FOCUS

THE NEWSLETTER OF THE MATHEMATICAL ASSOCIATION OF AMERICA

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# Keane Leads US Olympiad Team to 1st Place Tie with USSR

*Stephen B. Maurer*

Scoring 41 out of a possible 42, Joseph Keane of Pittsburgh, Pennsylvania, led the US team of 6 to a winner's tie with Russia in the 27th International Mathematical Olympiad, held July 9-10 in Warsaw. Both countries scored 203, followed by West Germany (196), China (177), East Germany (172) and Romania (171).

The Russians had 2 perfect papers (6 problems, 7 points each) and the Hungarians had one, but Keane was the only participant of the 210 from 37 countries to receive a Special Award for a particularly elegant solution. The problem he received it for is given at the end of this article. (Finding his solution is left to the reader!)

The US was the only one of last year's top 5 nations to make it to the top 5 this year. Last year the US was 2nd (180) behind Romania (201). The USSR was 6th in 1985 and 1st in 1984.

Keane received a Gold Medal, as did his teammates David Grabiner of Claremont, California (score 36), and Jeremy Kahn of New York City (35). The other team members all received Silver: Hohn Overdeck of Columbia, Maryland (32), Darien Lefkowitz of New York City (30), and William Cross of Kalamazoo, Michigan (29).

**USAMO winners are greeted by Dr. Erich Bloch, Director of NSF. The winners from left to right are: Ravi D. Vakil of Ontario, Eric K. Wepsic of Massachussetts, David J. Grabiner of California, William P. Cross of Michigan, followed by Dr. Bloch and then Joseph G. Keane of Pennsylvania, Darien G. Lefkowitz and Jeremy A. Kahn, both of New York, and John J. Bulten of Oklahoma.**

Notable this year was the strong showing by The People's Republic of China. This was only the 2nd time they participated, and the first time they fielded a full team. Another highlight was the Bronze Medal performance of a 10-year old from Australia.

The US team was again coached by Professor Cecil Rousseau of Memphis State University and Gregg Patruno of Columbia and the First Boston investment firm.

All the US team members but Kahn were seniors, an unusual situation. Thus, it will be challenging to build for next year's IMO in Cuba.

The US team was chosen based on the USA Mathematical Olympiad, held on April 22, and on additional work at a rigorous 4-week Training Session at the US Naval Academy. The highest scoring USAMO participants, and other high scoring nonseniors, were invited. 5 of the 6 students chosen for the IMO team were USAMO Winners (top 8); the 6th, John Overdeck, was a Winner in 1985. The other Winners of the 1986 USAMO were John Bulten of Tulsa, Ravi Vakil of Islington, Ontario, and Eric Wepsic of Boston. All 8 Winners were honored at elegant ceremonies in Washington, D.C., on June 2-3. The Greitzer/Klamkin Award, for the very top USAMO score, went to Keane—for the 2nd year in a row.

The success of the US team is partly the result of a broad-based program to discover and encourage mathematical talent. The USAMO is the third in the series of high school exams sponsored by the MAA and 6 other mathematics societies. Joe Keane also received the top score in the 2nd, the American Invitational Mathematics Examination, sharing a perfect score of 15 with Robert Southworth of Winchester,

*(continued on page 2)*

**Keane** *(continued from page 1)*

MA. For further information on the 1986 AIME, and on the 1st exam (AHSME), see page iii of the May-June ***FOCUS***; however, these results were erroniously attributed to 1985. MAA members can do much to strengthen this program by encouraging local schools to participate. An IMO/USAMO problems-solutions pamphlet, and similar pamphlets for the AIME and AHSME, are available. Members may contact Professor Walter E. Mientka, 917 Oldfather Hall, University of Nebraska, Lincoln, NE, 68588-0322 for prices.

Here is the problem that Joseph Keane solved so elegantly: 1986 IMO, Problem 3 (submitted by E. Germany): To each vertex of a regular pentagon an integer is assigned in such a way that the sum af all the five numbers is positive. If three consecutive vertices are assigned the numbers x, y, z, respectively, and $y<0$ then the following operation is allowed: the numbers x, y, z, are replaced by $x+y$, $-y$, $z+y$ respectively. Such an operation is performed repeatedly as long as at least one of the five numbers is negative. Determine whether this procedure necessarily comes to an end after a finite number of steps. (After participants asked for clarification it was announced that "necessarily" means regardless of which negative number y is operated on when there is a choice.)

FOCUS

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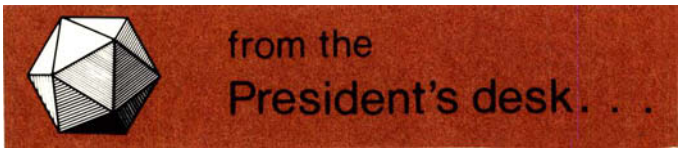



Lynn Arthur Steen, St. Olaf College

## Proposal Pressure

In recent years the National Science Foundation's support for educational activities has had a very bimodal distribution, with strong programs at the pre-collegiate and post-graduate levels but virtually no support for undergraduate activities. Moreover, all existing programs for mathematics education and mathematics research are seriously inadequate when measured by the needs of the mathematics community. As a consequence, many mathematicians—especially many college mathematics faculty—have lost interest in trying to get NSF support either for themselves, for their departments, or for their students.

That's bad for at least two reasons. Those who don't apply stand no chance of receiving an award, so the total support for mathematics begins to dwindle. Moreover, since there is insufficient "proposal pressure" from mathematics, future budgets for mathematics are also placed in jeopardy, especially when put in competition against other fields where proposers inundate NSF with strong requests.

Consider these examples selected from among the very few NSF programs that bear directly on undergraduate mathematics. Last year only 25 mathematics students received NSF graduate fellowships out of 500 total awards. And despite widespread need for increasing computer resources in undergraduate mathematics, only 2 out of 200 awards made in the College Science Instrumentation Program (CSIP) went to mathematics curricular projects.

It is well known that mathematics students score better on the Graduate Record Examination than do most other students who take that exam. Even after suitable normalization to account for different pools of students taking different exams, mathematics GRE scores average one standard deviation higher than those in chemistry, biology, computer science, or economics.

Then why don't more mathematics students receive NSF Graduate Fellowships? Because not enough of them apply. To promote fairness in administration, and because of the difficulty of making cross-disciplinary comparisons, awards in different fields are generally made in proportion to applications. Last year only about 100 students—about 1 in 40 of those applying to graduate school—applied for an NSF Graduate Fellowship in mathematics.

There are many possible reasons for the shortage of mathematics applicants in the Graduate Fellowship competition: low interest in mathematics graduate school; reputation that only geniuses can get a Graduate Fellowship; insufficient encouragement from advisors and departments. The fact is, however, that both applications and awards are low even in proportion to the number of students entering graduate school, and as the GRE scores show, graduate-school-bound mathematics students will quite likely fare well in head-to-head competition with other students. The crucial missing ingredient is faculty encouragement.

A similar problem of weak proposal pressure exists in the CSIP program, although almost certainly for different rea-

sons. Mathematicians are not used to thinking about or dealing with equipment, and administrations are not used to providing the necessary matching funds in budgets of mathematics departments. Whereas writing grant proposals for equipment is practically part of the graduate training of any physicist or chemist, it is **terra incognito** to a mathematics professor who normally worries only about an adequate supply of colored chalk.

Last year only 10 out of nearly 1000 applications for CSIP awards came from departments of mathematics, even though well over 1500 departments are eligible to apply for these awards. That so few mathematics departments are willing to even ask for resources to upgrade their curriculum is a professional problem that borders on the scandalous: we cannot expect others to help our profession if we are not willing to try to help ourselves.

Our nation needs more and better trained mathematics graduates at all degree levels. One way to achieve this is for undergraduate departments to integrate modern computing into the mathematics curriculum and to encourage the best students to select mathematics as a career. Within its still very limited education-related resources, NSF is supporting this strategy with specific programs. But the mathematics community is not providing sufficient proposal pressure to make the system operate at the level it should.

It takes effort to develop a good application—effort that must be based in part on altruism since the majority of applicants will not receive awards. The act of applying, however, will help raise the level of awards for mathematics generally, now and in the future. And it will help the applicant—whether a student or a department—determine a course of action for the future. Developing good proposals is one of the best indicators of professional activity, since the planning required for the proposal almost always leads to more effective work in the future.

This fall, as we discuss career options with seniors and debate curricular reform with colleagues, let's insist that our best students apply for NSF Graduate Fellowships and that every department apply for a College Science Instrumentation grant.

As a start, see the box containing names and phone numbers of key administrators of NSF programs that are of special importance to college mathematics that accomanies this article.

## Questions on Declining Graduate Enrollments

How great is the plunge in graduate mathematics enrollments, especially for US citizens? How does the community perceive this drop? What are the implications of these declines for education, research, technology, and defense? These questions will be addressed by a Conference Board of the Mathematical Sciences Committee chaired by Barry Simon and consisting of Joe Kohn, Betty Lichtenberg, Willard Miller, and Paul Sally. For its work, the committee solicits all available hard evidence together with any substantial anecdotal evidence bearing on these questions. Please send such information to Professor Barry Simon, Mathematics Department, 253-37 Caltech, Pasadena, CA 91125. The committee would like to hear from those with information on these matters by December 1, so that it can move ahead with its work quickly and effectively.

National Science Foundation, 1800 G Street, NW, Washington, D.C. 20550. Program Offices:

**College Science Instrumentation Program.** Robert F. Watson, Head. (202)357-9644; Deadline: November 7.

**Graduate Fellowship Program.** Douglas S. Chapin, Head. (202) 357-7856; Deadline: November 14.

**Mathematical Sciences Research Division.** John C. Polking, Director. (202)357-9669; Deadline: Anytime.

## 70th Annual Meeting in San Antonio

The 70th Annual Meeting of the Association will be held in San Antonio January 21-24, 1987. The list of invited hour speakers will include Steven J. Brams, Andy deSessa, Daniel H. Gottlieb, Richard K. Guy, Peter D. Lax, Frank T. Leighton, and John W. Milnor. Among the Joint AMS-MAA speakers will be Lipman Bers (tentative), Edward N. Lorenz, and Uta C. Merzbach.

