.m.

Open Reception: Sunday, 9:30 p.m. to 11:00 p.m.

National Association of Mathematicians (NAM)

Monday, 1:00 p.m. (David Blackwell Lecture).

Pi Mu Epsilon (PME)

A detailed program of PME activities will be available at the Registration Desk.

Marjorie Senechal, Smith College, *Tilings as diffraction gratings*, Monday, 8:30 p.m. (J. Sutherland Frame Lecture).

Sessions for Contributed Papers: Sunday and Monday afternoons.

Council Meeting: Sunday, 1:00 p.m. to 2:30 p.m.

Reception: Sunday, 4:45 p.m., cosponsored by PME and MAA.

Banquet: See the Social Events section.

Other Events of Interest

Book Sales and Exhibits

Open Sunday, Monday, and Tuesday, 9:00 a.m. to 5:00 p.m. 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. Other commercial publishers may be represented at the meeting.

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.

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. If you must cancel your attendance at a ticketed event, you are eligible for a 50% refund provided you return tickets to the Mathematics Meetings Service Bureau (MMSB) by July 31. After that date no refunds can be made. Special meals are available upon request at all banquets, including vegetarian, but this must be indicated on the Advance Registration and Housing (ARH) form. All prices include tax and gratuity where applicable.

N.B. Persons staying in university residence halls should be aware that room and board is offered as a package only, and meals cannot be purchased individually.

Opening Banquet: The special feature of this banquet held in the Ballroom of the Burlington Sheraton Hotel will be the awarding of AMS, AWM, 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. AWM will award the Alice T. Schafer Prize. For MAA, the recipients of the Merten M. Hasse Prize, and various 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 the recipients on Saturday, August 5, at 7:30 p.m. The banquet will be preceded by a cash bar reception at 6:30 p.m. The entrée is roast prime rib of beef au jus. Tickets are $25 per person, including gratuity and taxes.

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.

Dinner and Cruise: Travelers! Wayfarers! Refined Persons! (Professional Gamblers unwanted!): Join your colleagues on Sunday evening for a three-hour cruise aboard the *Spirit of Ethan Allen* on beautiful Lake Champlain and reminisce about the days when steamboats churned these waters to bring entertainment and commerce to Burlington. A delicious buffet including chicken cordon bleu with supreme sauce, baked scrod with lemon herb crumbs, carved roast beef, and several vegetable side dishes (plus strawberry shortcake for dessert!) will be served on board. Also, for your cruising and dining pleasure, entertainment will be provided by The Al Alessi Trio. Buses depart for the dock from the Living and Learning Center promptly at 5:30 p.m. Tickets are $32 per person, $26 for children 6-11 (no charge for children 5 and under eating from parent's plate). Return is at 9:00 p.m. to the Living/Learning Center.

AWM Reception: All participants are invited for camaraderie and refreshments, Monday, 9:30 p.m.

PME Banquet: This popular annual event will take place on Monday, August 7, at 6:45 p.m. Tickets are $10 for PME members and their families; $17 for nonmembers.

MAA 25-Year Member Banquet: The MAA is planning its eighteenth annual banquet on Tuesday 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 at 6:30 p.m. The entrée is chicken tarragon. Tickets are $25.

Tours

Because of its many attractions and marvelous climate, Vermont 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 Tour form, include applicable payments, and **send the form directly to Accent Travel/ CTN by July 5.** 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 price of the ticket listed below unless specified. **Pick up and drop off will be at the Living/Learning Center.**

Shelburne Museum: This tour takes us to one of the great treasure houses of American arts, architecture, and artifacts. The museum offers 37 period homes and historic structures on 45 acres near Lake Champlain and houses a collection of over 200,000 pieces of Americana. The Museum Visitor's Center houses orientation exhibits; the Round Barn features audiovisual presentations on the museum's history and reconstruction of the barn. Complimentary jitney service takes you around the grounds. 1:00 p.m.-5:00 p.m., Saturday, August 5, $28/adult, $23/child.

Vermont Teddy Bear Factory/ Shelburne Farms: This tour begins with a stop at the Vermont Teddy Bear Commons. You will visit the factory to see how these cuddly little friends are created. You may shop at the factory as well as among other factory outlet stores in the common. Then, we're off to Vermont's most well-known agricultural landscape and former estate. See an award-winning audiovisual presentation about the evolution of the Farms from an agricultural estate to a nonprofit conservation education organi-

zation. Enjoy the Farm Store, Walking Trail, Visitor Center, and the spectacular views from Lone Tree Hill. 1:00 p.m.-5:00 p.m., Monday, August 7, $24/person.

Stowe Area: On our way into the Green Mountains, we will stop at the Cold Hollow Cider Mill to see how apple cider is squeezed the old-fashioned way and sample the finished product. Then on to the lovely village of Stowe and its many unique gift and specialty shops. After lunch at The Shed, we'll drive to the base of Mt. Mansfield. You don't have to wear hiking boots!—our climb to the top of Vermont's highest peak is by way of an eight-passenger enclosed gondola. After our descent from the summit, we'll stop at famous Ben & Jerry's Ice Cream Factory. Here we'll find out the story behind the successful makers of this delicious ice cream and get a free sample in the bargain! 9:00 a.m.-5:00 p.m., Tuesday, August 8, $44/person, lunch included.

Champlain Scenic Ferry/Ausable Chasm: Carved by nature over millions of years, Ausable Chasm is a geologic wonder. We will cross scenic Lake Champlain on the pleasant LCT Ferry, and then it's a short ride to the chasm. Once there, you make your way down a walking trail into the heart of this deep gorge which has been cut by the rushing Ausable River. The adventurous may choose to take a boat ride through the rapids (included); a shuttle takes you back to the gift shop and restaurant. Casual clothing and sturdy footwear are strongly recommended. 9:15 a.m.- 3:30 p.m., Wednesday, August 9, $56/person.

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. There are two separate advance registration deadlines, each with its own advantages and benefits.

ORDINARY advance registration June 15

FINAL advance registration July 14

Ordinary Advance Registration: Those who register by the ordinary deadline of June 15 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 ARH form).

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. Please note that a **$3 replacement fee** will be charged for programs and badges that are mailed but are not brought by participants to Burlington.

Final Advance Registration: Those who register by the final deadline of July 14 must pick up their badge and program at the MathFest. 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 or group 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.

Registration Fees

	by July 14	on site
Member of AMS, Canadian Mathematical Society, MAA, PME	$125	163
Emeritus Member of AMS or MAA, Graduate Student, Unemployed, High School Teacher, Librarian, Third-World Country Participant	$35	45
Undergraduate Student	20	26
Temporarily Employed	95	120
Nonmember	194	252
High School Student	2	5
One-day Member	n/a	89
One-day Nonmember	n/a	139
MAA Minicourses by June 30		
Minicourses #1, 3, 4, 5	$45	
Minicourse #2	65	

- **Students:** Those currently working toward a degree or diploma, regardless of income. Students are asked to determine whether their status can be described as graduate (working toward a degree beyond the bachelor's), undergraduate (working toward a bachelor's degree), or high school (working toward a high school diploma).
- **Unemployed:** 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.
- **Emeritus:** Persons who qualify for emeritus membership in either the Society or the Association. The emeritus status refers to any person who has been a member of the AMS or MAA 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.
- **High school teacher:** Any person whose primary employment is teaching in any high school or secondary school.
- **Librarian:** Any librarian who is not a professional mathematician.
- **Third-world country participant:** Those participants from the third world where salary levels are radically noncommensurate with those in the U.S.
- **Temporarily employed:** Any mathematician currently employed but who will become unemployed by June 1, 1995, and who is actively seeking employment or any mathematician in a postdoctoral position.
- **Nonmembers** who register at the nonmember fee will receive mailings containing special membership offers from AMS and MAA.

