FOCUS

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The Major in the Mathematical Sciences

Bettye Anne Case

Approximately once a decade the Committee on the Undergraduate Program in Mathematics (CUPM) issues recommendations concerning the undergraduate major. In January 1991, CUPM endorsed a report from its Subcommittee on the Major (SUM) that updates the more lengthy 1981 *Recommendations for a General Mathematical Sciences Program* (which was reprinted in 1989 as the first six chapters of MAA Notes Volume 13, *Reshaping College Mathematics).* The new CUPM report emphasizes a unified (but not uniform) major in the mathematical sciences which supports various concentrations or tracks.

Although forward looking, these recommendations are anchored firmly in the reality of current practice and owe much to the 1981 CUPM *Recommendations.* The program philosophy's first five of nine tenets are similar to those in the 1981 report, sharpened to encourage independent mathematical learning and written and oral communication of mathematics. Four added tenets deal with availability of options, increased advising responsibilities, technology's effects and applications, and easier transitions between levels of study. A unified structure, presented as a tool for fashioning departmental course requirements, encourages broad course choices. Teaching and advising issues are natural adjuncts to the discussion.

Philosophy The report describes a curricular *structure* with fixed *components* which allow considerable latitude in specific course choices. Combined with specialized curriculum concentrations or *tracks* within the major, this structure provides flexibility and utility. The structure involves both specific courses (e.g., "linear algebra"), and more general experiences (e.g., "sequential learning") derived through those courses. By making appropriate choices within components, students can obtain a strong major for prospective secondary teaching or for graduate school preparation. Although most of the tracks may be considered options within applied mathematics, students desiring a background in classical pure mathematics can meet their needs by careful course selections. Every applied mathematics track should include fundamental components of "pure" mathematics, just as each pure mathematics student should gain experience with applied and computational mathematics.

The component structure with tracks is typical of the pattern of many of today's undergraduate mathematical sciences departments in that it allows many curricular choices. Track systems lead students to make lifetime choices with only minimal knowledge of their ramifications. Consequently, departments must accept advising responsibilities significantly greater than what was necessary in ear-

*(**Major** continues on page six.)*

MS 2000 Final Report Focuses on Undergraduate Mathematics

Michael H. Clapp

The final report of the Committee on Mathematical Sciences in the Year 2000 (MS 2000) was released on 9 April 1991 at a public policy briefing at the National Academy of Sciences in Washington, DC. In it the Committee calls for fundamental changes in undergraduate mathematics as it presently exists on most college and university campuses in the United States. The report, *Moving Beyond Myths: Revitalizing Undergraduate Mathematics,* examines the health of undergraduate mathematics education, identifies certain myths and deficiencies, and presents recommendations and an *Action Plan* for reinvigorating the quality of collegiate mathematics, using existing successful programs and strategies as the starting point.

Moving beyond Myths thus becomes the latest in a sequence of documents issued by the mathematics community over the last several years which have examined the overall health of the discipline in this country and cited the need for change. This report is the first to address specifically the broad issues of undergraduate mathematics education and to recommend change in how mathematics is taught; full use of the mathematical potential of women, minorities, and the disabled; and greater involvement of mathematics faculty with the preparation of teachers and with school mathematics.

The Committee found many examples of effective programs and dedicated faculty on individual campuses across the nation. The report's format features sidebars throughout the narrative which document successful initiatives and which, in the words of the report, ". . . provided both grounds for optimism and models for more widespread improvement." The Committee concludes that in view of this evidence, the mathematics profession knows what is working and what needs to be done; it is now time to take the next steps needed to revitalize undergraduate mathematics.

*(**MS 2000** continues on page four.)*

Inside This Issue

Contributed Papers in Baltimore

From Wednesday, 8 January through Saturday, 11 January 1992, the Mathematical Association of America will hold its Joint Annual Meetings, with the American Mathematical Society (AMS), in Baltimore, Maryland. The complete meetings program announcement will appear in the October 1991 issues of both FOCUS and the *Notices of the American Mathematical Society.* The Association publishes this preliminary announcement to encourage participation and to provide lead-time for organizing the MAA contributed paper sessions. Please note that the days scheduled for these sessions are tentative. The organizers mentioned below solicit contributed papers pertinent to their sessions' interests and concerns.

■ **Actuarial Mathematics**
Saturday, 11 January 1992

James W. Daniel
Department of Mathematics
RLM 8-100
University of Texas at Austin
Austin, Texas 78712

Contributions should address educational (or research) issues in actuarial mathematics, including such topics as curricula, teaching methods, program organization, textbooks, software, professional examinations, and research.

■ **Evironmental Mathematics**
Thursday morning, 9 January 1992
and Saturday, 11 January 1992

Ben A. Fusaro
Department of Mathematical Sciences
Salisbury State University
Salisbury, Maryland 21801

This session invites papers that treat environmental topics suitable for a liberal arts mathematics course or for a modeling course, preferably at the sophomore–junior level.

■ **Innovations in Mathematics Courses for Business**
Wednesday morning, 8 January 1992
and Thursday afternoon, 9 January 1992

Wade Ellis, Jr.
Department of Mathematics
West Valley College
14000 Fruitvale Avenue
Saratoga, California 95070

Barbara A. Jur
Department of Mathematics
Macomb Community College
Warren, Michigan 48093

This session, organized by the Subcommittee on Service Courses of the Committee on the Undergraduate Program in Mathematics (CUPM), seeks papers focused on service courses for business students. Contributions may address issues of specialized business subject matter, innovative instructional techniques, the relationship of business-oriented courses to the mathematics curriculum, or other, related topics.

■ **Mathematics for the Health Sciences**
Friday, 10 January 1992

Henry Clay Foehl
Philadelphia College of Pharmacy and Science
Woodland Avenue at Forty-Third Street
Philadelphia, Pennsylvania 19104

Contributions to this session should describe the content of courses or sequences of courses that constitute part or all of the mathematics requirements for degree programs in the health or health-related sciences. This session specifically invites discussions on the criteria for selecting the appropriate content for such courses and methods for integrating this content into the curricula of degree programs, especially where the courses also serve as the mathematics component of a core curriculum.

■ **Mathematics Placement Testing Programs: Their Organization, Administration, and Problems**
Wednesday, 8 January 1992

Rose C. Hamm
Honors Program
College of Charleston
Charleston, South Carolina 29424

John G. Harvey
Department of Mathematics
480 Lincoln Drive
University of Wisconsin at Madison
Madison, Wisconsin 53706

This session welcomes papers on various aspects of placement testing programs, including the test(s) and other data used (e.g., aptitude scores, high school GPAs) to place students in appropriate mathematics courses, the problems that arise during the placement process, and approaches to solving them.

■ **Research in Undergraduate Education**
Thursday morning, 9 January 1992
and Friday morning, 10 January 1992

Ed Dubinsky
Department of Mathematics
Purdue University
West Lafayette, Indiana 47907
*(**Papers** continues on next page.)*

FOCUS

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*(**Papers** continued from previous page.)*
This session invites presentations that describe research on the learning and teaching of any aspect of undergraduate mathematics. Descriptions of courses taught should investigate how students learn mathematics, teaching methods and their effectiveness, and similar issues.

- **THE "SEVEN INTO FOUR" PROBLEM**
  Wednesday afternoon, 8 January 1992
  and Friday afternoon, 10 January 1992

  David H. Carlson
  Department of Mathematical Sciences
  San Diego State University
  San Diego, California 92182

  Ann E. Watkins
  Department of Mathematics
  California State University at Northridge
  Northridge, California 91330

  The Subcommittee on Calculus Reform and the First Two Years (CRAFTY) of the Committee on the Undergraduate Program in Mathematics (CUPM) organized this session which will explore innovative strategies for solving the "seven-into-four problem." Seven courses (Calculus I, II, III, Differential Equations, Discrete Mathematics, Linear Algebra, and Probability-Statistics) have been recommended for the first four semesters of college mathematics. Is it possible to squeeze them all in? What are some good partial solutions to the problem?

- **A TOOLBOX FOR LIBERAL ARTS MATHEMATICS COURSES**
  Thursday afternoon, 9 January 1992
  and Friday morning, 10 January 1992

  John Wesley Emert and Kay Meeks
  Department of Mathematical Sciences
  Ball State University
  Muncie, Indiana 47305

  Liberal arts mathematics courses generally include as goals the changing of students' perceptions of mathematics and the illumination of relationships between mathematics and other disciplines. This session will share innovative, yet practical and transferable ideas and techniques to aid the development and realization of these common goals. Topics for discussion may include: creative classroom methods and assignments; fresh, unusual topics for inclusion in courses; and specific practices to encourage students' discovery of the usefulness of mathematics in their own fields of study.

- **USING SPREADSHEETS TO TEACH MATHEMATICS**
  Wednesday morning, 8 January 1992
  and Thursday afternoon, 9 January 1992

  Robert S. Smith
  Department of Mathematics and Statistics
  Miami University
  Oxford, Ohio 45056

  The spreadsheet offers a powerful and versatile—yet easy to use—software tool that has grown increasing popular in the teaching of the mathematical sciences. It is ideal for implementing algorithms which rely on iterative procedures or recurrence relations, and it remains a natural tool for solving many types of applied problems. This session welcomes papers which illustrate the spreadsheet as a problem solving, data analysis, or graphing tool. It also invites contributions which demonstrate how to use the spreadsheet to prove theorems, discover patterns and results, or illustrate mathematics concepts. Similarly, the session strongly encourages descriptions of courseware developed around the spreadsheet.

New Submission Procedures

1. After you have selected a session to which you wish to contribute a paper, forward **directly to the organizer(s):**
   - the name(s) and address(es) of the author(s); and
   - a *one-page summary* of the paper.

   You must submit these items by 11 September 1991.
2. The organizer will acknowledge receipt of your summary.
3. If the organizer accepts your proposal, you will receive an *abstract form.*
4. Complete the abstract form according to instructions on its cover and return to:

   Abstracts
   Editorial Department
   American Mathematical Society (AMS)
   PO Box 6248
   Providence, Rhode Island 02940-6248
   abs-submit@math.ams.com.
   (E-mail address for abstract submissions only.)

   You must return your completed abstract form to the AMS by 2 October 1991.
5. The AMS will photographically reproduce your abstract from the completed form and then publish it in an *abstracts journal.*
6. You may obtain a copy of this *abstracts journal* in the registration area during the January 1992 Annual Meeting in Baltimore, Maryland.

DO NOT SEND PROPOSALS TO THE MAA OFFICE IN WASHINGTON, DC.

Sessions generally must limit presentations to ten minutes each, but selected participants may extend their contributions up to twenty minutes. Each session room contains overhead projectors and a screen; blackboards are normally not available. Persons needing additional equipment should contact, as soon as possible, but prior to **9 November 1991**: Kenneth A. Ross, MAA Associate Secretary, Department of Mathematics, University of Oregon, Eugene, Oregon 97403-1222; ross@math.uoregon.edu. You may request: one additional overhead projector, a 35mm slide projector, or a $\frac{1}{2}$ inch or $\frac{3}{4}$ inch VHS VCR with one color monitor.

We invite potential contributors with experience of the TEX typesetting system to submit their abstracts electronically. To obtain the necessary file package, contact the AMS via Internet: abs-request@math.ams.com. The AMS will then fulfill your request electronically—the quickest and most convenient route. TEX users, however, may obtain the file package on IBM or Macintosh diskettes without charge. Contact: Secretary to the Director of Publications, American Mathematical Society, Publications Division, PO Box 5248, Providence, Rhode Island 02940. When you request the file package, you should specify whether you need the plain TEX, *AMS*-TEX, or the LATEX package. You should address questions concerning *abstracts* to abs-misc@math.ams.com. You should address questions concerning the *meeting* to meet@math.ams.com. You should use the e-mail address provided in the submission procedures box above ***only*** to submit your abstract.

*(**MS 2000** continued from front page.)*
The report established four goals for mathematical sciences faculty:

- ***Effective undergraduate mathematics instruction for all students.***

  Acknowledging the lack of interest and of success experienced by so many students who take mathematics, the report calls for the identification and use of effective alternatives to lecture as an instructional technique, greater uses of computers, and the linking of mathematics content and instruction to students' own experiences and to other disciplines. It urges faculty to become more knowledgeable about how mathematics is learned and to elevate the importance of effective mathematics instruction.

- ***Full utilization of the mathematical potential of women, minorities, and the disabled.***

  Noting that college mathematics attracts far too few African-American, Hispanic, and Native American students, the Committee points to examples of successful programs which reverse this pattern and which should be expanded and replicated. While women have about equal representation with men in undergraduate mathematics, their numbers decline precipitously between undergraduate and graduate school. Parity for women, minorities, and the disabled in mathematics education must be achieved, the report states, because failing to do so constitutes "... an appalling waste of human potential, denying to individuals opportunity for productive careers and to the nation the resources for economic strength."

- ***Active engagement of college and university mathematicians with school mathematics, especially with the preparation of teachers.***

  Because teachers of school mathematics receive their own instruction in colleges and universities, the report urges faculty to model effective instructional styles, since most teachers will eventually teach mathematics the way they themselves have been taught it. Mathematics faculty are also encouraged to become involved with issues of mathematics teacher preparation with K–12 mathematics education.

- ***A culture for mathematicians that respects and rewards teaching, research, and scholarship.***

  The report quotes Ernest L. Boyer's *Scholarship Reconsidered: Priorities of the Professoriate,* "What we urgently need today is a more inclusive view of what it means to be a scholar—a recognition that knowledge is acquired through research, through synthesis, through practice, and through teaching." Teaching and research ought not be viewed as competitive activities, it notes, and scholarship associated with how mathematics is taught and learned is needed and valuable.

The report's *Action Plan,* according to MS 2000 Committee chair Dr. William E. Kirwan, II "challenges our institutions of higher education to bring their mathematics education efforts up to the standard set by the nation's mathematical research enterprise, which is preeminent in the world." To meet that standard, the mathematical community is called upon to make fundamental changes in the content, context, and culture of undergraduate mathematics. Moreover, the report points out, that while leadership for mathematics education reform is the responsibility of the mathematics faculty at colleges and universities everywhere, others also have roles to play: colleges and universities, business and industry, professional societies (particularly the MAA in view of its role in undergraduate mathematics), governmental agencies, and educational policy makers. "For those who have worked hard on educational issues," the report states, "it is time for redoubled effort; for those who have not, it is time to begin."

The *Action Plan* identifies the roles for each of the players in helping to achieve the revitalization of undergraduate mathematics. The *Plan* contains three components, each containing multiple tasks for each of these groups to undertake. The components are:

- ***Develop and Promulgate Effective Instructional Models***

  Mathematics faculty and their departments are the principal focus of this component; it also details actions for colleges, universities, professional societies, and the government. It emphasizes mechanisms to improve teaching and learning in undergraduate mathematics, to increase the recruitment and retention of students currently underrepresented in the mathematical sciences, and to encourage experimentation and innovation in instruction and program development. It calls for the establishment of a journal dealing with undergraduate mathematical research and practice and for government support for undergraduate mathematics, program dissemination, and increased budgets for student support programs and fellowships.

*(**MS 2000** continues on next page.)*

*(**MS 2000** continued from previous page.)*

- ***Establish and Disseminate National Guidelines on Standards***

  The professional mathematical societies and the faculty and departments they represent are key players in this component, followed closely by colleges, universities, and the government. The *Plan* calls for development of new advisory national guidelines dealing with curriculum, teaching, and evaluation in undergraduate and graduate programs, aligned as appropriate with the NCTM *Standards* for school mathematics. The need for planning, top priority for teaching, and government support for emerging guidelines are also listed as basic elements for action.

- ***Build and Sustain Supportive Attitudes and Structures***

  Here the plan calls for the President and the governors of the fifty states, federal and state agencies and legislatures, and boards of regents and trustees to make primary contributions to reform efforts. These contributions are both policy oriented ("Retain the national education goal of being 'first in the world' ") and resource related (creation of a network of regional centers for excellence in the teaching of mathematics). Universities and colleges are asked to provide the resources needed for effective mathematics instruction, including the use of technology, and to speak out about the importance of support for research funding and scholarship in creating healthy undergraduate education. Faculty and their departments are urged to establish networks with colleagues on campus, on other campuses, and with mathematics teachers in local schools to strengthen the infrastructure of mathematics education.

The report points out that mathematics represents a major component of undergraduate instruction. It constitutes about 10% of higher education enrollment in the United States, and is the second largest discipline taught (next to English). Each year over three million students are enrolled in mathematics classes in some 3,000 two-year colleges, liberal arts colleges, comprehensive universities, and research institutions. Recently released figures show that in 1988, remedial enrollments accounted for 21% of this total; 48% of the enrollment was in (nonremedial) introductory courses below the level of calculus, 22% was in calculus courses, 8% was upper division, and 2% was in graduate courses in mathematics. Mathematics accounts for approximately one-third of all science and engineering enrollment in higher education. There are about 40,000 full and part-time faculty, half of whom hold the doctorate, teaching in these courses.

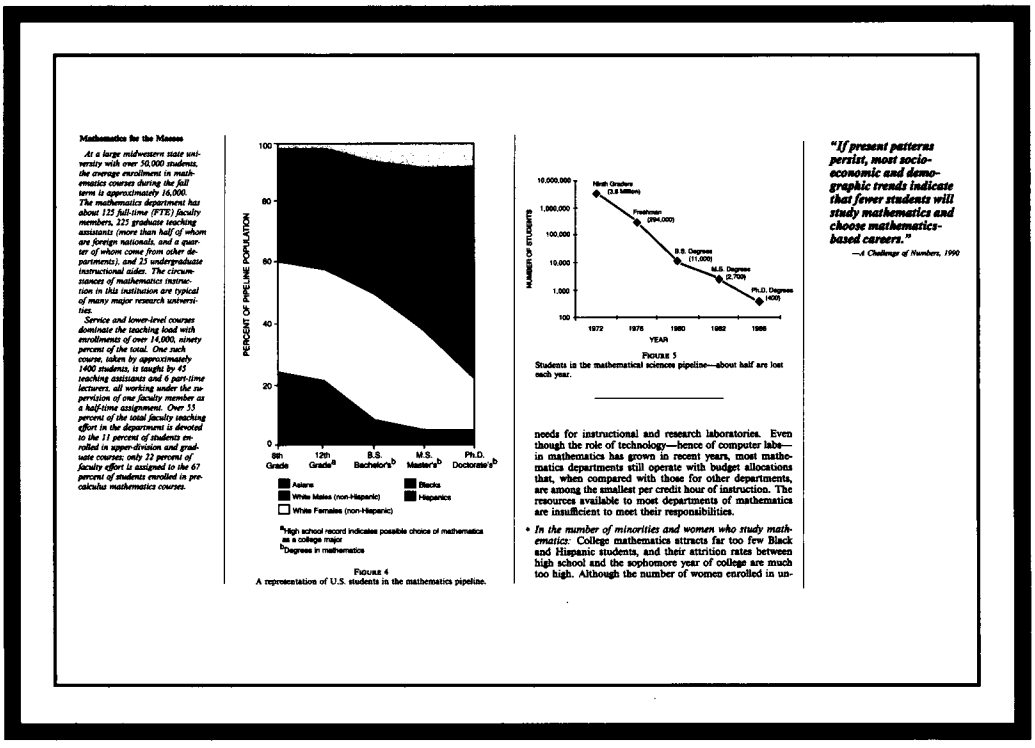
Given the sheer size of the enterprise, the changes called for in the report will take time and require significant effort. Still, the Committee observes that the time is propitious for change, because there is substantial consensus on the goals for mathematics education and the processes to achieve them. The report concludes, "The national revitalization of mathematics is within our reach, if only we are prepared to make a serious intellectual and financial commitment to our children's and our nation's future."

