

FOCUS

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MAY-JUNE 1985

NRC Aiming for June Launch of Education Board

The National Research Council (NRC) of the National Academy of Sciences is aiming for a June 1985 launch date for its new Board on Mathematical Sciences Education. [See *FOCUS*, March-April 1985.]

A major step in this direction was taken on April 12-13, when the NRC called a meeting of some 50 mathematical scientists, educators, and administrators to discuss the preliminary plans for the composition, funding, and projects of the Board. Meeting participants included MAA President Lynn A. Steen; F. Joe Crosswhite, President, National Council of Teachers of Mathematics; Gordon M. Ambach, President, Council of Chief State School Officers; and Bassam Z. Shakhshiri, Assistant Director, Science and Engineering Education Directorate of the National Science Foundation. The meeting was chaired by James Ebert, President of the Carnegie Institute and Vice-President of the National Academy of Sciences.

The purpose of the Board, which will report directly to the leadership of the National Research Council, is to provide a continuing national capability to assess and support educational conditions and needs in the area of mathematical sciences education across the country. NRC hopes the Board will be a practical response to present problems in developing quality instruction in mathematical sciences education. The Board's activities will be designed to provide advice and insight to users across the country who seek to rebuild the quality of mathematical sciences education.

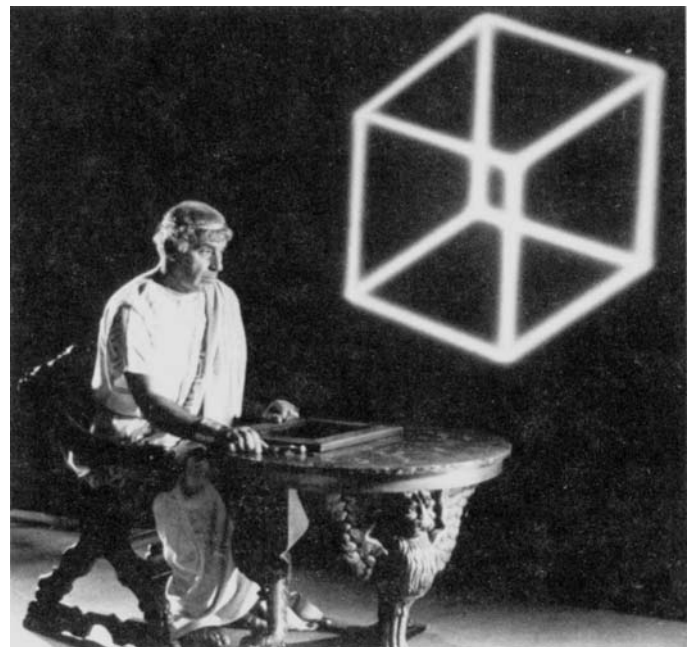
Key issues in precollege mathematical sciences education which have been identified for early action by the Board are testing, curriculum guidelines, staff development, communication and dissemination, and computer-enhanced mathematics education.

The 1985 Joint Summer Mathematics Meetings

The 1985 Joint Summer Mathematics Meetings will be held at the University of Wyoming, Laramie, Wyoming, August 12-15, 1985. The meetings will include the **65th Summer Meeting of the Mathematical Association of America**, the **89th Summer Meeting of the American Mathematical Society**, the **1985 Summer Meeting of the Association for Women in Mathematics**, and the **1985 Annual Meeting of Pi Mu Epsilon**.

A preliminary program for the meetings—including information and forms for preregistration, housing, and the Summer List of Applicants—was mailed to all MAA members in the center section of the March-April *FOCUS*. Additional copies may be obtained upon request from: Mathematical Association of America, 1529 Eighteenth Street, N.W., Washington, D.C. 20036; (202) 387-5200.

The center section of this issue contains additional meeting information, including descriptions of the MAA Mini-courses and the timetable for MAA sessions. The deadlines for meeting and minicourse preregistration are both **June 14**. Information about contributed papers must be submitted to MAA Headquarters by **May 28**.



A scene from NOVA's "Mathematical Mystery Tour," which was aired nationally on PBS on March 5. This program, produced by Jon Palfreman of BBC-TV, is the first in this popular science documentary series to attempt to explain concepts in pure mathematics to a general audience.

Nine MAA Governors Elected

Nine of the twenty-nine MAA Sections have elected new Governors. The Sections and the Governors who were elected this spring are: **Kansas** Frank S. Breneman, Tabor College; **Missouri** Harold W. Hager, Southeast Missouri State University; **Northeastern** James E. Ward III, Bowdoin College; **Ohio** Andrew Sterrett, Jr., Dennison University; **Pacific Northwest** D. George McRae, University of Montana, Missoula; **Seaway** Jack E. Graver, Syracuse University; **Southeastern** John W. Kenelly, Clemson University; and **Southwestern** David R. Arterburn, New Mexico Institute of Mining and Technology. All of these new Governors will serve terms from July 1, 1985 to June 30, 1988.

Last fall, the **New Jersey** Section elected Susan G. Marchand, Kean College of New Jersey, to fill out the term of Richard Gabriel and then serve a full term through June 30, 1988.

MAA Governors represent their Sections at all meetings of the MAA Board of Governors, the governing body of the Association. Each spring about one-third of the Sections elect new Governors.



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Ronald M. Davis, Northern Virginia Community College.

Readers are invited to submit articles, announcements, or Letters to the Editor for possible publication in *FOCUS*. All materials should be sent to the Editor at the MAA Headquarters in Washington, D.C.

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News from NSF

National Science Board Supports Higher Funding Levels for Mathematical Sciences Research

The National Science Board (NSB), the governing body of the National Science Foundation, has added its voice to those calling for increased levels of support for research in the mathematical sciences. At its December meeting, the NSB adopted a statement commending the National Research Council Committee on Resources for Mathematical Sciences, and its Chairman, Edward E. David, Jr., "for their timely and compelling report, *Renewing U.S. Mathematics—Critical Resource for the Future*."

The statement, noting the increases at NSF in support of graduate students and young researchers in mathematical sciences, includes this resolution: "That a concerted effort should be made by all funding agencies to increase support for the mathematical sciences for several years until a proper level of sustaining support has been achieved."

In its FY 1986 budget request, NSF has asked for a 15.1% increase for new appropriations for the mathematical sciences. The overall agency budget request for new appropriations is only 4.4%.

Precollege Activities

The National Science Foundation (NSF) has released its new guidelines for precollege activities, effective April 1, 1985. Copies of the Program Announcement may be obtained by writing to: Science and Engineering Education Directorate, NSF, Washington, D.C. 20550.