Several minicourses will be offered and several panel discussions are planned. There will be a joint MM/NCTM Panel on Reform in Mathematics Education, a AAAS Panel on Project 2061, a CCIME Panel on the Use of Computers in Teaching Differential Equations, a Panel on The Leading Edge of Software, a panel reporting on the work of the Joint MAA/ACM/IEEE Task Force on Teaching Computer Science in Mathematics Departments, and a joint AMS-MAA Symposium titled "The Role of Mathematicians in Pre-College Education". There will be a Presentation on Statistical Process Control (SPC), a presentation by Ben Fusaro on the mathematical competition in mathematical modeling, and an evening of films. There will also be a session chaired by Alvin White titled "Mathematics as a Humanistic Discipline".

Contributed papers are being accepted on five topics in collegiate mathematics. The topics and the organizers of these sessions are:

- "Remedial Mathematics: Issues and Innovations", Geoffrey R. Akst, Borough Manhattan Community College (CUNY);
- "The History of Mathematics", Duane Blumberg, University of Southwestern Louisiana;
- "New Methods of Teaching Calculus", Wade Ellis, Jr., West Valley College, San Jose;
- "Experiences with Computer Support for Service Courses", Carol Jones, University of Houston—Downtown;
- "Retaining and Recruiting Undergraduate Women in Mathematics Courses: Aspirations and Experiences", Patricia C. Kenschaft, Montclair State 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 should send the following information to the MAA Washington office (1529 Eighteenth Street, N.W., Washington, D.C. 20036) **by September 30**: (1) title; (2) intended session; (3) a one-paragraph abstract (for distribution at the meeting); (4) a one-page outline of the presentation; and (5) a list of special equipment required for the presentation (e.g., slide or film projector).

This information will be sent to session leaders who will arrange for refereeing. Selection of papers will be announced by October 15. Late papers will not be accepted.

## Chaos at the AAAS

The American Association for the Advancement of Science inaugurated its Science and Art Program with the exhibit "Frontiers of Chaos" also co-sponsored by the Mathematical Association of America, the Conference Board of Mathematical Sciences and the American Statistical Association. The June 24 opening featured a slide lecture and demonstration by physicist Peter H. Richter of the University of Bremen who together with Heinz-Otto Peitgen and his group there produced these images. The show ran at the AAAS through August 15.

The study of these mappings goes back to Poincaré's idea that one might understand dynamics by looking at iterated mappings. The current studies that yield this art began with Benoit Mandelbrot's work on fractals represented by his 1975 book and by later books and papers. The Julia sets and Mandelbrot sets featured in this exhibit arise from considering mappings of the complex plane of the sort $f_\mu(z) = z^2 + \mu$ where $z$ is the variable and $\mu$ is a parameter. For each fixed $\mu$ the associated Julia set is the maximal bounded set invariant under the mapping $f_\mu$. The Mandelbrot set is the set of all $\mu$'s whose Julia sets are connected subsets of the complex plane. These $\mu$'s are characterized by the fact that the orbit of 0 under the map $f_\mu$ is bounded. In moving from Poincaré's original framework of iterations of mappings to the special cases above or even to other parameterized families of analytic mappings the problem has been restricted a great deal, but the images and results remain astonishing in their richness and complexity. The behaviors exhibited by these examples are universal for polynomial-like mappings according to results of Adrien Douady and John H. Hubbard.

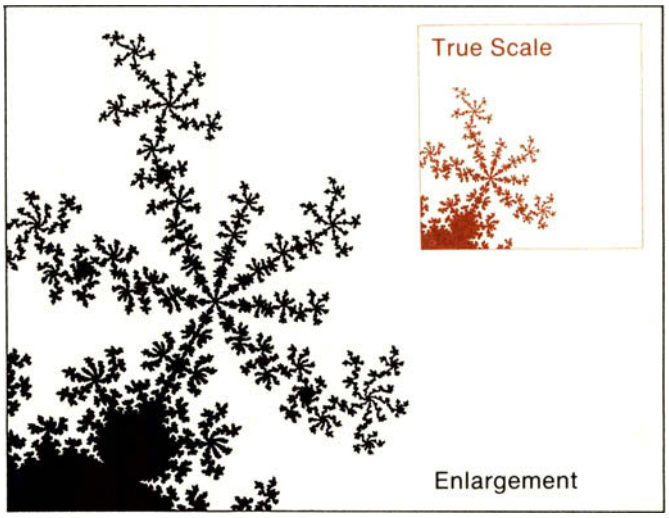
Crudely speaking, as the parameter $\mu$ moves toward the boundary of the Mandelbrot set both the shape of the Julia set and the motion of the points under the mapping $f_\mu$ become more intricate or more sensitive to perturbations of $z$. In this way, orderly deterministic dynamics may lead to chaotic behavior. This is how Richter got into this field; he is a dynamicist. At his lecture he demonstrated a double pendulum that showed how sensitive and surprising the behavior of even so simple a system can be—in one regiem very orderly and in another apparently irregular and chaotic.

The 80 graphics in this show are touring under the auspices of the Goethe Institute. They are beautiful, revealing, and surprising. They include pictures showing the attracting regions for various roots in the complex plane when an equation is solved by Newton's method. There were slides arising from computational investigations of models for magnetization. Each image showed interesting large scale structure coupled with compelling suggestions of the infinitely ramified detail we know is characteristic of fractals. It was a shock to see a Mandelbrot set appear in the fine detail of a slide shown by Richter showing where Newton's method might fail to converge when used to solve a parameterized family of cubic equations. This complex black mite is a somewhat distorted (quasiconformal) image of the Mandelbrot set. It is from work of Curry, Garnett, and Sullivan.

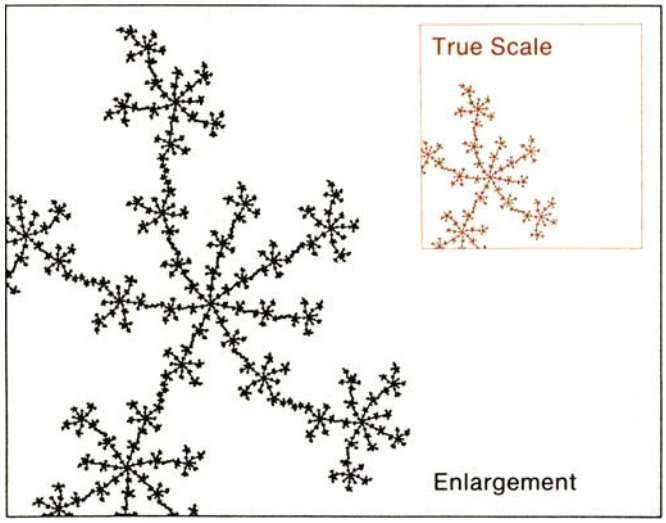
The viewers agreed that these images were fascinating and beautiful, but there is debate as to whether they are mathematics, physics, or art. These or related pictures have led to challenging conjectures and beautiful mathematics from Linda Keen, John Milnor, Dennis Sullivan, and William Thurston among others and in addition to those mentioned earlier.

The pictures speak for themselves, but it is not always easy to understand what they say. There is a considerable amount of freeware for exploring these sets on microcomputers and as you watch your machine paint a version of the Mandelbrot set on the screen you may well wonder how anyone could prove that this set is connected. The key is to look at its complement, as Douady and Hubbard discovered.

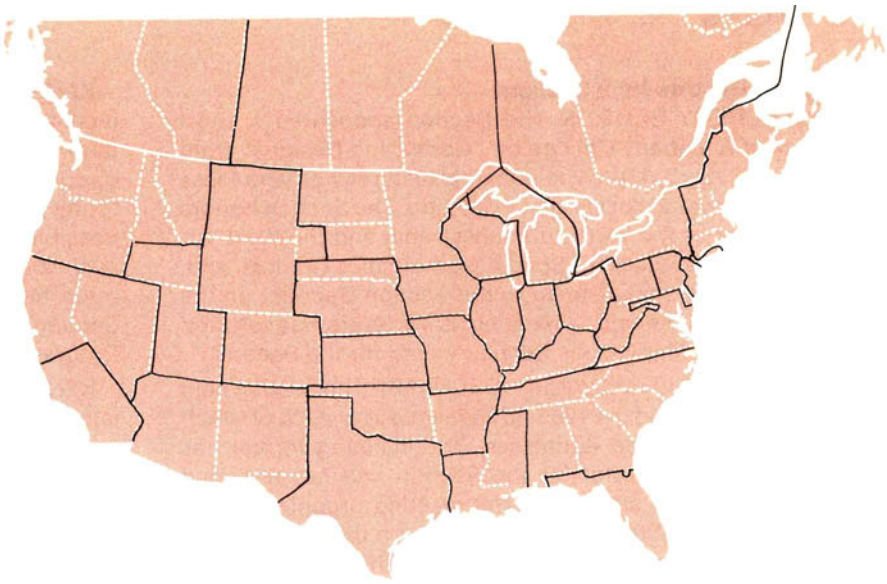
One may see or read about these objects in Peitgen and Richter's new Springer book *The Beauty of Fractals*. Related articles are found in *Scientific American*, most recently by A.K. Dewdney in March 1984; also see December 1976, April 1978, November 1981. Technical details can be found in an article by Paul Blanchard (*Bulletin of the American Mathematical Society* 11, (1984)) and K.J. Faulkner's book *The Geometry of Fractal Sets*. Anthony Barcellos has a nice brief overview of fractals in the March 1984 *College Mathematics Journal*. "Julia Set Fractal Generator", written by Tom Hedges, is vailable from EDUCOM. The AAAS exhibit shows that as art and science there is much to be seen, admired, and understood here.




**The infinitely elaborated detail of the Mandelbrot set is suggested by these two square images centered on the Miseurewicz point near 0.16172 + 0.67036*i*.** The upper square is 0.1 units on a side while the square below is magnified by 454,545,454 times. Graphics courtesy of Allan Wilks, AT&T Bell Laboratories. (See also page v)



# FOCUS on MAA SECTIONS



## Summary of the Section Activities

David Ballew

The twenty-nine sections of the Mathematical Association of America are alive and well. The material below summarizes the activities of each section and clearly demonstrates the diversity and strengths of each of the sections.