Registration fees only partially cover the expenses of holding meetings. 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 AMS and MAA Book Sales. 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 will be returned, therefore delaying the processing of any 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.

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.

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 AMS and MAA abstract forms.) The master copy of this list will be posted on the meetings bulletin board near the registration area.

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.

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 (Donovan Van Osdol, Department of Mathematics, University of New Hampshire, Durham, NH 03824-3591; dv@christa.unh.edu). These requests should be received by **June 1.**

All other speakers requiring additional equipment should contact the logistics coordinator for the meetings at the AMS office in Providence at 401-455-4139, or electronic mail to jtb@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: Budget Rent A Car has been designated as the official car rental company for the Burlington MathFest. To reserve a car at special rates, call 800-772-3773 and request group **ID# VNR2MATHF**. These rates are applicable one week prior to and one week after the MathFest and include unlimited mileage. Availability of these rates is limited. Valid driver's license and credit card are required. Minimum age for drivers is 25. Taxes, optional coverages, fuel, drop charges, additional driver fees, and other optional items are additional. Weekly rates require a five day minimum.

Car Class	Daily	Weekly	Weekend (per day)
Economy	$36	$189	$39
Compact	36	189	39
Intermediate	41	199	44
Full size	47	239	49
Luxury	54	279	58

E-mail: Internet access via telnet or tn3270 will be available at the Computer Lab, 113 Waterman (basement level). 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, since 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 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. Participants interested in securing a room for a short, informal interview should check with the logistics coordinator at the Registration Desk for availability.

Information Distribution: A table is set up in the exhibits area for dissemination of information of possible interest to participants but not promoting a product or program for sale. Those who wish to display information 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.

The administration of these tables is in the hands of the exhibits coordinator under guidance from the Joint Meetings Committee. To request a contract or more information, please contact Exhibits Coordinator, MMSB, P.O. Box 6887, Providence, RI 02940; 401-455-4143; meet@math.ams.org.

Mail/Messages: All mail and telegrams should be addressed with participant's name, UVM Conference Office, Attn: MathFest, 30 South Park Drive, Colchester, VT 05446. 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.

Note: There will be no provision for leaving telephone messages at the MathFest Registration Desk; participants should supply the telephone number of their hotel or dormitory to persons interested in contacting them.

Parent-Child Lounge: Open Sunday through Tuesday, 9:00 a.m. to 5:00 p.m. in

the Living/Learning Center, furnished with casual furniture, a crib, a changing area, and VCR and monitor. 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. See the Tours section for other activities suitable for children.

Parking: Participants staying in hotels or residence halls should refer to the housing page for parking instructions. There are limited public parking areas on campus; MathFest participants may find the most convenient to the meetings is the metered lot next to the Agriculture/Engineering Building. Cost is approximately $2.25/day with no in/out privileges.

Registration Desk for the MathFest: Billings Hall: noon to 4:00 p.m. on Saturday, and 8:00 a.m. to 4:00 p.m. on Sunday and Monday, and 8:00 a.m. to noon on Tuesday. Those who did not want their badges, programs, and tickets mailed should pick them up here.

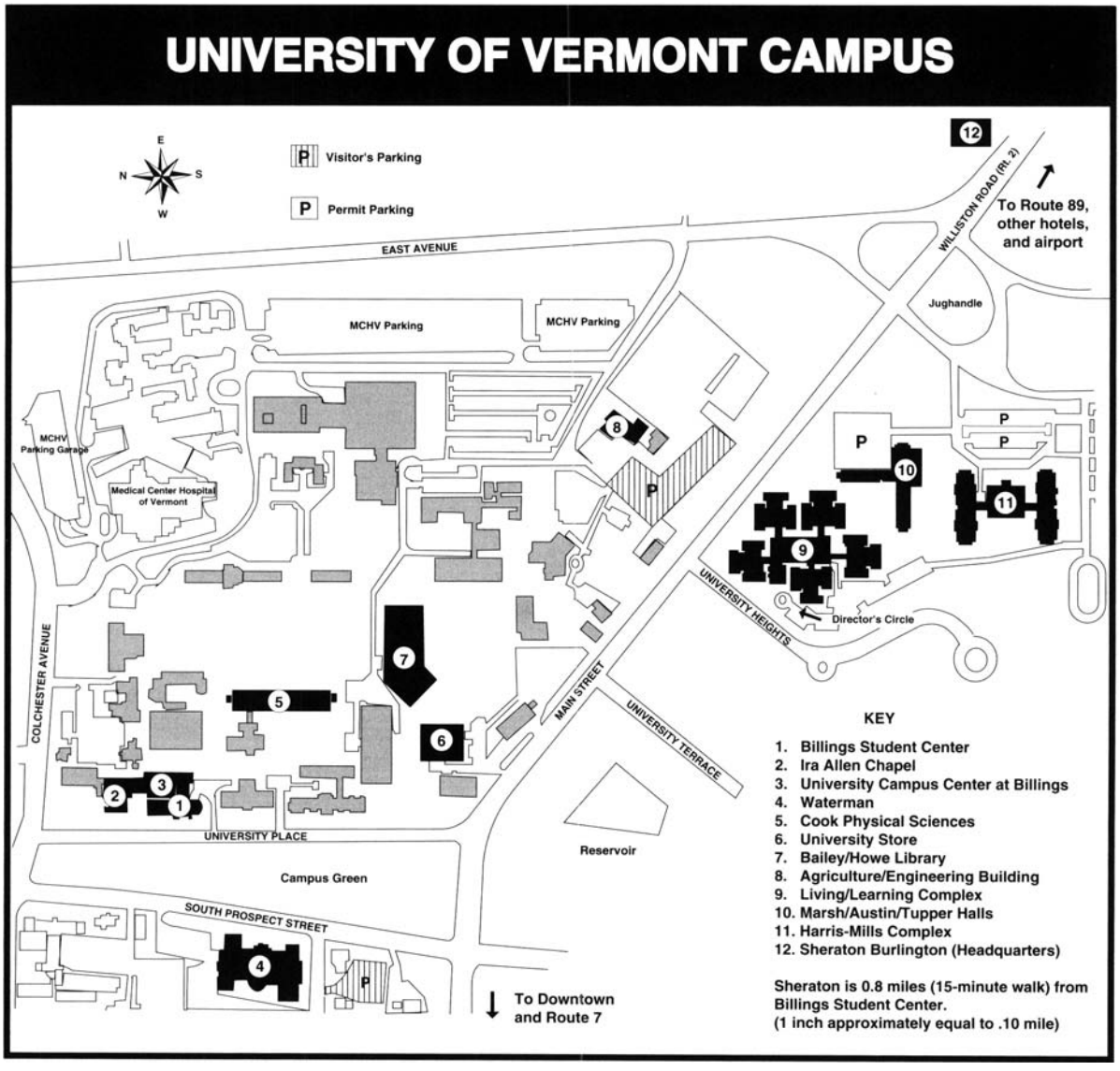
Travel: USAir has been selected as the official airline for the meeting for its generally convenient schedule to Burlington. Given the volatility in airfares because of "fare wars", we cannot guarantee that these are the lowest fares. However, we strongly urge participants to make use of this special deal 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 MathFests, thereby keeping the costs of the meeting (and registration fees) down.