Precollege education activities at NSF are the responsibility of two major divisions within the Science and Engineering Education Directorate: the Division of Materials Development and Research, which supports the generation of new knowledge and the development of materials, technologies, and model programs; and the Division of Teacher Enhancement and Informal Science Education, which supports enrichment and leadership activities for teachers, dissemination activities, and activities that use non-school settings for science and mathematics education.

Science Education Budget

The budget for the Science and Engineering Education Directorate (SEED), which the Foundation has submitted to Congress, has provoked considerable controversy for two reasons.

First, the FY 1985 spending level has been reduced by \$31 million, from \$113 to \$82 million. Second, and potentially more serious, is the fact that, although SEED will have \$82 million to spend in FY 1986, \$31 million of that is a carry-over from FY 1985, and not part of the base budget. This means that SEED will start FY 1987 budget discussions with a base of \$51 million, a far cry from the \$100 million numbers discussed so often in Congress in the last few years. Furthermore, \$27 million of the \$51 million is already committed for the graduate fellowship program, and \$5 million is committed for the college instrumentation program, leaving only \$19 million for precollege activities.

Many individuals and organizations concerned with science and mathematics education, including the MAA, have expressed their concern to officials at NSF, Office of Management and Budget, and Congress.

A Job on Our Hands

Peter Hilton

A colleague of mine once said, "I never read a paper I'm asked to review. In this way I avoid the risk of bias in my review." I was reminded of this remark when, on March 13, I received a phone call asking me to read an article from the February 13 issue of the *Chronicle of Higher Education* (CHE) and prepare a response to it which should reach MAA Headquarters by April 1. I decided I would be able to execute the second half of my task if I could be excused from the first half—especially since the article was spread over 20 densely-packed pages. Thus I confess from the outset that my comments are based on a somewhat superficial reading of the article in question; however, I did read with great care the summary provided by Malcolm G. Scully in the CHE.

The article is the report of the Association of American Colleges, based on its "Project on Redefining the Meaning and Purposes of Baccalaureate Degrees" which was set up in 1982 under the direction of a 19-member committee; it is pertinent to my purpose to point out that no member of the committee was (or, at least was willing to be identified as) a mathematician. The tenor of the article is well conveyed by the headline, on the front page of CHE, which read "A Job on Their Hands; Panel calls Bachelor's Degree Meaningless, Asks Professors to Take Lead in Restoration." Also prominently displayed on the front page is the following excerpt from the report:

The public at large and the academic community itself are uneasy with the evidence of the decline and devaluation of the bachelor's degree in the recent past. To restore integrity to the bachelor's degree there must be a renewal of the faculty's corporate responsibility for the curriculum.

The diagnosis of the cause of the malaise is clearly implied in Scully's first quotation from the report:

Central to the troubles and to the solution are the professors. . . . The development that overwhelmed the old curriculum and changed the entire nature of higher education was the transformation of the professors from teachers concerned with the characters and minds of their students to professionals, scholars with Ph.D. degrees with an allegiance to academic disciplines stronger than their commitment to teaching or to the life of the institutions where they are employed.

Consistent with this diagnosis, the committee devoted much attention to graduate studies and bemoaned the lack of attention given in graduate education to preparing people to teach:

. . . during the long years of work towards the doctoral degree, the candidate is rarely, if ever, introduced to any of the ingredients that make up the art, the science, and the special responsibilities of teaching . . . yet the major career option for most holders of the Ph.D. degree is full-time teaching in a college or university.


My response to the report is that I emphatically agree that there has been a "decline and devaluation" of the bachelor's degree, but, just as emphatically, I reject on behalf of mathematics the committee's diagnosis of the cause. The argument that there is a natural antithesis between scholarship and research on the one hand and teaching on the other is certainly not new; it was put forward forcefully by Morris Kline in his book *Why The Professor Can't Teach* (St. Martin's Press, 1978), and I attempted to refute it at the time (*American Mathematical Monthly* 86 (1979), 407-412). Suffice it to say

now that the only valid criterion of effective teaching we have, however unreliable, is a love of one's subject; and that the characteristic way in which a mathematician expresses that love is by engaging in research. Thus I would expect research activity to correlate positively rather than negatively with effective teaching.

Moreover, it is simply not true that active mathematicians lack a commitment to teaching and a concern for the curriculum. It suffices to consider the caliber of those who have been discussing the role of discrete mathematics in the undergraduate curriculum; or to reflect with what care and concern, and at what a cost in time and energy and effort, each of us, in our own institutions, endeavors to improve the curriculum and render it more accessible and more appropriate to our students' needs, interests and talents without sacrifice of integrity—and this despite the convincing evidence of the invariance of student response to such change in the curriculum. We also know that appointments, promotions and salary raises do not only depend on research output but also on the individual's devotion to good teaching; our problem here is the real one of how to evaluate the quality of teaching.

The authors import a discordant element into their analysis in impugning the professors' loyalty to their institutions. I do not believe this loyalty has been declining. If we measured it by the desire for tenure of untenured faculty or by the permanence of tenured faculty, we would surely conclude that such loyalty has in fact increased remarkably—but such a measure is, of course, unreliable since it ignores other factors.

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feature

**MAA Studies in Mathematics #24,
Studies in Numerical Analysis
Gene H. Golub, Editor**

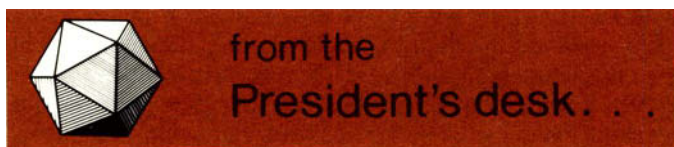
x + 415pp. Hardbound. List: \$36.00 MAA Member \$27.00
Prices valid until June 30, 1985.

This volume is a collection of papers describing the wide range of research activity in numerical analysis. The articles describe solutions to a variety of problems using many different kinds of computational tools. Some of the computations require nothing more than a hand-held calculator; others require the most modern computer.

Numerical analysis has a long tradition within mathematics and science, beginning with the work of early astronomers who needed numerical procedures to help them solve complex problems. The subject has grown and developed many branches, but it has not become compartmentalized. Solving problems using numerical techniques often requires an understanding of several of the branches. This fact is reflected in the papers in this collection.

Over the years, the range of computational devices has expanded tremendously and we can see that exciting developments are on the way. Hand-held calculators have become a basic tool for every modern engineer. At the same time, computers can do more now than we could ever have imagined. The papers in this volume present the different techniques needed for and made possible by several of these computational devices.

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Lynn Arthur Steen, St. Olaf College

Mathematics in the Marketplace

Undergraduate mathematics is full of paradoxes. Just as the world is re-discovering the value of mathematical training, the supply of new undergraduate mathematics teachers has declined to the lowest point in 30 years. And as enrollments are bulging in courses in the mathematical sciences, the percentage of students enrolled in advanced courses has dropped to a record low. On average, fewer than 10% of undergraduate credits in the mathematical sciences are in post-calculus level courses.