Over 3500 persons attended a section meeting in the 1985-86 academic year; this is far greater than the sum of all of those attending a Summer or Winter Joint Mathematics Meeting. Those attendees heard more than 165 invited addresses, 560 contributed papers and over 150 student presentations. At least ten sections are now sponsoring Summer Short Courses and twelve sections gave minicourses as part of their Annual Meetings. The number of contributed papers was as high as fifty in Oklahoma/Arkansas and the number of student presentations was as high as sixteen (in both Oklahoma/Arkansas and in Ohio); every section that was involved with student papers reported very favorable and positive responses to them from students and faculty alike.

This short summary cannot give adequate credit to all of the various section activities. You will see that several sections sponsor mathematics contest in various forms ranging from the Michigan High School Mathematics Competition to the Indiana Small College Mathematics Contest to the very successful Metropolitan New York Mathematic Fair. Many sections sponsor Visiting Lectureship Programs for high schools and for small colleges. A large number of sections (such as Michigan, Ohio, Kentucky, Florida, Texas, etc.) are becoming politically active and influencing areas of concern such as mathematics education, teacher training and curriculum reform. Several others (such as Illinois, Southwestern, Rocky Mountain, etc.) are concerned about articulation and transfer and they are trying to do something about the problem.

In short, the sections are *alive*, *involved* and *working* for mathematics, mathematics education and the mathematics community. We of the Committee on Sections believe, that because of the enormous support of the membership and because of the many programs that are supported, the sections are clearly one of the very most important activities and part of the MAA.

*(continued on page ii)*

## Be It Resolved. . .

Donald Hill

If mathematicians are serious about improving mathematics education at the state level, they must become involved with state governments. This state presence must be the work of MAA Sections either acting alone or in conjunction with other organizations. The symbolic and concrete successes of such efforts will lay the foundations for stronger mathematics programs in the future at the state and national level.

At the beginning of April, Governor Bob Graham and several members of the Florida Cabinet presented the "Mathematics Education Month" resolution, which had just been passed by the Florida Lesgislature, to the Florida Section of the MAA, represented by myself, and to the Florida Council of Teachers of Mathematics, represented by Daphne Kallenborn. Although resolutions such as this one may be regarded as symbolic, they strongly affect other interactions with state government that are very concrete. Making our presence felt in the political arena can help mathematics in terms of recognition and credibility.

In 1982, I was appointed to the Speaker's Task Force on Mathematics, Science, and Computer Education of the Florida House of Representatives. Following a year of deliberation, our suggestions were incorporated almost verbatim into

*(continued on page vi)*

**Governor Bob Graham of Florida and Ralph Turlington, Jim Smith, and Bill Gunter of his cabinet on the left present the "Mathematics Education Month" resolution to Don Hill of the MAA's Florida Section and Daphne Kallenborn of the Florida Council of Teachers of Mathematics on the right. April, Tallahassee, Florida.**

**Detailed Reports from Sections**

ALLEGHENY SECTION The Section sponsored a short course at Allegheny College on "Codes and Designs" from June 30 to July 3, 1986. The principal lecturer was Vera Pless from the University of Illinois at Chicago. The Section honors the winners of the Western Pennsylvania and the West Virginia phases of the High School Mathematics Contest, and, when possible, invites them to the Section Banquet on the Friday night of the Spring Meeting. Earle Myers was selected to receive the Meritorious Service Award for the Section.

EASTERN PENNSYLVANIA—DELAWARE The Section held two meeting during the 1985-86 academic year, each of which featured four invited addresses. This meeting format has proven very successful for the Section and has attracted large numbers of attendees. The meeting organizers state that the quality of the meeting depends on the quality of the speakers and they owe the success of the Section to the high quality of the presentations.

FLORIDA The invited addresses given at the Section meeting will be published and will cost $5 per copy. This publication is made possible by a grant from the National MAA Grants-To-Sections and through local Florida Section funds. The Florida Section has been particularly effective in working with State government on issues of interest to mathematics education; this past Spring they were able to get Governor Robert Graham and the Florida Cabinet to proclaim April as "Mathematics Education Month"; see the related article by Donald Hill in this issue of FOCUS.

The Spring Meeting of the Section featured several novel sessions that other sections may wish to consider: The Semi-Annual Meeting of the Florida Association of Mathematics Educators; an Articulation Conference; a Coordination Meeting of Chairs; and a Panel on Placement Testing. A minicourse on discrete mathematics is planned for 1987.

ILLINOIS The Section saw an increased participation from both two and four year institutions with programs on articulation, curriculum and emphasis on mathematics. The Section has initiated projects on teacher preparation, geometry in the high school and in college, and upon computing in the undergraduate curriculum. The Annual Meeting featured nine invited addresses and Gordon Mock was presented with the Section's Distinguished Service Award. The Section is particularly pleased with the quality and quantity of the participation in the High School Mathematics Contest.

INDIANA The 21st Annual Indiana Small College Mathematics Competition was held in conjunction with the Spring Section Meeting at Butler. The competition consists of teams of three students, working together, attempting to solve a set of problems. Any other sections that might be interested in creating such competitions should contact Bay Chotlos, Department of Mathematical Sciences, Butler University, 4600 Sunset Avenue, Indianapolis, IN 46208.

IOWA The Section had a very successful Joint Meeting with the Iowa Sections of SIAM and ASA. There were seven very good student papers and the Section awarded a one-year membership for each of these student papers. In addition, each student involved in the presentation of the "best" three papers, as determined by a panel of judges, was given a free copy of "Mathematical Gems I, II or III".

(All Sections are awarded three MAA Student Memberships to be distributed, as the Section decides, to three of the presentors of student papers. It is noteworthy that Iowa has extended this award using Section funds.)

KANSAS The Section reporter stated that "We had a good meeting this year with excellent talks and presentations; but the most important thing was the good fellowship and the opportunity to meet with our colleagues. We have the opportunity to talk about common problems and usually arrive at possible solutions. This Meeting is always worth attending and I look forward to it." (This aptly expresses a sentiment often heard about all of the MAA Section meetings.) The Section also reports that it is making its Visiting Lectureship Program more viable.

KENTUCKY The Kentucky Section publishes their Newsletter in conjunction with the Kentucky Two-Year College organization; they have separate meetings on different dates, but members of each organization are encouraged to attend the others meetings. This Section is one of the many that has found it successful to publish abstracts of papers in the newsletter.

LOUISIANA—MISSISSIPPI The Section had the unique opportunity to have its 1986 Section Meeting in conjunction with and parallel to the National Joint Winter Meetings in New Orleans. The Section reports that its membership efforts have been rewarded in that the Section now has the largest number of members in its history; this is in spite of the reductions in travel funds in both states over the past few years. The Section is very pleased with the growth in the number of students participating in the Student Paper Competition and this number is expected to increase due to the interest of the faculty members advising and encouraging their students; eleven students presented papers for the Section in New Orleans.

MARYLAND—DISTRICT OF COLUMBIA—VIRGINIA A highlight of the November Meeting was the minicourse on discrete mathematics given by Walter Meyer; the goal of the minicourse was to give some reasonable objectives of an introductory course in the subject. The Section sponsored a forum entitled "Should Our Section Become Involved In Issues Relating To Elementary and High School Mathematics Education" with over thirty in attendance. There has been followup with local sections of the National Council of Teachers of Mathematics and there has been positive response and interest in joint efforts which might "enhance the teaching and learning of mathematics in the public schools." This is an example of the influence mathematics education through joint efforts and the political process.

Every summer the Section sponsors two five-day workshops organized by Ben Fusaro at Salisbury State College on the Eastern Shore of Maryland. These workshops are very successful and are usually filled months in advance.

METROPOLITAN NEW YORK The Section conducts many activities such as a Speaker's Bureau and superb Annual Meetings, but there is one unique activity which should be better known in the national mathematics community; this is the Mathematics Fair. Following the excellent work of several individuals the first Fair was held in 1969 at Pace College; students were encouraged to read and think, to write papers on what they had learned, and then give talks before judges who could offer advice. The number of students has steadily increased and over 150 participated this past year; think of how many judges and hours this represents!

MICHIGAN The Michigan Section sponsored the Twenty-ninth Michigan Mathematics Prize Competition (See the related interview on this topic in this issue of ***FOCUS***.) Further the Section has taken positive steps to solve its financial

problems by collecting institutional section dues and by soliciting advertizing from publishers for its Newsletter. In December, the Section published an excellent history of the Section from 1924 to 1985 in memory of T.H. Hildebrandt.

MISSOURI The Section sponsors a variety of activities in addition to the traditional Spring Meeting; these include very successful High School Mathematics Examination and a active group of high school lecturers. Perhaps the most novel and popular new feature at the Annual Meeting has been the 5K run and walk. The prizes include honor, glory, envy, and blisters.

NEBRASKA The Section feels that the variety exhibited at the Annual Meeting is the most important ingredient in the Section's success. For example, at the most recent meeting a faculty member from a school of business discussed statistical work carried out while he was on leave, a philosopher gave his views on the philosophy of mathematics, a physicist discussed the orbits of celestial objects, an astronomer discussed Edmund Halley and the Comet, Leonard Gillman talked about choosing a wife, and a tour was arranged to a local museum containing one of the finest collections of musical instruments in the world.

NEW JERSEY The Section held two very successful meetings (with luncheons) over the past year; these meetings were highlighted by excellent invited addresses and panel discussions. The Section is making a concerted effort to involve graduate students and adjunct professors in the meetings and the organization. This is an area where many sections could increase their membership and provide a service to the growing number of adjunct and part-time professors and instructors.

NORTH CENTRAL Both of the meetings held this year were joint meetings; the Fall Meeting was in conjunction with the Ontario Association of Mathematics Professors and the Spring Meeting was with the Minnesota Council of Teachers of Mathematics with over 200 of their membership in attendance. The meeting with the high school teachers allowed for two excellent panels on "Early College Enrollment of High School Students" and "Calculus in High School". The Section is justifiably proud of its very successful and long-lived Summer Short Course and Seminar.

NORTHEASTERN Each summer the Northeastern Section has conducted a Short Course at the University of Maine in Orono. Last year the course was lead by Henry Pollak on the "Total Role of the Mathematician: Researcher, Consultant, Teacher, Curriculum Developer, Damn Nuisance." This summer Alan Tucker presented "A New Clarified Approach to Linear Algebra." In addition the Section has helped to sponsor a Graph Theory Conference at Colby College for each of the past three years. The Section's Newsletter is published under the generous sponsorship of Union Mutual Insurance Corporation. In each of the past two years, the meetings have been joint, first with the AMS and second with the American Statistical Association. An annual feature of the Meetings is a software exchange (see the related article in this issue of ***FOCUS***).