The following specially negotiated rates are available only for the period August 3-10: 5% discount off first class and any published USAir promotional round-trip fare, or 10% discount off unrestricted coach fares with seven-day advance reservations and ticketing required. These discounts are valid providing all rules and restrictions are met and are applicable for travel from the continental U.S., Bahamas, Canada, and San Juan, P.R. Discounts are not combinable with other discounts or promotions. Additional restrictions may apply on international travel. For reservations call (or have your travel agent call) 800-334-8644 between 8:00 a.m. and 9:00 p.m. Eastern Daylight Time. Refer to **Gold File Number 41380077.**

Travel from the airport: A taxi from the Burlington Airport to the campus costs approximately $6-$8.

Automobile approaches to campus: Burlington is easily accessible via Exit 14W off Interstate 89. Driving times are 5.5 hours from New York City, 3.5 hours from Boston, and 1.5 hours from Montreal. The Sheraton Hotel & Conference Center is located at the exit going west. To reach the Living/Learning Center, continue west in the right-hand lane, which takes you to Colchester Avenue; take an immediate left, then position yourself in the right-hand lane. Cross Williston Road to Spear Street. Follow the MathFest signs to the Living/Learning Center.

Weather: Temperatures range from 65° to 85°, cooler at night. Humidity is typically not a problem.



Burlington Mathfest

Advance Registration

Personal Information

Name _____

Mailing Address _____

_____

Telephone _____ e-mail _____

Badge Information

Affiliation _____

(Please limit affiliation to 35 characters – one line only)

Name to appear on badge _____

Guest Badge _____

Membership ✓ all that apply

AMS	☐
CMS	☐
MAA	☐
PME	☐
AWM	☐

If you do not wish your program and badge to be mailed to you on July 12, place a check in the box. ☐

Registration Fees

Mathfest	**by July 14**	**at meeting**
☐ Member AMS, CMS, MAA, PME	$125	$163
☐ Nonmember	$194	$252
☐ Graduate Student	$35	$45
☐ Undergraduate	$20	$26
☐ High School Student	$2	$5
☐ Unemployed	$35	$45
☐ Temporarily Employed	$95	$120
☐ Third World Fee	$35	$45
☐ Emeritus Member of AMS or MAA	$35	$45
☐ High School Teacher	$35	$45
☐ Librarian	$35	$45
☐ One-day Member	—	$89
☐ One-day Nonmember	—	$139

Event Tickets

Event	**# Tix**	**Price Per**	**Total**
Opening Banquet			
Regular	_____	$25	_____
Vegetarian	_____	$25	_____
Dinner and Cruise			
Adult	_____	$33	_____
Children 6–11 yrs	_____	$11	_____
PME Banquet			
Members and Families	_____	$10	_____
Nonmembers	_____	$17	_____
MAA 25-year Banquet			
Regular	_____	$25	_____
Vegetarian	_____	$25	_____

TOTAL for Event Tickets **$_____**

See separate tour form in this issue.

Deadlines

Advance Registration/Residence Hall Reser.	June 15, 1995
Hotel changes/cancellation thru MMSB	July 5, 1995
Final Advance Registration (no housing)	July 14, 1995
90% Refund on Residence Hall Package	July 25, 1995*
50% Refund on Events	July 31, 1995*
50% Refund on Registration Cancellation	August 4, 1995*

*no refunds after this date

Total Payment

Category	**Total**
Registration Fee(s)	_____
Event Tickets	_____
Dorm Payment or Hotel Deposit	_____
TOTAL Amount Due	**$** _____

Make checks payable to the AMS. Canadian checks must be marked "U.S. Funds". You may charge this total to your VISA or MasterCard.

Card Number: _____

Card Type: _____ Expiration Date: _____

Signature: _____

Name on Card: _____

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

For Office Use Only

Codes: _____

Options: _____

Hotel: _____

Dates: _____

Dorm: _____

Room Type: _____

Hotel Deposit: _____

Dorm Payment: _____

TOTAL Amt. Paid: _____

Room/Board Paid: $ _____

Room/Board Due: $ _____

Remarks: _____

_____

Burlington Mathfest

Accommodations

General Information

Where applicable, please check off one of the following

☐ I will be making my own reservations. Name of hotel or motel: _____

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

☐ I plan to share a room with _____, who is making our reservations.

University Reservations

Full prepayment for room and board is required. *Purchase of a room and board package (breakfast and lunch) is required, and it is included in the rates listed below.* All rates are per person. Mathfest participants may occupy the residence halls from Saturday, August 5 to Wednesday, August 9 only. Acknowledgment of your residence hall reservations will be sent to the address indicated on the reverse side of this application. Please mark applicable rates listed below and enter the totals where applicable. There is no children's rate, but sleeping bags are allowed.

Special Requests:

_____

_____

_____

_____

_____

_____

Description	**# Staying**	**At**	**# of Days**	**Total**
Single	_____	$36 x	_____	_____
Double	_____	$32 x	_____	_____
TOTAL				**$**_____

Rates are per person.

Please ✓ all that apply

Male ☐

Female ☐

Smoker ☐

Nonsmoker ☐

Date and Time of Arrival: _____

Date and Time of Departure: _____

Names of Other Occupants **Arrival Date** **Departure Date**

_____ Child? (give age) _____

_____ Child? (give age) _____

_____ Child? (give age) _____

Majority of rooms will be assigned in the Living/Learning Complex; Marsh/Austin/Tupper will be used for overflow.

Hotel Reservations

Please indicate type of room:

☐ Single $89

☐ Double $89

☐ Triple $89

☐ Quad $89

Special Requests:

_____

_____

_____

To guarantee a room, please include $89 by check or provide a credit card number.

☐ Deposit enclosed ☐ Hold with my credit card Card Number_____ Exp. Date_____

Date and Time of Arrival: _____

Date and Time of Departure: _____

Names of Other Occupants **Arrival Date** **Departure Date**

_____ Child? (give age) _____

_____ Child? (give age) _____

_____ Child? (give age) _____

All hotel reservations are for the Sheraton Burlington at 870 Williston Road, Burlington, VT.

How to get a room

General Information

Participants are required to register for the Mathfest in order to obtain residence hall and hotel accommodations through the Mathematics Meetings Service Bureau (MMSB). Reservations for the Sheraton Burlington and residence halls can be obtained through the MMSB only. All reservation requests must be received in writing by the MMSB prior to June 15, 1995. Be sure to complete the housing section of the Advance Registration/Housing (ARH) Form (located at the end of this issue) to insure accurate housing arrangements.

University Housing

All rooms on campus are offered through a room/board package (breakfast and lunch) only; cost is included in the rates below. A very limited number of rooms (room only; no meals) will be available for walk-ons.