Similar declines have affected the supply of Ph.D.'s in the mathematical sciences, although if you are not a department chairman or a dean you may not have noticed how dramatic this shift has been. Last year fewer than 700 U.S. citizens received a Ph.D. degree in all mathematical sciences combined. Of these, fewer than 300 were in traditional core mathematics—about the same number as in 1964. Approximately 200 of the new U.S. Ph.D.'s are in statistics and applied mathematics, and another 200 are in computer science.

Nearly half of the new mathematics doctorates took jobs in industry at average salaries of about \$36,000. Those who entered college teaching began at salaries of \$23,000. Just four years ago the average starting salary for a new Ph.D. in the mathematical sciences was \$17,000. And last year, while new Ph.D.'s were hired by colleges for about \$23,000, the bachelor's degree mathematics graduates of these same colleges received starting job offers at an average salary of \$23,400! The marketplace has indeed discovered the value of mathematical training.

Predicting the future is very risky, although a few patterns seem reasonably certain. About 4000 of the 25,000 full-time teachers of college and university mathematics are over 55 years old. So between now and the turn of the century, the mathematical community will have to hire on average about 300 new teachers per year just to replace those who retire. Moreover, it is virtually certain that the nation's effort to develop expertise in scientific supercomputing will require hundreds if not thousands of new mathematical scientists well versed in nonlinear analysis and parallel algorithms for numerical mathematics. Finally, we can see from current elementary school enrollments that the next upturn in student enrollment will hit the secondary schools in the early 1990's, and the colleges in the late 1990's.

The Ph.D. graduates of the late 1990's will be entering college classes as freshmen during the next few years. They will come to college with expectations of lucrative careers in computer science and electrical engineering. Mathematicians must let students know early in their college years that there are good career opportunities for mathematics graduates at all degree levels—bachelors, masters, doctorate—and in all types of work—teaching (both secondary and collegiate), research, and industrial applications.

But career information is not enough. We must also insure that good freshman and sophomore students see mathematics as a rich subject, alive in opportunities for both research

and application. The most effective way to insure a larger pool of Ph.D.'s a decade from now is to attract a solid number of majors during the undergraduate years. It is no longer sufficient to wait for the cream to rise naturally to the top, or to encourage only the best 1% to major in mathematics. The marketplace of ideas and, fortunately, the marketplace of money now demand more than that.

Mathematical People Published

A series of interviews of mathematicians by mathematicians, which first appeared in the MAA's *Two-Year College Mathematics Journal* (renamed *The College Mathematics Journal* in 1984), has recently been published by Birkhäuser-Boston, in an attractive volume titled *Mathematical People*. Produced through a unique collaborative effort between the MAA and Birkhäuser, the book contains twenty-four profiles and interviews, some of which were done specifically for inclusion in the book. Among those interviewed are Garrett Birkhoff, Persi Diaconis, Paul Erdős, Paul Halmos, Donald Knuth, Ronald Graham, Mina Rees, and Raymond Smullyan. Joint editors of the volume are Donald J. Albers, Menlo College, and G.L. Alexanderson, University of Santa Clara.

The emphasis throughout is on the human side of mathematics—why these people chose mathematics, why they are excited by mathematics, and why they think that what they do is important. It is hoped that the book will appeal to a broad audience of readers, mathematicians and non-mathematicians alike.

In the introduction to the book, Philip J. Davis states,

The essays, interviews, and reminiscences . . . present profiles of some of the finest contemporary mathematical minds. They link men and women of extraordinary achievement with both their material and their environment. Although the writing is relaxed, informal, and delightfully easy to read, we come away exhilarated, feeling that we too have been present at moments when great mathematics was created and have shared the feelings of the creators.

At the level of shop talk we will learn what mathematician is skilled at parlor tricks and how this relates to his professional work. We will read of the mathematician who says, quite flatly, that the computer is important, but not to mathematics; and we will read the exact opposite view expressed. We will know, if we read on, which mathematician, much more than most, explained in his papers how he got his results.

Mathematical People was the Library of Science Main Selection in March. Copies may be ordered directly from Birkhäuser-Boston, 380 Green Street, Cambridge, MA 02139. The list price is \$24.95; the cost to MAA members is \$17.50.

Panel to Study Impact of Computing on Undergraduate Mathematics

The Committee on the Undergraduate Program in Mathematics (CUPM) and the Committee on Computers in Mathematics Education (C²IME) have formed a joint panel to study the impact of computing on the undergraduate program in mathematics. The primary concern of this panel is the impact of computing and computer science on *what* is taught in the undergraduate mathematics program. Questions concerning the impact of the computer on *how* mathematics is taught will be the concern of a sister panel sponsored by the Committee on the Teaching of Undergraduate Mathematics (CTUM) and C²IME.

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Mathematical Association of America 65th SUMMER MEETING

August 12-15, 1985 • Laramie, Wyoming

The August 1985 Joint Mathematics Meetings, including the 65th Summer Meeting of the Mathematical Association of America, the 89th Summer Meeting of the American Mathematical Society, the 1985 Summer Meeting of the Association for Women in Mathematics, and the 1985 Annual Meeting of Pi Mu Epsilon, will be held August 12-15, 1985 (Monday-Thursday), at the University of Wyoming, Laramie. Sessions will take place on the campus of the University of Wyoming, Laramie.

A preliminary program for the meetings—including information and forms for preregistration, housing, and the Summer List of Applicants—was mailed to all MAA members in the center section of the March-April *Focus*. Additional copies may be obtained upon request from: Mathematical Association of America, 1529 Eighteenth Street, N.W., Washington, DC 20036; 202-387-5200.

This center section contains additional meeting information, including descriptions of the MAA Minicourses and the timetable for MAA sessions.

Hedrick Lectures

The 34th Earle Raymond Hedrick Lectures will be given by Arthur M. Jaffe of Harvard University. These lectures will be given at 11:00 a.m. on Tuesday, Wednesday, and Thursday, August 13-15.

Invited Addresses

There will be invited fifty-minute addresses. The list of speakers, their affiliations, and some of the titles follow:

Interactive computer graphics in elementary differential geometry, **Thomas F. Banchoff**, Brown University; *Truth and meaning in mathematics*, **Reuben Hersh**, University of New Mexico; *The nervous system: Some recent work in mathematical biology*, **Frank C. Hoppensteadt**, University of Utah; *Women in the American mathematical community: The pre-1940 Ph.D.'s*, **Jeanne LaDuke**, DePaul University; *Integration: Why you can and why you can't*, **Henry P. Miranda**, Colorado State University; *The place of the Riemann hypothesis in modern prime number theory*, **Hugh L. Montgomery**, University of Michigan; Title to be announced, **Michael Sachs**, Bell Communications Research.