NORTHERN CALIFORNIA For many years this Section has been quite successful with meeting format consisting of four invited hour addresses by distinguished mathematicians both from within and without the Section. The strong feeling is that quality presentations are sufficient to attract an audience and history has proven this thesis to be correct.

OHIO The Spring Meeting of the Section featured, for the seventh consecutive year, a student paper session. The Ohio Section was one of the first to encourage student papers at their meetings and they feel that these papers have added much to their programs. There were sixteen student papers this year. The Section continues to follow its long tradition of sponsoring Summer Short Courses; the 1986 program was "The History of Calculus" presented by Frederick Rickey of Bowling Green. The Fall Meeting of the Section featured a "Teacher's Corner" contributed paper session which dealt directly with college-level classroom instruction; also featured was a microcourse "Discrete Event Computer Simulation" by Zaven Karian of Denison University.

OKLAHOMA—ARKANSAS The highlight of the Annual Spring Meeting is the Nathan Altshiller Court Lecture which was given by John Keesee of the University of Arkansas this year. This Lectureship is endowed and has been a very successful part of the program for fourteen years. All of the Sections have seen great mathematicians who have also made large contributions to the MAA and the Section; Oklahoma/Arkansas strongly recommends that these sections should consider such endowed lectureships to honor these past greats and to add to the annual programs.

PACIFIC NORTHWEST Joe Buhler of Reed College presented a minicourse aimed at a general mathematical audience on some of the main ideas and problems related to NP-completeness, a topic in complexity theory. At the Saturday luncheon, a representative of the Oregon Shakespearean Festival highlighted some of the most interesting and entertaining aspects of the history of the Festival productions; this was a most enjoyable addition to the mathematics program.

ROCKY MOUNTAIN AND INTERMOUNTAIN This year was the first Joint Meeting (reunion?) of the two Sections which split apart in 1974. The Annual Meeting featured a minicourse on computer software, a variety of invited addresses and contributed papers, and a strong selection of student presentations. In the Summer of 1986, the Rocky Mountain Section sponsored a Short Course on Discrete Mathematics given by Ben Manville at Fort Lewis College; the Section hopes to make summer short courses and annual event. The Section is particularly proud of its Visiting Lectureship program which gave over fifty presentations in the last year.

SEAWAY The tradition of the Annual Harry M. Gehman Lecture (Nineteenth) continued and featured an address by John Hopcroft on "The Role of Algebra and Topology in Robotics and CAD/CAM." The Section noted a 40% increase in attendance and participation, a doubling of student papers and an increased ability to attract publishers to display their wares at the Annual Meeting. The report stated that the excellent student presentations have generated much additional interest and positive faculty comment; further, the banquets have been very well received and successful.

SOUTHERN CALIFORNIA The Section offered a Short Course in conjunction with the Spring Meeting on "Coloring and Path-Following Algorithms in Numerical Analysis" by William Lucas of Claremont Colleges, and felt that it was very successful and a good complement to the normal four or five invited addresses. This Section usually has joint meetings with AMS or SIAM and feels that these add a great deal to the success of their meetings.

SOUTHEASTERN The Section reports that because it encompasses five states it usually has between 300 and 350 members in attendance at its Annual Meetings. The Section awards $50 to the student from the five state area that places the highest in the Putnam Competition, and students speakers at the Meeting are given one-year memberships in the MAA; the Section hopes to be able to provide funding for the expenses of these students. The Section Lecturer, John Baxley, dedicated his address to his former teacher Bob Kasriel.

SOUTHWESTERN The Section met jointly with the Greater El Paso Council of Teachers of Mathematics and the New Mexico Council of Teachers of Mathematics; this was the first joint meeting of these groups and drew an attendance of 196 registrations. The Section felt that this interaction was very useful and important, and they recommend that other sections hold such meetings with the high school teachers.

TEXAS The Annual Meeting was highlighted by seven invited addresses, thirty-three contributed papers, and a minicourse "Mathematical Applications" by Marvin Keener of Oklahoma State. The spouse activity was a tour of the Wendy and Emery Reves Collection at the Dallas Museum of Art.

WISCONSIN The Spring Meeting featured thirty-three contributed papers and three invited addresses; the theme was mathematical modeling. Eight of the contributed papers were in computer science. Further, there was a very well received panel discussion on teacher education program review standards. In June of 1986, the Section sponsored a Short Course, "Algorithms of Discrete Mathematics" given by John Dossey, Doug Harris, Walt Meyer and Karl Beres. This course was partially sponsored by a grant from the fund for Aid to Sections from the MAA. This Section has been active in reviewing initiatives in mathematics education from the Wisconsin Department of Public Instruction. In line with such efforts, the Section is now reviewing a new K through 12 curriculum guide for Wisconsin. This Section hopes to forge closer ties to high schools and work on problems of articulation with the intent of strengthening mathematics curriculum generally.

## Northeastern Section Software Exchange

The Northeastern Section of the MAA has been providing a Microcomputer Software Exchange since 1982. The Exchange allows interested persons to obtain copies of non-copyrighted microcomputer programs, especially for classroom use, and with the programmer's cooperation.

The Section provides a list of offered programs with the name and address of the contact person, title and brief description of the program and computer configuration needed for execution. The programs are grouped by type of computer: Apple, Commodore, IBM, etc. The programs are actually exchanged by the requestor sending a blank diskette to the author and having it returned by mail. The Section Meetings have also been successful in promoting exchanges; there is a separate location at the Section meeting for this purpose.

Some current titles on the list are: Class Roster, Nim Markov Chains, Least Squares Line and Other Statistics Programs, Combinatorics Programs, Linear Programming, Operating Room Simulation, Eigenvalues and Eigenvectors, etc., etc.

If you are interested in this exchange or if your Section would like to provide its own exchange, you can contact either W. Thurmon Whitley of the University of New Haven or Steven L. Snover of the University of Hartford.

## The Michigan Mathematics Prize Competition

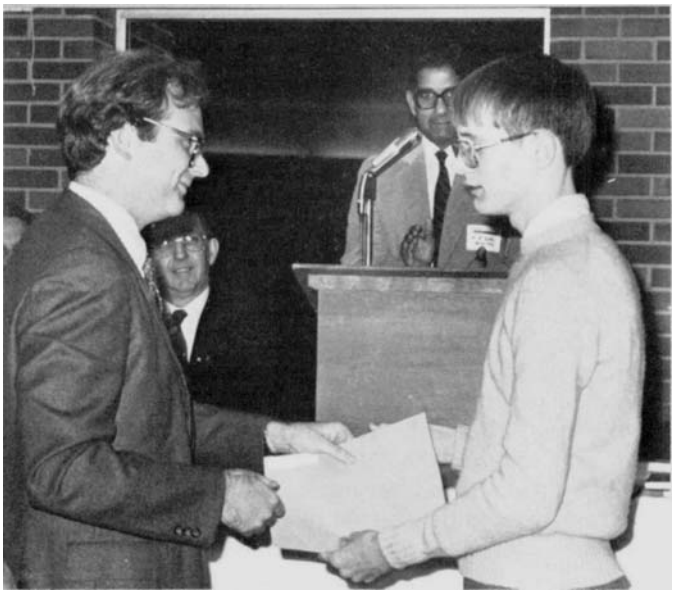
The following simulates an interview between the Editor and two members of the Michigan Section, Douglas Nance, the current Chair of the Section, and James Bidwell, a former director of the Michigan Mathematics Prize Competition and the present Coordinator of A.H.S.M.E. for Michigan.

What is the "Michigan Mathematics Prize Competition"?

The Michigan Mathematics Prize Competition (MMPC) is a two-part examination sponsored by the Michigan Section of the Mathematical Association of America. It is taken by secondary students throughout Michigan. Part I of the examination consists of forty multiple choice items. These items include concepts from algebra, geometry, trigonometry and the typical precalculus courses. This part is given during October. Part II consists of five open-ended questions and written explanations with proofs are required.

Typical questions (from the 1985-86 examination) are:

1. A prime is an integer greater than 1 whose only positive integer divisors are itself and 1.
   a. Find a triple of primes (p,q,r) such that $p = q + 2$ and $q = r + 2$.
   b. Prove that there is only one triple (p,q,r) of primes such that $p = q + 2$ and $q = r + 2$.



**Thomas Baumgarten, representative of the Burroughs Corporation, a corporate sponsor of the 1985-6 "Michigan Math Prize Competition", awarding a prize to Matthew Mullin. Mangalam R. Gopal of Michigan Technical University in the background is presiding.**

2. A round robin tournament was played among thirteen teams. Each team played every other team exactly once. At the conclusion of the tournament, it happened that each team had won six games and lost six games.
   a. How many games were played in this tournament?
   b. Define a circular triangle in a round robin tournament to be set of three different teams in which none of the tree teams has beaten both of the other two teams. How many circular triangles are there in this tournament?
   c. Prove your answer to Part b.

This test (Part II) is given during the month of December and is taken by approximately the top 1,000 of those who took Part I.

When did the Competition start?

MMPC originated in 1957 as a result of wanting to award prizes to stimulate interest in mathematics. Pledges of financial support were solicited from universities and industries. Using borrowed funds, the first contest was held in the Spring of 1958. A total of 6,100 students from 315 high schools participated in this initial examination. Volunteers, including graduate students, helped stuff envelopes in the basement of R.H. Oehmke's (now at Iowa) home.

What is the current status?

In 1985, over 23,000 students from over 500 schools took Part I of the examination. Of these, the top 1,000 then took Part II. The Competition is well received by the Michigan Section and public schools and is financially secure.

Who directs the program?

The Executive Committee of the Michigan Section appoints an institutional member to direct the Competition. Seven different mathematics departments have housed the MMPC. Each Director is a faculty member of the university who typically volunteers to direct the program for a three year period. The Director's institution usually provides one-quarter released time, clerical assistance, and sometimes computer services. The Director oversees the entire project (except for the creation of the exams) including printing and mailing exams, obtaining banquet speakers, planning menus, issuing scholarship checks, keeping financial records, dealing with glitches in the system and dealing with irate parents (who sometimes even call their State Representatives to complain!).