The Mathematical Sciences Education Board (MSEB) plans a broad dissemination of the report and its accompanying *Action Plan* that will include mathematics department chairs at two and four-year college and university campuses and the leadership of the professional mathematical associations, societies, and organizations. Additional copies of the report will be sent to deans of colleges of science, the leadership of major scientific and higher education professional organizations, to policy makers, government agencies, and selected corporate officers in business and industry. Individual copies of the report are available for $7.95 from: National Academy Press, 2101 Constitution Avenue Northwest, Washington, DC 20418; (800) 624-6242.

The Committee on Mathematical Sciences in the Year 2000 (MS 2000) was appointed in 1988 by the National Research Council as a joint project of the MSEB and the Board on Mathematical Sciences (BOMS). The Committee was chaired originally by J. Fred Bucy, former Chief Executive Officer of Texas Instruments, Inc. Dr. William E. Kirwan, II, the president of the University of Maryland at College Park, assumed the Committee leadership when Mr. Bucy was drawn away by other commitments. Bernard L. Madison was the project director through December of 1989; he was succeeded in the position by James A. Voytuk, who served through the end of the Committee's work in December 1990.

The publication of *Moving Beyond Myths* completed a ten-year analysis of the US mathematical science enterprise by boards and commissions of the NRC. These efforts included the work of the so-called David Committee on the status of US mathematical research, whose report *Renewing US Mathematics* was issued in 1984 and updated last year in *Renewing US Mathematics: A Plan for the 1990s.* Other reports resulting from NRC studies include *A Challenge of Numbers: People in the Mathematical Sciences* (1990) and *Everybody Counts: A Report to the Nation on the Future of Mathematics Education* (1989). ■

Michael H. Clapp is Associate Executive Director of the Mathematical Sciences Education Board (MSEB) and Director of its College and University Programs.



Mathematics for the Masses

At a large midwestern state university with over 50,000 students, the average enrollment in mathematics courses during the fall term is approximately 16,000. The mathematics department has about 125 full-time (FTE) faculty members, 225 graduate teaching assistants (more than half of whom are foreign nationals, and a quarter of whom come from other departments), and 25 undergraduate instructional aides. The circumstances of mathematics instruction in this institution are typical of many major research universities.

Service and lower-level courses dominate the teaching load with enrollments of over 14,000, ninety percent of the total. One such course, taken by approximately 1400 students, is taught by 45 teaching assistants and 6 part-time lecturers, all working under the supervision of one faculty member as a half-time assignment. Over 55 percent of the total faculty teaching effort in the department is devoted to the 11 percent of students enrolled in upper-division and graduate courses; only 22 percent of faculty effort is assigned to the 67 percent of students enrolled in pre-calculus mathematics courses.

FIGURE 4
A representation of U.S. students in the mathematics pipeline.

FIGURE 5
Students in the mathematical sciences pipeline—about half are lost each year.

needs for instructional and research laboratories. Even though the role of technology—hence of computer labs—in mathematics has grown in recent years, most mathematics departments still operate with budget allocations that, when compared with those for other departments, are among the smallest per credit hour of instruction. The resources available to most departments of mathematics are insufficient to meet their responsibilities.

- *In the number of minorities and women who study mathematics:* College mathematics attracts far too few Black and Hispanic students, and their attrition rates between high school and the sophomore year of college are much too high. Although the number of women enrolled in un-

"If present patterns persist, most socio-economic and demographic trends indicate that fewer students will study mathematics and choose mathematics-based careers."
—A Challenge of Numbers, 1990

Why There Should Be Turmoil in Calculus

Peter D. Lax and Louise A. Raphael

We were surprised and saddened to read in the November–December 1990 issue of FOCUS that Paul Halmos, whose inspired texts have brought so much new mathematics and new points of view into the graduate and undergraduate curriculum, finds nothing deficient in what we teach in the calculus courses today or how we teach it. He contends that there is nothing better, and even if there were, our current students would be incapable of benefiting from it.

As all mathematicians know, mathematical knowledge grows at an exponential rate; we would drown in it, were it not, as Hilbert noted at the dawn of this century, that advances in mathematics bring with them unifying ideas and new methods, more powerful and simpler than the old ones. Our task as educators is to bring as much new mathematics and as many new ideas and new methods into the curriculum as seem appropriate.

Calculus is not immune to historical change. We now have better, simpler ways of looking at the basic concepts of analysis than before. We have clearer ideas of what is peripheral and vestigial, and therefore safe to omit, and what is important: that the ideas and language of calculus are central in the framework and laws of physics, chemistry, engineering, economics, physiology, environmental studies, or any other science that deals with continuum models. Today we can demonstrate convincingly, even at the level of an introductory course, that calculus can solve significant scientific problems.

It is very important to teach future mathematicians about the close links between mathematics and science. It is even more important to teach this to the vast majority of our students who are not future mathematicians, are not interested in mathematics per se, but want to know what it is good for.

Halmos dismisses texts as irrelevant—the student's don't read them because the formal language is repulsive and incomprehensible to them; teachers don't need them because once they have taught one calculus course, they can teach them all. He points out that all reform calculus books in the past have failed to gain acceptance and takes this as evidence that none are needed. It seems to us that the correct explanation is that all texts deviating from the standard model are deliberately excluded from colleges by the calculus committees that choose a common text for all instructors. Publishers, aware of the system, manipulate the profession; they include in their offerings all topics dear to a committee member's heart. Hence the bloated, 1,200 page tomes that contain 200 pages' worth of mathematics.

Thanks to the Sloan Foundation, the National Science Foundation, and other agencies, new calculus texts are on the way. But they will likely suffer the same fate as earlier efforts, unless we insist that academic freedom guarantees all qualified members of a mathematics department the right to choose their calculus texts and to devise their own tests.

Halmos is right: education in America has to be reformed from the bottom up. But we cannot in the meanwhile continue to serve warmed-up oatmeal year after year to first-year calculus students. ■

Peter D. Lax is Professor of Mathematics at the Courant Institute for the Mathematical Sciences of New York University.

Louise A. Raphael is Professor of Mathematics at Howard University in Washington, DC.

*(**Major** continued from front page.)*
lier, simpler days when all mathematics majors took essentially the same sequence of courses. Students need regular and frequent departmental advice to explore the many intellectual and career options opened by a mathematical sciences major. Advisors should pay particular attention to the need to retain capable undergraduates in the mathematical sciences pipeline, with special emphasis on the needs of underrepresented groups.

Components and Tracks Seven components form the structure of the mathematical sciences major:

A. Calculus (with differential equations)

B. Linear algebra

C. Probability and statistics

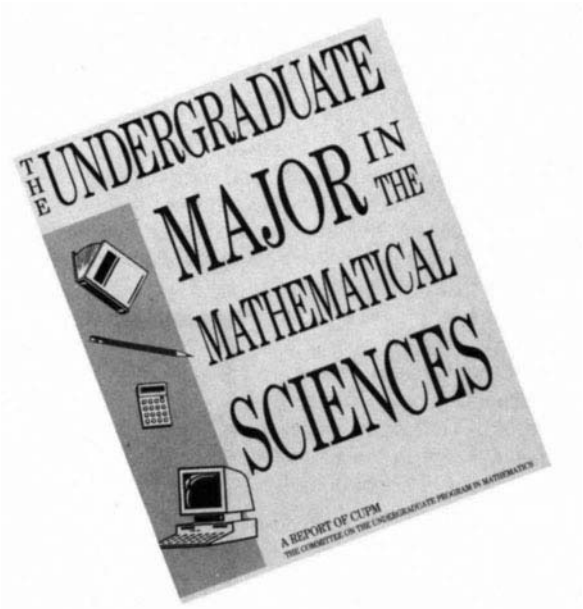
D. Proof-based courses

E. An indepth experience in mathematics

F. Applications and connections (e.g., computer science, physics)

G. Track courses, departmental requirements, and electives

The first six components normally require nine or ten courses (typically three or four semester-hours each), at least seven of which would be taught by the major department. The seventh component highlights the common practice in many colleges of offering formal clusters of courses from which students majoring in the mathematical sciences may choose; these tracks may be offered in one or several mathematical sciences departments.



The report includes information about typical tracks, including actuarial mathematics, administrative or management science, computational and applied analysis, computer analysis, data or systems analysis, discrete mathematics, operations research, pure mathematics, scientific computing, statistics (applied), and teaching (secondary). In some, specificity of the structural component courses may be desirable. Others may require many courses (either outside or inside the mathematical sciences) to complement the structural components. Note that no track is specifically labeled as preparatory for graduate study: with appropriate choices for the structural components, most tracks could provide sound preparation.

Completing the Major In addition to courses and components, the mathematical sciences major should also involve a variety of other types of experiences and activities that are, in some cases, *(**Major** continues on next page.)*

It is only by requiring substantive achievement of our students that we will be able to produce the sort of quantitatively expert individuals who are going to be the mainstay of the discipline and of society for the next century.

*(**Major** continued from previous page.)*
"cocurricular." Several supportive activities are specifically cited in the CUPM report as contributing to students' self-confidence and ability to work with others:

- *Integrative experiences.*

  Every major should be encouraged to think about the mathematical sciences as a whole. Common means include senior independent projects, research or scholarly investigations, problem-oriented senior seminars, independent study that includes writing about some area of mathematics, seminars in which students present accessible journal articles, or an undergraduate colloquium series.

- *Communication and team learning.*

  Major programs should prepare students to communicate mathematics, both orally and in writing. Communication skills are honed when upper-division students assist freshman and sophomores, tutor high school students, or work in teams to investigate mathematical problems of some complexity.

- *Independent mathematical learning.*

  Whether a mathematics graduate enters a mathematical sciences career immediately, goes directly to graduate school, or enters another career path, the student will need to function as an independent learner. Independent study projects and teaching strategies that increase the number of student presentations encourage independent learning.

- *Structured activities.*

  Out-of-class student activities have a long tradition on many campuses, including mathematical honorary societies, MAA Student Chapters, local club activities, and honors programs. Other activities can provide valuable broadening opportunities in teamwork and independent learning; these include preparations for mathematical contests, undergraduate research experiences, and internships and cooperative education.

IMPLICATIONS The statements of philosophy in the report embody educational principles that can lead to an enriching education experience and the recommended program structure provides a flexible vehicle for fulfilling those principles. One underlying tenet, however, transcends the particular form of curriculum implementation: It is only by requiring substantive achievement of our students that we will be able to produce the sort of quantitatively expert individuals who are going to be the mainstay of the discipline and of society for the next century.

A forum to present and discuss these recommendations will be held at the Orono, Maine meeting in August 1991. If you wish to receive a copy of the full report, write: Publications, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385. ■

Bettye Anne Case is Associate Professor of Mathematics at Florida State University in Tallahassee, Florida. She served as chair of the CUPM Subcommittee on the Major.

1990 Annual AMS-MAA Survey *(Second Report)*

Each year the Annual AMS-MAA Survey collects information concerning departments, faculties, and students in the mathematical sciences in the United States and Canada. The highlights below, extracted from the *Second Report,* briefly describe the results from two parts of the 1990 Annual AMS-MAA Survey. First, it updates information about new doctorates earlier reported in the November 1990 *Notices of the AMS,* (pages 1217–1221). (The January–February 1991 FOCUS includes highlights from this *First Report* on page thirteen.) Second, it summarizes results on the characteristics of faculties and instructional programs at the undergraduate and graduate levels.

The AMS-MAA Data Committee patterned the *Second Report* after its previous years' reports to sustain continuity and to facilitate year-to-year comparisons. The *Second Report,* however, also includes new types of information on faculty hiring and categories of faculty positions. The Committee and its chair, Donald E. McClure of Brown University, welcome suggestions from the mathematics community concerning additional types of information or reporting about the mathematics scene which would interest members of the profession.

The final (spring) count reveals that, in the period 1 July 1989 through 30 June 1990, US institutions awarded 950 doctorates in the mathematical sciences. This represents the largest number since 1975–1976 and a 24% increase since the 1984–1985 count.

US citizens accounted for 410 or 43% of the 947 doctoral recipients whose citizenship status is known. This number realizes the second highest total of US citizens in the past six years, but the percentage marks a historical low for the seventeen years in which the survey has tracked citizenship status.

In 1989–1990, 537 non-US citizens earned doctorates—the largest number ever reported. This total represents a 148% increase over the number of noncitizen new doctorates awarded ten years earlier.

In US doctorate-granting mathematics departments, 56% of all graduate students, including master's degree candidates and special students, are US citizens. This percentage is substantially higher than the percentage US citizens represent among new doctorates.

In the final count, women earned 90 (22%) of the 410 doctorates awarded to US citizens. Among non-US citizens, women represent 15% of the new doctorates. These percentages are substantially lower than the ones for earlier stages of the mathematics education pipeline. Women constitute 36% of all US citizen graduate students in US mathematical sciences departments. At the undergraduate level, the representation of women increases to 43% of junior–senior mathematical sciences majors.

Of the 943 new PhDs from US or Canadian institutions whose employment status is known, 60% are employed in academic positions in the US; 16% are employed in nonacademic positions in the US; and 20% are employed outside the US. Only 2% are not yet employed; the remainder are not seeking employment.

The complete *Second Report* of the 1990 Annual AMS-MAA Survey (which also contains enrollment and faculty data) appears in the May-June 1991 *Notices of the AMS.* For a reprint, contact: Monica Foulkes, American Mathematical Society, PO Box 6248, Providence, Rhode Island 02940; (401) 455-4000. ■

The *Car-and-Goats* FIASCO

A number of mathematicians were thrown into a tizzy by the following problem, which appeared last fall in Marilyn vos Savant's column, "Ask Marilyn," in *Parade* (a Sunday newspaper supplement):

> *One of three doors hides a car (all three equally likely) and the other two hide goats. You choose Door 1. The host, who knows where the car is, then opens one of the other two doors to reveal a goat, and asks whether you wish to switch your choice. Say he opens Door 3; should you switch to Door 2?*

Marilyn said yes, arguing that the probability for Door 2 is now 2/3. This led to protests, another column, and then a deluge of additional protests. Altogether she heard from "thousands" of people. Nine-tenths of them insisted that with Door 3 now eliminated, Doors 1 and 2 were still equally likely.

Of the respondents from the general public, 92% disagreed with her, while of the responses from universities, 65% disagreed. It follows that 7 1/2% of the responses came from universities. Therefore 5% were naysayers from universities, and one may suppose that just about all of this group were professional mathematicians.

The mathematicians were a disgrace to the profession. The puzzle requires more patience than readers predisposed toward the rough-and-ready answer seemed willing to devote. Many writers appear to have rushed to reply without first letting their ideas jell. I saw no evidence of the patient attitude of a *teacher*. Instead, the writers quoted were arrogant and condescending—"Get yourself a standard book on probability," "You're the goat," "We're having enough trouble with mathematical illiteracy as it is"—and then proudly identified themselves as PhDs or faculty members. One of them asserted that if the PhD critics were wrong then the country would be in serious trouble.

The country is in serious trouble.

These writers are the products of our graduate schools. Is that where they acquire these attitudes? In class? From professors they see rushing into print?

Interestingly enough, no one seemed to notice that Marilyn had introduced not one game but two. Game I, stated above, is the one the writers are upset about.

As for Game II, Marilyn defined it implicitly by just solving it: If the car is actually at Door 1 (probability 1/3), then when you switch you lose; but if it is at Door 2 *or* Door 3 (probability 2/3) then the host's revelation of a goat shows you how to switch and win. Therefore the chance you win by switching is 2/3. Elegant. But in this argument, we are still considering the possibility that the car is behind Door 3; so the host cannot have already opened that door (much less to reveal a goat). In this game, you have to announce *before a door has been opened* whether you intend to switch.

Game I is a different matter. Here the probability, P, that switching wins is a *conditional* probability: that it wins *given that the host has opened Door 3.* It is easy to see that $P \geq 1/2$. (So the critics are quite wrong.) The host has opened Door 3. It was *certain* he would do that if the car is at Door 2, but less than certain (except in an extreme case) if it is at Door 1. This gives the edge to Door 2. (This reasoning depends on the fact that the *a priori* probabilities for the two doors are equal.)

In fact, P *can be any number between 1/2 and 1.* The nub of the matter is what happens when the car is actually at Door 1, so that the host has a choice of doors to open. The value of P depends on how he makes that choice—on the *probability,* q, that he will open Door 3.

In the extreme case, $q = 0$, the host opens Door 3 only when the car is at Door 2, and $P = 1$.

When $q = 1/2$ we get $P = 2/3$. For when the car is at Door 1 the host opens Door 3 one time in two; but if it is at Door 2 he opens Door 3 two times in two. So when he actually does open Door 3, the car is at Door 2 two times out of three.

Similarly, $P = 1/(1+q) = n/(n+m)$ for any rational $q = m/n$. (By Bayes's rule, the first equation holds for all real q.) Of course, $0 \leq q \leq 1$ implies $1 \geq P \geq 1/2$.