Contributed Papers

Papers are being accepted on four topics in collegiate mathematics for presentation in contributed paper sessions at the MAA Summer Meeting in Laramie. The topics and days they will meet are:

- The role of the history of mathematics in the undergraduate curriculum (Duane D. Blumberg, University of Southwestern Louisiana)
- What's happening in college geometry courses? What should? (Lester H. Lange, San Jose State University)
- Experience with innovation in solving the discrete/continuous mathematics dilemma (Michael G. Murphy and Nancy T. Rich, University of Houston-Downtown)
- What's new in teaching statistics? (Ann E. Watkins, Los Angeles Pierce College)

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes.

Individuals wishing to submit papers for any of these sessions in Laramie should send the following information to the MAA Washington office (1529 Eighteenth Street, NW, Washington, DC 20036) **before May 28**.

1. Title
2. Intended session
3. A one-paragraph abstract (for distribution at the meeting)
4. A one-page outline of the presentation
5. A list of special equipment required for the presentation (e.g., slide or film projector).

Late papers will not be accepted.

This information will be sent to session leaders who will arrange for refereeing. Selection of papers will be announced by June 15.

Joint AMS-MAA Sessions

The names of the speakers, their affiliations, and some of their titles are:

Title to be announced, **Richard A. Askey**, University of Wisconsin; Title to be announced, **Saunders Mac Lane**, University of Chicago; *Fractal geometry: Setting, birth, and growth*, **Benoit B. Mandelbrot**, IBM and Harvard University.

(continued on page iv)

MAA PROGRAM

Sunday, August 11

9:00 a.m. – 4:00 p.m. **Board of Governors' Meeting**

Monday, August 12

morning **Contributed Paper Session:** *Experience with innovation in solving the discrete/continuous mathematics dilemma*, Michael G. Murphy and Nancy T. Rich, University of Houston–Downtown

8:15 a.m. – 8:25 a.m. **Welcome Address**

8:30 a.m. – 10:30 a.m. **Minicourse #1 (Part A):** *Geometry for college teachers*, Branko Grünbaum, University of Washington

9:00 a.m. – 10:30 a.m. **Panel on the Use of Computing in the Teaching of Linear Algebra**, Sponsored by the Committee on Computers in Mathematics Education, Organizer: Eugene A. Herman, Grinnell College

9:45 a.m. – 10:45 a.m. **AMS–MAA Invited Address:** *Title to be announced*, Saunders Mac Lane, University of Chicago

afternoon **Contributed Paper Session:** *What's new in teaching statistics?*, Ann E. Watkins, Los Angeles Pierce College

2:15 p.m. – 3:05 p.m. **Invited Address:** *Title to be announced*, Michael Sachs, Bell Communications Research

2:15 p.m. – 4:15 p.m. **Minicourse #3 (Part A):** *Teaching experiential applied mathematics (TEAM)*, James R. Choike, Oklahoma State University

2:15 p.m. – 4:15 p.m. **Minicourse #5 (Part A):** *Microcomputer software in mathematics instruction*, Roy E. Myers, Pennsylvania State University, Kensington

3:30 p.m. – 5:30 p.m. **Section Officers' Meeting**

7:00 p.m. – 9:00 p.m. **Film Program**

7:30 p.m. – 9:30 p.m. **Minicourse #1 (Part B):** *Geometry for college teachers*, Branko Grünbaum, University of Washington

Tuesday, August 13

morning **Contributed Paper Session:** *The role of the history of mathematics in the undergraduate curriculum*, Duane D. Blumberg, University of Southwestern Louisiana

8:30 a.m. – 10:30 a.m. **Minicourse #4 (Part A):** *Computing in undergraduate linear algebra*, Eugene A. Herman, Grinnell College

8:40 a.m. – 9:30 a.m. **Invited Address:** *The nervous system: Some recent work in mathematical biology*, Frank C. Hoppensteadt, University of Utah

9:45 a.m. – 10:45 a.m. **AMS–MAA Invited Address:** *Fractal geometry: Setting, birth, and growth*, Benoit B. Mandelbrot, IBM and Harvard University

11:00 a.m. – noon **Earle Raymond Hedrick Lecture I:** *Title to be announced*, Arthur M. Jaffe, Harvard University

2:15 p.m. – 3:05 p.m. **Invited Address:** *The place of the Riemann hypothesis in modern prime number theory*, Hugh L. Montgomery, University of Michigan

2:15 p.m. – 4:15 p.m. **Minicourse #3 (Part B):** *Teaching experiential applied mathematics (TEAM)*, James R. Choike, Oklahoma State University

2:15 p.m. – 4:15 p.m. **Minicourse #5 (Part B):** *Microcomputer software in mathematics instruction*, Roy E. Myers, Pennsylvania State University, Kensington

4:35 p.m. – 5:35 p.m. **Business Meeting:** Presentation of the 1985 Carl B. Allendoerfer, Lester R. Ford, and George Pólya Awards for expository writing

Program Committee: David W. Ballew, Robert E. Gaines, Kenneth I. Gross (chairman), A. Duane Porter

AMS-MAA Joint Program Committee: Jeanne L. Agnew, George E. Andrews, Paul F. Baum, William P. Ziemer

Wednesday, August 14

<i>morning-</i>	Contributed Paper Session: <i>What's happening in college geometry courses? What should?</i> , Lester H. Lange, San Jose State University
8:30 a.m. – 10:30 a.m.	Minicourse #2 (Part A): <i>Applied mathematics via classroom experiments</i> , Herbert R. Bailey, Rose-Hulman Institute of Technology
8:30 a.m. – 10:30 a.m.	Minicourse #4 (Part B): <i>Computing in undergraduate linear algebra</i> , Eugene A. Herman, Grinnell College
9:45 a.m. – 10:45 a.m.	AMS-MAA Invited Address: <i>Title to be announced</i> , Richard A. Askey, University of Wisconsin
11:00 a.m. – noon	Earle Raymond Hedrick Lecture II: <i>Title to be announced</i> , Arthur M. Jaffe, Harvard University
1:00 p.m. – 1:50 p.m.	Invited Address: <i>Women in the American mathematical community: The pre-1940 Ph.D.'s</i> , Jeanne LaDuke, DePaul University
2:15 p.m. – 3:05 p.m.	Invited Address: <i>Interactive computer graphics in elementary differential geometry</i> , Thomas F. Banchoff, Brown University
3:20 p.m. – 4:10 p.m.	Invited Address: <i>Integration: Why you can and why you can't</i> , Henry P. Miranda, Colorado State University
6:15 p.m.	Banquet for Twenty-five Year Members
7:30 p.m. – 9:30 p.m.	Minicourse #2 (Part B): <i>Applied mathematics via classroom experiments</i> , Herbert R. Bailey, Rose-Hulman Institute of Technology