Residence Halls: **Living/Learning Complex (L/LC)** (used for majority of rooms)
Marsh/Austin/Tupper (MAT) (used for overflow)

Rates: **Single: $36**
(per person) **Double: $32**
Note: There is no children rate. Sleeping bags are allowed.

Each hall has two lounges w/small kitchenette (refrigerator, stove, sink), no utensils included; no smoking is allowed in public areas. Smoking is allowed only inside sleeping rooms. The residence halls are not air-conditioned.

Residence Hall Rooms: in L/LC - suites that contain two doubles, two singles, a common area, two bathrooms.
in MAT - typical dormitory style; bathrooms at end of halls.

Meals: There are no refunds for missed meals. A limited number of meals are available on a cash basis ($6 breakfast, $8 lunch). Vegetarian meals are available; Kosher are not.

Meal Cards: Meal cards will be included with your registration materials. If your registration materials are not mailed, they will be available at dormitory check-in. **Lost meal cards are nonrefundable and cannot be replaced.** Participants who lose their meal cards are encouraged to buy their remaining meals on a cash basis.

Dining Halls/Hours: Breakfast: **The Weathervane**, L/LC; 7:00- 8:30 a.m
Lunch: **Cook Commons**, behind Billings Student Center; 11:30 a.m.- 1:30 p.m.

Check-in Desk: Located in the Fireplace Lounge in the L/LC or at Billings Student Center. Staggered check-in hours and exact location will be determined at a later date based on dates of major arrivals; for arrivals off-hours, check instructions in front of L/LC for assistance: the maximum wait for response is 15 minutes.

Received at Check-in: Key and instructions for keypad use (on the front door of assigned residence hall). Bed linen, three towels, one washcloth, soap, and a glass will be placed on the bed; towels and washcloth to be exchanged daily in a central location.

Parking: Temporary parking for dormitory check-in at Director's Circle in front of L/LC. Permits sold @ $2.25/day or $12.50/week during major check-in periods at the Check-in Desk and at the Local Information Desk in the registration area.

General: Gym passes sold during major check-in periods at the Check-in Desk and at the Local Information Desk for $6/week. A limited supply of fans are available for rental at a cost of $5/day at dormitory check-in.

Hotel Housing

Participants are required to guarantee their reservations with either a first-night deposit by check or a major credit card. Changes and/or cancellations for the Sheraton will be accepted by the MMSB through July 5, 1995. **The Sheraton Burlington will not take reservations directly before July 18, 1995.** Reservations at the other hotels listed must be reserved through the hotels directly prior to July 3, 1995. Mention of attending the Mathfest or MFC will insure the convention rates listed. The MMSB cannot guarantee the availability of the special convention rates listed below after July 3 at those other hotels. Rates listed are subject to a 7% Vermont state tax. Nonsmoking rooms and rooms accessible to the physically challenged are available at all properties. Please call the MMSB for further information, if necessary.

Sheraton Burlington (Headquarters)

870 Williston Road
Burlington, VT 05403
(802) 865-6600
0.8 miles from the University of Vermont

Single, double, triple, quad - $89
Children under 18 yrs. free in room with parents
Free parking
Free airport shuttle
Lounge, two restaurants
All rooms have two phones and data port
Fitness center, indoor pool
Windows which open
In-room coffee makers

Holiday Inn

1068 Williston Road
South Burlington, VT 05403
(800) 799-6363
(802) 863-6363
1.2 miles from the University of Vermont

Single - $79, double (2 beds) - $79, double (king) - $89
$10 per additional person
Children under 18 yrs. free in room with parents
Free parking
Free airport shuttle
Lounge, restaurant
Exercise room, indoor/outdoor pool
Windows which open
Laundry facilities

Howard Johnson

One Dorset Street
South Burlington, VT 05403
(802) 863-5541
1.2 miles from the University of Vermont

Single/double - $65
$6 per additional person
Children under 19 yrs. free in room with parents
No elevators (2 stories)
Free parking
Lounge, restaurant
Refrigerators in some rooms
Children's playground, recreation area
Exercise room; indoor/outdoor pool
Windows which open
Laundry facilities

Econolodge

1076 Williston Road
South Burlington, VT 05403
(800) 55-ECONO; (802) 863-1125
1.4 miles from the University of Vermont

Single - $59, double - $65
$5 per additional person
Children under 19 yrs. free in room with parents
Free parking
Free airport shuttle
Free continental breakfast
Lounge, restaurant (lunch & dinner)
Health spa, outdoor pool
52-acre nature trail
Windows which open

Please complete a separate form for each individual attending. *Burlington Mathfest*

Tour Registration

Personal Participant Information

Name _____

Mailing Address _____

_____

Telephone _____ Fax _____

Registration for Tours

Please check the box for all tours you wish to attend

- ☐ Stowe Area Tour
- ☐ Shelburne Museum
- ☐ VT Teddy Bear/Shelburne Farms
- ☐ Ausable Chasm

Deadline

Tour registration forms must be received by

July 5, 1995

Fees for Tours

Tour		
Stowe Area Tour	$44.00 per person	
Shelburne Museum	$28.00 per person	$23.00 per child
VT Teddy Bear/Shelburne Farms	$24.00 per person	
Ausable Chasm	$56.00 per person	

Payment Method

Check Only

Name _____

Mailing Address _____

_____

Telephone _____ Fax _____

Authorization Signature _____

Terms

Cancellation Penalty
Prior to July 19, 1995, refunds will be made subject to a $25.00 non-refundable penalty fee.
After July 19, 1995, all payments are nonrefundable.

Return only this form and payment to:
Accent Travel/CTN
P. O. Box 753
Williston, VT 05495

For further information
on tours contact
Accent Travel/CTN:

Telephone

802-879-6903 x3

Fax

802-878-9129

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Burlington Mathfest

MAA Minicourses

Advance Registration Form

Burlington, Vermont, August 6–8, 1995

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

Minicourse Coordinator
Mathematical Association of America
1529 Eighteenth Street, N.W.
Washington, DC 20036
Telephone: 202-387-5200, 800-331-1622

After the deadline, potential participants are encouraged to call the MAA headquarters at 800-331-1622 to check on availability. The MAA reserves the right to cancel any Minicourse which is undersubscribed. Should this occur, those registered in advance will be notified and will receive a full refund. MAA Minicourses are open only to persons who register for the Mathfest and pay the regular registration fee.

Each participant must fill out a separate Minicourse Advance Registration Form. Enrollment is limited to two Minicourses.

Name: _____

Mailing Address: _____

_____

Telephone: _____

e-mail: _____

Registration

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 # _____

❒ I plan on registering for the Burlington Mathfest ONLY in order to attend the MAA Minicourse(s). Should the course(s) of my choice be fully subscribed, a full refund of the Mathfest advance registration fee will be made.

Payment

Make checks payable to MAA. Canadian checks must be marked "US Funds". You may also charge this total to your VISA or MasterCard.