Over a long series of games, where the host opens Door 3 or Door 2 according to his strategy and you switch every time, your win probability is 2/3. This is true regardless of how he chooses or mixes his strategies. Say he sticks with the strategy of the first example. Then he opens Door 3, giving you the sure shot, only 1/3 of the time; the remaining 2/3 of the time, when he opens Door 2, your win probability is 1/2. Your net chances are 1/3 in each case, for a total of 2/3. This is no surprise: you are now playing Game II. ■

LEONARD GILLMAN

Leonard Gillman is Professor Emeritus at the University of Texas at Austin. His many services to the Association include terms as MAA Treasurer (1973–1985) and MAA President (1987–1988). Readers interested in the car-and-goats problem will discover a fuller account of its mathematics in the January 1992 issue of the MAA's AMERICAN MATHEMATICAL MONTHLY.

Sixty-Seventh Summer Meeting Updates
University of Maine, Orono, Maine
8–10 August 1991

1955. Members of the Topology Institute (TI) Softball Team at the University of Wisconsin at Madison. From left to right: unidentified, Robert F. Williams, Morton L. Curtis, Orville G. Harrold, Jr., Marion Kirk Fort, Jr., Jeff Harrold, Eldon Dyer, unidentified, Ernest A. Michael, Edwin Earl Floyd, Morton Brown, C. Edmund Burgess, Leonard Gillman, and Richard D. Anderson.

On Thursday, 8 August 1991 from 8:30 am until 9:20 am, Louis Nirenberg of the Courant Institute of Mathematical Sciences of New York University will deliver his **AMS-MAA Invited Address,** *On the Maximum Principle.*

The Committee on Mathematicians Outside Academia will direct an open meeting on Thursday, 8 August 1991, from 1:00 pm until 6:00 pm. For information on this open meeting, contact: Patrick D. McCray, Chair, Committee on Mathematicians Outside Academia, PO Box 374, Winnetka, Illinois 60093; (708) 982-8532.

Paul A. Foerster of Alamo Heights High School will deliver the **MAA-Mu Alpha Theta Lecture** on *Calculus in an Age of Technology* from 1:40 pm until 2:30 pm on Thursday, 8 August 1991.

An **MAA-AWM Panel Discussion** will explore *Careers That Count: Opportunities in the Mathematical Sciences* on Thursday, 8 August 1991 at 3:00 pm. Jenny Antoinette Baglivo of Boston College will moderate. Immediately following this discussion, the **Membership Meeting** of the Association for Women in Mathematics (AWM) will convene at 4:00 pm.

The Committee on Computers in Mathematics Education (CCIME) (Eugene A. Herman of Grinnell College, chair) and the Subcommittee on Symbolic Computer Systems (Zaven A. Karian of Denison University, chair) of the Committee on the Undergraduate Program in Mathematics (CUPM) will cosponsor a **Panel Discussion** on *Uses of Computers in NSF Calculus Projects* on Thursday, 8 August 1991, from 4:15 pm until 6:15 pm. Organizer Phoebe T. Judson of Trinity University has assembled the following panelists: William H. Barker of Bowdoin College on *Mathematica in Calculus Reform;* Joan R. Hundhausen of the Colorado School of Mines on *Calculus, Physics, and Technology—Mutually Supportive;* David O. Lomen of the University of Arizona at Tucson on *The Role of Technology in Calculus;* and Dennis M. Schneider of Knox College on *Using Mathematics to Teach Calculus.*

The Association invites all contributors to the MAA Mathematical Center Fund to attend its **Donors Reception** on Thursday, 8 August 1991, from 5:30 pm until 6:30 pm. The MAA also encourages each donor to invite a prospective donor to attend this reception.

SUMMA (Strengthening Underrepresented Minority Mathematics Achievement) and its Director, William A. Hawkins, Jr., have organized a **Workshop** on *Intervention Programs Serving Minorities* on Friday, 9 August 1991, from 4:00 pm until 6:00 pm. Participants include Bonnie A. Berken of St. Norbert College and Paul J. Sally, Jr. of the University of Chicago.

The Office of Governmental and Public Affairs (OGPA) of the Joint Policy Board for Mathematics (JPBM) will sponsor a **Forum** on *Employment Issues in the Mathematical Sciences* on Friday, 9 August 1991 from 6:30 pm until 7:30 pm.

On Saturday, 10 August 1991 from 8:30 am until 9:20 pm, Fan R. K. Chung of Bell Communications Research will deliver his **AMS-MAA Invited Address,** *Laplacians of Graphs and Hypergraphs.*

The **Committee on Minority Participation in Mathematics** (CMPM) (Manuel P. Berriozábal of the University of Texas at San Antonio and Sylvia T. Bozeman of Spelman College, cochairs) will meet on Saturday, 10 August 1991 from 1:00 pm until 3:00 pm.

Minicourse 10 on *Mathematical Computer Graphics on the HP-28 C and S and HP-48SX: A Means to Arouse Students' Interest in Mathematics,* organized by Yves Nievergelt of Eastern Washington University, has been cancelled.

Henry O. Pollak of Bell Communications Research and Visiting Professor at Columbia University's Teacher's College will deliver his **Pi Mu Epsilon J. Sutherland Frame Lecture,** *Some Mathematics of Baseball,* on Friday, 9 August 1991 from 8:30 am until 9:30 am.

> "The game of baseball has often been used to provide motivating examples and applications for traditional school mathematics. Baseball also provides a suitable setting for a variety of investigations in data analysis and statistical modeling, in mathematical physics, in stochastic processes, in game theory, and in number theory. The selection of baseball situations which Dr. Pollak will discuss is likely to include the problem of modeling the progress of the World Series and the problem of reconstructing numbers of hits and at bats from information on batting averages. Here are some thoughts about the first of these.
>
> In writing about the World Series, sports writers tend to speak of the relative strength of the teams, of home field advantage, of momentum, of "back to the wall," of "choking," of "experience." How can you quantify these concepts, and how close do they come to explaining the collection of past World Series? One measure of success would be the expected length of the World Series. This is pretty easy to match. A more difficult historical phenomenon is, for example, the fact that a seven-game series is roughly twice as likely as a six-game series. What kind of model would tend to account for this? The speaker would be most pleased if you would come with your own theory!" ■

feature from the new FOCUS editor

How to Find the Right College Position

KEITH DEVLIN

Calculus courses may indeed be growing leaner, and one day calculus texts may even follow suit, but the pile of job applications that lands on the desk of the mathematics chair at any college or university is very definitely growing fast. If things seemed bad last year, this time around the situation has turned out to be even worse for the poor job-seeker, and something of a nightmare for the hiring departments, or so at least it appears to both parties in this ritual.

Despite all those predictions of a huge shortfall of mathematics PhDs a few years from now, at the moment college hiring committees are having to sift through anything up to a thousand applications for a single position. Why is this?

Well, I don't know, and the situation seems to be so chaotic and frantic that I doubt that anyone really knows just what is going on. But as a department chair having filled two vacancies last year and two more this year, I can offer both my own opinions and some anecdotal evidence.

First of all, there are many foreign nationals in the job market. In particular, there are a lot of young mathematicians from mainland China who have recently completed their doctorates at US universities, and a not insignificant number of established (and in some cases very well known) mathematicians from the Soviet Union, both groups having taken advantage of new opportunities to take up permanent residency in the US.

Secondly, the "Reader's Digest syndrome" is at work. Ready access to word-processors has made it easy to send out what amounts to a mass-mailing of a generic job application.

This second factor appears to have been spurred to an even greater extent this year by the hiring freezes that worsening state economies have forced on many state universities and colleges, creating a panic to find a job at one of the places that are still hiring.

The result is that, to take my own institution as an illustration, a small, private college that not long ago could count its job applications in double figures, my colleagues and I were faced with a pile of some 600 dossiers as we started to try to fill our two vacancies back in January.

Having somehow managed to survive that process, I am prompted to try to offer some advice to those on the other side of the fence. For one thing that was abundantly clear, is that a great many applications were a complete waste of time, both for the applicant and the hiring institution. (My sense was that at least a half fell into this category, but I did not take any kind of count—there were too many applications to read to leave any time for a systematic analysis!) Faced with such huge numbers of dossiers, any institution is going to have to make a fairly crude initial cut, in order to produce a more manageable pool of candidates who seem appropriate for the position concerned.

Here then, as one hiring season draws to an end and another will shortly start, is the advice of this particular department chair, to all those facing that seemingly impossible hurdle: finding the first (or maybe the second) job.

First of all, ask yourself just what type of institution you want to apply to. They differ quite a lot in nature: the prestigious research universities, the large state research schools, the smaller state universities, the elite liberal arts colleges, the four-year colleges, and the two-year colleges. Each kind of institution will be looking for different kinds of skills and abilities.

One obvious thing to look for is: does the institution expect applicants to have a PhD? Practically all universities, and a great many colleges do (certainly all of the well-known, four-year colleges). So if your highest degree is a master's, don't waste your time applying to such an institution. Look for a more appropriate place.

And if you do in fact have a PhD, what then? Well, the better-known, large, research schools usually look for extremely good research (either proven or evidentially supported promise) coupled with an acceptable level of teaching ability. In the case of a genuinely talented researcher, they may even settle for quite poor teaching skills. (These days such institutions will probably protest that this is not the case, but in my experience this is not what actually happens. And if such an institution is sufficiently big to carry people purely for their research skills, what is wrong with that if research is a primary function?)

At a selective, small, private, liberal arts college such as my own, the priorities go the other way around. With a bright, highly motivated student body that has chosen the intimate atmosphere of the small college, we cannot afford to hire anyone whose teaching is not of an extremely high standard, but with our fees the same as those of the Ivy League schools, our faculty have to be highly active scholars as well.

*(**Right Position** continues on next page.)*

*(**Right Position** continued from previous page.)*
Or perhaps neither of these two models is quite right for you. In which case, you are wasting your time applying to such an institution; your letter will not pass the first read-through. Both last year and this, I saw many vitae that began with a declaration that the applicant's goal was to secure a position in a large, research-oriented department. Needless to say, such letters did not make the second round.

And then there is the issue of location: do you want an urban campus or are you unable to live unless surrounded by dense forests or rolling plains? The time to ask such questions is before you start to write your letters. Again, on several occasions we pursued an application from what seemed like an ideal candidate for one of our positions, only to discover quite far into the proceedings that the person would never dream of living in rural Maine. Why apply then?

So far, all my points have been fairly general ones. Suppose now that you have thought about the issues involved, and decided the kind of place you wish to apply to. What then? Somehow, you have to ensure that the search committee will include your application among the twenty or so that will receive really detailed consideration.

The trick, I would suggest, is to put yourself in the position of a member of that hiring committee. They have several hundred letters to read and precious little time to do it in. Their initial decision will probably be made on up to four factors, depending on the type of institution concerned: whether your field is appropriate, whether you have a sufficiently strong research record, whether or not you have enough teaching experience, and why you actually want to be at such an institution. So make sure that you address each of these points clearly. Keep it brief at first. You can elaborate later in your letter, or elsewhere in your dossier. Also, give both office and home telephone numbers and, if possible, an e-mail address, so the committee can contact you quickly and easily if the need should arise.

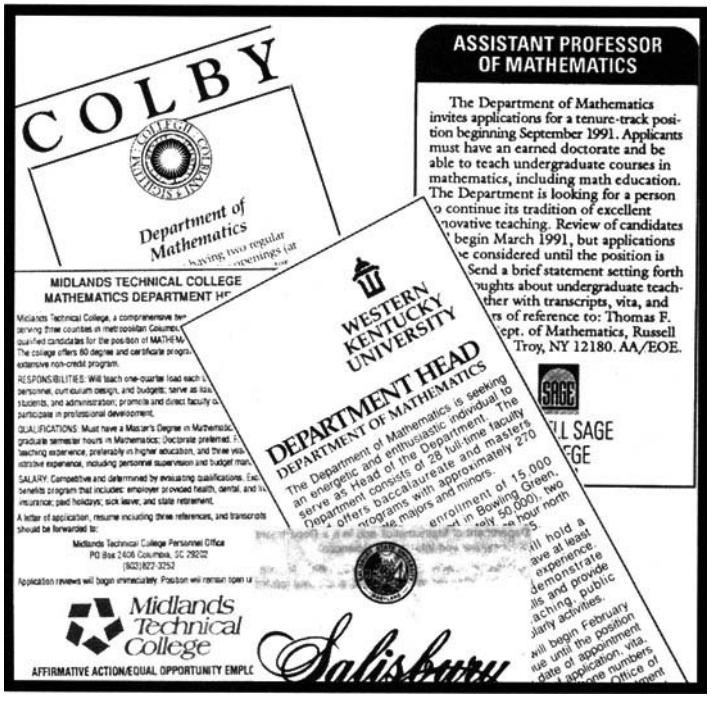
Now let's imagine that you have passed that first hurdle, and your carefully crafted application has found its way into the "short-list" of the twenty (or thirty?) or so that the search committee thinks are really appropriate. What happens next?

Well, at this stage the committee will start to take a much closer look at everything, including those letters of reference that have been flooding in, three or four for each applicant. And it is in order to help you survive this stage that you need to be quite clear what kind of job you are looking for, and tell your referees! Should the letter of reference concentrate on research, on teaching, or both? In our own search I saw numerous letters that extolled at great lengths the fine details of candidate x's research work, and then ended with a single sentence, added almost as an afterthought, that x was also quite an accomplished teacher. For a postdoc at a large research school, such a letter would be fine, of course, but for us it is of almost no use at all. The research is important to us, but nothing like as significant as the teaching ability. At other places the priorities will be different. Clearly then, a generic application that attempts to cover all bases is not at all the best way to proceed. Both your letter and those of your referees should be tailored to the kind of institution you are applying to. Of course, you don't have control over the letters written by your referees. But there is nothing to stop you advising them as to what points you would like them to emphasize.

Naturally, it is not quite as straightforward as the above might suggest. Faced with finding a first job, few candidates feel that they can be very picky. But using the mail-merge utility on your word-processor to mass-produce three hundred identical letters is not the answer. Your chances will increase significantly if you take note of the kinds of institutions to which you want to apply, and craft letters appropriate to each one. (This sounds like an invitation to "cheat." It isn't. Unless you have the credentials to back up your application, no amount of application tailoring is going to get you the job.)

What was the outcome of our own search? At the end of the day, our six hundred applications resulted in some dozen or so that we felt were well-suited for each of our two positions, and out of each of these groups there were some four or five that we invited to interview. As you might expect, these were, by and large, the same people that were being invited to institutions very similar to ours, to Bowdoin and Bates Colleges in Maine and the other selective, private liberal arts colleges around the country. Proof of a sort, I suppose, that for all its seeming chaos right now, the system does appear to result in fitting round pegs into round holes and square pegs into square ones.

And if you were not one of the lucky ones this year, or you are in the final year of your postgraduate work and are about to enter the hunt next year, what then? Well, after you first draft out your letter of application and prepare your vita, pause for a moment and try to imagine you are the department chair faced with all those applications. How will your letter look at the other end? In a field where the institution will undoubtedly be able to find just the kind of person it wants, will it even pass the first cut? It is up to you to ensure that it does. Good luck! ■



Dr. Keith Devlin is Carter Professor and Chair of the Department of Mathematics and Computer Science at Colby College in Waterville, Maine. A native of England, he taught for many years at Lancaster University in England. Prior to moving to Maine, he spent two years (1987–89) on the faculty at Stanford University. He has written some forty-five research papers and a dozen books, including the best-selling MATHEMATICS: THE NEW GOLDEN AGE *(Penguin, 1987). His latest book,* LOGIC AND INFORMATION, *was published by Cambridge University Press in late May. Next month, Dr. Devlin takes over as the editor of FOCUS. His address is: Department of Mathematics and Computer Science, Colby College, Waterville, Maine 04901; kjdevlin@colby.edu.*

President's Message

Deborah Tepper Haimo

As the MAA begins the last quarter of its first century of existence, it enters an era of unparalleled opportunity and challenge. With President Bush continuing to declare that, by the year 2000, our students will be first in the world in science and mathematics, we are witnessing, for the first time, the nation's rising awareness of our discipline's importance to and impact on society.

The MAA has reached its chronological milestone following a decade of accelerating expansion in its membership and of expanding diversity in its activities. It has surged ahead to become the largest professional organization in the world devoted to mathematics at the college level. A succession of farsighted leaders has guided the Association to its current state. Leonard Gillman's judicious committee appointments, while president, set the stage for the Association's direction in recent years. This led to the selection of Marcia P. Sward as Executive Director to succeed Alfred B. Willcox, who retired after serving ably and effectively for two decades. Lida K. Barrett, whose presidency spanned that transition, contributed significantly to imbuing the MAA with renewed energy and vibrancy. Lida and Marcia provided enlightened leadership in addressing the major issues of mathematics and mathematics education.

The MAA has thus emerged as the organization that has taken bold action by:

- welcoming all segments of the mathematical community into its ranks;
- encouraging active participation by underrepresented groups;
- appointing new and diverse representatives to serve on committees;
- initiating student chapters;
- cooperating with other organizations to study and identify problems in our educational system, to propose solutions, and to prepare to oversee their implementation;
- providing realistic, useful career information involving mathematics;
- publishing mathematical materials accessible to a broad readership;
- developing programs to strengthen the mathematics achievement of underrepresented minorities
- supporting programs that introduce technology into mathematics classes; and
- introducing pilot projects on teaching in doctoral-level mathematics departments.

The atmosphere the MAA has created through these initiatives has far-reaching implications for the profession and merits being emulated by other organizations.

It is with considerable enthusiasm that I have assumed my office intent on continuing along the course set. I feel privileged to have the opportunity to move the Association yet further towards its goal of promoting the interests of the mathematical sciences, especially at the college and university level.
*(**President** continues on page fourteen.)*

From the Executive Director's Desk

Marcia P. Sward

. . . making this land all it should be.

America 2000:
An Educational Strategy

A year ago, President Bush challenged the nation to make "US students first in the world in science and mathematics achievement." This April, he and the new Secretary of Education, Lamar Alexander, took the next step and announced a national educational strategy, *America 2000,* designed to lead the nation toward "a true renaissance in American education."

America 2000 calls for the establishment of world-class national standards in five core subjects (English, mathematics, science, history, and geography), a voluntary nationwide examination system (the American Achievement Tests), a *New Generation of American Schools* (starting with one in each congressional district), and designation as an "America 2000 Community" for any community adopting these standards and working toward their achievement.

The Role of the Mathematical Community

This bold plan does not come out of the blue. The mathematics community has been highly active for many years in identifying the problems in US mathematics education and in working towards solutions. Through *Everybody Counts* (National Research Council, 1989) and *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989), both of which received extensive national publicity, and a number of subsequent publications, we have put our case before the public, cautioning about the danger of staying on our present course and articulating a new vision of the teaching and learning of mathematics.