Thursday, August 15

8:40 a.m. – 9:30 a.m.	Invited Address: <i>Truth and meaning in mathematics</i> , Reuben Hersh, University of New Mexico
11:00 a.m. – noon	Earle Raymond Hedrick Lecture III: <i>Title to be announced</i> , Arthur M. Jaffe, Harvard University

Local Arrangements Committee

Sandy H. Adams, Myron B. Allen (chairman), Lois Kline, William J. LeVeque (ex-officio), Melfried Olson (publicity director), Kenneth A. Ross (ex-officio)

MAA Minicourses

Minicourse #1: *Geometry for college teachers* is being organized by Branko Grünbaum, University of Washington. Part A is scheduled from 8:30 a.m. to 10:30 a.m. and Part B from 7:30 p.m. to 9:30 p.m. on Monday, August 12. Total enrollment for this Minicourse is limited to 45 persons. Geometry instruction at the college level has practically disappeared. Many people find this an intolerable loss, which imposes heavy and unnecessary handicaps on future professionals of all kinds. The Minicourse will attempt to present a practising geometer's views on what should be the philosophical and educational underpinnings of college level geometry courses, what should be the aims of such courses, what kinds of topics can be presented with chances of success, and what difficulties will have to be overcome if the feeling for spatial relations is not to atrophy completely in the next few generations.

Minicourse #2: *Applied mathematics via classroom experiments* is being organized by Herbert R. Bailey, Rose-Hulman Institute of Technology. Part A is scheduled for 8:30 a.m. to 10:30 a.m. and Part B from 7:30 p.m. to 9:30 p.m. on Wednesday, August 14. Total enrollment for this Minicourse is limited to 80 persons. This Minicourse is based on a junior level applied mathematics course which has been developed to encourage students to combine their knowledge of physics, calculus, and differential equations. Students are asked to derive and solve the equations that model simple classroom experiments. For example, the first experiment is to let a ball bounce until it stops. The problem is to relate "percent rebound" and "time to stop bouncing." The student must combine the concepts of time of fall and summation of geometric series. The full course includes five units: I—The Chain, II—Rotation, III—Fluid Flow, IV—Heat Flow, and V—Calculus of Variations. The Minicourse will begin with a brief description of each unit including demonstrations of most of the experiments. Participants will then be asked to work through some of the units either individually or in small groups. Each participant will be given a writeup and a solution manual for each of the units. The writeups include review sections covering the necessary mathematics and physics.

Minicourse #3: *Teaching experiential applied mathematics, (TEAM)* is being organized by James R. Choike, Oklahoma State University. Part A is scheduled from 2:15 p.m. to 4:15 p.m. on Monday, August 12 and Part B from 2:15 p.m. to 4:15 p.m. on Tuesday, August 13. Total enrollment for this Minicourse is limited to 80 persons. This Minicourse will feature applied mathematics multi-media learning modules for use in college classrooms which were produced by a project called TEAM, funded by a grant to the MAA from the Fund for the Improvement of Postsecondary Education (FIPSE). TEAM learning modules consist of video cassettes, written materials, and (for some modules) microcomputer software. In these real-world industrial problems, solutions are presented by industrial representatives who have actually encountered

these problems in their work. The Minicourse will introduce participants to the six TEAM learning modules produced during the first two years of this project. Of special interest to those already familiar with TEAM modules, this Minicourse will mark the first official release of three new TEAM learning modules. Each participant will receive a complete set of TEAM written materials. Participants will be shown how these modules can be used (i) to prevent a course in applied mathematics at the upper division level or at the lower division level; (ii) to offer students independent study projects, or (iii) to provide a lecture presentation of an application in industry.

Minicourse #4: *Computing in undergraduate linear algebra* is being organized by Eugene A. Herman, Grinnell College. Part A is scheduled from 8:30 a.m. to 10:30 a.m. on Tuesday, August 13 and Part B from 8:30 a.m. to 10:30 a.m. on Wednesday, August 14. Total enrollment for this Minicourse is limited to 30 persons. A major reason that linear algebra is now taught to so many students so early in their education is that the computer has made linear algebra much more useful to scientists than it was 35 years ago. Yet computing has not had a significant effect on how undergraduate linear algebra is usually taught. This Minicourse explores the possibilities and consequences of putting powerful matrix computation packages in the hands of beginning linear algebra students. We will demonstrate and give participants experience using one such package. We will discuss the mathematical algorithms incorporated in the software, the importance of the user interface, the probable changes needed in the course, the kinds of application problems that can be assigned to students, the demands such a course puts on instructors and students, and the possible effects of the course. The capabilities possessed by the packages include: LU-factoring, QR-factoring, finding least square solutions, finding complete sets of eigenvectors and associated eigenvalues, orthonormalizing vectors, and finding Jordan and rational canonical forms.

Minicourse #5: *Microcomputer software in mathematics instruction* is being organized by Roy E. Myers, Pennsylvania State University, Kensington. Part A is scheduled from 2:15 p.m. to 4:15 p.m. on Monday, August 12 and Part B from 2:15 p.m. to 4:15 p.m. on Tuesday, August 13. Total enrollment for this Minicourse is limited to 30 persons, but a second session will be offered if demand warrants. A wide variety of instructional software is becoming available for use with microcomputers. It varies in nature, including drill and practice, tutorial, and materials for use as lecture aids. Software is available for use in courses from introductory algebra through calculus, statistics, differential equations, and linear algebra. In this Minicourse, various types of software will be demonstrated, and issues relating to their uses will be discussed. It is planned that a large variety of software will be available and that Minicourse participants will have the opportunity to work with the software on microcomputers.

Panel (continued from page 4)

The curriculum panel will investigate:

- How existing mathematics courses have been changed because of the availability of numerical computation packages, computer graphics packages specifically designed for mathematicians, and symbolic algebraic manipulators.
- Whether these software packages are bringing about the introduction of new courses, either through the reorganization of subject matter or because they open new areas of interest for undergraduate mathematics students.
- How the use of algorithmic methods is changing present and future mathematics courses.
- The effects of incorporating the mathematical needs of computer science students into the undergraduate curriculum.

The panel expects to publish a report of its findings within one to two years, which will include a bibliography of texts reflecting the impact of computing on undergraduate mathematics. Members of the curriculum panel are: Sheldon Gordon, Adelphi University; John Hosack, Colby College; Carl Leinbach (Chairman), Gettysburg College; David Leslie, San Diego State University; Stephen Maurer, Swarthmore College; Robert Miller, Tulane University; Arthur Seebach, St. Olaf College. Gerald Porter of the University of Pennsylvania, Chairman of C²IME, serves on the panel as an ex officio member.