Check enclosed: $_____ ❒ MasterCard ❒ VISA

Card number _____ Exp. date _____

Signature on card _____

Deadlines

MAA Minicourse Advance Registration:	June 30, 1995
Cancellation in order to receive a 50% refund:	August 4, 1995

Minicourse	Fee
1 Interdisciplinary Lively Applications	$45
2. Instructional Aspects of Mathematics on the Internet	$65
3. Calculus: An Active Approach with Projects	$45
4. An Activity-Based Approach to Teaching Introductory Statistics	$45
5. The Use of Software in an Introductory Linear Algebra Course	$45

Minicourse #1: ***Interdisciplinary Lively Applications***, Frank Giordano and David Arney, United States Military Academy. Part A: Sunday, 1:45 PM-3:45 PM; Part B: Tuesday, 1:45 PM-3:45 PM. Enrollment limit: 40; registration fee: $45.

Interdisciplinary applications can be used to weld mathematics with the concepts of other disciplines to provide student growth in modeling and problem solving. We will discuss projects that can be used in a wide range of mathematics courses, with the applications related to subjects in chemistry, biology, physics, engineering, economics, technology, and social sciences. Projects are designed to take 4 to 6 hours of student effort and can be done in groups or individually, and some require a computer or calculator. Participants will work with materials prepared for students and instructors in printed, video, and multimedia formats.

Minicourse #2: ***Instructional Aspects of Mathematics on the Internet***, Brian E. Smith, Dawson College (Montreal), and Sandra Villas, Dona Ana Community College. Part A: Monday, 4:00 PM-6:00 PM; Part B: Tuesday, 1:45 PM-3:45 PM. Enrollment limit: 40; registration fee: $65.

The orientation of this minicourse is on locating mathematics resources on the Internet and using them in the mathematics classroom or laboratory. One part of the course will focus on identifying different types of mathematical resources and the Internet search tools which are required to locate them. We will describe how to find FTP sites for archived files, using ARCHIE servers; Gopher servers, and the VERONICA searches that find them, will also be discussed. The second part of the course will deal with applications of the Internet in the teaching of undergraduate mathematics, and specific examples will be presented. The course will involve a combination of demonstrations and hands-on experience; handouts will be provided.

Minicourse #3: ***Calculus: An Active Approach with Projects***, Stephen R. Hilbert, John C. Maceli, Diane D. Schwartz, Stanley E. Seltzer, and Eric E. Robinson, Ithaca College. Part A: Sunday, 4:00 PM-6:00 PM; Part B: Tuesday, 1:45 PM-3:45 PM. Enrollment limit: 40; registration fee: $45.

This minicourse will address issues relating to the use of group projects and in-class activities in calculus, including an overview, examples of projects and activities, and the impact on the curriculum. The organizers, who have been teaching calculus using group projects since spring 1989, have found that open-ended projects challenge students to develop problem-solving skills beyond looking for a similar problem solved in the text or class notes. They use in-class activities to help the students to become active learners and to develop the skills to successfully complete the projects.

Minicourse #4: ***An Activity-Based Approach to Teaching Introductory Statistics***, Richard Scheaffer, University of Florida, and Ann Watkins, California State University, Northridge. Part A: Sunday, 1:45 PM-3:45 PM; Part B: Monday, 1:00 PM-3:00 PM. Enrollment limit: 40; registration fee: $45.

This minicourse is for teachers of introductory statistics who want to change their course from a traditional lecture-and-listen model to activity-based lessons. Participants will be engaged in a series of field-tested, hands-on activities that illustrate many of the key concepts taught in an introductory statistics course. They will play the role of students, actually working through a selection of activities. Experienced instructors will explain how they have made use of the activities in various settings. Each participant will be supplied with copies of the student pages and the instructor notes, which include suggestions for assessment of the activities. The Activity-Based Statistics (ABS) project is funded by the NSF.

Minicourse #5: ***The Use of Software in an Introductory Linear Algebra Course***, Homer Bechtell, University of New Hampshire. Part A: Sunday, 4:00 PM-6:00 PM; Part B: Monday, 1:00 PM-3:00 PM. Enrollment limit: 80; registration fee: $45.

The focus of this minicourse is on developing goals and strategies for the successful implementation of computer-aided instruction into an undergraduate introductory linear algebra course. Emphasis is on introducing software in order to increase mathematical maturity and the depth of understanding for the concepts without compromising the theoretical development. Problem sets will be distributed, and the construction of problem sets will receive special attention. Familiarity with software for linear algebra is a prerequisite. During the course, participants will not have access to computer software but will develop outlines for problem sets based on their experience with linear algebra software.

The Lighter Side of Mathematics

Proceedings of the Eugène Strens Memorial Conference on Recreational Mathematics and its History

Richard K. Guy and Robert E. Woodrow, Editors

In August of 1986 a special conference on recreational mathematics was held at the University of Calgary to celebrate the founding of the Strens Collection. Leading practitioners of recreational mathematics from around the world gathered in Calgary to share with each other the joy and spirit of play that is to be found in recreational mathematics. Martin Gardner says of recreational mathematics: "I don't know of any better way to hook the interests of students."

The papers in this volume represent a treasure trove of recreational mathematics by a star-studded cast: Leon Bankoff, Elwyn Berlekamp, H.S.M. Coxeter, Ken Falconer, Branko Grünbaum, Richard Guy, Doris Schattschneider, David Singmaster, Athelstan Spilhaus, Stan Wagon, and many others.

You will not soon find another collection of wonderful articles on recreational mathematics by a more distinguished group of authors. If you are interested in tessellations, Escher, tiling, Rubik's cube, pentominoes, games, puzzles, the arbelos, Henry Dudeney, or change ringing, then this book is a must for you.

If you believe that recreational mathematics must be the mathematics that is fun, then look no further, for **The Lighter Side of Mathematics** is full of fun.

376 pp., Paperbound, 1994
ISBN 0-88385-516-X
List: $38.50 MAA Member: $29.00
Catalog Code: LSMA/FOC

Exploring Mathematics With Your Computer

Arthur Engel

Today's personal computer gives its owner tremendous power which can be used for experimental investigations and simulations of unprecedented scope, leading to mini-research. This book is a first step into this exciting field.

This is a mathematics book, not a programming book, although it explains Pascal to beginners. It is aimed at high school students and undergraduates with a strong interest in mathematics, and teachers looking for fresh ideas. It is full of diverse mathematical ideas requiring little background. It includes a large number of challenging problems, many of which illustrate how numerical computation leads to conjectures which can then be proved by mathematical reasoning.

You will find 65 interesting and substantial mathematical topics in this book, and over 360 problems. Each topic is illustrated with examples and corresponding programs. The major goal of the book is to use the computer to collect data and formulate conjectures suggested by the data. It is assumed that readers have a PC at their disposal.

264 pp., Paperbound, 1993
ISBN 0-88385-636-0
List: $38.00 MAA Member: $26.50
Catalog Number NML-35/FOC
You need a Pascal compiler in order to use the 3.5" IBM-compatible disk packaged with this volume.

Game Theory and Strategy

Philip D. Straffin, Jr.

This important addition to the New Mathematical Library series pays careful attention to applications of game theory in a wide variety of disciplines. The applications are treated in considerable depth. The book assumes only high school algebra, yet gently builds to mathematical thinking of some sophistication. ***Game Theory and Strategy*** might serve as an introduction to both axiomatic mathematical thinking and the fundamental process of mathematical modelling. It gives insight into both the nature of pure mathematics, and the way in which mathematics can be applied to real problems.