How are the tests created?

A four-person Examination Committee writes both Part I and Part II of the examination. Committee members are appointed by the Executive Committee of the Section and serve a rotating four-year term. The Chairperson is always the senior member.

How are all of these tests graded?

The forty questions from Part I are machine scored. In determining the overall winners, 40% of the total score comes from Part I. The five questions of Part II are weighed to provide the other 60% of the final score. The grading of Part II takes place on a Saturday in January. Fifty to seventy faculty members from around the state travel to the grading site (usually the Director's host institution). They separate into five grading teams, one for each problem. After deciding upon partial credit assignment (an interesting exercise!), each team grades their single Part II question. Over the years, this grading session has become an enjoyable significant activity for Section members. Lunch is provided and other social time is usually available. The loyalty of the grading faculty outweighs severe Michigan winters, Saturday basketball games and, in some cases, 400 miles of driving one way. Some graders have come regularly for 15 to 20 years.

How is the Competition financed?

Income is generated in two ways. Students (or their schools) pay $1.00 each to take Part I of the exam. Part II is given at no additional cost to them. Corporate sponsors also contribute directly to the Competition, and the Michigan Council of Teachers of Mathematics buys book awards. This income was used in 1985-86 to provide $18,800 in scholarship awards to the 52 top students. The next 48 received a volume of the Mathematical Gems published by the Association. The remaining income is used to cover competition expenses not provided by the Director's institution.

How are the awards presented?

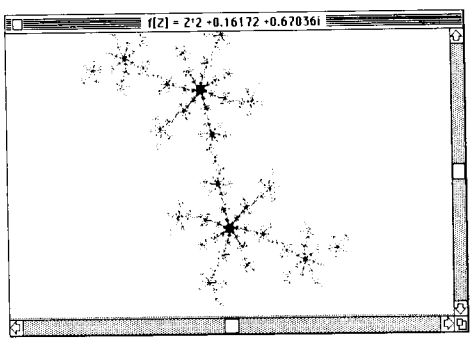
The highlight of each Annual Competition is the MMPC Awards Banquet. This is held in late February or early March and is attended by approximately 400 students, parents, high school teachers and university faculty. The top 100 finishers are invited as award winners. The day's events include an afternoon program with two nationally prominent speakers and an evening banquet and presentation ceremony. This is a very memorable experience for all attending.

How does MMPC compare with AHSME?

Both competitions identify the same top young mathematicians in the state. Part II of the MMPC does require the ability to write mathematics whereas the corresponding AIME concentrates on discovering numerical solutions. Historically, in Michigan, MMPC is the more popular examination. Only about 4,000 students take AHSME in Michigan. The lure of scholarship dollars is a greater attraction at the moment than the USAMO. Most of the scholarship winners in MMPC qualify for AIME if they attempt both exams.

Do you think other Sections should emulate MMPC?

This has been a successful program for us. If the other sections are currently strong supporters of AHSME, then they might think twice about attempting to launch their own competition. It might be better to let the local AHSME grow into the mold of MMPC (with scholarships and a banquet) as has been done in Ohio.




**Macintosh version of Julia set, same μ. Note similarity to Mandelbrot set page 4.**

**Be It Resolved . . .** *(continued from page i)*

Florida law with an appropriation of $40,000,000 for the improvement of mathematics and science in Florida. Also as a result of general involvement at the state level, several mathematicians have participated in establishing our college sophomore exit exam. Others have assisted in creating and maintaining the common course numbering system used in Florida.

When I spoke at the presentation as governor of our MAA Florida section, I used the alloted time to thank the cabinet and the legislature for their efforts on behalf of mathematics, to mention positive results being seen in the teaching of math in Florida, and to draw their attention to matters needing further attention. I shared my frustration concerning the various aspects of the alarming decrease of new Ph.D.'s in the USA. Subsequent letters from cabinet members and the chancellor of the state university system expressed their dismay at the low percentage of doctorates going to American citizens and the very distressing statistic of only five American Blacks receiving Ph.D's in 1984-5 in the mathematical sciences. The resolve of these legislators to assist in reversing this situation was encouraging. This gives some hint of the potential benefits of such political involvement at the section level.

The benefits to undergraduate mathematics in Florida have been striking. One requirement is that math class size in the lower level is limited to 22 students. But this also creates problems. At my institution we still have four new positions at the associate level open that will probably go unfilled for the Fall of 1986. Yet one should not think in terms of individual or even institutional gain. To be effective one must respond to the needs of the entire state. That means cooperating with other professional organizations to make clear to political and educational leaders the needs and benefits of a strong program for mathematical education. This can be done in part by developing and publicizing careful official statements either from the MAA or from joint committees with other relevant organizations. These are essential in making a persuasive case for states to commit more money to mathematics.

We can make changes at the state level. However, let nothing I have said above be interpreted in any way to lessen the importance of a "Washington Presence" and national efforts of MAA at the federal level. They are clearly important and successful. Each sort of presence reinforces the other. But here I emphasize activity at the state level that must come primarily from the sections and powered by our individual state or regional MAA members.

## from the maa . . .

**MAA Notes #1**
PROBLEM SOLVING IN THE MATHEMATICS CURRICULUM
prepared by the Committee on the Teaching of Undergraduate Mathematics
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prepared by the CUPM Panel on Teacher Training
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Washington, D.C. 20036

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Anyone wishing to place an employment ad in FOCUS should write to: FOCUS Employment Ads, Mathematical Association of America, 1529 Eighteenth Street, N.W., Washington, D.C. 20036. Or for more information, call the MAA Washington Office at (202) 387-5200.

The deadline for submission in the October issue is September 1.

**NAZARETH COLLEGE**
**Rochester, New York**

Junior level tenure-track position in mathematics beginning January or August 1987. Ph.D. preferred. Commitment to teaching in an undergraduate liberal arts college essential. Send resume to Dr. Judith Rose, Chair, Department of Mathematics/Computer Science, Nazareth College, 4245 East Avenue, Rochester, NY 14610.

**DEPARTMENT HEAD**
**MATHEMATICS AND COMPUTER SCIENCE**
**SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY**

Nominations and applications are invited for the position of Head of the Mathematics and Computer Science Department. Candidates should have an appropriate earned doctorate, established leadership and administrative potential, and a strong interest in developing an innovative undergraduate program in Mathematics and Computer Science as well as graduate and research programs in Computer Science. The anticipated appointment date is August 1987. Salary will be commensurate with qualifications. Applications with a resume, letter of transmittal indicating philosophy and objectives in education and research, and references should be submitted not later than November 15, 1986 to:

Chairman, Search Committee
Dr. G.L. Scofield
Vice President
South Dakota School of Mines and Technology
501 E. St. Joe
Rapid City, SD 57701
SDSM&T is an Equal Opportunity/Affirmative Action Employer.

**CARLETON UNIVERSITY**
**OTTAWA**
**Department of Mathematics and Statistics**

The Department of Mathematics and Statistics has an opening for a tenure track position at the level of Assistant Professor or Associate Professor, beginning July 1, 1987. Applicants should hold a Ph.D. degree and have demonstrated research ability in an area of Analysis. The appointment is open to both female and male applicants. The successful candidate shall be expected to make significant research contributions to an active area in Mathematical Analysis, carry out graduate and undergraduate instruction, and supervise graduate students. In accordance with Canadian Immigration requirements, this advertisement is directed to

Canadian citizens and permanent residents. Applications, including curriculum vitae and the names of three referees, should be sent to:

Dr. B.M. Puttaswamaiah, Chairman
Carleton University
Ottawa, Ontario
Canada K1S 5B6

**DIRECTOR OF ACADEMIC COMPUTING**
**KENYON COLLEGE**

Kenyon College, an undergraduate liberal arts institution with a distinguished reputation for educational excellence, is seeking a Director of Academic Computing to replace the late Robert A. Rennert. The Director, who normally holds faculty rank, serves as the chief administrative officer of the new Olin Computing Center, and provides leadership that encourages the integrated use of academic computing in a liberal arts environment. The Director reports to the Provost and has overall responsibility for all aspects of academic computing, including long range planning, budgeting, provision of services, and staff development and supervision. Teaching in an appropriate academic discipline is welcome but optional. Major facilities include the Olin Computing Center, based upon a VAX 8600, and the Crawford Center for personal computing and graphics; and the College seeks an individual who will capitalize on these facilities to enhance Kenyon's commitment to the integration of computing into the traditional liberal arts.

Qualifications: a Ph.D. in an academic discipline; advanced training in computer science; demonstrated administrative competence; at least three years experience in an academic computing center; demonstrated ability to work congenially with students, faculty, administrators, and staff; a coherent vision of the role of computing in the liberal arts.

Salary open to reflect background and experience. Position available immediately. Send letter of application, resume, transcripts, and at least three professional references to: Provost, Kenyon College, Gambier, OH 43022. The Search Committee will begin reviewing applications on September 1, 1986, and will continue to do so until position is filled. Kenyon College is an Equal Opportunity Employer and encourages applications from women and minority candidates.

**MANKATO STATE UNIVERSITY**
**DEPARTMENT OF MATHEMATICS, ASTRONOMY, AND STATISTICS**
**MANKATO, MN 56001**

Tenure track faculty position in mathematics available. Rank/salary dependent upon qualifications. Ph.D. in mathematics required. Applicants must have strong background in applied mathematics, strong interest in teaching at freshman through graduate levels, and show evidence of successful teaching at postsecondary level. Teaching load at most 36 quarter hours per 9 month academic year. Successful candidate will teach courses in mathematics and applied mathematics, assist with student advising, serve on various departmental committees, and conduct appropriate research. Open until filled. Send application letter, vita, research and teaching interests, and three (3) letters of reference to F.T. Hannick, Chairperson.

**AUBURN UNIVERSITY**

The Division of Mathematics at Auburn University invites applications and nominations for the position of Coordinator of Undergraduate Mathematics, whose principal concern will be freshman and sophomore mathematics service courses. The Coordinator will be responsible for scheduling teaching assignments, registration of students, oversight of curriculum revisions and textbook selections, administration of course and teaching evaluations, and supervision and evaluation of Graduate Teaching Assistants.

Ph.D. in mathematics and significant undergraduate teaching experience required. Academic rank, eligibility for tenure, and salary commensurate with qualifications.