We have also followed through with a multitude of actions, the most recent of which was a National Summit on Mathematics Assessment, 23–24 April 1991, organized by the Mathematical Sciences Education Board (MSEB). The highlight of the Summit, attended by 550 people from all over the country, was an address by President Bush in which he commended the mathematics community for leading the way toward an "American education renaissance" and pledged that "we at the White House will do our level best to back you up every inch of the way" as we take the next steps toward world-class standards in mathematics education.

MAA Accomplishments

The MAA has not been standing still as the nation's spotlight has turned on mathematics education. We have provided strong and consistent leadership at the national level, particularly in the area of undergraduate mathematics, and we have worked within our own membership at the national and Sectional levels, and within the broader mathematical sciences community, to develop awareness, consensus, and action.

I hope you will read the accounts in this Annual Report of the many exciting and promising projects we have underway—endeavors like our recently launched SUMMA Project (Strengthening Underrepresented Minority Mathematics Achievement) and our blossoming Student Chapters. You should also read about the accomplishments of the past year in our publications program, minicourses, competitions, visiting lecturers, etc.

*(**Director** continues on page fifteen.)*

As we look toward the future, our challenge is to continue to identify the changing needs of the mathematical community and the nation and to meet them boldly and effectively.

*(**President** continued from page twelve.)*
With the MAA's rapid growth, structural problems have had to be resolved. To meet the needs of our increasing membership, more than one hundred committees have proliferated. The Board of Governors dealt with the resulting complexity when it recently adopted a proposal in which every committee is assigned to one of six *Areas:* Awards, Competitions, Education, Human Resources, Meetings, and Publications. For each Area, a *Coordinating Council* is appointed to oversee all committee activities and to keep the Executive Committee abreast of what goes on and what changes should be introduced. It is important for me to implement the new structure, making sure that it streamlines the work of the Association without imposing additional bureaucratic barriers, and that it preserves the collegiality that has always been a hallmark of the MAA.

One of our most important and exciting initiatives is the introduction of MAA awards for distinguished teaching at the college and university level. Although there has been a program of awards for many areas of mathematics, including, for example, expository writing and service, there has never been specific recognition of outstanding teaching, despite the fact that improving teaching, interpreted in its broadest sense, has been a major concern of the Association. We will now correct this omission during my presidential tenure, as we name awardees at both the Sectional and national levels.

Our concern with good teaching is not limited merely to college faculty. We are also involved with school mathematics, recognizing that teachers are prepared at the postsecondary level, and that colleges depend on the quality of secondary-level preparation. Consequently, in conjunction with the issuance of reports by other mathematical organizations, including *Professional Standards for Teaching Mathematics* (National Council of Teachers of Mathematics (NCTM), 1991) and *Counting on You: Actions Supporting Mathematics Teaching Standards* (Mathematical Sciences Education Board (MSEB), 1991), the MAA recently published *A Call for Change: Recommendations for the Mathematical Preparation of Teachers of Mathematics,* edited under the dedicated guidance of James R. C. Leitzel of Ohio State University.

With the MAA's establishment of SUMMA (Strengthening Underrepresented Minority Mathematics Achievement), and the appointment of its director, William A. Hawkins, Jr., we are making substantial progress in this area. A most gratifying development is the culmination of this office's extensive activity in the award of a major grant for its intervention program from the Carnegie Foundation.

In the selection of its leadership, the MAA has toppled gender barriers decisively. We need to continue to extend the great strides made to the general membership as well. The problems have been addressed dauntlessly in recent years and are featured in the MAA's newly released volume, *Winning Women into Mathematics,* edited by Patricia Clark Kenschaft of Montclair State College.

Many other mathematics organizations exist, some at different levels, and some directed to specific interests. We must continue to develop close ties with all of them. In striving to find ways to complement each other's efforts and to coordinate our activities, we can best serve the mathematical community.

We have a special historical relationship with the American Mathematical Society (AMS). The unfortunate fact is that, too often, artificial obstacles have separated research and undergraduate teaching. Our two organizations have significant overlapping constituencies and many common interests. In recent years, we have successfully cooperated in some areas, but we must work more closely toward a common goal. We must recognize our respective strengths and directions, and we must meet as equals to determine our most constructive roles. We need to collaborate, rather than to compete, and we must learn to appreciate the contributions of all those involved in and committed to college-level mathematics.

The MAA has actively addressed many of the major issues that are now gaining increasing national attention, attesting to its stance as a forward-looking, vibrant organization, sensitive to the problems of the age. As we look toward the future, our challenge is to continue to identify the changing needs of the mathematical community and the nation and to meet them boldly and effectively. ■

Committee on Sections

In 1990, more than 5,000 MAA members attended Section meetings and sampled from the numerous invited addresses, contributed papers, minicourses, and workshops offered. In addition, more than 170 students delivered papers at these meetings. Banquets, pizza parties, and social breaks in the meeting program encourage the renewal and establishment of friendships. The Association enthusiastically supports its Sections through numerous avenues including the MAA Fund to Aid Sections. This fund enables Sections to initiate projects and improve existing ones.

The Committee on Sections continues to review its service to the MAA's twenty-nine Sections. At the Association's annual and summer meetings, the Committee hosts Section Officers' meetings and, indeed, although only the annual meeting receives funding, many members attend both meetings.

Each year in late spring, each Section files an annual report describing its recent activities. The Committee on Sections then compiles these reports and distributes the resultant summary to Section officers. These reports discuss many of the innovative ideas, outstanding speakers, and diverse elements forging a successful Section meeting. If you would like to receive a copy of this report, contact: Mary McLean Bancroft, MAA Sections Liaison, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1387; (202) 387-5200; cap@hilda.umd.edu

Finally, the Committee on Sections and its current chair, Barbara Trader Faires of Westminster College, wish to thank its longstanding chair, David W. Ballew of Western Illinois University, for his active and dedicated leadership. ■

Committee on Student Chapters

The MAA's Student Chapters continued to grow markedly in 1990; approximately 3,000 students now belong to the Association's 265 Chapters. The 1991 Annual Meeting in San Francisco, California incorporated several student-oriented activities for the first time. Highlights included a hospitality center and reception for students. Lester H. Lange of San Jose State University prepared a lecture for students entitled *Desirable Scientific Habits of Mind Learned from George Pólya* and Marilyn B. Durkin of Bentley College conducted an engrossing minicourse on fractals. The 1991 Summer Meeting in Orono, Maine promises more exciting student activities.

In 1990, the Exxon Education Foundation provided support for five Sections to experiment with pilot student projects that hold promise for implementation at national meetings. With this funding, the Eastern Pennsylvania and Delaware (EPADEL), Allegheny Mountain, Northeastern, Ohio, and Oklahoma-Arkansas Sections organized overwhelmingly successful workshops and other programs for students. The Maryland-District of Columbia-Virginia and New Jersey Sections collaborated with EPADEL in this endeavor. Exxon awarded an additional $32,500 to the Student Chapters program to support several activities. Under this grant's provisions, each Section may request a $500 award to finance initiatives designed to attract more students to mathematics. The MAA will apply some Exxon funds to mount a *Career Fair* for students during the January 1992 Annual Meeting in Baltimore, Maryland.

In 1990, Deborah A. Frantz of Kutztown University accepted the editorship of the Student Chapter newsletter and, to date, has produced two attractive and informative issues. The Committee also developed several Student Chapter resource materials, including a monthly mailing entitled *Mathematician of the Month.* These mailings feature mathematicians from business, industry, government, and academia narrating their educational and career histories. In August 1990, the Association published its *Careers in the Mathematical Sciences* brochure and subsequently distributed 25,000 copies. A complementary brochure, *More Careers in the Mathematical Sciences,* will appear in 1991. This forthcoming brochure introduces six mathematical scientists who embarked on diverse and demanding careers without earning a doctorate.

For additional information on the MAA's Student Chapters program, contact: Howard Anton, Chair, MAA Committee on Student Chapters, Department of Mathematics and Computer Science, Drexel University, Philadelphia, Pennsylvania 19104; (215) 895-2668; antonh@duvm.bitnet. FAX: (609) 770-8297. ■

*(**Director** continued from page thirteen.)*
In addition to these reports, we have several other projects that address such topics as the use of calculators and computers in the mathematics classroom, the preparation of future mathematics teachers, information about careers in the mathematical sciences, and the role of mathematics in solving environmental problems.

To help deal with the complex mix of on-going activities and special projects, President Haimo appointed six Coordinating Councils to assist our 135 committees in mapping out their activities, reducing unnecessary overlap with other committees, and communicating with the elected officers.

Finding the Necessary Resources

A critical dimension of the MAA's work is the resource base that we obtain from our members, together with the grants and contracts we secure from outside sources. Our membership has continued to climb, now standing at 34,000 members, albeit at a slower rate of growth than in recent years. In grants, we received a total of $2,413,453 since June 1990 to support special projects. This comprises 16% of our $4.5 million budget. Proposals are pending for a number of other projects, some major, some modest, and as funding is received, we hope to develop new thrusts in curriculum, quantitative literacy, interactive computing, and minority education.

As Treasurer Donald L. Kreider reports (on page thirty of this issue of FOCUS), we ended 1990 solidly in the black. Furthermore, the many generous contributions to the Greater MAA Fund (devoted exclusively to the support of SUMMA) and to the Mathematical Center Fund provide eloquent testimony to the value of our work to its friends and members. These contributions have greatly strengthened our ability to act in this time of opportunity.

Strategic Planning

To ensure that we give careful consideration to the future directions of the Association, we are launching a strategic planning activity to be carried out over the next fifteen months. Common wisdom is that in an environment which is changing rapidly in almost every possible dimension (technology, competition, finances, demographics, communications, etc.), the organization which is not prepared to deal with change in an organized way may find itself quickly outmoded and no longer of value to its members.

We will launch this strategic planning activity important to the Association's future in August 1991 with a two-day retreat immediately before the Summer Meeting in Orono, Maine. A critical ingredient is an analysis of our members' changing needs, so we will be calling upon you to engage with us in identifying your professional needs, particularly those which the MAA's national and Sectional organizations can help meet.

Conclusions

This year has been a banner year for the MAA and for mathematics education. But evidence is accumulating that the coming year will go off the scale! We should all be proud that we have built a strong and effective organization ready to meet the challenges that the President has put before us. We must all be ready to reassess and reshape the MAA to become even more effective, a potent national force for world class mathematics education and for "making this land all that it should be." ■

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Committee on Visiting Lecturers

The Association's Visiting Lecturers Program serves departments of mathematics across the country. Its objectives include:

1. strengthening and stimulating the mathematics programs in two-year colleges and in those four-year colleges not offering a PhD in mathematics;

2. affording staff and students at such colleges with opportunities to meet and converse with creative mathematicians and mathematical scientists;

3. communicating new and relevant applications of mathematics and computer science to not only the physical sciences and engineering, but also the biological and social sciences; and

4. strengthening the rapport among mathematicians working for government, industry, and educational institutions of all types.

Visiting lecturers agree to remain in the program for four years, after which they must take at least a two-year hiatus before the Committee invites them to participate again. MAA Visiting Lecturers not only deliver formal presentations, but also meet with students and faculty informally. They will happily discuss opportunities for graduate study and employment with students, and they will cooperate with departments to further the aims of their mathematics programs.

In January 1991, the Committee distributed its current booklet to chairs of departments of mathematics across the nation. Inside, a geographical register organizes lecturers according to location. By consulting this register, you could select lecturers residing near your institution and, consequently, reduce transportation costs. The booklet's principal section introduces lecturers alphabetically with addresses and lecture topics. (The 1991 booklet omitted biographies to conserve space and expense. You may obtain these details from the lecturer.) One or more letters follow each topic—E, I, A—to indicate that lecturers can adapt their presentations for an elementary, intermediate, or advanced audience. Interested departments should arrange for visits directly with the lecturers. Following a visit, you should notify the Committee chair and briefly evaluate your impressions of and experience with the program.

Members of the Committee on Visiting Lecturers urge you to take advantage of the opportunities this program provides. You can defray the expenses of a lecturer's visit through several approaches. Some institutions maintain faculty development funds which could provide financing. You might discover grants from other institutional sources. Some of the lecturers' home institutions have indicated a willingness to assist with travel costs (asterisks distinguish these listings in the principal section). To assist you, the 1991 booklet discusses guidelines for financial considerations.

A Note to Current and Potential Lecturers Please ask your institution if they will underwrite—either partially or completely—your visiting lecturer travel expenses; the 1992 booklet will indicate that information. In addition to lecturing, you may interview prospective candidates for your graduate program (a benefit which may open the coffers of the Graduate Admissions Office!)

The Committee welcomes suggestions and comments to improve the program. It also invites the names of potential lecturers, and particularly solicits names from states currently without representatives. If you have heard an outstanding speaker whom you think might further the program's objectives as stated above, or if you wish to receive additional information on the program, contact: James G. Ware, Chair, MAA Visiting Lecturers Program, Department of Mathematics, University of Tennessee at Chattanooga, Chattanooga, Tennessee 37403. ■

Committee on Faculty Development

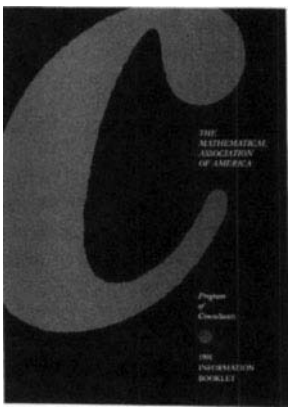
The Committee on Faculty Development formulates recommendations and submits proposals to the Association to encourage and guide professional growth. Suggested activities, appropriate for both national and Sectional meetings, include minicourses, workshops, and summer institutes. The Committee currently pursues three objectives:

- development of a position statement for the Association on the role of faculty development in higher education;
- sponsorship of a minicourse at the January 1992 Annual Meeting in Baltimore, Maryland on small group instruction in college mathematics classrooms; and
- parallel with such sponsorship, publication of an MAA Notes volume on programs for faculty development at the local, state, and provincial levels.

For additional information on this Committee's endeavors, contact: John A. Dossey, Chair, MAA Committee on Faculty Development, RR One, Box 165, Eureka, Illinois 61530; (309) 438-8781; NDOSSEY@ECN.CDC. ■

Committee on Consultants

In early 1991, the MAA Committee on Consultants completed production of its informational brochure, *Program of Consultants.* Currently, eighty-six consultants represent the forty-eight contiguous states. Their areas of expertise encompass mathematics, mathematics education, statistics, emerging doctoral programs, two- and four-year college programs, and university programs. In addition, the *Program of Consultants* also includes individuals with expertise in such timely topics as funding and calculators and computers in the classroom. The Committee hopes that every department of mathematics in the United States will examine its brochure and decide if they would like some consultants to visit their campus and, if so, for what purpose. For additional information on this program, contact: Richard S. Millman, Chair, MAA Committee on Consultants, College of Science and Mathematics, Wright State University, Dayton, Ohio 45435; (513) 873-2611; RMILLMAN@WSU.BITNET. ■



1990 Prizes and Awards 1990 Prizes and Awards 1990 Prizes and Awards 1990 Prizes and Awards

In 1990, the MAA honored several authors for their achievement in mathematical exposition. Each winner received a check, a certificate, and the recognition and esteem of his colleagues. So many mathematicians rely on written communication to learn of recent developments in our discipline. The efforts of these authors to explore such developments in lucid and engrossing prose deserve both our admiration and gratitude.

At the 1991 Annual Meeting in San Francisco, California, **W. B. Raymond Lickorish** of the University of Cambridge and **Kenneth C. Millett** of the University of California at Santa Barbara received the 1990 Chauvenet Prize for "The New Polynomial Invariants of Knots and Links," which appeared in *Mathematics Magazine,* **61** (February 1988): 2–23. In 1989, before winning the prestigious Chauvenet Prize, this graceful article earned the Carl B. Allendoerfer Award for its "basic information, very helpful figures, and good references . . . ." The Chauvenet Prize Committee characterized Lickorish's and Millett's essay as "a beautifully written account of the fundamental and unexpected developments stemming from V. F. R. Jones' discovery that trace functions on operator algebras give rise to new and amazingly simple invariant polynomials for knots and links. The Jones invariants are the first new tools for classifying simple closed curves in three space since the introduction of the Alexander polynomials sixty years ago."

In addition to the Chauvenet Prize, the Association, through its journal awards committees, also honors outstanding articles in each of its periodicals: the Carl B. Allendoerfer Award for papers in *Mathematics Magazine;* the Lester R. Ford Award for papers in *The American Mathematical Monthly;* and the George Pólya Award for papers in *The College Mathematics Journal.* (For a more detailed discussion of 1990's winners and their exceptional exposition, see page nine of the November–December 1990 issue of FOCUS.)

■ THE CARL B. ALLENDOERFER AWARD

Thomas W. Archibald of Acadia University for "Connectivity and Smoke-Rings: Green's Second Identity in Its First Fifty Years," in *Mathematics Magazine,* **62** (October 1989): 219–232.

Fan R. K. Chung and **Ronald L. Graham,** both of Bell Communications Research, and **Martin Gardner** for "Steiner Trees on a Checkerboard," in *Mathematics Magazine,* **62** (April 1989): 83–96.

■ THE LESTER R. FORD AWARD

Jacob Eli Goodman of City College of the City University of New York, and **János Pach** and **Chee K. Yap,** both of the Courant Institute of Mathematical Sciences of New York University for "Mountain Climbing, Ladder Moving, and the Ring Width of a Polygon," in *The American Mathematical Monthly,* **96** (June–July 1989): 494–510.

Doron Zeilberger of Drexel University for "Kathy O'Hara's Constructive Proof of the Unimodality of the Gaussian Polynomials," in *The American Mathematical Monthly,* **96** (August–September 1989): 590–602.

■ THE GEORGE PÓLYA AWARD

Israel Kleiner of York University for "Evolution of the Function Concept: A Brief Survey," in the *College Mathematics Journal,* **20** (September 1989): 282–300.

Richard Dean Neidinger of Davidson College for "Automatic Differential and APL," in the *College Mathematics Journal,* **20** (May 1989): 238–251.

In January 1991, also during the Annual Meeting in San Francisco, California, the MAA recognized several mathematicians for their myriad and enduring contributions to both the Association and mathematics education. Recipients of the MAA's Meritorious Service Award included: **Arlington M. Fink** of Iowa State University and the Iowa Section; **Alice King** of California State Polytechnic University and the Southern California Section; **Calvin T. Long** of Washington State University and the Pacific Northwest Section; **Harry D. Ruderman** of Hunter College High School and the Metropolitan New York Section; **Doris W. Schattschneider** of Moravian College and the Eastern Pennsylvania and Delaware Section; and **Alvin Swimmer** of Arizona State University and the Southwestern Section. These six Sections first submitted their nominations for this award; the Association's Board of Governors then endorsed their selections. (For additional information on the contributions of these dedicated individuals, see pages six and seven of the April 1991 issue of FOCUS.)