Since its creation by John von Neumann and Oskar Morgenstern in 1944, game theory has contributed new insights to business, politics, economics, social psychology, philosophy, and evolutionary biology. In this book, the fundamental ideas of game theory share the stage with applications of the theory. How might strategic business decisions depend on information about a rival company, and how much would such information be worth? When is it advantageous to vote for a candidate who is not your favorite? What can we learn about the problem of "free will" by imagining playing a game with an Omnipotent Being? Game theory gives insight into all of these questions.

200 pp., Paperbound, 1993
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List: $27.50 MAA Member: $22.00
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THE BEST IN MATHEMATICAL

Lion Hunting and Other Mathematical Pursuits

A Collection of Mathematics, Verse, and Stories by Ralph P. Boas, Jr.

Gerald L. Alexanderson and Dale H. Mugler, Editors

As a young man at the Institute for Advanced Study in Princeton, Ralph Philip Boas, Jr., together with a group of other mathematicians, published a light-hearted article on the "mathematics of lion hunting" under a pseudonym (1938). This sparked a sequence of articles on the topic, several of which are drawn together in this book.

Lion Hunting includes an assortment of articles that show the many facets of this remarkable mathematician, editor, writer, and teacher. Along with a variety of his lighter mathematical papers, the collection includes Boas' verse and short stories, many of which are appearing for the first time. Anecdotes and recollections of his numerous experiences and of his work and meetings with many distinguished mathematicians and scientists of his day are also included.

The mathematical articles in this collection cover a range of topics. They include articles on infinite series, the mean value theorem, indeterminate forms, complex variables, inverse functions, extremal problems for polynomials, and more.

Boas' wit and playful humor are reflected in the verses included in this collection. The verses reflect the phases of his career as author, editor, teacher, department chair, and lover of literature. A section of the book describes the feud that Boas supposedly had with Bourbaki. Also included are many amusing anecdotes about famous mathematicians.

We profit from Boas' labor, and treasure it as an inheritance. We should allow ourselves in some measure to walk along his path. This collection will allow the reader a glimpse of that path.

240 pp., Paperbound, 1994,
ISBN 0-88385-323-X
List: $35.00 MAA Member: $25.00
Catalog Code: DOL-15/FOC

Algebra and Tiling

Sherman Stein and Sándor Szabó

Often questions about tiling space or a polygon lead to other questions. For instance, tiling by cubes raises questions about finite abelian groups. Tiling by tripods or crosses raises questions about cyclic groups. From tiling a polygon with similar triangles, it is a short step to investigating automorphisms of real or complex fields. Tiling by triangles of equal areas soon involves Sperner's lemma from topology and valuations from algebra.

The first six chapters of **Algebra and Tiling** form a self-contained treatment of these topics, beginning with Minkowski's conjecture about lattice tiling of Euclidean space by unit cubes, and concluding with Laczkowicz's recent work on tiling by similar triangles. The concluding chapter presents a simplified version of Rédei's theorem on finite abelian groups: if such a group is factored as a direct product of subsets, each containing the identity element, and each prime order, then at least one of them is a subgroup. A remarkable geometric implication of this result is developed in Chapter 2.

Algebra and Tiling is accessible to undergraduate mathematics majors, as most of the tools necessary to read the book are found in standard upper division algebra courses, but teachers, researchers and professional mathematicians will find the book equally appealing. Beginners will find the exercises and the material found in the appendices especially useful. The "Problems" section will appeal to both beginners and experts in the field. The book could serve as the basis of an undergraduate or graduate seminar, or a source of applications to enrich an algebra or geometry course.

224 pp., Hardcover, 1994
ISBN 0-88385-028-1
List: $34.00 MAA Member: $26.00
Catalog Code: CAM-25/FOC

A Radical Approach to Real Analysis

David Bressoud

This book is an undergraduate introduction to real analysis. Use this book as a textbook for an innovative course, or as a resource for a traditional course. If you are a student and have been through a traditional course, yet still do not understand what real analysis is about and why it was created, read this book.

This course of analysis is radical; it returns to the roots of the subject, but it is not a history of analysis. It is rather an attempt to follow the injunction of Henri Poincaré: let history inform pedagogy. The author wrote the book as a first encounter with real analysis, laying out its context and motivation in terms of the transition from power series to those that are less predictable, especially Fourier series. Bressoud marks some of the traps into which even great mathematicians have fallen in exploring this area of mathematics.

The book begins with Fourier's introduction of trigonometric series and the problems they created for the mathematicians of the early nineteenth century. Cauchy's attempts to establish a firm foundation for calculus follow, and the author considers his failures and his successes. The book culminates with Dirichlet's proof of the validity of the Fourier series expansion and explores some of the counterintuitive results Riemann and Weierstrass were led to as a result of Dirichlet's proof.

To facilitate graphical and numerical investigations, *Mathematica* commands and programs are included in the exercises. However, you may use any mathematical tool that has graphing capabilities, including the graphing calculator.

336 pp., Paperbound, 1994
ISBN 0-88385-701-4
List: $29.00 MAA Member: $22.00
Catalog Code: RAN/FOC

EXPOSITION ... JUST PUBLISHED!

All the Math That's Fit to Print

Articles from the Manchester Guardian

Keith Devlin

Between 1983 and 1989 Keith Devlin, research mathematician, author, and educator, wrote a semi-monthly column on mathematics and computing in the English national daily newspaper, *The Manchester Guardian*. This book is a compilation of many of those articles. It is witty, entertaining, and easy to read.

The mathematical topics range from simple puzzles to deep results including open problems such as Faltings Theorem and the Riemann Conjecture. You will find articles on prime numbers, how to work out claims for traveling expenses, calculating pi, computer simulation, patterns and palindromes, cryptology, and much more.

This book is meant for browsing by anyone who regularly reads a serious newspaper and has some interest in matters scientific or mathematical. Keith Devlin tells us "from the mail I received I know that the readers of the column were a varied bunch. They ranged from students at schools in their early teens (occasionally even younger!), to retired people in their nineties (often the ones who best succeed in cracking the brain teasers I occasionally included in my articles); from prison inmates to executives in the computer industry; from truckers to schoolteachers; both men and women."

It you think that nothing of interest has happened in mathematics since the time of Pythagoras, this book will change your mind. Keith Devlin presents mathematics as a living human enterprise, both a science and an art.

345 pp., Paperbound, 1994
ISBN 0-88385-515-1
List: $32.50 MAA Member: $25.00
Catalog Code: ATMAFOC

Linear Algebra Problem Book

Paul Halmos

This is a book for mathematicians at all levels. Paul Halmos tells us, "Even if I know some answers, I don't think I understand a subject until I know the questions. The questions in mathematics are called problems—and although I learned some linear algebra a long time ago, until now I have made no serious effort to examine the problems that the solutions are based on. I wrote this book to organize those questions—problems—in my own mind."

This book can be either the main course or the dessert for someone who needs linear algebra—and nowadays that means every user of mathematics. It can be used as the basis of either an official course or a program of private study.

If used as a course, the book can stand by itself, or if so desired, it can be stirred in with a standard linear algebra course as the seasoning that provides the interest, the challenge, the motivation that is needed by experienced scholars as much as by beginning students.