Any person who would like to contribute information for the consideration of the curriculum panel should contact: Professor Carl Leinbach, Department of Computer Studies, Box 506, Gettysburg College, Gettysburg, PA 17325.

Ford Foundation to Establish "Urban Mathematics Collaboratives"

The Ford Foundation has announced an experimental program to strengthen mathematics teaching in inner-city high schools. Five grants, totaling \$379,000, will help establish "urban mathematics collaboratives" in Philadelphia, Minneapolis, Cleveland, San Francisco, and Los Angeles.

Bringing together mathematicians from local educational, cultural, and business institutions, the collaboratives will marshal community resources to stimulate the professional renewal of high school teachers. The Ford Foundation grants, supplemented by \$725,000 in local support, will assist such activities as lectures on applied mathematics in business, intensive summer mini-courses on new technologies, and exchange programs with local colleges and industries.

"The collaboratives will give teachers added resources to learn about new ideas, to develop relationships with other mathematicians, and to augment classroom activities," says Ford Foundation President Franklin Thomas. "We believe that increasing teachers' collegiality with other professionals will lead to enriched learning opportunities for students."

The new initiative, part of the Foundation's on-going commitment to strengthening schools serving disadvantaged inner-city students, will support the collaboratives' first eighteen months of operation. If successful, the projects will receive additional Foundation funding, eventually becoming self-sustaining, locally-funded programs. Over the next five years, the five collaboratives and a half-dozen more currently under discussion with other cities will receive some \$6 million in grants and other support, including \$2 million from the Foundation.

Modeling Competition Results

Solomon A. Garfunkel

The first Mathematical Competition in Modeling (MCM) was held during the weekend of February 15-18. This competition is supported by a grant to the Consortium for Mathematics and its Applications (COMAP) from the U.S. Department of Education's Fund for the Improvement of Post-secondary Education. One hundred fifty-eight (158) teams representing 104 colleges entered the competition and 90 teams from 70 colleges submitted solution papers. Each team selected one of two problems in this year's MCM and the solutions were graded as two separate exams. The first problem involved the maintenance of a strategic reserve of raw materials and the second dealt with a harvesting problem for an animal or fish population. Approximately two-thirds of the teams worked on the harvesting problem, which was the more open-ended of the two.

Eighteen (18) teams received meritorious standing of which 6 were deemed outstanding. The spread—both geographic and with respect to the size and type of college—of the meritorious schools is instructive. The outstanding papers from the harvesting problem were submitted by Harvey Mudd College, Mount Saint Mary's College, Southern Methodist University, and Washington University. The outstanding papers for the strategic reserve problem came from Calvin College and New Mexico State University.

The remaining schools with meritorious teams were Beloit College, Central Washington University, Cooper Union (2), California State University, Harvey Mudd College, Trinity University, University of California-Berkeley (2), Oklahoma State University, Harvard University, California Polytechnic State University.

In terms of both the quantity and quality of the papers received, this first competition far exceeded expectations. Project director B.A. Fusaro of Salisbury State College and the COMAP staff have prepared a questionnaire for MCM faculty advisors to help plan next year's examination. We seek not only to increase participation, but to move toward our underlying goal of increasing the presence of applied mathematics and modeling on our campuses.

Committee to Study Mathematics Teaching by Graduate Students and Adjunct Faculty

A new MAA committee has been formed to look at the issue of the increasing number of college mathematics courses being taught by teaching assistants and adjunct faculty or part-time instructors. Data regarding the amount of teaching done by these personnel, and about the amount of training and supervision which they receive, will be collected by a questionnaire which will be mailed to chairs of doctorate granting mathematics departments. (No results will be released from which information from particular departments may be deduced.)

Since many other mathematics departments experience problems as a result of increased proportions of teaching done by other than regular faculty, the committee would like to add their experience to the data base. Anyone wishing to participate in the survey should request a questionnaire from: Professor Bettye Ann Case, Department of Mathematics, Florida State University, Tallahassee, FL 32306.

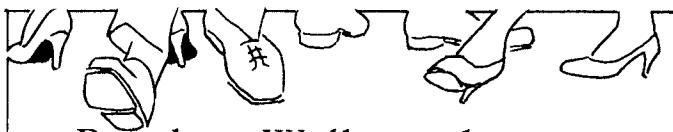
UC-Davis and Washington University Tie on Putnam

For the first time anyone can remember, two schools have tied for first place on the William Lowell Putnam Examination. For the efforts of their students on December 1, 1984, the University of California-Davis and Washington University in St. Louis will each receive the \$5000 first prize. Each member of both teams—John Boyland, Robert Filippini, and Michael Quinn from Davis; William Paulsen, Richard Stong, and Dougin Walker from Washington—will receive the usual \$250 team member prizes.

Harvard, Princeton, and Yale were next, in that order. The next five teams, in alphabetical order (further ranks are not announced) were: California Institute of Technology, Colorado State University, Rose-Hulman Institute of Technology, University of California-Berkeley, and the University of Chicago.

The five highest scoring individuals, also in alphabetical order, were Noam Elkies (Columbia University), Benji Fisher (Harvard University), Daniel Johnson (Rose-Hulman), Michael Reid (Harvard), and Richard Stong (Washington University). Elkies was among the top five last year also, and Stong was in the next five. Elkies, Fisher, Reid and Stong are all former winners (top eight) on the high school USA Mathematical Olympiad.

Two thousand one hundred and forty nine (2,149) students from 350 colleges and universities took the Putnam this time. It takes 24 people two days each to grade their examinations.



Random Walks and Electric Networks

by J. Laurie Snell and Peter Doyle
xiii + 159 pages. Hardbound
MAA Member: \$16.00 List: \$21.00

In this newest addition to the Carus Mathematical Monographs, the authors examine the relationship between elementary electric network theory and random walks, at a level which can be appreciated by the able college student. We are indebted to them for presenting this interplay between probability theory and physics in so readable and concise a fashion.

Central to the book is Polya's beautiful theorem that a random walker on an infinite street network in d -dimensional space is bound to return to the starting point when $d = 2$, but has a positive probability of escaping to infinity without returning to the starting point when $d = 3$. The authors interpret this theorem as a statement about electric networks, and then prove the theorem using techniques from classical electrical theory. The techniques referred to go back to Lord Rayleigh who introduced them in connection with an investigation of musical instruments.

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Toronto School Tops AHSME Student Aces AHSME and AIME

With nearly complete returns, it appears that the University of Toronto School has attained the highest team score on the 36th annual American High School Mathematics Examination (AHSME). The UT School team (three highest scorers) attained 370. [The AHSME has a maximum individual score of 150.] Although Ontario schools have done very well since they entered the AHSME in force several years ago, this will be the first time a Canadian school has been number one.