The Division has approximately 70 faculty members and 40 Graduate Teaching Assistants (in M.S. and Ph.D. programs) in two departments of mathematics. Enrollment in about 475 sections of lower division service courses is approximately 13,000 students annually. The coordinator will hold a 12 month position and be responsible to the heads of the two departments.

Auburn University, located in Auburn, Alabama, is a state land-grant university enrolling more than 19,000 students. The city of Auburn is a picturesque university community located about 120 miles southwest of Atlanta in a region of farms and woodlands.

Women and minorities are encouraged to apply. Send nominations, or applications including resume and names of three references to Robert E. Kribel, Acting Dean, College of Sciences and Mathematics, Auburn University, AL 36849. AUBURN UNIVERSITY IS AN EQUAL OPPORTUNITY, AFFIRMATIVE ACTION EMPLOYER.

**Associate of Assistant Professor position in Probability** is anticipated for Fall 1987. Demonstrated excellence in research and a strong committment to teaching at the graduate and undergraduate level required. Candidates with established research records as well as new Ph.D's are encouraged to apply. Send vita and three letters of reference to: Professor Murad Taqqu, Probability Position, Department of Mathematics, 111 Cummington St., Boston University, Boston, MA 02215.

**NORTH CENTRAL COLLEGE**
**Naperville, IL 60566**

North Central College announces a new tenure-track position beginning September, 1987. A Ph.D. in mathematics is required. Teaching experience is desirable. North Central is a church-related (United Methodist) college located in the western suburbs of Chicago with an enrollment of about 1800. Candidates must be able to teach all standard undergraduate courses within the framework of a liberal arts college. Quality of teaching and advising are the two main evaluative measures used for faculty members at the college. Applications, vitae, and three letters of recommendation which speak to teaching ability should be sent to Dr. Richard J. Wilders, Department of Mathematics, North Central College, Naperville, IL 60566.

**NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES CORNELL UNIVERSITY, Assistant Professor**

This is a twelve-month tenure track position: 60% teaching and statistical consulting, and 40% research. Successful candidate will share in the teaching and statistical consulting responsibilities of the Biometrics Unit and will conduct research in Statistics or Biometry; will research in collaboration with Agriculture, Life Sciences, or elsewhere in the University; will direct grad students, will teach undergrad and grad level courses, and have the opportunity to develop graduate level courses. A Ph.D. in Statistics or Biometry reguired with some training in statistical theory, a background in biology, and an interest in biometric applications. Send resume and three letters of reference by January 15, 1987, to:

Professor George Casella
Biometrics Unit, 337 Warren Hall
Cornell University
Ithaca, New York 14853

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Women, Minorities, and the Handicapped are Encouraged to Apply.

**ARIZONA STATE UNIVERSITY**

**CHAIR**
**DEPARTMENT OF MATHEMATICS**

Arizona State University invites nominations and applications in an external search for the position of Chair of the Department of Mathematics.

**The University** is one of the largest comprehensive public institutions in the United States, with a student enrollment of over 40,000, approximately one-quarter of which is at the graduate level, with undergraduate enrollment concentrated at the upper division. Located in the rapidly growing Phoenix metropolitan area, ASU enjoys the change and development characteristic of the American Southwest. A progressive academic setting and high technology environment provide a wide range of living, educational, recreational and cultural opportunities.

**The Department** of Mathematics offers the Bachelor of Arts and Bachelor of Science degrees, as well as the Master of Arts and the Ph.D. It participates in the Master of Natural Science degree and collaborates with the College of Education in offering the Bachelor of Arts in Education and programs leading to the Ed.D. and Ph.D. in education. A regular faculty of 48 supported by visiting faculty, graduate assistants and staff are responsible for general education instruction for students throughout the University, especially those in the sciences, engineering and business, and programs for approximately 200 undergraduate and 50 graduate majors. The Department has growing research programs in various areas of applied mathematics and analysis. Instructional programs are offered in general, computational, and applied mathematics, mathematics education, and statistics and probability.

**The chair** is expected to provide leadership for growth, renewal and development of the Department during a period of rapid change and expanding resources. The position carries significant responsibilities for administering a department which serves a large undergraduate and graduate population with disproportionate needs in the applied, computational and statistical areas, as well as expanding research activities. A successful candidate must be willing to devote substantial effort to further enhancing the general quality of the Department and its programs. The chair reports to the Dean of the College of Liberal Arts and Sciences, which encompasses the physical and life sciences, the social and behavioral sciences, and the humanities.

**Qualifications.** The Department Chair should possess demonstrated leadership qualities and a strong commitment to academic values and excellence in teaching, research and service. Additional qualifications include the following:

- An earned doctorate and outstanding research credentials commensurate with the rank of professor.
- Evidence of ability to lead and to manage a complex organization, including responsibilities for personnel and financial resources.
- Experience with program planning, development and enhancement, including outreach to those sectors of society which depend on modern mathematics, and a record of university teaching are preferred.
- Continuing record of professional activity and involvement in the national mathematical sciences community and broad knowledge of mathematics as a discipline and its role in contemporary society, including higher education, secondary schools, government, and the private sector.
- Commitment to curricular and instructional enhancement to ensure a productive learning experience for undergraduates (majors and non-majors) and a quality research-based graduate program for students pursuing careers in education, industry and government.
- Commitment to faculty recruitment and development which emphasizes high research and teaching standards.
- Commitment to affirmative action in employment and in the diversification of the student population.
- Sensitivity to the needs of students and faculty working in all areas of mathematics and demonstrated interpersonal characteristics and skills necessary to relate to the faculty, students, the administration and external publics.

**Appointment Information.** The position carries a 12-month appointment to be effective as early as January 1, 1987 and preferably no later than August 15, 1987. Salary is competitive and commensurate with qualifications and experience.

**Application.** Nominations should be received by September 30, 1986. Candidates should forward a letter of interest, resume, and the names, addresses, and telephone numbers of at least four references no later than October 15, 1986 to Dr. Brice Corder, Assistant Dean and Secretary to the Search Committee, Office of the Dean, College of Liberal Arts and Sciences, Arizona State University, Tempe, Arizona 85287.

*Arizona State University is an Equal Opportunity, Affirmative Action, Title IX Employer. Women and minorities are encouraged to apply.*

Julia set for $\mu = 0.42 + 0.21i$. Note similarity to Mandelbrot set at right. Image courtesy of Alan Wilks, AT&T Bell Labs.

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**The Department of Mathematics at Boston Unversity** anticipates an opening for an Assistant Professor in Fall 1987. Preference given to applicants in Applied Mathematics, Dynamical Systems, Statistics and related fields. Women and minorities are encouraged to apply. Send vita and three letters of reference to: Search Committee, Department of Mathematics, Boston University, 111 Cummington Street, Boston, MA 02215.

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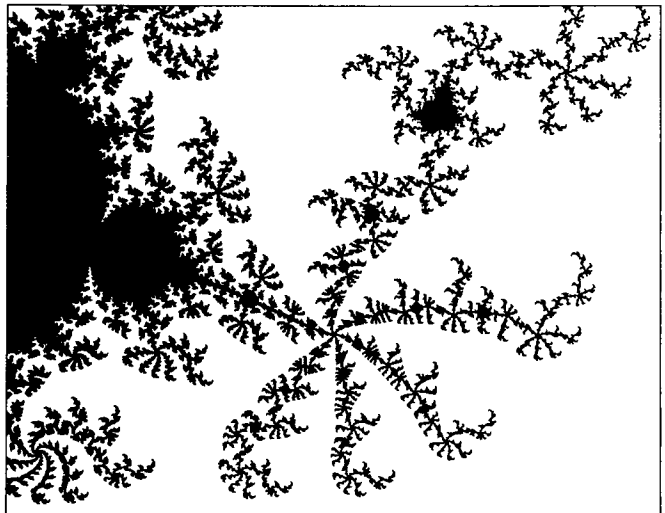
**Senior level appointment in Mathematical Statistics** anticipated for Fall 1987. Record of distinguished achievements in research, commitment to excellence in teaching required. Women, minorities esp. encouraged to apply. Send nominations and applications to Search Committee, Department of Mathematics, 111 Cummington St., Boston University, Boston, MA 02215.



Mandelbrot set near $0.42 + 0.21i$ courtesy of Allan Wilks, AT&T Bell Labs.

## In Memoriam

**Gretta Berglund,** Wesleyan University student, died recently at the age of 19. She was an MAA member.

**R. H. Bing,** University of Texas, died recently at the age of 72. He was an MAA member for 40 years.

**Dr. William Borgman,** Wayne State University, died March 1986, at the age of 82. He was an MAA member for 60 years.

**Paul Boschan,** Guardian Insurance Company, retired, died recently, at the age of 83. He was an MAA member for 16 years.

**Fannie Boyce,** Professor Emeritus, Wheaton College, died recently, at the age of 89. She was an MAA member for 33 years.

**Charles Burton,** Professor Emeritus, San Diego State University, died July 1985, at the age of 67. He was an MAA member for 23 years.

**Donald Clanton,** Furman University, died August 1985, at the age of 60. He was an MAA member for 33 years.

**Donald Clark,** Purdue University, died March 1985, at the age of 52. He was an MAA member for 12 years.

**Dr. Louis Deluca,** University of Connecticut, died April 1986, at the age of 48. He was an MAA member for 4 years.

**Jacob Duerksen,** U.S. Coast & Geodetic Survey, retired, died April 1986, at the age of 91. He was an MAA member for 60 years.

**Joseph Ercolano,** CUNY-Baruch College, died May 1986, at the age of 55. He was an MAA member for 25 years.

**Professor Emeritus Hyman J. Ettlinger,** University of Texas at Austin, died June 8 in Austin at age 96. Professor Ettlinger was a member of the MAA for 71 years, being one of the MAA's charter members.

**Stephen Ewing,** Ravenscoft School, died June 1986, at the age of 42. He was an MAA member for 20 years.

**Daniel T. Finkbeiner II,** Professor Emeritus, Kenyon College, died March 28, 1986, at the age of 66. He was an MAA member for 35 years.

**Frederick Frey, Jr.,** Rochester Institute of Technology, died March 1986, at the age of 54. He was an MAA member for 11 years.