At the same meeting, **Shirley A. Hill,** Curator Professor of Education and Mathematics at the University of Missouri at Kansas City, accepted the second Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics. Hill is a distinguished and indefatigable leader in mathematics—particularly in the area of mathematics education. Her contributions range from early involvement in mathematics curriculum development in Africa in the late 1960s to her pivotal role, from 1985 through 1989, as chair of the Mathematical Sciences Education Board (MSEB) of the National Research Council (NRC). Throughout her career, Hill has served the mathematics community in numerous professional capacities, including the presidency (1979–1980) of the National Council of Teachers of Mathematics (NCTM) and membership on the Board of Governors of the Mathematical Association of America, the editorial board of the *American Mathematical Monthly,* the National Board of Professional Teaching Standards (NBPTS), and the Screening Committee of the 1986 International Congress of Mathematicians (ICM). The January 1991 issue of *The American Mathematical Monthly* opens with the complete citation accompanying Hill's award. ■

Shirley A. Hill

Committee on the Undergraduate Program in Mathematics (CUPM)

The work of the Committee on the Undergraduate Program in Mathematics (CUPM) encompasses a broad agenda that is carried out by several subcommittees and coordinated with the work of other, related committees through discussions sponsored by the CUPM at the MAA's annual and summer meetings.

In 1990 several CUPM subcommittees completed reports that had been under development for some time. During the past twelve months, the MAA published the following volumes:

- *Priming the Calculus Pump: Innovations and Resources*
- *Models for Undergraduate Research in Mathematics*
- *Challenges for College Mathematics: An Agenda for the Next Decade*
- *The Undergraduate Major in the Mathematical Sciences*

In addition, the CUPM prepares a regular column for *UME Trends,* the newsletter on undergraduate education sponsored by the Joint Policy Board for Mathematics (JPBM). Each issue features a report from one of the CUPM subcommittees.

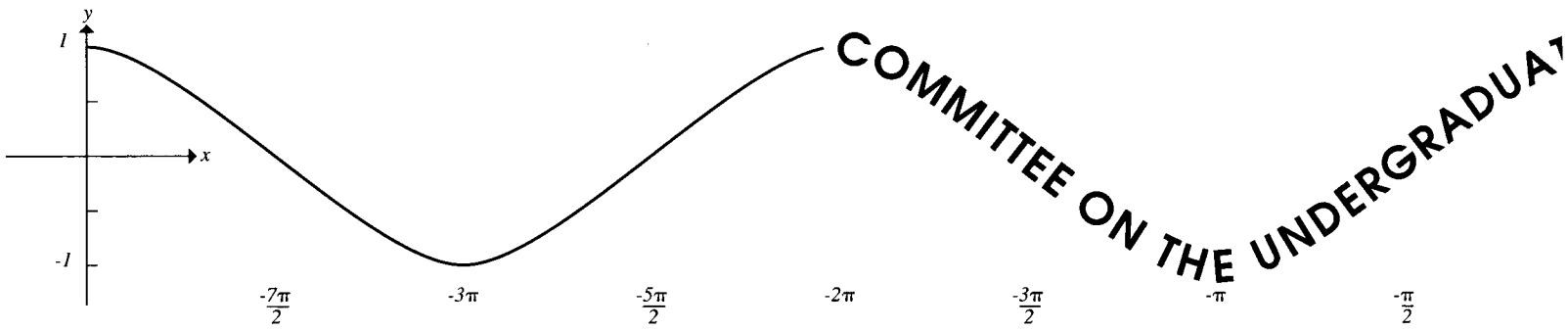
Near the close of 1990, the MAA received a grant from the National Science Foundation (NSF) to launch a Curriculum Action Project (CAP) (described in this issue of FOCUS, below) that will provide impetus in several areas where new initiatives are timely and important: assessment, geometry, mathematics and the environment, quantitative literacy, and statistics. Several CUPM subcommittees are actively involved in this project.

For additional information on the CUPM and its concerns, contact: Lynn A. Steen, Chair, MAA Committee on the Undergraduate Program in Mathematics, St. Olaf College, Northfield, Minnesota 55057; (507) 663-3114; steen@stolaf.edu.

CUPM Subcommittees

Subcommittee on Assessment
Chair: Bernard L. Madison of the University of Arkansas
Charge: To examine current practice and make recommendations concerning assessment programs for undergraduate mathematics majors. This is the newest Subcommittee of the CUPM and is just beginning its work via an electronic Focus Group as part of the MAA's Curriculum Action Project (CAP) discussed below.

Subcommittee on the Basic Library List
Chair: Lynn A. Steen of St. Olaf College
Charge: To prepare a revision of the MAA's *Basic Library List.* This Subcommittee is nearing the end of a two-year project to screen approximately 20,000 books and make recommendations for the revised *Basic Library List,* which should appear in the fall of 1991.
*(**CUPM** continues on next page, top.)*



Developing an Intellectual Agenda for Undergraduate Mathematics

The MAA's Curriculum Action Project (CAP) seeks to build a foundation for a comprehensive national effort to strengthen the mathematical sciences at the undergraduate level. This nine-month project, with support from the National Science Foundation (NSF), will develop an intellectual agenda for undergraduate mathematics and initiate a broad-based dialogue within and among both the mathematical community and its various external constituencies. The project convened a series of *Focus Groups* to identify key issues, produce a statement of priorities, and make recommendations or observations which will then shape the undergraduate intellectual agenda. Lynn A. Steen of St. Olaf College serves as its Project Director. James R. C. Leitzel of The Ohio State University acts as the MAA Staff Liaison for CAP while serving this year as Visiting Mathematician at MAA Headquarters in Washington, DC.

The project selected five Focus Groups: Assessment, Geometry, Mathematics and the Environment, Quantitative Literacy, and Statistics. Each Focus Group will ultimately contribute a chapter towards CAP's chief product—a volume devoted to the mathematical sciences at the undergraduate level. These Focus Groups, varying in size from fifteen to twenty-five participants, operated as moderated, e-mail conference collectives. In mid-May 1991, they completed the lively interchanges that characterized their conference periods and have now directed their attention towards organizing and compiling the groups' reports into a cohesive statement. This CAP volume should appear at the close of 1991. A brief description of the five FOCUS groups follows.

Assessment Bernard L. Madison, Dean of the Fulbright College of Arts and Sciences at the University of Arkansas at Fayetteville and chair of the CUPM Subcommittee on Assessment, moderated this group. The CUPM Subcommittee examines and makes recommendations concerning all aspects of assessment of undergraduate majors in the mathematical sciences, including those used for individual assessment, for departmental self-evaluation, and for external review of departments.
*(**Intellectual Agenda** continues on next page, bottom.)*

*(**CUPM** continued from previous page, top.)*

Subcommittee on Calculus Reform and the First Two Years
Chair: Thomas W. Tucker of Colgate University
Charge: To examine practice and make recommendations concerning the content, sequencing, and relationships among beginning courses in the mathematics curriculum. Having finished its MAA Note 17, *Priming the Calculus Pump: Innovations and Resources,* this Subcommittee is now turning its attention to linear algebra and related courses. It will sponsor a contributed paper session at the 1992 Annual Meeting in Baltimore, Maryland.

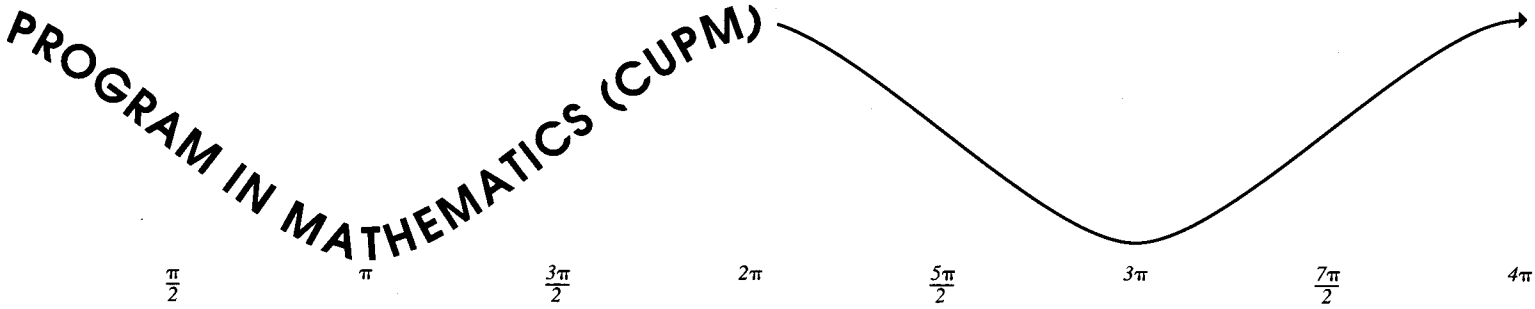
Subcommittee on Quantitative Literacy Requirements
Chair: Linda R. Sons of Northern Illinois University
Charge: To examine and make recommendations concerning all aspects of undergraduate mathematics or quantitative literacy requirements. This new Subcommittee is beginning its work via an electronic Focus Group as part of the MAA's Curriculum Action Project (CAP) discussed below.

Subcommittee on Service Courses
Chair: Barbara A. Jur of the University of Tennessee
Charge: To promote dialogue with client disciplines in order to recommend the content of mathematics courses designed especially for students majoring in other subjects (e.g., engineering, biology, chemistry). This Subcommittee now studies mathematics service courses for business students and has planned panel meetings and a contributed paper session at the 1992 Annual Meeting in Baltimore, Maryland to engender widespread discussion of this topic.

Subcommittee on Symbolic Computer Systems
Chair: Zaven A. Karian of Denison University.
Charge: To stimulate development of curricular materials and teaching methods appropriate to a world in which common mathematical practice will routinely employ the power of symbolic computer systems. This Subcommittee regularly sponsors panels and talks at the annual meetings and is currently preparing two publications—a set of annotated problems that use computer algebra systems and a volume of papers addressing curricular matters.

Subcommittee on the Undergradute Major
Chair: Bettye Anne Case of Florida State University
Charge: To examine present practice regarding the undergraduate mathematics major and update the 1981 CUPM Report, *Recommendations for a General Mathematical Sciences Program.* During 1990 this Subcommittee completed its work on *The Undergraduate Major in the Mathematical Sciences,* which the MAA published in the spring of 1991. (See the cover page and pages six and seven of this issue of FOCUS for a summary of this CUPM document.)

Subcommittee on Undergraduate Research
Chair: Lester Senechal of Mount Holyoke College
Charge: To stimulate interest in research experiences for undergraduates. This Subcommittee organized several events for both students and faculty mentors at the January 1991 Annual Meeting in San Francisco, California, and produced MAA Note 18, *Models for Undergraduate Research in Mathematics,* a volume of papers selected from various special sessions devoted to this topic. ■



*(**Intellectual Agenda** continued from previous page, bottom.)*

Geometry Joseph Malkevitch of York College of the City University of New York moderated this group. He also contributes to a geometry project of the Consortium for Mathematics and Its Applications (COMAP). Despite the increased pace of exciting development in both the theory and applications of geometry in the last forty years, it appears that colleges currently teach less geometry than in the recent (or distant) past. Today, geometric applications to biology, computer science, engineering, etc., provide opportunities to rethink geometry's role in the undergraduate curriculum.

Mathematics and the Environment Ben A. Fusaro of Salisbury State University and chair of the MAA's Committee on Mathematics and the Environment moderated this group. In contrast to CAP's other Focus Groups—divisions with a history of discussion—mathematics and the environment is the "new kid on the block." This Focus Group considered strategies to introduce problems relating mathematics and the environment into general mathematics courses, to increase the emphasis on environmental modeling in courses for mathematics majors, and to encourage faculty and students to use their mathematical skills to seek solutions to local, regional, and national environmental problems.

Quantitative Literacy Linda R. Sons of Northern Illinois University and chair of the CUPM Subcommittee on Quantitative Literacy Requirements moderated this group. As citizens, we confront conflicting quantitative information every day and need to recognize both the power and limitations of mathematics. This group discussed possible guidelines and recommendations for quantitative literacy of college graduates.

Statistics George Cobb of Mount Holyoke College and chair of the joint Statistics Committee of the MAA and the American Statistical Association (ASA) moderated this group. Its discussion sharpened the charge made to that joint committee. Every statistics teacher and every student of statistics must contend with an essential tension: to the practicing statistician, methods serve the process of coming to understand particular data sets; to the student of statistics, data sets serve the process of coming to understand particular methods. This group examined approaches for reconciling these contending priorities.

For further information on the Curriculum Action Project, contact: James R. C. Leitzel, MAA Staff Liaison for CAP, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385; (202) 387-5200; cap@hilda.umd.edu. ■

Committee on Testing (COT)

The Committee on Testing (COT) concerns itself with mathematics testing, assessment, and evaluation. Its current activities include administration of the Association's Placement Testing (PT) Program, oversight of externally funded projects related to testing, development of policy statements addressing trends and issues in testing, and creation of mathematics placement testing networks. COT engages in some of these activities with other MAA committees, e.g., the Subcommittee on Assessment (SUM) of the Committee on the Undergraduate Program in Mathematics (CUPM).

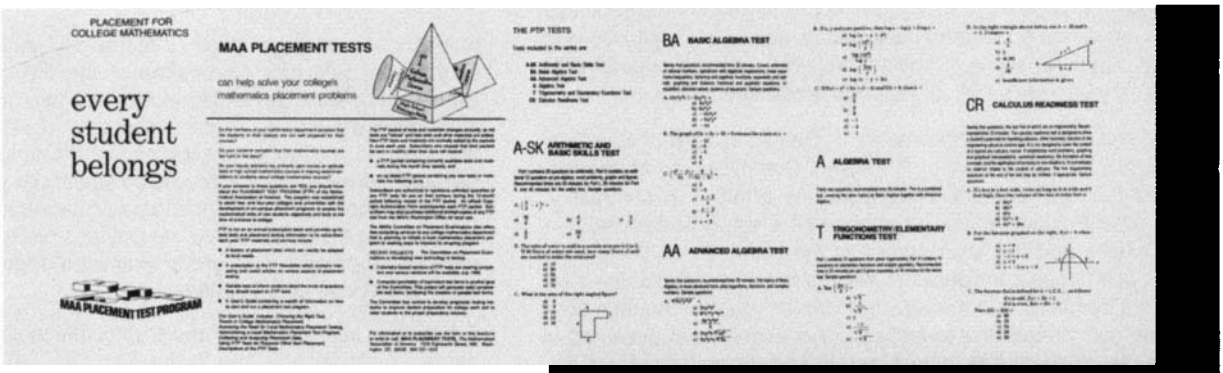
MAA Placement Testing (PT) Program COT's primary, long-term commitment rests with its PT Program. Approximately 400 two- and four-year colleges and universities subscribe to this program annually. The PT Program test packet currently includes six college-level placement tests with which subscribers test rising high school juniors. This test packet also contains two calculator-based tests: the *CB Arithmetic and Skills Test* and the *CB Calculus Readiness Test.* In mid-1990, a new *Arithmetic and Skills Test* replaced the *Arithmetic and Basic Skills Test* and, by mid-1991, the test packet will also incorporate two additional calculator-based tests—the *CB Basic Algebra Test* and the *CB Algebra Test.*

Funded Projects At present, COT oversees three externally funded projects: the Calculator-Based Placement Test Program (CBPTP) Project, the Computer-Generated Placement Test (CGPT) Project, and Teaching Mathematics with Calculators: A National Workshop (TMC). The CBPTP Project, established in late 1986 with continuing funding from Texas Instruments, Inc., develops the calculator-based tests destined for the PT Program test packet. At present, the project is preparing two calculator-based prognostic tests and has initiated production of college-level trigonometry and advanced algebra placement tests. The CGPT Project, with support from the Fund for the Improvement of Postsecondary Education (FIPSE), devises computer software to generate PT Program test items. This project also directs a large-scale study of the items and tests this new software generates to determine if structurally parallel test items are also statistically parallel. Teaching Mathematics with Calculators: A National Workshop (TMC), a joint venture of the MAA and the National Council of Teachers of Mathematics (NCTM), has just completed its first year. The National Science Foundation (NSF) and Texas Instruments Inc. provide its funding. During 1990, the TMC workshop conducted a four-week summer institute for "Mathematics Technology Lead Teachers" in Mesquite and Fort Worth, Texas. It also began formulating two twenty-minute videotapes and accompanying printed materials for teachers to review while learning to incorporate calculators effectively in their mathematics instruction. During 1991–1992, the TMC Project will complete production of these two of its planned nine videotapes and accompanying printed materials. It will also organize three two-week summer institutes for its teachers from Mesquite and Fort Worth.

Outreach and Training COT also continues its outreach and training activities. For example, the Committee gathers information concerning mathematics prognostic testing and offers consulting services to PT Program subscribers. During 1990–1991 several states, including Iowa, Kansas, Missouri, Montana, and Tennessee, expressed interest in or launched a prognostic testing program; they join the more than twenty states who already administer or wish to establish such programs. In addition, COT members frequently conduct placement testing workshops and minicourses. In 1990–1991, Committee members directed such workshops and minicourses at the annual meeting of the American Mathematical Association of Two-Year Colleges (AMATYC), at the January 1990 Annual Meetings of the Association and the American Mathematical Society (AMS), and at the annual meeting of the National Association of Development Education (NADE). COT members also delivered papers on placement tests at the 1990 Ohio State University International Conference on Technology in Collegiate Mathematics Education, at the Iowa State Conference on Junior-Level Testing, and at the 1991 annual meeting of the National Association of Developmental Education (NADE).

For additional information on COT and its many projects, contact: John G. Harvey, Chair, MAA Committee on Testing, Department of Mathematics, University of Wisconsin at Madison, 480 Lincoln Drive, Madison, Wisconsin 53706-1388; (608) 262-3746; harvey@math.wisc.edu. FAX: (608) 238-3811.