The next highest schools are: Stuyvesant High School in New York City (many times first in the past) at 366; the Collegiate School of New York City at 357; a tie at 355 between Evanston Township High School in Evanston, Illinois, and the Maimonides School of Brookline, Massachusetts; Hunter High School in New York City at 354; Miami Killian High School in Miami at 351; and Claremont High School in Claremont, California at 350.

There was one perfect individual score, attained by Bjorn Poonen, a senior at Winchester High School in Winchester, Massachusetts. There was a five-way tie for second place: Chris Atamian (Collegiate School), Ed Bailey (LBJ High School, Austin, Texas), David Grabiner (Claremont High School), Jeremy Kahn (Hunter High School), and Moses Klein (University of Toronto School) all attained 145.

American Invitational Mathematics Examination

All students who scored 95 or above (under 1000 out of over 380,000 AHSME participants) were invited to the American Invitational Mathematics Examination (AIME), given on March 19. By *FOCUS* presstime, 911 papers had been processed. So far, six students have perfect scores of 15, among them Poonen. By answering 10 or more correctly, 64 students have qualified to take the USA Mathematical Olympiad on April 23. A report on the Olympiad, and the International Mathematical Olympiad to follow in July in Helsinki, will appear in the September *FOCUS*.

For a summary of American and Canadian AHSME/AIME results, send \$4 to Professor Walter Mientka, American Mathematics Competitions, 917 Oldfather Hall, University of Nebraska, Lincoln, NE 68588-0322.

Ohio Section to Offer Short Course on Discrete Structures and Discrete Math

The MAA Ohio Section will offer a Short Course, "Discrete Structures for Computer and Discrete Mathematics (Combinatorics)," July 17-19, 1985, at the University of Akron. The principal lecturers are David Buchthal, The University of Akron, and Donald Beane, College of Wooster.

The course will begin at 1:30 p.m. on the 17th. Each afternoon and morning session will consist of one-and-one-half to two hours on discrete structures by Buchthal, followed by one-and-one-half to two hours on discrete mathematics by Beane.

The registration fees are \$35 for college faculty and \$95 for corporate employees. Room and board at the University of Akron is \$70 for two nights lodging and six meals.

To register for the course, send a deposit of \$10 for the course and \$20 for lodging and meals to: Dr. William Beyer, Department of Mathematical Sciences, The University of Akron, Akron, Ohio 44325.

Coordinators Sought for Women and Mathematics Program

The National Director of the MAA's Women and Mathematics (WAM) Program, Carole B. Lacampagne, University of Michigan-Flint, is seeking volunteers to serve as WAM Regional Coordinators in these cities or states: Texas; Louisville, Kentucky; Durham, North Carolina; Albuquerque, New Mexico; Nebraska; Pittsburgh, Pennsylvania; Wyoming, and Montana/Idaho.

WAM currently operates in Baltimore/Washington, Boston, Central Ohio, Chicago Area, Connecticut, Greater Seattle, Kansas City, New York/New Jersey, Northern California, Oregon, Salt Lake City, South Florida, and Southern California. Lacampagne hopes to double the number of regions within the next four years.

WAM is a secondary school lectureship program designed to encourage students, especially young women, to continue their study of mathematics. Regional coordinators are responsible for recruiting speakers, advertising the program at schools in their areas, "matching up" speakers and schools, and keeping the National Director informed about their programs. The National Director and MAA Washington Office assist Regional Coordinators in these tasks. Regional Coordinators are paid a small stipend out of the grants that support WAM, and are funded to travel to national meetings to attend coordinators' meetings.

Individuals interested in coordinating a WAM region should write to: Dr. Carole B. Lacampagne, Department of Mathematics, University of Michigan-Flint, Flint, MI 48503.

People in the News



Edward E. David, Jr., President of Exxon Research and Engineering Company, was presented with the prestigious Arthur M. Bueche Award of the National Academy of Engineering in ceremonies at the Massachusetts Institute of Technology on April 8. David will also be presented with the Public Service Award of the Conference Board of the Mathematical

Sciences in ceremonies at the National Academy of Sciences on May 12, 1985.

Both of these awards honor David for his contributions to mathematical sciences research as Chairman of the National Research Council's Committee on Resources for the Mathematical Sciences. The work of the committee culminated in June 1984, after three years of strenuous effort, in the publication of the report, *Renewing U.S. Mathematics: Critical Resource for the Future*. (See "News from NSF" on page 2 of this issue.)

The 1984 Jacob Wolfowitz Prize has been awarded to **Edward J. Dudewicz**, Syracuse University, and **Siddhartha R. Dalal**, Bell Communications Research, for their paper "Multiple-Comparisons with a Control when Variances are Unknown and Unequal."

Herman H. Goldstine, Executive Officer of the American Philosophical Society and IBM Fellow, was awarded the National Medal of Science on February 27. Goldstine gained distinction as an inventor and mathematician. During World War II he played a vital role in the development of ENIAC and EDVAC, the first electronic computers.

The Wolf Foundation has announced that the 1984-85 prize in mathematics is to be shared by **Kunihiko Kodaira** of the Japan Academy and **Hans Lewy** of the University of California-Berkeley. The prize is \$100,000.

Kodaira is being honored for his outstanding contributions to the study of complex manifolds and algebraic varieties, and Lewy for initiating many developments, now classic and essential, in partial differential equations.

Job (continued from page 3)

I also cannot agree that our research students are encouraged to ignore the teaching aspect of their future academic careers. Almost all of them are seriously engaged in teaching while they are graduate students. They all know that their teaching will be a factor in determining their career prospects. No letter of recommendation from a thesis supervisor or a faculty member at the student's institution will fail to refer to the evidence of the student's teaching ability and commitment. On this particular issue, I am sure the report is wrong—the concern for teaching among graduate students and their advisors is greater, not less than it was 20 years ago. I also believe the report is mistaken in referring to the "science" of teaching. There is no such science and those who perpetrate the phrase are bound to be suspected of special pleading. Surely, too, the authors err in describing a faculty member's responsibilities in a college or university as "full-time teaching." Is it not common ground that we give half our time to duties connected with our teaching, half our time to research and study, and the rest of our time to committee work? And is not this committee work further evidence of our concern for the curriculum and for our institutions? No, I find the committee's diagnosis faulty even in those areas outside mathematics in which I have the right to an opinion.