**William Hill,** Memorial Senior High School, retired, has recently died. He was an MAA member for 14 years.

**Donald E. Kibbey,** Professor Emeritus, Syracuse University, died June 30, 1986. Kibbey was an MAA member.

**Byung Chul Kim,** Oregon State University student, died September 1985, at the age of 29. Byung was an MAA member.

**Eric Michalup,** University Central de Venezuela, retired, died September 1985, at the age of 83. He was an MAA member for 43 years.

**C. E. Rhoades,** Browan Community College, died recently at the age of 55. He was an MAA member for 11 years.

**Chien Wenjen,** California State University, retired, died January 1986, at the age of 75. He was an MAA member for 30 years.

**Frances Wright,** Harpur College, retired, died April 1986. She was an MAA member for 61 years.

Word has also been received on the deaths of the following MAA members: **Robert Adams,** Dallas, Texas; **Myrl Ahrenot,** Gaithersburg, Maryland; **Edna Feltges,** Winter Park, Florida; **Emmert Gassman,** Mt. Carmel, Illinois; **Preston Hammer,** Milesburg, Pennsylvania; **Ralph Hull,** Santa Monica, California; **Vladimir Ivanoff,** San Carlos, California; **Dr. Tony Johnson,** Albuquerque, New Mexico; **Michael Morelli,** Alexandria, Virginia; **Franklin Rothwell,** La Jolla, California; **Carl Tellefsen,** Roswell, New Mexico; **Gale Wilson,** Somerset, California; **Clement Winston,** Washington, D.C.

## News From the ICM

There were almost four thousand registrants at the twentieth International Congress of Mathematicians, held at Berkeley, California, from August 3 to 11. The addresses on the work of the Nevanlinna and Fields medal recipients set the tone for the Congress. We give these in the order in which they were presented. Volker Strassen led, speaking on the work for which Leslie G. Valiant was awarded the Nevanlinna Prize. Much of Valiant's work deals with complexity. In the theory of context-free grammars, he proved that the recognition problem could be solved in less than cubic time. In graph theory, he showed the existence of a class of m-superconcentrators whose number of edges grows linearly in m. This latter work has implications for the theory of efficient general purpose parallel computers. Valiant's results show that computations may be done more quickly than was believed possible.

Strassen then turned to work that Valiant did with several co-workers showing that problems which require Turing machine times of order $t$ can be run on machines having tapes whose lengths are bounded by $t/\log(t)$. This shows the difference between measuring complexity in terms of time versus space requirements. Next, Strassen showed how Valiant was led to consider straight-line algorithms, that is, finite sequences of arithmetical instructions executed over a suitable algebraic structure. These considerations led Valiant to an algebraic counterpart of Cook's hypothesis that there is no polynomial-time algorithm for NP-complete problems. Strassen called this new hypothesis "Valiant's hypothesis". In essence, it says that if you wish to evaluate an $n \times n$ permanent by substituting its variables into an $r \times r$ determinent, then the $r$'s must increase more rapidly than any power of $n$. In this work Valiant intricately combined ideas from mathematical logic, graph theory, and algebra. The interweaving of diverse fields and interplay between mathematics, computation, and computer science to the enrichment of all were repeated themes at this Congress.

John Milnor outlined the work for which Michael H. Freedman was awarded the Fields Medal. Freedman brought together the handle-body constructions of classical differential topology and R.H. Bing's decomposition-space theory to prove, among other things, that compact simply connected topological four-dimensional manifolds are completely determined by three invariants: their two dimensional homology group ($H_2$), the intersection form on $H_2 \times H_2$, and the Kirby-Siebenmann obstruction to stable triangulation. As a special case, this result proves the four-dimensional Poincaré conjecture. Freedman's theory gives a way of building compact simply connected four-dimensional manifolds that is directly analogous to the way of building compact connected two-dimensional manifolds using spheres, handles, and real projective planes. Freedman also used his theory to show that $S^3 \times \mathbf{R}$ admits a differentiable structure that can not be smoothly embedded in $\mathbf{R}^4$. Because $S^3 \times \mathbf{R}$ with the usual product differentiable structure can be smoothly embedded in $\mathbf{R}^4$, this provided what was the first example of an exotic differentiable structure on a smooth four-manifold. These are only a few of the results that Freedman established using his new methods. Moreover, his techniques apply to other four-manifolds provided their fundamental groups are not too complicated. For a brief outline see Freedman's "There is no Room to Spare in Four-Dimensional Space" in *The Notices of the AMS*, January 1984.

While Freedman was taking firm hold of the topological theory of four manifolds, Simon Donaldson, whose Fields Medal work was presented by Michael Atiyah, was developing tools to deal with the differentiable theory of such manifolds. The tools of Freedman and Donaldson can be used together to prove the existence of an utterly astonishing exotic differentiable structures on $\mathbf{R}^4$. Such a structure may be chosen so that the resulting manifold contains a compact set that can not be surrounded by any smoothly embedded three-sphere; moreover, $\mathbf{R}^4$ with this differentiable structure admits no orientation-reversing diffeomorphisms. Thus, there is no smooth map on this space with the properties of reflection in Euclidean four-space.

Donaldson uses Yang-Mills fields to prove results about four-manifolds in a way somewhat analogous to the way results on the topology of two-manifolds are proven using complex analysis. H. Blaine Lawson, Jr.'s notes, *The Theory of Gauge Fields in Four Dimensions* (AMS, 1985), give a nice overview and the technical details. Donaldson's main result, proved in 1982 while he was a graduate student, is that if the intersection form of a compact simply connected smooth four-manifold is positive definite, then that form is equivalent to the diagonal form.

Donaldson's work yields astonishing conclusions. Its methods draw broadly on topological and analytic methods (work of Taubes, Uhlenbeck, and Atiyah-Hitchin-Singer). It shows the unity of the subject and the fertility of mathematical and physical ideas working together. A look at the program shows that there were more than two dozen plenary addresses, invited talks, or sessions immediately identifiable as mathematical physics, so general cross-fertility of these two fields was evident at this Congress.

The third Fields Medalist was Gerd Faltings whose work on the Mordell conjecture was presented by Barry Mazur. Faltings proved the conjecture in the following form: *If K is any number field and X is any curve over K of genus greater than 1, then X has only a finite number of K-rational points.* Mazur outlined the work by Grothendieck, Serre, Mumford, Lang, Néron, Tate, Manin, Shafarevich, Parsin, Arakelov, Zarhin, Raynaud, and others that formed both the background and basis for the proof that Faltings gave. This list of names suggests the power and sophistication of the ideas involved. Despite, or possibly because of, all this elaborate machinery no one would have guessed that a proof of the Mordell conjecture was in the offing before Faltings did his work. The surprise of his proof is one measure of his accomplishment. Some sense of this can be gotten from Gina Kolata's article in *Science*, July 22, 1983. See also David Harris's "The Mordell Conjecture" in the June 1986 *Notices of the AMS*. Mazur concluded, "We have been discussing only Faltings' approach to the conjecture of Mordell, but his other mathematical contributions, whether they be concerned with moduli spaces of abelian varieties, the Riemann-Roch theorem for arithmetic surfaces, or p-adic Hodge theory, all immediately impress one as the work of a marvelously original mind from which we may expect similarly wonderful things in the future."

The program for this Congress shows the developing links between mathematics, computation, and computer science. This is evidenced by plenary talks on complexity and efficient algorithms by Steve Smale, Hendrik W. Lenstra, and Arnold Schonhage. By contrast, there were no plenary talks on such subjects at the previous Congress.

Computation and computer graphics led David Hoffman and William Meeks III to discover a new family of minimal surfaces, as Meeks explained in his beautifully illustrated talk. In another talk, Oscar E. Lanford III outlined his computer assisted proof of convergence for the Feigenbaum-Cvitanović operator. Lanford's calculation is still the critical step in proofs of universal bifurcation behavior of parameterized mappings as sketched by Dennis Sullivan and Jean-Pierre Eckmann in their talks.

Traditional areas where computation plays a role were well represented, for example, in the talks by Alexandre J. Chorin and Steven Orszag on fluid dynamics. Newer areas linked to computer science were represented by Narendra Karmarkar on new polynomial-time linear programming algorithms, Manuel Blum on zero-knowledge proofs and Adi Shamir on provably secure cryptographic systems.

An evident coming together of ideas and methods could be seen in the work on mathematical physics and on the topological and differential structure of manifolds represented here by the work of two of the Fields Medalists among others. The plenary talks were on broadly applicable ideas and common themes. For example, Steve Smale's talk showed how the effort to understand Newton's method leads to powerful and interesting results in complexity theory. Hendrick W. Lenstra showed the parallels between simple number theoretic algorithms and powerful modern methods based on elliptic curves.

It is worth noting that this mathematical event was exceptionally well covered by the press. There were sixteen reporters registered at the news room including ones from United Press International, the *Los Angeles Times*, the *New York Times*, *Fortune*, *Science News*, various state and local papers, and National Public Radio. More than fifteen articles covering conference events have already appeared in nationally circulated newspapers, and further articles in magazines here and abroad are in the works.

Official actions of the ICM included the election of two new members of the International Mathematical Union—The People's Republic of China and The Ivory Coast—and confirmation that the next Congress will be held in Kyoto, Japan in 1990. During the closing ceremony, IMU President Jurgen Moser thanked the host institution and host country and congratulated all the members and participants on the high level of international cooperation. He noted that all those invited to participate in the Congress had been granted U.S. visas. Furthermore, member countries generally made it possible for their nationals to speak at the Congress if invited to do so, the exception being the USSR whose delegation was at about half strength and thus did not adequately represent that country's contributions to the field. Moser expressed the hope that the spirit of international cooperation would grow so that by the time of the Kyoto meeting all invited participants would be able to attend.

## Publicizing Mathematics

No news is bad news for mathematics. Especially so now when the needs of the community are great and resources are scarce and under pressure. Within the mathematical community, news of new developments spreads quickly by many means: word of mouth, preprints, articles, seminars, and so on. These channels not only transmit the bare facts, the events and discoveries themselves, but they also amplify

and elaborate these to give us a full sense of their broader importance and implications. Little of this reaches the outside world, where most people think mathematics is as old as Euclid, as dry as dust, and as esoteric as surreal numbers or inaccessible cardinals. The truth is otherwise, but outside of the mathematical community this fact is as little known as if it were a state secret. This is true despite occasional leaks to the press, such as Lee Dembert's *Los Angeles Times* editorial "It Figures" that was reprinted in March-April 1985 issue of ***FOCUS***.