The best way to learn is to do, and the purpose of this book is to get the reader to DO linear algebra. The approach is Socratic: first ask a question, then give a hint (if necessary), then, finally, for security and completeness, provide the detailed answer.

340 pp., 1994, Paperbound
ISBN 0-88385-322-1
List: $35.00 MAA Member: $25.00
Catalog Code: DOL-16/FOC

Use order form on page 35, or call 1-800-331-1622

Assessing Calculus Reform Efforts

A Report to the Community

James R. C. Leitzel and Alan C. Tucker, Editors

Assessing Calculus Reform Efforts: A Report to the Community provides a review of various aspects of the calculus reform movement. This study gives an assessment of the current attitudes and involvement of mathematical sciences departments—their faculty and students—in efforts to revise calculus instruction.

A key finding of the assessment study is that *how* calculus is taught has changed more than *what* is taught. The changes in instructional practice, more frequent use of technology, and increased focus on building students' conceptual understanding are finding their way into both precalculus and post-calculus mathematics courses. This has encouraged increased interest in research about how undergraduate students learn mathematics. Many of the institutions that currently report using reform materials in experimental sections have plans to move their efforts to course-wide adoption in the near future. The fact that in the past two years over 95% of institutions using a reform text continue using a reform text the next year (for at least some sections) indicates that calculus reform is likely to be around for the foreseeable future.

Data is provided on the number of institutions at each of the levels of postsecondary education that are engaged in reform efforts and also gives information on faculty and student involvement, and reviews of texts produced by some of the major curriculum development projects. The appendices to the report include brief descriptions of selected calculus reform texts and a complete listing of the NSF awards made during the seven years of the Calculus Initiative.

100 pp., Paperbound 1994
ISBN 0-88385-093-1
List: $15.00
Catalog Code: ACRE/FOC

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Santa Clara University
Applied Mathematics Department
School of Engineering
Santa Clara University

Applications are invited for the position of assistant professor in the Applied Mathematics Department. The position is tenure-track. The primary function of the department is to teach service courses in mathematics on the undergraduate and graduate level for the School of Engineering. The department also awards the Masters degree in the areas of numerical analysis, engineering mathematics, and probability and statistics as applied to the engineering fields.

Teaching duties include undergraduate courses in numerical methods and differential equations. The candidate will also be expected to teach graduate courses in one or more of the following areas: complex variables, numerical analysis, graph theory, optimization theory. Research activity is required.

Deadline for applications is May 1, 1995. Applications should be sent to **Search Committee, Applied Mathematics, School of Engineering, Santa Clara University, Santa Clara, CA 95053.** Do not send letters of recommendation until requested by committee.

Santa Clara University is an equal opportunity/affirmative action employer, and welcomes applications from women, persons of color, and members of other historically underrepresented U.S. ethnic groups.

Agder College
Department of Mathematics

Agder College is one of the largest colleges in Norway. The professional activity is organized in 8 departments. The college has nearly 600 employees and 6000 students. Agder College offers different courses at all levels including several main subjects.

PROFESSORSHIP IN MATHEMATICS EDUCATION

Applications are invited for a position as Professor of Mathematics Education at Agder College beginning either January 1, 1996, or an agreed upon later date.

A Ph.D. degree in mathematics or a Ph.D. degree in mathematics education together with a master's degree in mathematics or equivalent is required. Evidence of scholarly work in mathematics education is also required.

The application must contain complete information about the applicant's education and professional activities, including a curriculum vitae and graduate transcripts. The above should be submitted in 4 copies. Scientific works which the applicant wants considered (and a list of these) are to be sent in 3 copies.

A letter of intent to apply will be accepted until June 1, 1995, and a complete application should follow as soon after as possible. Scientific work in progress may be submitted within 4 weeks of this day.

Send application to: Agder College, Personalseksjonen, Tordenskjolds gt 65, N-4604, Kristiansand, Norway.

Further information can be obtained by contacting Professor Åsvald Lima, phone +47.38.07.95.72 or e-mail: aasvalsl@adh.no.

Women are particularly encouraged to apply. Agder College is an Equal Opportunity Employer.

Marshall University
Chair, Department of Mathematics

Marshall University invites applications and nominations for Chair of the Mathematics Department. Minimum qualifications include a Ph.D. in mathematics, broad mathematical interests, and a history of successful teaching and scholarly activities. Applicants should also possess effective communication and leadership skills, as well as experience in innovative program development. Demonstrated administrative abilities, success in obtaining external funds, and good interpersonal skills are highly desirable.

The Chair will represent the department to the administration, provide leadership in both curricular and faculty development, and promote mathematics to the Marshall University community. Experience in curricular activities across disciplines is preferred.

Qualifications should be sufficient for full professor with tenure. Salary will be commensurate with qualifications and experience.

Marshall University, a comprehensive higher education institution, is located in Huntington, West Virginia, just across the Ohio River from Ohio, and thirteen miles from the Kentucky border. There are approximately 12,500 students and 600 faculty. The department has 17 regular faculty members and about 15 part-time faculty and graduate assistants. The department offers bachelor's and master's degrees in mathematics and service courses for many other degree programs.

Applicants should send a letter of application, a current curriculum vita, and names, addresses, and phone numbers of three professional references. Nominations and applications should be sent to:

Dr. Herbert Tesser
Chair of Search Committee
Marshall University
Huntington, WV 25755-2580

Application review will begin March 27, 1995 and continue until position is filled. Anticipated starting date is Fall 1995. Women and minorities are encouraged to apply. Marshall University is an Equal Opportunity/Affirmative Action Employer.

The Ohio State University
Department of Statistics
Visiting Professorship in Statistical Education

The Ohio State University has been at the forefront of an innovative movement in statistical education. Our focus has been on the effective use of technology in the classroom in conjunction with the implementation of a "learn through discovery" and "data analytic" philosophy. As part of these efforts, the Department of Statistics has available a Visiting Professorship in Statistical Education or a Post-doctoral position in Statistical Education beginning Fall 1995. The Professorship would be appropriate for a senior person on sabbatical. The Post-doctoral position is intended for recent Ph.D. recipients with an interest in statistical education. The purpose of the position is to offer faculty interested in statistical education the opportunity to teach courses that make extensive use of technology (state-of-the-art Macintosh Labs, lecture halls with high-end video and computer projection equipment, experiment with technology-based teaching, and pursue technology-based course development. The professorship could additionally involve further development of existing courses, development and implementation of creative used of technology, labs, and/or development and implementation of technology-based course materials. Duties are negotiable, but will include teaching one or two undergraduate courses per quarter. Courses include our technology-based course intended for students in the Arts and Humanities, our technology-based course for Social Science majors, our technology-based course for science majors, and our sequences for engineering majors. Candidates should have a

serious interest in statistical education. Salary negotiable. Applicants should send a CV, transcript, and three letters of reference.