What then is my diagnosis of the malaise, from the perspective of a mathematician and a teacher? Let me be as brief as possible. I diagnose the malaise which creates such real difficulties for us in maintaining the integrity of our courses and our bachelor degrees to be an increasing disrespect for education and true learning in our society, and its replacement by the philistine concept of training. This training consists in the acquisition of ephemeral skills through the agency of memory and not understanding. The trend is reinforced by a system of tests, judiciously administered sufficiently close in time to the acquisition of the skill for the memory to function reasonably and permit a socially acceptable success rate. These tests in turn become for the student the purpose of the training since advancement and, ultimately, career prospects are based on them. Education is seen only as a means to the attainment of a qualification, of a union card. How else can we explain that, in our society, those who exhibit exceptional talent are rewarded by "acceleration," that is, by having the period of their education reduced to a minimum? It makes sense to accelerate the training of the most apt, it is disgraceful to curtail the education of the brightest. The problem is one of decline because the regrettable trend away from genuine education is getting stronger; and the decline is highly conspicuous in mathematics because mathematics cannot be learned without being understood—it is not a matter of formulae being committed to memory but of acquiring a capacity for systematic thought. Our students seem to want merely to be able to execute mechanical processes—but we have machines and do not need human substitutes.

Calendar

National MAA Meetings

65th Summer Meeting, Laramie, Wyoming, August 12-15, 1985.
69th Annual Meeting, New Orleans, Louisiana, January 9-11, 1986.
70th Annual Meeting, San Antonio, Texas, January 23-25, 1987.

71st Annual Meeting, Atlanta, Georgia, January 8-10, 1988.
72nd Annual Meeting, Phoenix, Arizona, January 10-14, 1989.

Sectional MAA Meetings

Illinois University of Illinois, Champaign-Urbana, Illinois, May 3-4, 1985.
Metropolitan New York Webb Institute of Naval Architecture, Glen Cove, New York, May 4, 1985.
Michigan Western Michigan University, Kalamazoo, Michigan, May 3-4, 1985.

Northeastern Norwich University, Northfield, Vermont, June 14-15, 1985.
Pacific Northwest Willamette University, Salem, Oregon, June 21-22, 1985.

Other Meetings

May 1985

20-24. **NSF/CBMS Regional Conference—Special Functions, Physics and Computer Algebra**, Arizona State University. Lecturer: Richard Askey. Contact: Mourad Ismail, Mathematics Department, Arizona State University, Tempe, AZ 85287.

21-22. **Downeast Graph Theory Conference**, Colby College; sponsored by Colby College and the Northeast Section of the MAA. Papers of twenty minutes in length on any topic in graph theory or combinatorics are being solicited. Contact: Don Small, Department of Mathematics, Colby College, Waterville, Maine 04901; (207) 872-3255.

June 1985

2-4. **Eleventh Annual Meeting of the Canadian Society for History and Philosophy of Mathematics**, Montreal, Quebec, Canada. Contact: Louis Charbonneau, Department de Mathematiques, UQAM, CP 8888, Succ. A, Montreal, P.Q. H3C 3P8.

3-7. **MAA Maryland-DC-Virginia Section Summer Workshop—Program Design and Pascal**, Salisbury State College. (See *FOCUS*, January-February 1985.)

3-7. **NSF/CBMS Regional Conference—Construction and Salient Properties of Nonparametric Priors**, Pennsylvania State University. Lecturer: Jayaram Sethuraman. Contact: James D. Lynch, Department of Statistics, 501 Keller Building, Pennsylvania State University, University Park, PA 16802.

8-9. **MAA Maryland-DC-Virginia Section Weekend Summer Workshop—Fractals and the Geometry of Nature**, Salisbury State College. (See *FOCUS*, March-April 1985.)

10-14. **MAA Maryland-DC-Virginia Section Summer Workshop—Computer Solutions of Differential Equations**, Salisbury State College. (See *FOCUS*, January-February 1985.)

10-14. **MAA Northeast Section Seventh Annual Short Course—The Total Role of the Mathematician—Researcher, Consultant, Teacher, Curriculum Developer, and Damn Nuisance**, University of Maine at Orono. (See *FOCUS*, January-February 1985.)

10-14. **NSF/CBMS Regional Conference—Approximation Theory and Numerical Analysis**, University of Alaska. Lecturer: E.W. Cheney. Contact: Gary A. Gislason, Department of Mathematics, University of Alaska, Fairbanks, AK 99701.

10-28. **MAA Ohio Section Short Course—Data Systems**, Denison University. (See *FOCUS*, January-February 1985.)

10-28. **MAA Ohio Section Short Course—Operating Systems**, Bowling Green State University. (See *FOCUS*, January-February 1985.)

16-20. **NSF/CBMS Regional Conference—New Constructions of Holomorphic Functions in the Unit Ball of C^n** , Michigan State University. Lecturer: Walter Rudin. Contact: Joel H. Shapiro, Department of Mathematics, Michigan State University, East Lansing, MI 48824.

16-21. **MAA North Central Section Fifth Biennial Summer Seminar—Applications of Discrete Mathematics**, St. Olaf College. (See *FOCUS*, March-April 1985.)

17-21. **NSF/CBMS Regional Conference—Applications of Combinatorics and Graph Theory to Computer Science**, University of Alabama. Lecturer: C.L. Liu. Contact: Peter J. Slater, Department of Mathematics, University of Alabama, Huntsville, AL 35899.

17-21. **NSF/CBMS Regional Conference—Group Rings, Crossed Products and Galois Theory**, Mankato State University. Lecturer: Donald S. Passman. Contact: Francis T. Hannick, Department of Mathematics, Mankato State University, MSU Campus Box 41, Mankato, MN 56001.

July 1985

15-19. **NSF/CBMS Regional Conference—Jordan Algebras and Applications to Analysis, Operator Theory and Quantum Mechanics**, University of California-Irvine. Lecturer: Harald Upmeyer. Contact: Bernard Russo, Mathematics Department, University of California-Irvine, Irvine, CA 92717.

17-19. **MAA Ohio Section Discrete Structures for Computer and Discrete Mathematics (Combinatorics)**, University of Akron. (See page 6 of this issue.)

August 1985

12-15. **Meeting of the Association for Women in Mathematics**, Laramie, Wyoming. Contact: AWM, Box 178, Wellesley College, Wellesley, MA 02181.

12-16. **NSF/CBMS Regional Conference—Optimization in Operator Theory, in Analytic Function Theory, and in Electrical Engineering**, University of Nebraska-Lincoln. Lecturer: J. William Helton. Contact: David R. Larson, Department of Mathematics, University of Nebraska, 414 Administration Building, Lincoln, NE 68588-0430.

19-23. **NSF/CBMS Regional Conference—Combinatorial Theory and Invariant Theory**, West Chester University. Lecturer: Gian-Carlo Rota. Contact: Frank D. Grosshaus, Department of Mathematical Sciences, West Chester University, West Chester, PA 19383.

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