Mathematics has less press coverage than it ought to because not enough effort has been directed toward public awareness of mathematics. This problem is compounded when mathematicians fail to recognize that legislators and laypersons have a very different view of mathematics than do its initiates. The details may not be of immediate interest to these outsiders; yet, they may be fascinated by the potential of new methods in linear programming. Anyone can appreciate the great energy, ingenuity, and excitement that mathematicians bring to their work. Mathematical news can be ordinary yet important: for example, the rise or fall of test scores at a local high school. It can be as exceptional as the triumphs of Mathematical Olympiad contestants or the emergence of new general principles (catastrophe theory, fractal geometry, etc.).

Today, reporters and public officials are accustomed to the help of press officers and others particularly in dealing with technical fields. Fields that do not offer such assistance tend to be overlooked. This has been the case with mathematics, but present efforts sponsored by the MAA, the AMS, and SIAM are helping this problem by directing public attention to mathematics in order to:

- Show the mathematical foundations of our technological and scientific society;
- Point to the increasing need for mathematical ideas and techniques in meeting today's problems;
- Establish mathematics as a dynamic, vital, and growing field.

To do this we must present an accurate and positive image of mathematics. This must be done regularly and in many ways at many levels. This must be a continuing effort to put mathematics back in style and to keep it there—for its own sake and for its uses.

The chief way to bring this subject to the public is to communicate news about mathematics. It is impossible to completely define what will be news, but things in the following categories generally qualify:

- New results including proofs of classical conjectures or the launching of new theories.
- Significant recognition of mathematical work whether that recognition comes from within mathematics (e.g., the Fields medals) or from outside of it (e.g., the awarding of the Nobel Prizes for work of an essentially mathematical nature as was that of Alan Cormack, Herbert Hamptman, and Kenneth Arrow, among others).
- The impact of mathematics on current public concerns (e.g., educational test scores, mathematics anxiety, the expected shortfall in mathematical staff for supercomputing facilities, and so on).

However, what will be seen as news depends on the audience, the times, and, most of all, on the individual reporter. What *Discover* could serve to its readers one year might also be fascinating, in different form, to the readers of a medium sized daily newspaper the next. This is a business where the presentation of information plays a critical role. Even old stories need to be retold and old points restated. More effort must be made to help the public understand such basics as the fundamental role that mathematics plays for the sciences and technology. The role of mathematics for physics, chemistry, biology, and all aspects of engineering is so pervasive and extensive that it fades into the background and is taken for granted. Because mathematics is familiar, its importance is often not properly appreciated and it may be neglected when the spotlight falls on some flashy aspect of computer science or other new field. Even mathematicians may lose sight of the fact that one can not be "computer literate" without having a grasp of the quantitative and procedural aspects of mathematical thinking. Mathematicians should not neglect the possibility that an amusing and revealing analysis of the local state's lottery may make a better case for the importance of analytical thinking than might a report of applications of the theory of classification of operator algebras to knot theory and hence to the twisting and twining of DNA molecules.

The mechanisms all exist to accomplish our goals. Mathematics has established a solid schedule of meetings; high quality newsletters and journals cover the field (***FOCUS***, *SIAM News*, etc.). Our public information people will be at the ICM-86, covering the Fields Medalists and more. Moreover, they know from highly placed national reporters for such publications as *Science*, *Science News*, and the *Chronicle of Higher Education* that they want more stories about and more spokespeople for mathematics.

Our audiences are clear and so are the media that reach them. We have Capitol Hill, other national opinion leaders, the public at large, and specialty publics (be they defined by geographic locations, professional concerns, or whatever). This outreach is not a job for the MAA's Washington office alone, but one that must be carried out by the sections and at the local level as well. Mathematicians should keep an eye out for newsworthy events in mathematics and cultivate the press whenever possible. MAA members who would like to work to get our press releases into local media should get in touch with the public information officers in their sections or write to the editor of ***FOCUS***.

Our task is to be alert for newsworthy developments in mathematics and bring them to the media in interesting and understandable terms. This will be good news for mathematicians and for others.

These observations and suggestions come from Kathleen Holmay, whose media and public affairs consulting firm, Kathleen Holmay and Associates, spearheads the JPBM public information campaign for mathematics. Her work is usually the public presentation of mathematics; however, MAA public information officers will already know her from the workshop she conducted at the New Orleans meeting. Those in the media know her well for her skill in recognizing what will be news and for whom it will be news and for being able to get the message across in a brief news release. This article brings some of her ideas to all MAA members with the expectation that they will help carry on the good work.

# People in the News

**Professor David Blackwell** of the University of California at Berkeley has been given the R. A. Fisher Award by the Committee of Presidents of Statistical Societies. His R. A. Fisher Lecture titled "Likelihood and Sufficiency" was given at the 1986 Joint Statistical Meetings in Chicago in August. The broad contributions for which he was honored include work in sequential analysis, statistical decision theory, game theory, information theory, Markov chains, and dynamic programming.

**Dr. Fred Burchsted** has been appointed archivist of The University of Texas at Austin's Archives of American Mathematics. UT Austin's Archives of American Mathematics is a major repository of mathematical papers in the U.S., and includes the papers of the late Prof. Robert L. Moore, along with those of many other individual mathematicians, and the archives of the School Mathematics Study Group.

**Manuel Keepler**, chairman of mathematics and computer science at South Carolina State College became the first black vice president of the S.C. Academy of Science and will succeed to the office of president in two years.

**Professor Peter D. Lax** of New York University's Courant Institute was awarded the National Medal of Science for his contributions to the theory of partial differential equations, applied mathematics, numerical analysis, and scientific computation. The awards were made by President Reagan in the White House on March 12.

**Professor Dr. Wolfgang Walter** has been elected president of "Gesellschaft fur Angewandte Mathematik und Mechanik" [GAMM— (Society for Applied Mathematics and Mechanics)] for the three-year period 1986-1989 at the annual meeting of the GAMM in Dortmund, Germany.

# Calendar

## National MAA Meetings

**70th Annual Meeting**, San Antonio, Texas, January 21-24, 1987.
**64th Summer Meeting**, Salt Lake City, Utah, August 5-8, 1987.
**71st Annual Meeting**, Atlanta, Georgia, January 6-9, 1988.
**72nd Annual Meeting**, Phoenix, Arizona, January 11-14, 1989.
**73rd Annual Meeting**, Louisville, Kentucky, January 24-27, 1990.

## Sectional MAA Meetings

**Allegheny Mountain**, Gannon University, Erie, Pennsylvania, April 1987.
**Illinois**, Northern Illinois University, DeKalb, Illinois, April 24-25, 1987.
**Indiana**, Franklin College, Franklin, Indiana, October 3-4, 1986; Wabash College, Crawfordsville, Indiana, March 28, 1987.
**Iowa**, University of Northern Iowa, Cedar Falls, Iowa, April 24-25, 1987.
**Kansas**,Washburn University, Topeka, Kansas, March 27-28, 1987.
**Kentucky**, University of Louisville, Louisville, Kentucky, April 3-4, 1987.
**Louisiana—Mississippi**, Mississippi University for Women, Columbus, Mississippi, February 27-28, 1987.
**Maryland—D.C.—Virginia**, Loyola College, Baltimore, Maryland, November 21-22, 1986.
**Metropolitan New York**, Borough of Manhattan Community College, New York, New York, May 2, 1987.
**Michigan**, Michigan State University, East Lansing, Michigan, May 1-2, 1987.
**Missouri**, Northeast Missouri State University, Kirksville, Missouri, April 3-4, 1987.
**Nebraska**, Nebraska Wesleyan University, Lincoln, Nebraska, April 10-11, 1987.
**New Jersey**, Georgian Court College, Lakewood, New Jersey, November 15, 1986.
**North Central**, University of North Dakota, Grand Forks, North Dakota, October 24-25, 1986.
**Northeastern**, Worcester Polytechnic Institute, Worcester, Massachusetts, November 21-22, 1986.
**Northern California**, San Jose State University, San Jose, California, February 28, 1987; Special Meeting, University of Hawaii, Honolulu, Hawaii, March 28, 1987.
**Ohio**, University of Toledo, Toledo, Ohio, October 24-25, 1986.
**Oklahoma—Arkansas**, East Central Oklahoma State University, Ada, Oklahoma, March 27-28, 1987.
**Pacific Northwest**, Pacific Lutheran University, Tacoma, Washington, June 19-20, 1987.
**Rocky Mountain**, University of Southern Colorado, Pueblo, Colorado, April 24-25, 1987.
**Seaway**, Mohawk Valley Community College, Utica, New York, November 7-8, 1986.
**Southeastern**, Armstrong State College, Savannah, Georgia, April 3-4, 1987.
**Southern California**, California State College at San Bernadino, California, November, 1986.
**Southwestern**, University of New Mexico, Albuquerque, New Mexico, Spring, 1987.
**Texas**, Tarleton State University, Stephenville, Texas, April 2-4, 1987.
**Wisconsin**, University of Wisconsin Center, Sheboygan, Wisconsin, April, 1987.

## Other Meetings

### October 1986

3-4. **Fourteenth Annual Mathematics and Statistics Conference**, Miami University, Oxford, Ohio. Contact: Gary G. Gilbert, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056.

3-4. **Thirteenth Annual Student Conference of the Ohio Delta Chapter of Pi Mu Epsilon**. Contact: Milton Cox, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056.

10-11. **NRC Board on Mathematical Sciences Chairmen's Symposium**, Washington, D.C. Departmental Representatives should contact Frank Gilfeather, NRC, 2101 Constitution Ave., Washington, D.C. 20418.

### November 1986

13-16. **AMATYC National Convention**, Golden Gateway Holiday Inn, San Francisco, California. Contact: Hal Anderson, Department of Mathematics, Santa Rosa Junior College, Santa Rosa, California 95401.

### June 1987

24-26. **1987 National Educational Computing Conference**, Temple University, Philadelphia, Pennsylvania. Conference information and registration forms: Frank L. Friedman, General Chair, NECC'87, Computer Activities Bldg, Box JA1, Dept. of Computer and Information Sciences, Temple University, Philadelphia, PA 19122 (215) 787-8450; specifications for submission of original papers: Laurie Schteir.

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