If you wish to receive an informational packet on the MAA's Placement Testing Program, contact: Linda M. Heineman, MAA Placement Test Coordinator, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385; (202) 387-5200; maa@athena.umd.edu. FAX: (202) 265-2384. ■



Placement Testing (PT) Program

On 27 August 1990, SUMMA (Strengthening Underrepresented Minority Mathematics Achievement) opened its offices at MAA headquarters in Washington, DC. As the Association's Board of Governors advocated in its September 1989 policy statement, SUMMA seeks to increase minority representation in mathematics, science, and engineering, and to improve the mathematical education of minorities. The program first undertook to inform both the minority and majority mathematical communities of its existence and its mission; it continues to address both audiences.

Several organizations provided planning grants to support SUMMA while it sought funding for these five components. Contributors included the Exxon Education Foundation ($50,000), the Carnegie Corporation of New York ($25,000), and the MAA ($15,000 and an additional $49,000 from the Greater MAA Fund). In early 1991, the Carnegie Corporation approved increased support to finance $5,000 planning grants for SUMMA's first component: to encourage mathematicians to initiate mathematics-based, precollege intervention projects for minority students.

S U M M A

Strengthening Underrepresented Minority Mathematics Achievement

SUMMA emphasizes minority outreach because, historically, minorities have not fully participated in the larger mathematical environment. Indeed, many minority institutions, including historically black colleges and universities, Hispanic-serving institutions, and tribal colleges, have not joined the MAA, the American Mathematical Society (AMS), or the Society for Industrial and Applied Mathematics (SIAM) as institutional members. Few have organized MAA Student Chapters or hosted MAA Sectional or AMS regional conferences. Moreover, few minority mathematicians attend these or the Association's annual or summer meetings.

Many mathematicians participated in such intervention projects in their youth and readily recognize their crucial role in developing an enduring curiosity about mathematics. Furthermore, numerous national reports cite intervention strategies as the most effective means through which to attract minority students into mathematics. Consequently, SUMMA has assigned its highest priority to this first component. In addition, SUMMA recently designed its other four components and currently seeks funding for their implementation. (For additional information on all five initiatives, see page nineteen of the January–February 1991 issue of FOCUS.)

To reverse this disconcerting phenomenon, SUMMA has coordinated several mailings to minority institutions to advise them of its manifold components and initiatives. These institutions demonstrate an impressive track record for nurturing minority mathematical talent and have accumulated much invaluable experience to impart to the entire mathematical community. SUMMA's outreach campaign invites them to play this edifying role in concert with majority mathematicians and institutions.

To supplement these initial mailings, the Association distributed several thousand flyers introducing SUMMA to both departments of mathematics and their MAA representatives. Other dissemination activities included speeches, presentations at numerous forums, and articles in *UME Trends* and FOCUS. Moreover, at the 1991 Annual Meeting in San Francisco, California, more than one hundred mathematicians responded enthusiastically to a SUMMA workshop on three precollege intervention programs serving minorities.

SUMMA's agenda incorporates five components:

1. intervention projects for middle and high school students;
2. mainstreaming projects for college and university students;
3. a mentorship program for minorities in mathematics;
4. an organization to serve departments of mathematics at minority institutions; and
5. programs to attract minorities into teaching mathematics.

The SUMMA offices also research and catalogue both information on and photographs of minority mathematicians. These growing biographical archives enable SUMMA's staff to respond to information requests ranging from suggestions for proposal reviewers for government agencies to names of minority mathematicians for high school and college class assignments.

SUMMA's future plans include workshops at both the 1991 Summer Meeting in Orono, Maine and the 1992 Annual Meeting in Baltimore, Maryland; an increased emphasis on two-year colleges; expanded interaction with state mathematics coalitions; and continued participation in the Alliance to Improve Mathematics for Minorities (AIMM) of the Mathematical Sciences Education Board (MSEB).

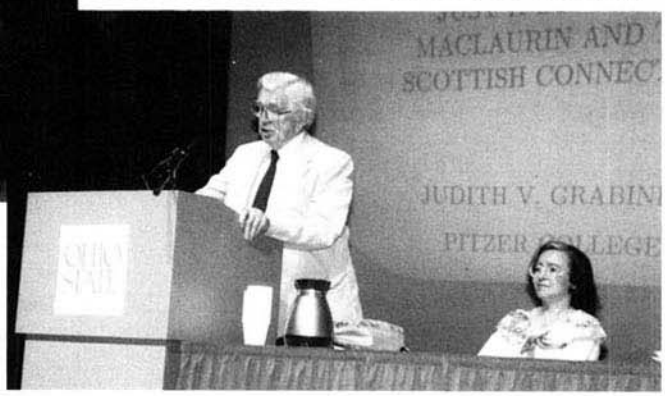
The MAA Committee on Minority Participation in Mathematics (CMPM) and its cochairs, Manuel P. Berriozábal of the University of Texas at Austin and Sylvia T. Bozeman of Spelman College, oversee the SUMMA offices, as does MAA Executive Director Marcia P. Sward. These leaders' steadfast involvement in SUMMA reflects the Association's commitment to the program. The nation now recognizes that minority mathematicians and students constitute a critical factor in the health of American mathematics. SUMMA seeks to enlarge upon that recognition—to challenge and enlist the collegiate mathematics community in effecting fundamental changes in attitude and practice, particularly with regard to minority students.

For additional information on the SUMMA program and its components, contact: William A. Hawkins, Jr., Executive Director, SUMMA, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385; (202) 387-5200; maa@hilda.umd.edu. FAX: (202) 265-2384. ■

SUMMA seeks to challenge and enlist the collegiate mathematics community in effecting fundamental changes in attitude and practice, particularly with regard to minority students.

MAA Executive Director Marcia P. Sward at the convivial conclusion to MAA Day—the Seventy-Fifth Anniversary Banquet.

William L. Duren, Jr. of the University of Virginia, twenty-sixth president of the MAA, introduced Judith V. Grabiner of Pitzer College. In her Invited Address, Grabiner considered *Was Newton's Calculus Just a Dead End? Maclaurin and the Scottish Connection.*

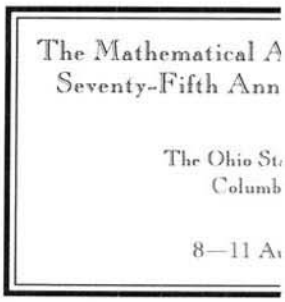


At the Association's Summer Meeting in Columbus, Ohio 8–11, August 1990, the spotlight was on the MAA and the seventy-fifth anniversary of its founding. Indeed, the meeting program devoted its first day entirely to Association activities. This "MAA Day" celebration commenced in Mershon Auditorium with a grand procession of the Sections to the accompanying fanfare of the Ohio State University Faculty Brass Quintet. Representatives of the MAA's twenty-nine Sections, in order of their founding, mounted the stage bearing Section banners in various shades of blue and gold. These banners formed a vivid backdrop to the opening ceremonies and other events.

In December 1915, on the campus of Ohio State University, several members of the American Mathematical Society (AMS), including Herbert Ellsworth Slaught and Earle Raymond Hedrick, organized the Association during a conference of the American Association for the Advancement of Science (AAAS). During the MAA Day opening ceremonies, representatives of these two organizations so instrumental in the MAA's inception greeted and congratulated the Association upon its anniversary. MAA President Lida K. Barrett presided over the opening session and these salutations from Warren Page, Secretary of Section A of the AAAS and William Browder, President of the AMS. In addition, Edward H. Jennings, President of The Ohio State University and host to the meeting, graciously welcomed the Association upon its return to its official birthplace.

The celebration continued as Henry L. Alder, the Association's thirty-seventh president, introduced the day's first invited address: G. Baley Price, Professor Emeritus at the University of Kansas and the Association's twenty-seventh president. In *The Seventy-Fifth Anniversary Celebration,* Professor Price narrated the early history of the MAA. His chronicle included photographs of some of those most prominent in the Association's founding, including W. D. Cairns, Benjamin J. Finkel, E. H. Moore, and others. A dedication ceremony followed this excursion into mathematical history as the Association installed two commemorative plaques—one in Ohio State University's current Mathematics Building and one outside 101 Page Hall, the room from which the MAA emerged.

After this dedication ceremony, William L. Duren, Jr., twenty-sixth president of the Association, introduced the day's second invited address: **Judith V. Grabiner** of Pitzer College, who considered *Was Newton's Calculus Just a Dead End? Maclaurin and the Scottish Connection.* Following lunch, the audience enjoyed a spectacular session of four half-hour invited addresses. **Wade Ellis, Jr.** of West Valley College discussed the challenges and opportunities of *Mathematics and Computation: Proliferation and Fragmentation.* In *Has Progress in Mathematics Slowed Down,* **Paul R. Halmos** of Santa Clara University surveyed some of the mathematical progress of the last seventy-five years. **Peter J. Hilton** of the State University of New York at Binghamton assessed several fundamental yet controversial issues concerning *The Contribution of Mathematics to Education.* Finally, in *The Last Seventy-Five Years,* **Cathleen S. Morawetz** of the Courant Institute for Mathematical Sciences of New York University reviewed the contributions of four leaders in mathematics during the Association's first forty years.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Richard K. Guy of the University of Calgary and Robert J. Bumcrot of Hofstra University in the Ohio Union on the campus of Ohio State University.

During her invited address, prepared especially for the MAA Day program, Cathleen S. Morawetz of the Courant Institute of Mathematical Sciences of New York University discussed *The Last Seventy-Five Years: Giants of Applied Mathematics.*

Later that afternoon, a photography session on the sunlit lawn behind the Ohio Union captured all those assembled for the celebration in a historical group photograph. Meeting participants then reconvened in Mershon Auditorium for the *Mathematical Circus:* a lively demonstration of juggling, acrobatics, and magic tricks, organized by Joe P. Buhler of the Reed College. Under this extraordinary big top, former First Vice-President of the Association (1982–1983) Ronald L. Graham of Bell Communications Research courted the mathematical limelight—while standing on one hand. Other "circus clowns" included Danalee Buhler, Brad Jackson of San Jose State University, and Peter Frankl of the University of Paris at Tokyo. Bruck Pollack-Johnson of Oberlin College performed a music video on teaching calculus. Gregg Ferrar of Ohio State University premiered *There's a Delta for Every Epsilon*—a calypso song Tom Lehrer composed in the early 1960s. Unfortunately, Lehrer never recorded the song; its lyrics appeared in *The American Mathematical Monthly,* **81** (1974): 612. A social hour and subsequent banquet in the Ohio Union concluded the MAA Day program. Eileen L. Poiani of St. Peter's College graciously presided over this anniversary fête. David P. Roselle, former Secretary of the Association (1975–1983) and now President of the University of Delaware, delivered a delightfully drole after-dinner address. Finally, the American Mathematical Society surprised the MAA with a gift in commemoration of its seventy-fifth anniversary—Robert Szczarba's *Three Pentagons,* a sculpture inspired by Isaac Schoenberg's *Mathematical Time Exposures.*

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In addition to these MAA Day events, the Association, in cooperation with other mathematical organizations, cosponsored ten special invited addresses, delivered throughout the meeting. These addresses, presented in the order of these sibling organizations' foundings, included: **Richard A. Askey** of the University of Wisconsin for the American Association for the Advancement of Science (AAAS) on *Lost and Found Mathematics;* **Saunders Mac Lane** of the University of Chicago for the American Mathematical Society (AMS) on *Algebra as a Means of Understanding Mathematics;* **John A. Dossey** of Illinois State University for the National Council of Teachers of Mathematics (NCTM) on *Mathematics Education—Yesterday, Today, and Tomorrow;* **Ivan M. Niven** of the University of Oregon for Pi Mu Epsilon (PME) on *Problems for All Seasons;* **Paulo Ribenboim** of Queen's University for the Canadian Mathematics Society (CMS) on *Prime Number Records;* **Richard A. Tapia** of Rice University for the Society for Industrial and Applied Mathematics (SIAM) on *Interior Point Methods for Linear Programming: An Overview;* **Juris Hartmanis** of Cornell University for the Association for Computing Machinery (ACM) *On the Computational Complexity of Doing Mathematics;* **Carl L. Prather** of Virginia Polytechnic Institute and State University for the National Association of Mathematicians (NAM) on *Intriguing Problems about Zeros in Complex Analysis;* **Judith Roitman** of the University of Kansas for the Association for Women in Mathematics (AWM) on *The Uses of Set Theory;* and **Karl J. Smith** of Santa Rosa Junior College for the American Mathematical Association of Two-Year Colleges (AMATYC) on *Crisis in Mathematics Education: Perspective from the Two-year College.*

Women and Mathematics (WAM)

The Women and Mathematics (WAM) program encourages female students, primarily in grades six through twelve, to explore mathematical and scientific topics and to develop their talents in these areas. The program seeks chiefly to free female students from the "women-can't-or-don't-do-mathematics" stereotype. WAM provides contacts with role models, career and academic counseling, workshops, corporate tours, and mentors, as well as student-parent-teacher association meetings and classroom presentations. WAM participants are all women pursuing careers that require an extensive, foundational knowledge of mathematics. The program, founded in 1975 with initial funding from IBM (still its primary grantor), recently celebrated its fifteenth anniversary.

Active regions in the Women and Mathematics program include: Baltimore-Washington, Boston, Chicago, Greater Philadelphia, Hawaii, Kansas City, Michigan, Montana, New York-New Jersey, North Carolina, Northern California, Puget Sound, Texas, and Utah. The Central Ohio, Connecticut, Oregon, and Southern California regions remain inactive while WAM identifies coordinators and funding. The program also contemplates expanding its efforts into Colorado and New Hampshire. A region in Florida implemented the WAM program, but that state's success with an aggressive career and academic advising program has minimized its demand for WAM activities. WAM is always interested in developing new regions where coordinators and funding can be established.

WAM and the Association for Women in Mathematics (AWM) continue to explore possible avenues along which to link school contact activities. Volunteers available through AWM would enable WAM to address a more geographically and academically diverse audience; WAM's regional structure would assist AWM speakers in contacting schools and arranging visits. Clearly, an alliance would benefit both organizations and the students they serve.

The program has also initiated production of a problem book designed to appeal especially to secondary school students. Both the collection's form and content will resemble a exemplary WAM presentation. To achieve this ingenious effect, WAM volunteers submitted career descriptions, brief biographies, and mathematical problems they frequently encounter in their work place. Their narratives answer questions concerning the many uses of mathematics and the exciting, perhaps unexpected careers it can open. The program will use any profits from the book to support its activities.

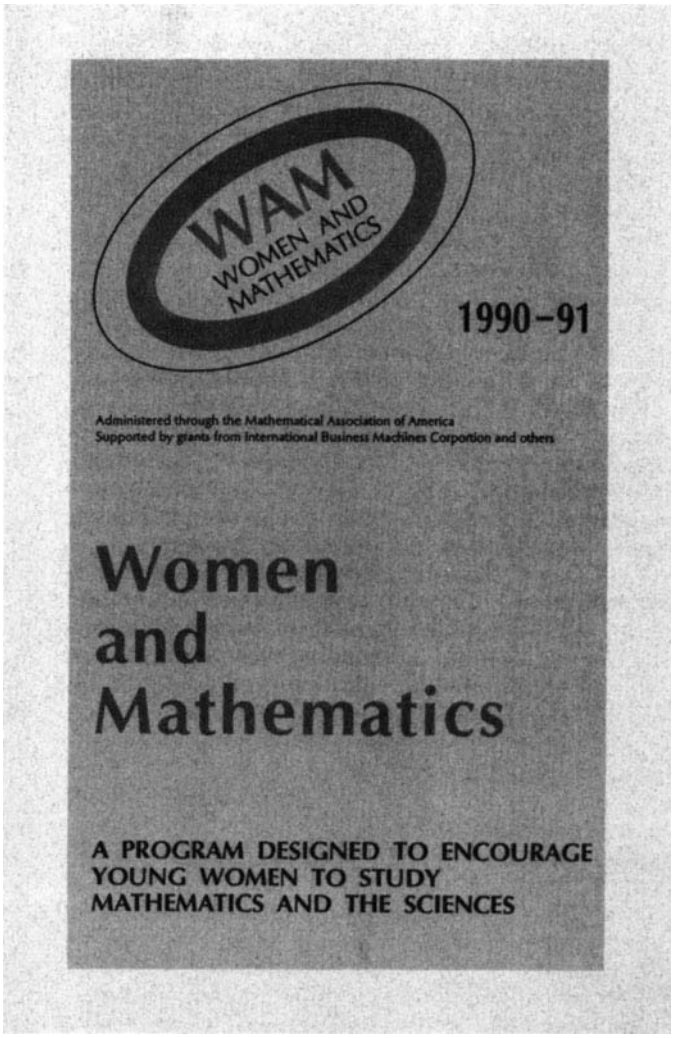
At the January 1991 Annual Meeting in San Francisco, California WAM sponsored a panel discussion entitled, *WAM: Yesterday, Today, and Tomorrow—In Commemoration of WAM's Fifteen Years of Service.* This panel discussion, moderated by Alice J. Kelly, the program's National Director, featured Mary R. Hesselgrave, New York-New Jersey Coordinator; Virginia E. Knight, North Carolina Coordinator; Eileen L. Poiani, WAM's first director; and Maria Magana, a WAM volunteer employed at IBM. Kelly provided a broad overview of the program; Poiani reflected on the daunting challenges of launching the program; Hesselgrave described her experiences directing a large region; and Knight rehearsed the process of creating a new region. Magana, one of WAM's first volunteers in the San Francisco Bay area, movingly described her participation in the program as "a lifetime commitment." Her inspiring remarks reflect the dedication of all WAM's participants.

In 1990, WAM contacted over 29,000 students, 2,500 teachers, and 1,300 other adults through more than 450 presentations. Currently, two national directors, twenty regional coordinators, and five hundred role models administer and implement the program.

WAM funding in 1990 totaled over $40,000. One-third was inkind contributions from WAM participants and coordinators, as well as contributions of time and other support from their employers. IBM, Inc., Northern Telecom, the George I. Alder Trust, and the MAA donated monetary grants. Hewlett-Packard contributed thirty 32S calculators for distribution as awards throughout the regions.

WAM regions, independently and in cooperation with other women's groups, also organize and participate in such career conferences as Sonya Kovalevskaya Day, Expanding Your Horizons, and Math Options. These conferences include workshop leaders who first received encouragement to study mathematics at a similar conference or at a WAM presentation.

If you would like to participate in, or contribute to the Women and Mathematics Program or, if you wish to receive additional information on its activities, contact: Alice J. Kelly, National Director, Women and Mathematics Program, Department of Mathematics, Santa Clara University, Santa Clara, California 95053. ■



1990 American Mathematics Competitions and Mathematical Olympiads

In 1990, the American Mathematics Competitions (AMC) realized another remarkable year under the savvy leadership of its Executive Director, Walter E. Mientka of the University of Nebraska; 394,214 students from 6,411 secondary schools and 242,300 students from 3,547 middle schools participated in the AMC's challenging examinations. In addition, 1,181 students subsequently competed in the American Invitational Mathematics Examination (AIME).