The Ohio State University is an Equal Opportunity/Affirmative Action Employer. Qualified women, minorities, Vietnam-era veterans, disabled veterans, and individuals with disabilities are encouraged to apply. Applications requested by May 1, 1995 to

Professor William Notz
Department of Statistics
The Ohio State University
1958 Neil Avenue
Columbus, Ohio 43210-1247

SUNY College at Fredonia

The Department of Mathematics and Computer Science invites applications for tenure-track positions in mathematics. A doctorate in mathematics or mathematics education is required. Candidates must have a commitment to excellence in teaching and to continued scholarly activity along with an interest in curriculum development, especially the application of technology. Candidates who can document excellence in teaching are likely to be ranked higher in our selection process. Review of applications will commence April 15, 1995 and will continue until the position is filled. Fredonia actively encourages applications from women and minority candidates and is an Affirmative Action/Equal Opportunity Employer. Send a letter of application, a curriculum vita, and three letters of reference to:

Dr. Nancy Boynton, Chair
Mathematics Search Committee
Mathematics and Computer Science
SUNY College at Fredonia
Fredonia, NY 14063-1198
masearch@cs.fredonia.edu

Simon's Rock College

One-year, sabbatical replacement position in mathematics for 1995-96. Send letter of application, curriculum vita, and three letters of recommendation to Prof. Robert Snyder, Simon's Rock College of Bard, Gt. Barrington, MA 10230.

West Virginia State College
Faculty Positions (2)
Department of Mathematics

The Department of Mathematics invites applications for two tenure-track positions effective August 1995. Primary responsibility to teach approximately twelve credits of undergraduate mathematics, possibly including secondary math methods or computer science courses, per semester. Duties also include student advisement, curriculum development, committee work, and scholarly activity. Ph.D. in Mathematics or Mathematics Education preferred for the second position. Rank and salary negotiable. Preference will be given to those applicants with experience in the use of technology in mathematics instruction, or research potential in discrete or computational mathematics. The department operates two microcomputer labs and is preparing to open a PC classroom. We have an extensive developmental math program, and serve many nontraditional and part-time evening students.

West Virginia State College is a historically black college, which has evolved into a fully accessible, racially diverse, and multi-generational baccalaureate institution. Because of this tradition, the College enrolls a wide range of students and assists them in achieving their academic, civic, and career potential through quality undergraduate programs in a campus environment nationally recognized as a "Living Laboratory of Human Relations." West Virginia State College (WVSC) is the largest institution of higher education in the Charleston metropolitan area serving approximately 4,700 students.

Applicants should send a letter of application (including e-mail address and fax number, if available), curriculum vitae, academic transcripts, and three letters of reference by April 15, 1995 (or until suitable candidates are chosen), to

Barbara J. Oden, Ph.D.
Vice President for Academic Affairs
West Virginia State College
P.O. Box 1000, Campus Box 192
Institute, WV 25112-1000.

Adelphi
UNIVERSITY A Commitment to Intellect

ASSISTANT/ ASSOCIATE PROFESSOR

Science And Mathematics Education

Candidates should have an extensive background in science and mathematics, proven ability as an educator of teachers, and the skill needed to develop a dynamic new science and mathematics education curriculum. Review of applications will begin immediately and continue until the positions are filled. **Appointment begins September, 1995.** Send letter of application, vita, and at least three letters of recommendation to Jeffrey Kane, Dean, School of Education, Adelphi University, South Avenue, Garden City, New York 11530. Equal Opportunity/ Affirmative Action Employer.

Calendar

National MAA Meetings

August 6-8, 1995 Seventieth Annual Joint Summer Meeting, University of Vermont-Burlington, Burlington, VT

January 10-13, 1996 Seventy-ninth Annual Meeting, Orlando, FL. Board of Governors Meeting January 9, 1996

January 9-7, 1997 Eightieth Annual Meeting, San Diego, CA. Board of Governors Meeting January 8, 1997

January 7-10, 1998 Eighty-first Annual Meeting, Baltimore, MD. Board of Governors Meeting January 6, 1998

Sectional MAA Meetings

ALLEGHENY MOUNTAIN April 1996, Indiana Univ. of Pennsylvania, Indiana, PA

IOWA April 21-22, 1995, University of Northern Iowa, Cedar Falls, IA

KANSAS April 14-15, 1995, Wichita State University, Wichita, KS

METRO. NEW YORK May 6, 1995, Hunter College-CUNY, New York, NY

MICHIGAN May 5-6, 1995, Grand Valley State University, Allendale, MI

MISSOURI April 1996, Southeast Missouri State Univ., Cape Girardeau, MO

Spring 1997 Missouri Western State College, St. Joseph, MO

Spring 1998 Southwest Missouri State University, Springfield, MO

NEBRASKA-SOUTHEAST SOUTH DAKOTA April 28-29, 1995, Creighton University, Omaha, NE

NEW JERSEY April 29, 1995, William Paterson College, Wayne, NJ

NORTH CENTRAL April 21-22, 1995, Carleton College, Northfield, MN

October 1995, North Dakota State University, Fargo, ND

NORTHEASTERN June 9-10, 1995, Bates College, Lewiston, ME

November 17-18, 1995, Salem State College, Salem, MA

Spring 1996, Hampshire College, Amherst, MA

NORTHERN CALIFORNIA October 21-22, 1995, Cal Polytech State University, San Luis Obispo, CA

(joint meeting w/ S. California Section)

OHIO April 21-22, 1995, Miami University, Oxford, OH

PACIFIC NORTHWEST June 15-17, 1995, Whitman College, Walla Walla, WA

ROCKY MOUNTAIN April 21-22, 1995, University of Southern Colorado, Pueblo, CO

April 1996, Mesa State College, Grand Junction, CO

SEAWAY April 21-22, 1995, Hobart & William Smith Colleges, Geneva, NY

November 3-4, 1995, Skidmore College, Saratoga Springs, NY

1996, Elmira College, Elmira, NY

SOUTHERN CALIFORNIA October 21-22, 1995, Cal Polytech State University, San Luis Obispo, CA

(joint meeting w/ N. California Section)

TEXAS March 28-30, 1996, Texas Tech University, Lubbock, TX

Spring 1997 Southwest Texas State University, San Marcos, TX

WISCONSIN April 12-13, 1996, University of Wisconsin-Platteville

Other Meetings

July 30–August 4, 1995 Ninth Iberamerican Conference on Mathematics Education (IACME IX), Santiago, Chile. Contact: Organizing Committee, IACME IX, Casilla 33081, Correo 33, Santiago, Chile; fax: 56-02-6811739; e-mail: hgonzale@eculides.usach.cl.

August 9-18, 1995 Conference on Fermat's Last Theorem, Boston University. For more information, contact: Fermat Conference, Department of Mathematics, Boston University, Boston, MA 02215; fermat@math.by.edu.

August 16–19, 1995 Fifth Conference of the International Algebra Society, Georgia State University, Atlanta, GA. For more information, contact Frank Hall, Dept. of Math & Computer Science, Georgia State University, Atlanta, GA 30303; (404) 651-2253; e-mail: fhall@cs.gsu.edu; or Paul Van Dooren, Universite Catholique de Louvain, CESAME, Batiment Euler A.119, B-1348 Louvain-la-Neuve, Belgium; 32-10-47-8040; e-mail: vdooren@anma.ucl.ac.be.

October 12—24, 1995 Seventeenth Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (PME-NA XVII), Columbus, OH. Deadline for Poster Session proposals is June 30,1995. For a copy of the Final Announcement, contact Doug Owens, 253 Arps Hall, The Ohio State University, 1945 North High Street, Columbus, OH 43210-1172; (614) 292-8021; fax (614) 292-7695; e-mail Owens.93@osu.edu.

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