In March 1990, the Committee on the American Mathematics Competitions (CAMC) administered both the American High School Mathematics Examination (AHSME) and the American Invitational Mathematics Examination (AIME) in secondary schools throughout the US and Canada. Top performers on these two examinations then progressed to the next tier in the competition sequence—the Nineteenth Annual United States of America Mathematical Olympiad (USAMO). In 1990, 141 students from 118 schools competed in this sophisticated examination designed to sound both mathematical knowledge and ingenuity. From these 141 participants, eight remarkably talented students emerged as Olympiad champions: **Kiran S. Kedlaya** of Silver Spring, Maryland; **Jeffrey M. Vanderkam** of Raleigh, North Carolina; **A. Hugh R. Thomas** of Winnipeg, Manitoba, Canada; **János Csirik** of Szeged, Hungary (residing in Canada during the USAMO's administration); **Daniel R. L. Brown** of Willowdale, Ontario, Canada; **Joel E. Rosenberg** of West Hartford, Connecticut; **Royce Y. Peng** of Rancho Palos Verdes, California; and **Jonathan T. Higa** of Honolulu, Hawaii.

In early June 1990, the USAMO winners travelled to Washington, DC for the whirlwind festivities associated with the Olympiad. During an elegant awards ceremony at the National Academy of Sciences (NAS), then MAA President Lida K. Barrett conferred an Olympiad medal upon each student and Alan Hoffman of IBM presented them with engraved silver trays. Rhonda J. Hughes of Bryn Mawr College delivered the USAMO Address on *From Fourier Series to Wavelets: Harmonic Analysis in Its Third Century.* The guests then adjourned for a reception and dinner in the Diplomatic Functions Area of the United States Department of State where many treasures of early American history permanently reside. The evening before this ceremony, the winners and their families gathered together at the MAA's Dolciani Mathematical Center for the Sponsors' Reception—an opportunity to meet informally with the members of the Committee on the USAMO, representatives of the Olympiad's sponsors, and others affiliated with the American Mathematics Competitions.

These eight winners and sixteen other students who performed with distinction on the Olympiad examination thereafter embarked on an intensive, four-week mathematical training session at the US Naval Academy in Annapolis, Maryland. During these training sessions, their coaches—Gerald A. Heuer of Concordia College and Gregg N. Patruno of The First Boston Corporation—conditioned the students, as both *individuals* and as members of a *team,* for the demands of the Thirty-First Annual International Mathematical Olympiad (IMO).

From left to right, around the Einstein sculpture: Daniel R. L. Brown, Joel E. Rosenberg, Kiran S. Kedlaya, Royce Y. Peng, A. Hugh R. Thomas, Jeffrey M. Vanderkam, and Jonathan T. Higa. In front of the sculpture, Michael Fusco, President of the Casualty Actuarial Society, a USAMO sponor, and Rhonda J. Hughes of Bryn Mawr College who delivered the USAMO Address.

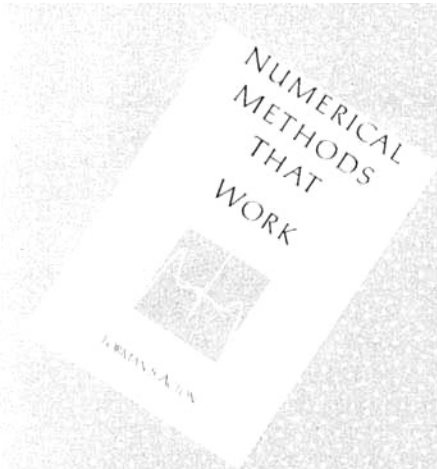
Following this rigorous preparation, six of the twenty-four trainees traveled to Beijing, China—site of the Thirty-First Annual IMO. **Avinoam Freedman** of Teaneck, New Jersey, Kiran S. Kedlaya, **Timothy P. Kokesh** of Bartlesville, Oklahoma, Royce Y. Peng, Joel E. Rosenberg, and Jeffrey M. Vanderkam formed the US team. Kedlaya and Vanderkam won gold medals; Freedman, Peng, and Rosenberg earned silver medals; and Kokesh narrowly missed achieving a bronze medal. These students, as a team, captured third place in the competition with a combined score of 174 out of a possible 252. Only two teams earned more points than the US: China (230) and the USSR (193). Romania and France placed immediately behind the US with scores of 171 and 168 respectively.

The IMO teams competed by tackling solutions to six formidable mathematical problems in two, four and one-half hour sessions. The cutoff scores for gold, silver, and bronze range as follows: 34–42 for gold, 23–33 for silver, and 16–22 for bronze. Among the IMO's 308 participants representing 54 countries, 23 received gold medals, 56 received silver medals, and 76 received bronze medals. Most competitors considered the 1990 examination more exacting than usual—only four students achieved perfect scores (compared with ten last year). These four students served on teams from China (two perfect individual scores), the Soviet Union, and France.

In each of its last four years, the IMO has surpassed previous participation records, and in 1990, Japan entered the competition (replete with network television crew) for the first time. It placed a respectable twentieth as it now seeks to institute a national olympiad program. Returning countries registering the strongest improvements from 1989 included France (thirteenth to fifth), the United Kingdom (twentieth to tenth), and Norway (thirty-sixth to eighteenth). In 1991, the IMO will invite teams from over sixty countries to compete in Sigtuna, Sweden. The inaugural team of a unified Germany should prove a strong contender in that competition.

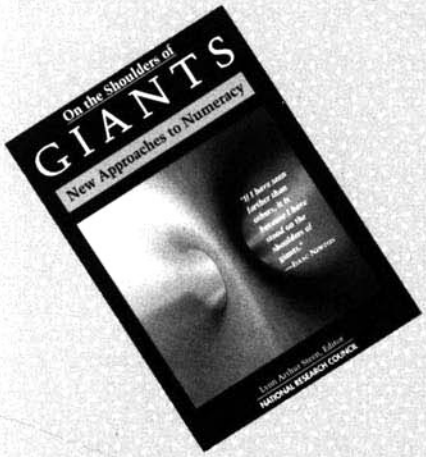
Eight national organizations serving mathematical scientists from several professions sponsor the Olympiad activities: the American Mathematical Association of Two-Year Colleges (AMATYC), the American Mathematical Society (AMS), the American Statistical Association (ASA), the Casualty Actuarial Society (CAS), the Mathematical Association of America (MAA), Mu Alpha Theta, the National Council of Teachers of Mathematics (NCTM), and the Society of Actuaries. The MAA administers the Olympiad program and its awards ceremonies. Both public and private agencies provide financial support; these generous and much-appreciated groups include the Army Research Office, Hewlett-Packard, IBM, the Matilda R. Wilson Fund, and the Office of Naval Research.

For additional information on the AMC program, contact: Walter E. Mientka, Executive Director, American Mathematics Competitions, 917 Oldfather Hall, MAA, University of Nebraska, Lincoln, Nebraska 68588-0322; (402) 472-2257. FAX: (402) 472-6087. BITNET: WALTER@UNLAMC. Internet: AMC.UNL.EDU. ■



1990 Publications

In 1990, MAA Publications delivered six new volumes, three revised and updated editions, and five outstanding titles from related organizations. Furthermore, these additions to the MAA's collection, along with the Association's other titles, generated $405,000 in sales for the year. In April 1991, the MAA distributed its most recent publications catalogue to the membership; the cover features a stunning reproduction of the stained-glass window gracing the foyer of the Dolciani Mathematical Center. You may consult this catalogue, available upon request, to learn more about the titles mentioned below as well as for ordering information and instructions. If you wish to submit a manuscript for any of the Association's book series, contact the appropriate committee chair at the address provided.



Carus Monographs

Ralph P. Boas, Chair
MAA Subcommittee on Carus Monographs
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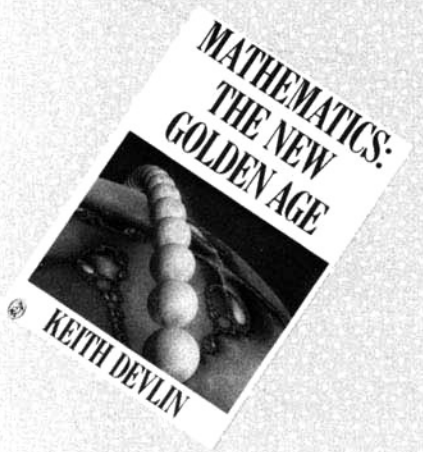
Northwestern University
Evanston, Illinois 60208

This series promotes exposition on pure and applied mathematics, accessible to both teachers and students. In 1990, it released the long-awaited *Complex Analysis: The Geometric Viewpoint* from Steven G. Krantz of Washington University. This monograph explores how the methods of geometry can open and illuminate the study of complex analysis. It assumes no background in Riemannian geometry and only one semester in complex analysis. Krantz, a leading researcher in complex analysis, addresses the role of Hermitian metrics and of curvature in understanding the Schwarz lemma, normal families, Picard's theorems, conformal mappings, and many other topics. He employs a minimum of geometric formalism to gain a maximum of geometric and analytic insight.



Dolciani Mathematical Expositions

Joe P. Buhler, Chair
MAA Subcommittee on the
Dolciani Mathematical Expositions
Department of Mathematics
Reed College
Portland, Oregon 97202

In 1990 this series, appropriate for the undergraduate and even the mathematically inclined secondary school student, introduced another tantalizing volume from MAA best-selling author Ross A. Honsberger of the University of Waterloo. *More Mathematical Morsels,* a companion to Honsberger's 1979 *Mathematical Morsels,* exemplifies his lifelong fascination with problem solving; each example or "vignette" in this collection, although elementary, delightfully exceeds the ordinary—through a startling result, an intriguing approach, or perhaps, a quintessential stroke of Honsberger ingenuity.

MAA Notes and Reports

Warren Page, Chair
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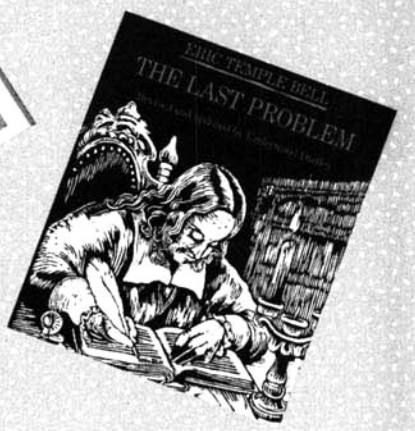
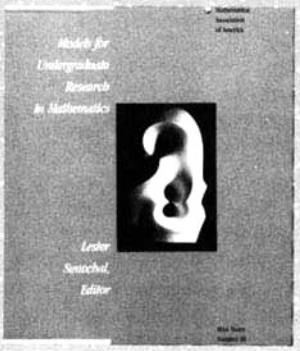
Brooklyn, New York 11201

This series, designed to disseminate topical information rapidly and inexpensively, published four volumes in 1990. The annual report of the Committee on the Undergraduate Program in Mathematics (CUPM) (pages eighteen and nineteen of this issue of FOCUS) discusses two such Notes—*Models for Undergraduate Research,* edited by Lester J. Senechal of Mount Holyoke College; and *Priming the Calculus Pump: Innovations and Resources,* edited by Thomas W. Tucker of Colgate University.





from the MAA...

Using Writing to Teach Mathematics, edited by Andrew Sterrett of Denison University, offers numerous practical suggestions for incorporating writing in the mathematics classroom. Marcia Stubbs of The Writing Program at Wellesley College applauds this volume—"I'm struck not only by the imaginative teaching I find in these articles, but also by the lucid writing and collegial tone."

A Source Book for College Mathematics Teaching, edited by Alan Schoenfeld of the University of California at Berkeley, delineates the resources and perspectives necessary to develop a broader, deeper, more successful mathematics program. Its six sections, Goals for Instruction, Curriculum Recommendations from the MAA, Resources, Advising, Suggestions for Teaching, and Evaluation, provide incisive recommendations for improving the undergraduate mathematical experience.

NEW MATHEMATICAL LIBRARY

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Department of Mathematics
Courant Institute for the Mathematical Sciences
New York University
251 Mercer Street
New York, New York 10012

In 1990, this series, designed for secondary school and undergraduate students, reissued Oystein Ore's renowned *Graphs and Their Uses,* with revisions and an update from Robin J. Wilson of the Open University, England. Since this volume's first appearance in 1963, graph theory has developed many new applications and the terminology and notation to describe them. Wilson discusses several of these applications including interval graphs, the travelling salesman problem, bracing frameworks, shortest route problems, and coloring maps on surfaces.

MAA SPECTRUM

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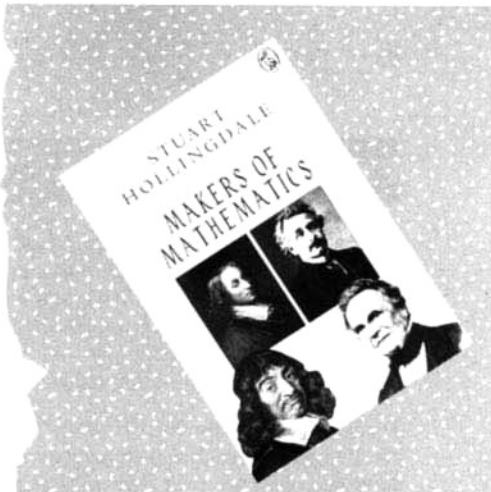
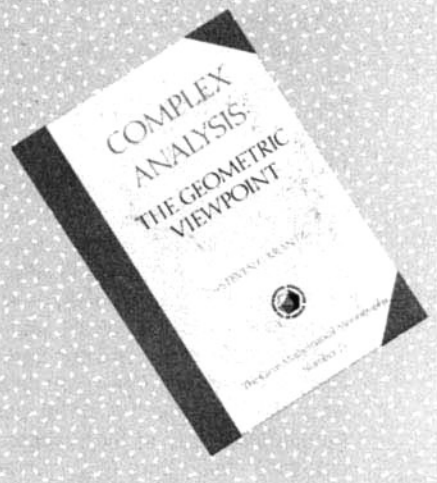
RLM 8-100
University of Texas at Austin
Austin, Texas 78712

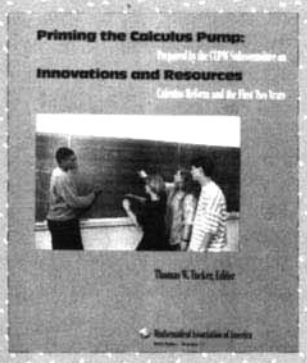
In 1990, Spectrum, the Association's most recent and delightfully eclectic series, rereleased two classics in mathematical exposition. In *The Last Problem,* E. T. Bell's traces Fermat's last problem—that $x^n + y^n = z^n$ has no solution in positive integers when $n \geq 3$—from Babylonia in 2000 BC to seventeenth-century France. Underwood Dudley of De Pauw University revised and updated Bell's treatment of Fermat's maddening problem from the margins for this edition. Bell's exuberant style, coupled with such a rich and varied topic, is irresistible.

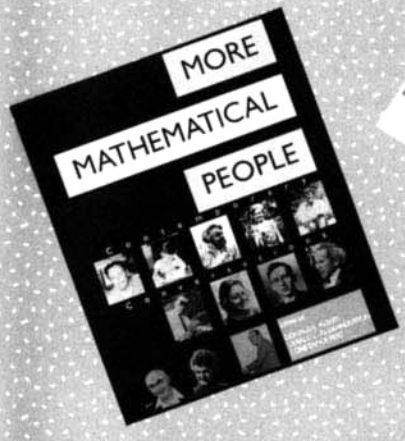
In *Numerical Methods that [Usually] Work,* first published in 1970, Forman Acton, Professor Emeritus of Computer Science at Princeton University, develops a common sense approach to numerical algorithms for the solution of algebraic, transcendental, and differential equations. *Choice* declared this volume, "A first rate book which can be used either as a text or reference."

In 1990, the Association also featured several engaging titles from other publishers. These special selections include: William W. Dunham's *Journey Through Genius: The Great Theorems of Mathematics;* Stuart Hollingdale's *Makers of Mathematics;* Keith Devlin's *Mathematics: The New Golden Age; More Mathematical People,* Donald J. Albers, Gerald L. Alexanderson, and Constance Reid, editors; and *On the Shoulders of Giants: New Approaches to Numeracy* from the Mathematical Sciences Education Board (MSEB).









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The appealingly eclectic program of continuing education minicourses scheduled during the MAA's annual and summer meetings continues to attract enthusiastic and substantial participation. The 1990 Annual Meeting in Louisville, Kentucky offered 17 minicourses and registered 617 participants. At the 1990 Summer Meeting in Columbus, Ohio, 336 mathematicians enrolled in 13 minicourses.

These numerical profiles, however, only suggest the scope and sources of the Association's minicourse program. Many MAA Sections now operate their own minicourse or summer short course programs; these programs complement those the Committee on Minicourses organizes for national meetings. Indeed, the Sections and the Committee on Minicourses exemplify a cooperative and mutually beneficial relationship. Many Sections adapt successful minicourses first offered at the national meetings; conversely, some national offerings originated as Sectional minicourses.

In its selections, the Committee on Minicourses strives to balance courses focused primarily on mathematical content with those concerned with pedagogical issues. The Committee also maintains a similar balance between "hot" topics of current interest and traditional topics of perennial interest. The following list of 1990 minicourses and their instructors reveals the inviting assortment of subjects within this balance.

A Calculus Laboratory Using Mathematica, Michael J. Barry, Benjamin D. Haytock, and Richard F. McDermot, all of Allegheny College ■ *CAS Laboratory Projects for Calculus,* L. Carl Leinbach of Gettysburg College ■ *Coaching a Team for the Modeling Contest,* B. A. Fusaro, Salisbury State University ■ *Computer-Based Discrete Mathematics,* Nancy Hood Baxter of Dickinson College, Ed Dubinsky of Purdue University, and Donald L. Muench of St. John Fisher College ■ *Creating Order out of Chaos in Freshman Mathematics: Instituting a Mathematics Placement Program,* Linda H. Boyd of DeKalb College and sponsored by the MAA Committee on Testing (COT) ■ *Derive Workshop,* Wade Ellis, Jr. of West Valley College ■ *Exploring Mathematics with the NeXT Computer,* Charles G. Fleming and Judy D. Halchin, both of Eastern Illinois University ■ *Exploring Statistics and Discrete Mathematics Topics Using Inexpensive Graphing Calculators,* Franklin D. Demana and Bert K. Waits, both of Ohio State University ■ *Finite-Pak—Software for Linear Programming,* Marvin L. Bittinger and J. Conrad Crown, both of Indiana University-Purdue University at Indianapolis ■ *How to Use Inexpensive Graphing Calculators to Enhance the Teaching and Learning of Precalculus Mathematics and Calculus,* Franklin D. Demana and Bert K. Waits, both of Ohio State University ■ *The Informed Consumer's Instructional Guide to Graphing Calculators,* Iris B. Fetta and John W. Kenelly, both of Clemson University ■ *An Introduction to the Mathematical Elements of Computer Graphics,* Joan Wyzkoski Weiss of Fairfield University ■ *Lagrange First-Year Calculus,* Alain Schremmer of the Community College of Philadelphia and Françoise Schremmer of West Chester University ■ *Mathematica and College Teaching,* Stan Wagon of Smith College and the University of Washington ■ *A Mathematician's Introduction to the HP-48SX Scientific Expandable Calculator for First-Time Users,* John W. Kenelly and Donald R. LaTorre, both of Clemson University ■ *Planning, Funding, and Administering Teacher Enhancement Projects,* T. Christine Stevens of St. Louis University and John A. Thorpe of the State University of New York at Buffalo ■ *Producing Mathematics Courseware with Mathematica: Calculus and Mathematica,* Don Brown, Horacio A. Porta, and J. Jerry Uhl, Jr., all of the University of Illinois at Urbana ■ *Random Mappings,* Bernard Harris of the University of Wisconsin ■ *A Seminar on Women in Mathematics,* Miriam P. Cooney of Saint Mary's College (offered at both the 1990 Annual and Summer Meetings) ■ *Spreadsheet-Based Mathematical Topics for Nonmathematics Majors,* V. S. Ramamurthi of the University of North Florida ■ *Starting, Funding, and Sustaining Mathematics Laboratories,* Stavros N. Busenberg of Harvey Mudd College and sponsored by the MAA Science Policy Committee ■ *Starting, Funding, and Sustaining Mathematics Laboratories,* James E. White of Kenyon College ■ *A Survey of Educational Software,* Virginia E. Knight and Vivian Yoh Kraines, both of Meredith College ■ *Teaching Mathematical Modeling,* Frank R. Giordano of the US Military Academy and Maurice D. Weir of the Naval Postgraduate School ■ *Using History in Teaching Calculus,* V. Frederick Rickey of Bowling Green State University (offered at both the 1990 Annual and Summer Meetings) ■ *Using Metacognitive Strategies to Improve Instruction,* Genevieve M. Knight of Coppin State College ■ *Writing to Learn Mathematics,* Agnes Azzolino of Middlesex County College ■ *Writing in Mathematics Courses,* George D. Gopen and David A. Smith, both of Duke University.

Persons interested in leading minicourses during the Association's annual meetings in January, or its summer meetings in August should contact: Richard F. McDermot, Chair, MAA Committee on Minicourses, Department of Mathematics, Allegheny College, Meadville, Pennsylvania 16335; (814) 332-3393. ■

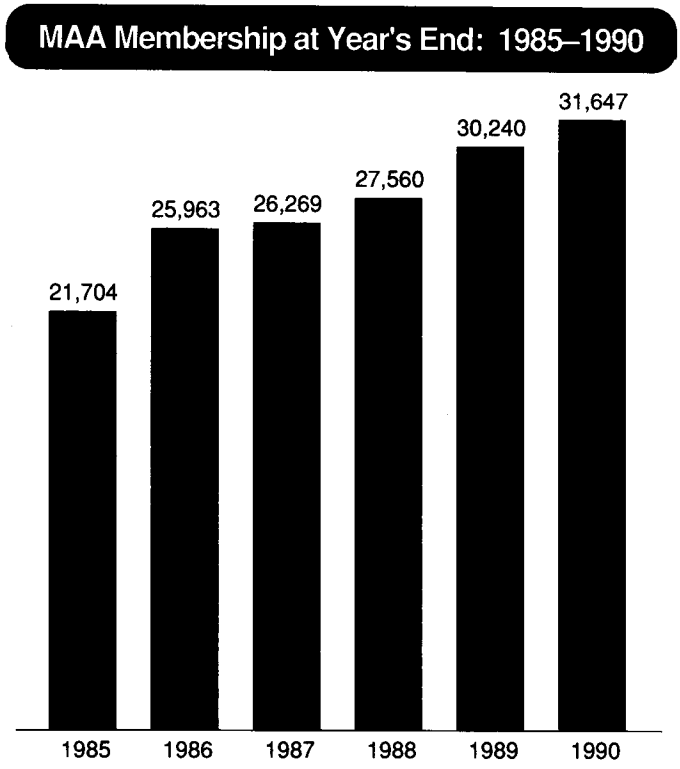
The MAA Introduces a New Journal

In January 1992, the MAA will premiere a new journal designed especially for students in the mathematical sciences. This forthcoming publication, *Mathematics Major Magazine,* will feature: biographical sketches, interviews, career information, problem-solving, recreational mathematics, fellowship and assistantship information, book and software reviews, and expository articles on mathematics.

We need your help, however, to introduce a magazine that will engage and inform students—that will, ideally, both welcome them into our community and nurture their interest and talent in mathematics.

Perhaps you currently produce a student or department newsletter. A calendar detailing significant dates in the history of mathematics. A mathematical games column for your institutional newspaper. Perhaps your students have sought further information on some topic but never discovered material appropriate for them. Perhaps lack of time and resources has prevented you from launching your own student publication but, through experience and imagination, you have accumulated many promising ideas. We need you to furnish us with your samples and suggestions—your vision of a student magazine—so that we may incorporate the best being produced into *Mathematics Major Magazine.* Your achievements will contribute significantly to the success of our new venture.

Forward your publication samples and suggestions to: ***Mathematics Major Magazine,*** Donald J. Albers, Associate Director for Publications and Programs, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385; (202) 387-5200; maa@ athena.umd.edu. FAX: (202) 265-2384.



Membership Increases to Over 31,500

In 1990 MAA membership grew nearly 4.5%, reaching a record of 31,647. Since 1983, the MAA has grown more than 50%. The Association attributes this growth largely to the direct mail campaigns of *Marketing General,* a direct mail marketing consultant firm, and to the significant increase in undergraduate membership—an increase accomplished especially through the thriving MAA's Student Chapters program.

The total membership includes 446 Life Members. In addition, Institutional Members—high schools, junior and community colleges, four-year colleges and universities and 15 special Corporate Members—increased from 593 to 599.

Reciprocal agreements with the Canadian Mathematical Society (CMS) encourage joint activities and membership. CMS members not residing in the US may receive a 15% discount on MAA dues. MAA members not residing in Canada may receive a 15% discount on CMS dues.

In addition, the MAA now offers a free, one-year membership to students who deliver papers at Section meetings, as well as to each new recipient of a doctorate in mathematics or mathematics education from a US or Canadian institution.

Year's-End Membership Demographics

Membership Category	1989	1990
Students	6,202	7,595
Secondary School Teachers	2,760	2,429
College and University Faculty	13,477	13,351
Industry or Government	4,090	4,190
Retired or Unemployed	2,239	2,326
Other	1,472	1,756
Total Membership	***30,240***	***31,647***

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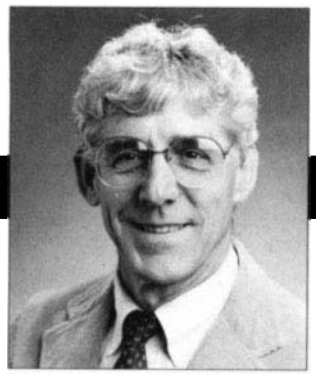

1990 MAA Financial Report

Donald L. Kreider, Treasurer

In 1990 the MAA experienced a surplus of $467,814 in its total budget of around 4.5 million dollars. In the general fund, which is the MAA's operating fund, the surplus was $97,897. The surplus in the total budget includes approximately $300,000 in contributions toward the renovation of the MAA's buildings in Washington, DC. The surplus in the operating fund is largely the result of careful financial management in controlling expenses.

The year 1990 saw a dramatic increase in the MAA's pace of activity in national efforts to improve mathematics education and to strengthen the mathematics achievement of all students. SUMMA (Strengthening Underrepresented Minority Mathematics Achievement) is now acquiring the major funding needed to carry out its difficult charge and is moving rapidly under the direction of William A. Hawkins, Jr. The American Mathematics Competitions (AMC), under Walter E. Mientka's canny leadership, involve hundreds of thousands of American young people in annual mathematics contests. And a variety of MAA projects aimed at curriculum improvement are well underway. Grant-supported activity of the MAA has increased from approximately $300,000 in 1989, to $650,000 in 1990, to an estimated $1,000,000 in 1991.

The MAA has a Technical Advisory Committee that is guiding its movement toward more modern and effective computing facilities for the Washington headquarters. We are looking forward to a computing system that will not only support the data processing needs of the MAA, but will also strengthen our database management capabilities, modernize our publishing operations with a possible eye to electronic publishing, and allow electronic communication with members. Major expenses are involved, but upgrading our computer systems is essential to the MAA's future. Careful financial planning has taken place and enables us to take the first steps during the next year.

The MAA depends on its broad membership to achieve its goals on behalf of mathematics education. The work of its officers, committees, and staff are essential, of course, to its success. But we need to acknowledge the even greater level of activity within the Sections and by a large number of members who volunteer their services. The MAA's financial house is in order. It is poised to fulfill its major obligation to the improvement of mathematics education, in collaboration with its sister mathematical organizations. ■

Revenues and Expenditures

Revenues	1989	1990
Dues	$1,459,000	$1,819,000
Subscriptions	345,000	430,300
Book Sales and Advertising	493,000	533,000
Interest, Dividends, and Capital Gains	112,000	123,000
Contributions	107,000	346,700
Grants and Direct Cost Reimbursements	307,000	633,000
Contest Fees and Sales	554,000	606,000
Space Rental	22,000	65,000
Miscellaneous	150,000	174,000
Total Revenues	***$3,549,000***	***$4,730,000***

Expenditures	1989	1990
Journals and FOCUS	$1,245,000	$1,382,000
Membership Department	241,000	340,000
Books	581,000	613,000
Sections, Meetings, and Joint Programs	292,000	357,000
Development	48,000	57,000
Grant-Supported Programs	332,000	650,000
Mathematical Competitions	571,000	507,000
Building Operations	123,000	173,000
Miscellaneous Programs	173,000	183,000
Total Expenditures	***$3,606,000***	***$4,262,000***

Marcia P. Sward's energy as Executive Director of the MAA is amazing. She has an able and loyal staff, including Rhoda Dechter Goldstein as Associate Director for Finance and Administration, and will soon be joined by Donald J. Albers as Associate Director for Publications and Programs. During the past year, both Andrew Sterrett and James R. C. Leitzel were visiting members of the MAA Washington staff, playing a large part in accommodating the increased level of activity.

The year 1990 saw the newly restored headquarters buildings of the MAA become the mathematical center that had been only a vision a few years ago. Our adjoining building at 1527 Eighteenth Street Northwest is now home to SUMMA, the Conference Board of the Mathematical Sciences (CBMS), the Office of Governmental and Public Affairs (OGPA) of the Joint Policy Board for Mathematics (JPBM), and some of the activities of the Mathematical Sciences Education Board (MSEB). The building fund drive for the MAA headquarters buildings is approaching $420,000 in contributions and pledges and has already reduced the mortgage by approximately $300,000.

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January 1991

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1990 Consolidated MAA Balance Sheet*

Assets	1989	1990
Current Assets		
Cash	$776,415	$115,207
Liquid Assets	468,152	992,039
Accounts Receivable	219,337	578,151
Publications Inventory	178,944	208,861
Prepaid Expenses	130,450	284,323
Total Current Assets	**$1,773,298**	**$2,178,581**
Noncurrent Assets		
Investments (at cost)	$810,671	$867,763
Furniture and Equipment	478,105	524,803
Building (at cost)	816,456	816,456
Building Improvements (at cost)	684,618	685,722
Accumulated Depreciation	(543,481)	(614,240)
Deferred Development Costs	57,448	80,407
Total Noncurrent Assets	**$2,303,817**	**$2,360,911**
Total Assets	***$4,077,115***	***$4,539,492***

Liabilities and Fund Balances	1989	1990
Current Liabilities		
Accounts Payable	$29,948	$322,446
Accrued Royalties	29,632	28,683
Other Accrued Liabilities	257,869	104,597
Prepaid Dues and Subscriptions	1,689,493	1,742,887
Total Current Liabilities	**$2,006,942**	**$2,198,613**
Long-Term Liabilities		
Mortgage Payable	$801,963	$502,368
Unexpended Grant Receipts	145,520	248,008
Total Long-Term Liabilities	**$947,483**	**$750,376**
Total Liabilities	***$2,954,425***	***$2,948,989***
Fund Balances		
Unrestricted Fund Balances	$440,949	$575,811
Restricted Fund Balances	265,960	586,329
Endowment	415,781	428,363
Total Fund Balances	**$1,122,690**	**$1,590,503**
Total Liabilities and Fund Balances	***$4,077,115***	***$4,539,492***

* ***All figures shown above are accurate as of 31 December of the year specified.***

The Greater MAA Fund

In 1990, 1,033 donors contributed $49,323 to the Greater MAA Fund. The Officers of the Association express their gratitude to the membership for its generous support of this fund. The names of all 1990 donors, except of those wishing to remain anonymous, appear below.

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Calendar

National MAA Meetings

8–10 August 1991 67th Summer Meeting, Orono, Maine (Board of Governors, 7 August 1991)
8–11 January 1992 75th Annual Meeting, Baltimore, Maryland (Board of Governors, 7 January 1992)
6–9 January 1993 76th Annual Meeting, San Antonio, Texas (Board of Governors, 5 January 1993)

Sectional MAA Meetings

Allegheny Mountain Slippery Rock University, Slippery Rock, Pennsylvania: 10 and 11 April 1992
Eastern Pennsylvania and Delaware Drexel University, Philadelphia, Pennsylvania: 9 November 1991
Florida University of North Florida, Jacksonville, Florida: 6 and 7 March 1992
Illinois North Central College, Naperville, Illinois: 24 and 25 April 1992
Indiana Indiana-Purdue University, Fort Wayne, Indiana: 18 and 19 October 1991
Intermountain Weber State University, Ogden, Utah: 10 and 11 April 1992
Iowa Graceland College, Lamoni, Iowa: 24 and 25 April 1992
Kentucky Bellarmine College, Louisville, Kentucky: 27 and 28 March 1992
Maryland-District of Columbia-Virginia Marymount University, Arlington, Virginia: 15 and 16 November 1991
Michigan Saginaw Valley State University, University Center, Michigan: 8 and 9 May 1992
Missouri Northwest Missouri State University, Maryville, Missouri: 10 and 11 April 1992
Nebraska Hastings College, Hastings, Nebraska: 10 and 11 April 1992
New Jersey County College of Morris, Randolph, New Jersey: 16 November 1991
North Central Bemidji State University, Bemidji, Minnesota: 18 and 19 October 1991
Northeastern Providence College, Providence, Rhode Island: 22 and 23 November 1991
Northern California University of the Pacific, Stockton, California: 29 February 1992
Ohio John Carroll University, University Heights, Ohio: 25 and 26 October 1991; University of Dayton, Dayton, Ohio: 27 and 28 March 1992
Oklahoma and Arkansas Henderson State University, Arkadelphia, Arkansas: 3 and 4 April 1992
Pacific Northwest Seattle Pacific University, Seattle, Washington: 20–22 June 1991
Rocky Mountain Colorado College, Colorado Springs, Colorado: 10 and 11 April 1992
Seaway State University of New York, College at Fredonia, Fredonia, New York: 1 and 2 November 1991; Queen's College, Kingston, Ontario, Canada: 1 and 2 May 1992
Southeastern Kennesaw College, Marietta, Georgia: 10 and 11 April 1992
Southern California University of California at Santa Barbara, Santa Barbara, California: 9 November 1991
Texas University of Houston-Downtown, Houston, Texas: 9–11 April 1992
Wisconsin University of Wisconsin–Center at Fond du Lac, Fond du Lac, Wisconsin: 5 October 1991 (joint meeting with Wisconsin Mathematics Council); University of Wisconsin at Whitewater, Whitewater, Wisconsin: 24 and 25 April 1992

Other Meetings

3–7 August 1991 *Eighth InterAmerican Conference on Mathematics Education,* University of Miami at Coral Gables, Florida. Conference will address integration of the sociocultural context in mathematics teaching and innovative uses of calculators and computers in teaching. For additional information, contact: Patrick Scott, Latin American Programs in Education, College of Education, University of New Mexico, Albuquerque, New Mexico 87131.
12–16 August 1991 North Central Section Summer Seminar on *Chaotic Dynamical Systems,* University of Minnesota at Duluth, Duluth, Minnesota. Principal lecturer Robert L. Devaney of Boston University will discuss chaos, the transition to chaos, Julia sets, the Mandelbrot set, fractals, and bifurcations. For additional information, contact: Dynamical Systems Conference, Department of Mathematics and Statistics, University of Minnesota at Duluth, Duluth, Minnesota 55812. Internet: math@ub.d.umn.edu.
1 and 2 November 1991 *The Sixth Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference,* St. Norbert College, De Pere, Wisconsin 54115-2099. The conference welcomes all students, faculty, and others interested in mathematics. Invited speaker: J. Douglas Faires of Youngstown State University. For additional information, contact: Richard L. Poss of the Department of Mathematics at St. Norbert College; (414) 337-3198.
1 and 2 November 1991 The Consortium for Computing in Small Colleges will sponsor the *Fifth Annual Southeastern Small College Computing Conference,* David Lipscomb University, Nashville, Tennessee. Theme: "In Support of Computing in Small Colleges." For additional information, contact: Frank D. Cheatham, Department of Mathematics, Campbellsville College, 200 West College Street, Campbellsville, Kentucky.
7–10 November 1991 *The Seventeenth Annual Convention of the American Mathematical Association of Two-Year Colleges,* (AMATYC), Westin Hotel, Seattle, Washington. For additional information, contact: Vicky Ringen, 1991 General Chair, Department of Mathematics North Seattle Community College, 9600 College Way North, Seattle, Washington 98103; (206) 527-3746.

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